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DOCUMENT # DOE/RL 92-04 Draft B

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SECTION 1 **OF** 2

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PUREX Source Aggregate Area Management Study Report

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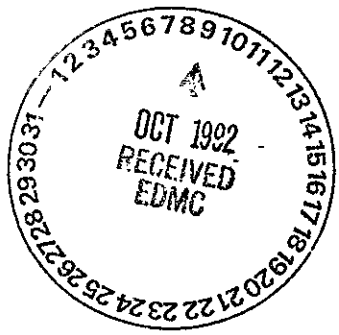

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PUREX PLANT SOURCE AAMS EXECUTIVE SUMMARY

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.

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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 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

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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, three waste management units were recommended for ERA, 25 units were recommended for IRMs, 25 units were recommended for LFIs which could lead to IRMs 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.

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

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

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

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

Waste Management Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
Septic Tanks and Associated Drain Fields								
2607-EA	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-EC	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-ED	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-EG	Septic Tank	--	--	--	--	X	--	--
2607-EJ	Septic Tank	--	--	--	--	X	--	--
2607-EL	Septic Tank	--	--	--	--	X	--	--
2607-E6	Septic Tank/Drain Field	--	--	--	--	X	--	--
Transfer Facilities, Diversion Boxes, and Pipelines								
216-A-524	Control Structure		X	X				
Basins								
207-A	Retention Basin	--	--	--	--	X	--	--
216-A-42	Retention Basin	--	--	--	--	X	X	RARA - Surface Contamination
Burial Sites								
218-E-1	Burial Ground	--	--	--	--	X	--	--
218-E-8	Burial Ground	--	--	--	--	X	--	--
218-E-12A	Burial Ground	--	--	--	--	X	--	--
218-E-13	Burial Ground	--	--	--	--	X	--	--
Unplanned Releases								
UN-200-E-10	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-11	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-12	Unplanned Release	--	--	--	--	X	--	

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

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

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

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

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

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	No Adverse Consequences?	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.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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
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.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	No Adverse Consequences?	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.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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.

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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

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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
RARA	Radiation Area Remedial Action
RAS	Routine Analytical Services

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ACRONYMS AND ABBREVIATIONS (cont.)

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

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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.

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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.

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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

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- 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

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- 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).

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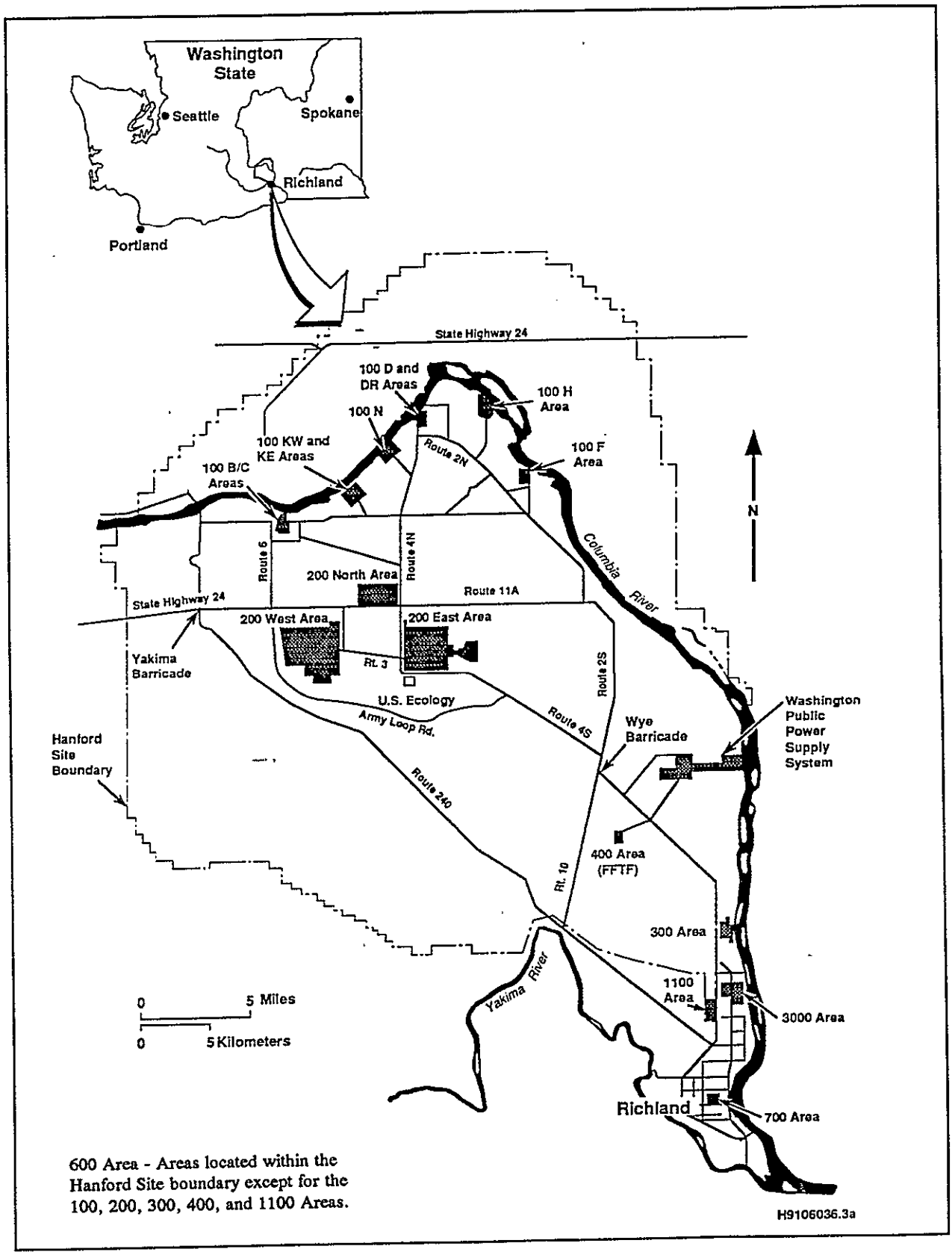

Figure 1-1. Hanford Site Map.

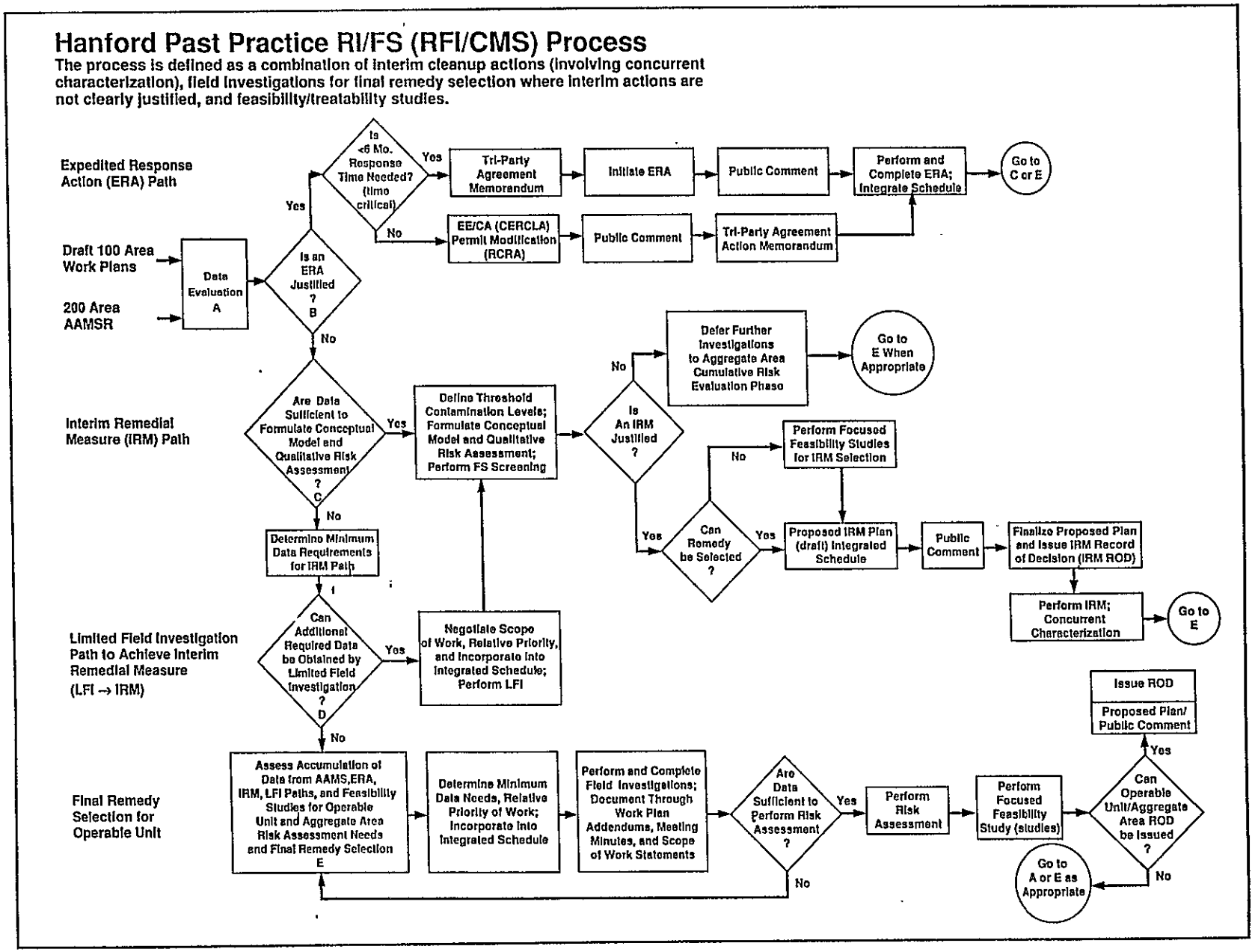

Figure 1-2. Hanford Past-Practice Strategy Flow Chart (DOE/RL 1992a).

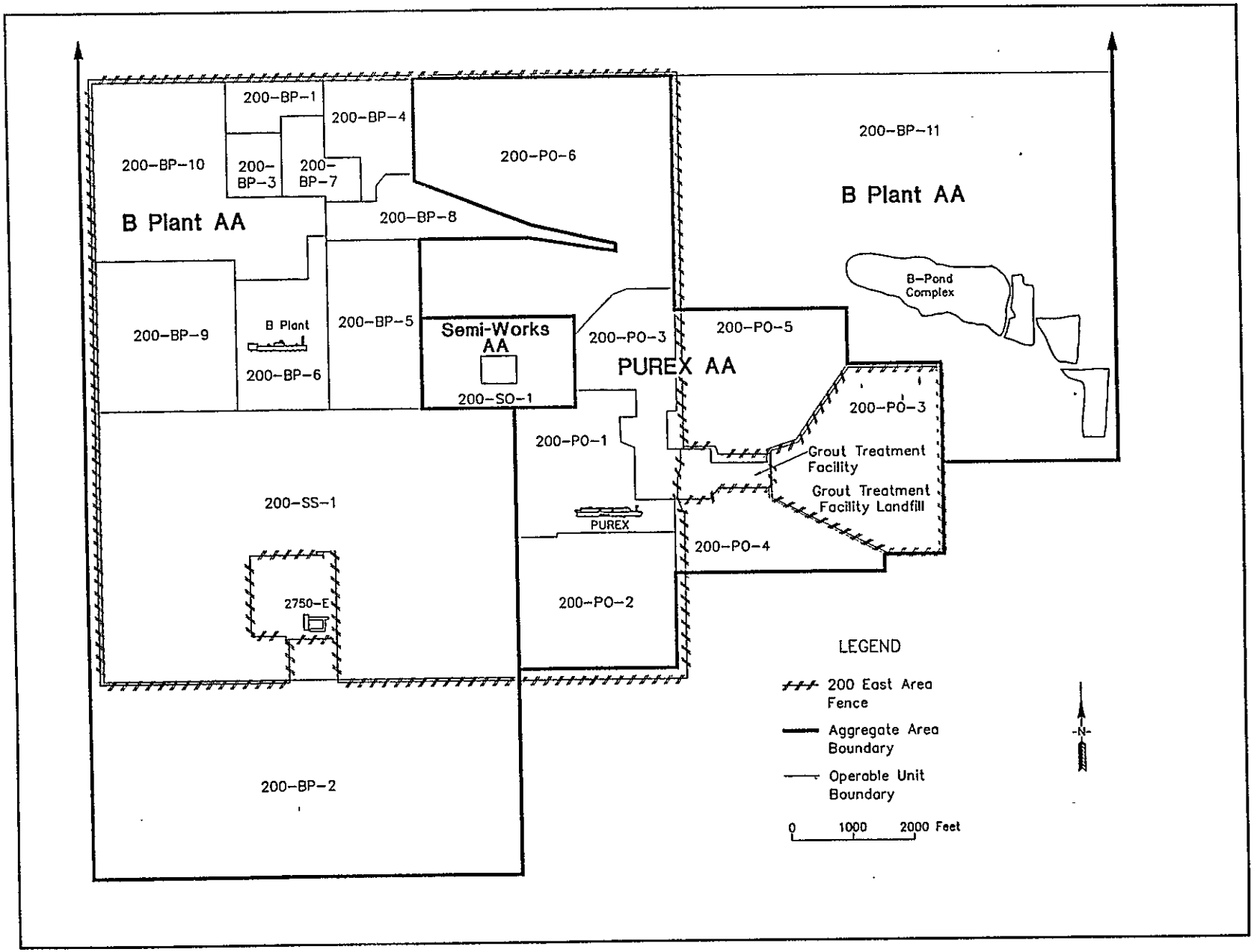

Figure 1-3. 200 East Aggregate Areas.

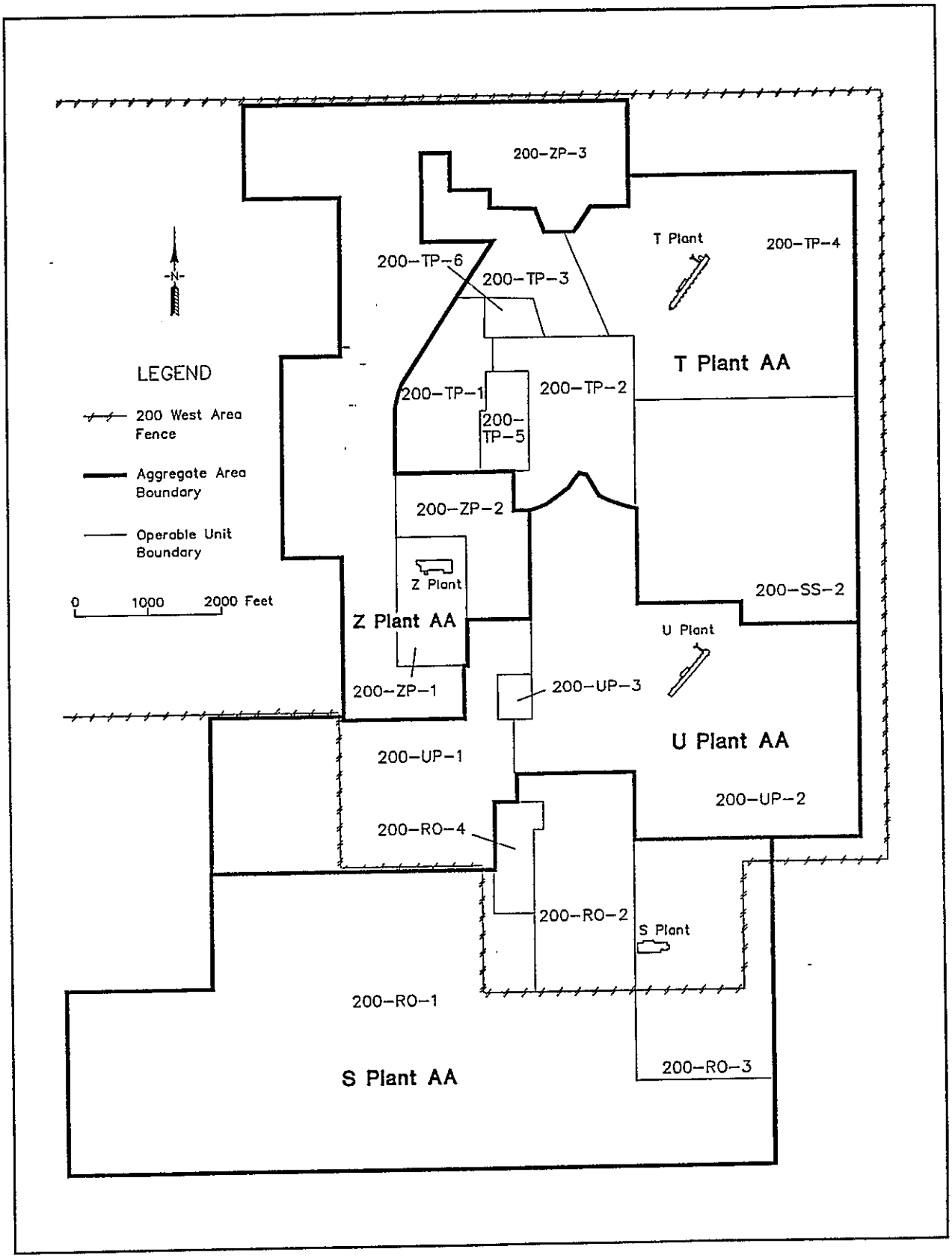

Figure 1-4. 200 West Aggregate Areas.

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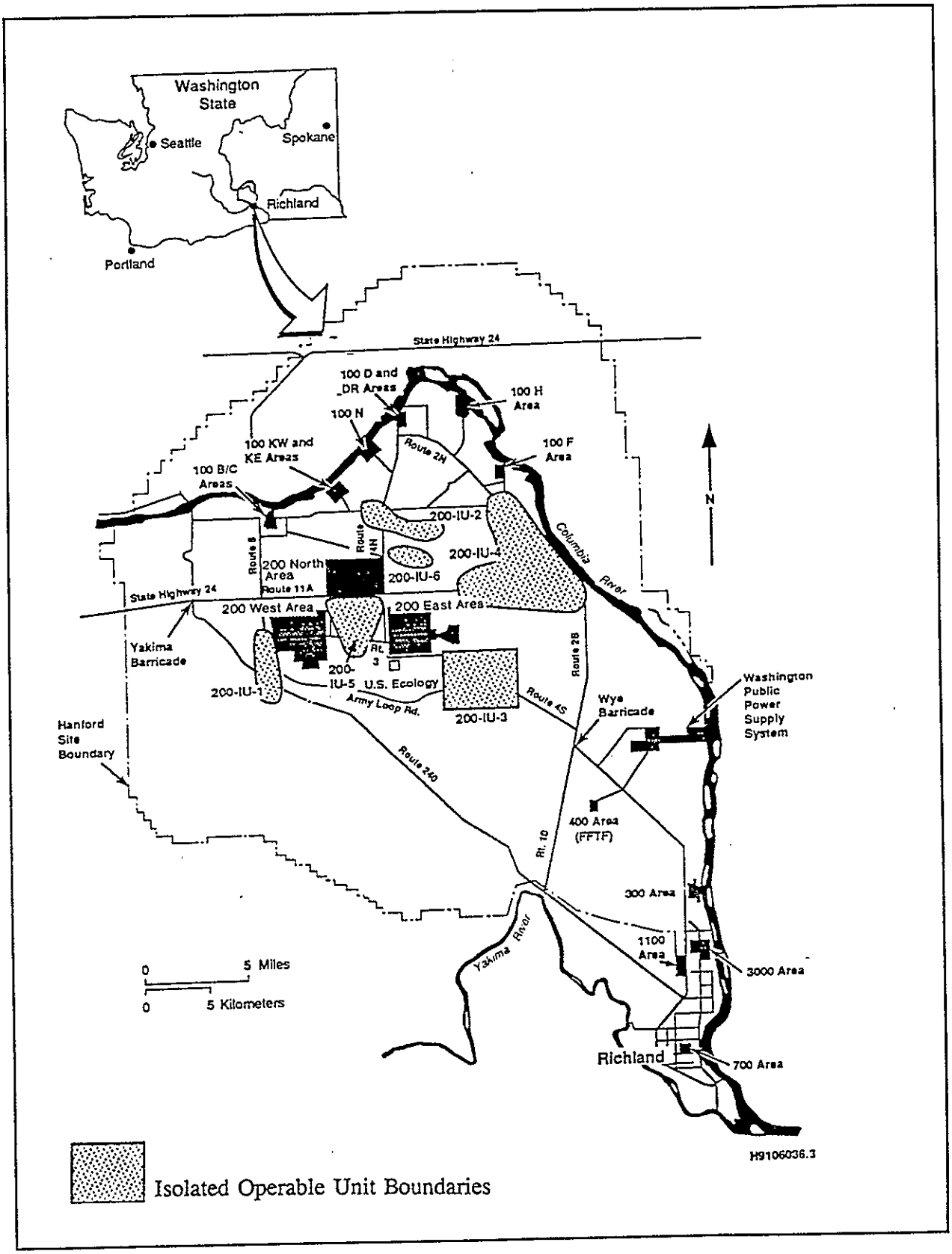

Figure 1-5. 200 NPL Site Isolated Operable Units.

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

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

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2.0 FACILITY, PROCESS AND OPERATIONAL HISTORY DESCRIPTIONS

Section 2.0 of the aggregate area management study (AAMS) presents historical data on the 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 ~~1-4~~ 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 a 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 of non-operation, the building resumed operations in November 1983. The 202-A Building ceased operating in 1990 and is currently in standby mode.

The 241-A Tank Farm contains six single-shell tanks constructed in the mid-1950's. ~~Four tanks were retired in 1980, two of the tanks, 241-A-104 and 241-A-105, were retired in 1975 and 1971, respectively.~~ These tanks received mixed waste from the plutonium/uranium

extraction (PUREX) ~~plutonium recovery~~ process. ~~All of the tanks are currently inactive and each has undergone initial stabilization.~~

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. ~~All of the tanks are currently inactive and each has undergone initial stabilization.~~

The 241-C Tank Farm contains 16 single-shell tanks constructed during the mid-1940's and retired in the late 1970's ~~to mid-1980'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 ~~209-E~~ (Critical Mass Laboratory). ~~All of the tanks are currently inactive and each has undergone initial stabilization.~~ A detailed description of the interim ~~initial~~ 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. ~~Prior to the evaporator process, the waste is sampled and analyzed for parameters such as visual appearance, percent solids, exotherms, total organic carbon (TOC), gamma energy spectrum, pH, and for specific ions including plutonium, uranium, and americium. All of the tanks are currently active.~~

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. ~~Prior to the evaporator process, the waste is sampled and analyzed for parameters such as visual appearance, percent solids, exotherms, total organic carbon, gamma energy spectrum, pH, and for specific ions including plutonium, uranium, and americium. All of the tanks are currently active.~~

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. ~~Prior to the evaporator process, the waste is sampled and analyzed for parameters such as visual appearance, percent solids, exotherms, total organic carbon, gamma energy spectrum, pH, and for specific ions including plutonium, neptunium, technetium, and americium. All of the tanks are currently active.~~

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

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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. ~~Prior to the evaporator process, the waste is sampled and analyzed for parameters such as visual appearance, percent solids, exotherms, TOC, gamma energy spectrum, pH, and for specific ions including plutonium, strontium, neptunium, and americium. All of the tanks are currently active.~~

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. ~~Prior to the evaporator process, the waste is sampled and analyzed for parameters such as visual appearance, percent solids, exotherms, TOC, gamma energy spectrum, pH, and for specific ions including plutonium, strontium, neptunium, and americium. All of the tanks are currently active.~~

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 ~~transuranic (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 at the time of assay. Heads of Field Elements can determine that other alpha contaminated wastes, peculiar to a specific site, must be managed as TRU waste.

- Low-Level Waste is defined as: 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. ~~Each waste management unit is listed as either active or inactive. Inactive waste management units do not currently receive wastes, nor are they intended to receive wastes in~~

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~~the future. Active waste management units are in operation and will receive wastes in the future. Units that are on standby are considered active (DOE/RL 1992a). In addition, the aggreagete area contains a number of unplanned release sites. There are two varieties of unplanned releases: UNs and UPRs. Unplanned releases designated as UNs are considered separate waste managment units (i.e., road spills). Unplanned releases designated as UPRs are associated with specific waste management units (i.e., UPR 200 E 66).~~ 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)~~database~~. These inventories include all of the contaminants reported in the databases, but do not necessarily include all of the contaminants disposed of at each ~~site~~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~~, Ecology et al. 1990~~) and will generally be addressed under the ~~Surplus Facilities~~ Decommissioning and RCRA Closure Program. The program is responsible for the surveillance, maintenance, and decommissioning of surplus facilities within the ~~Westinghouse Hanford~~ Environmental Restoration Programs. 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 ~~of~~ 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 ~~on~~ in Figure 2-2.

The 202-A Building ~~(PUREX Plant)~~, 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. ~~This~~ These plants, and the buildings associated with ~~them~~ it, 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)
- ~~291-A-1 Stack (stack inside 291-A Building)~~
- 241-AX-801-B Building
- 203-A Building (acid pumphouse)
- 218-E-14 PUREX Tunnel
- 218-E-15 PUREX Tunnel
- 242-A Evaporator ~~Building.~~

2.3.1.1 Process Facilities

2.3.1.1.1 202-A Building. The 202-A Building ~~(PUREX Plant)~~ 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 is still considered an active facility ~~site~~. 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) ~~of the height~~ 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 ~~(P&O)~~, 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

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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 (AMU). 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.

Volume one of the *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford* (Stenner et al. 1988) provides the following generic description of these processes:

Zirconium cladding on fuel elements is removed in an ammonium fluoride ammonium nitrate (AFAN) solution. Ammonium fluoride reacts with the zirconium, resulting in a soluble zirconium compound. The ammonia and hydrogen evolved during decladding present a potential combustion hazard. Therefore, hydrogen is converted to ammonia by reaction with ammonium nitrate present in the AFAN solution. A majority of fuel processed through the 202-A Building was aluminum clad. This cladding was dissolved with NaOH. Gas released from the dissolver is treated to remove iodine in a silver reactor, acid vapors are absorbed, and is only then released to the atmosphere. The offgasses are treated with hydrogen peroxide to remove nitrogen oxides before being released.

Declad fuel elements are dissolved in nitric acid for the solvent extraction process. An organic solvent is used to separate the uranium, plutonium and neptunium from associated fission products and from each other. The organic solvent used in a series of extraction and stripping operations is a 30% tributyl phosphate solution in a normal paraffin hydrocarbon (kerosene) diluent. The first extraction cycle separates the bulk of the fission products from the plutonium, uranium and neptunium; the fission products remain in the aqueous phase. 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. From 1956 to 1972, the concentrated plutonium nitrate solution was sent to the plutonium finishing operations located in the 200 West Area. When the PUREX Plant resumed operations in 1983, another facility (the PUREX Plant) was added that produced plutonium oxide from the plutonium nitrate.

~~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; concentration of the aqueous solution follows. The uranium product, uranyl nitrate hexahydrate, is then stored in tanks until it is shipped (via truck) to the Uranium Oxide (UO_3) Plant in the 200 West Area.~~

~~A portion of the concentrated neptunium solution from the final uranium cycle is sent to the neptunium recovery and purification cycle. In this cycle, neptunium is separated from the uranium, plutonium, and the remaining fission products in the neptunium stream. This separation is accomplished by a series of extractions and ion exchange columns. The plutonium and uranium fractions are recycled to the backcycle waste stream and partitioning cycle, respectively.~~

~~Supporting process systems include organic solvent decontamination and recovery, nitric acid recovery, and waste concentration and recovery (Stenner et al. 1988).~~

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. ~~It contains radioactively contaminated equipment and concrete. The contamination levels are estimated~~

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at 6 Ci of beta radioactivity (WHC 1991a). 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 provided 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 of mixing and pumping equipment. The dry solids are is 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 10 m by 15 m by 38 m deep (33 ft by 45 ft by 125 ft)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~~by 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 m (32 ft) long by 8 m (26 ft) wide and 8 m (28 ft) deep~~10 x 8 x 8 m (32 x 26 x 28 ft). The bottom 3m (910 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 ~~Building~~Evaporator. The 242-A Evaporator/Crystallizer is located just north of the 241-AW Double-Shell Tank Farm. The 242-A ~~Building~~Evaporator contains the evaporator vessel, supporting process equipment, and the principal process components of the evaporator-crystallizer system. Section 2.4.2 ~~explains~~discusses the 242-A Evaporator waste volume reduction process in greater detail.

No unplanned releases are associated with this unit.

~~**2.3.1.2.6 244-AR Lift Station/UPR-200-E-70.** The 244-AR Lift Station is located between the 241-AX and 241-AY Tank Farms. The lift station began operating in 1975 and is still active.~~

~~A typical lift station includes a filter pit, pump pit, and a tank vault, which contains a catch tank; however, no information was found specific to the 244-AR Lift Station. The lift station is used to transport waste solutions from processing and decontamination operations.~~

~~One unplanned release (UPR-200-E-70) is associated with this unit. Contamination was spread during a jumper removal at the lift station. The contamination consisted of unknown beta/gamma with readings of 1,000 to 5,000 ct/min and an isolated area at 100,000 ct/min. The area was decontaminated to background radiation levels and stabilized.~~

2.3.2 Tanks and Vaults

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Tanks and vaults were constructed on the Hanford Site to handle and store liquid wastes generated by uranium and plutonium processing activities. Several types of tanks are present in the PUREX Plant aAggregate aArea including 65 catch tanks, ~~settling tanks, and storage 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. ~~Storage tanks were used to collect and store large quantities of liquid wastes.~~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~~Aggregate Area Management Study~~: 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~~Aggregate Area Management Study~~: 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. ~~More details concerning the individual tank farms are discussed in the following sections.~~

~~All of the tanks and vaults within the 241-A Tank Farm, the 241-AX Tank Farm, and the 241-C Tank Farm will be addressed by the single-shell tank closure program. The structure and the related contamination in the tank farm will be described in this report, but investigation and remediation strategies will be deferred to the single-shell tank closure program. The double-shell tanks are still active and are discussed in the PUREX Plant Aggregate Area Management Study due to their location within the confines of the PUREX Plant Aggregate Area and due to their involvement with other facilities, which are part of this study.~~

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). 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. 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.

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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.

~~Initial stabilization interim stabilization, and interim isolation have been performed on the tanks to varying degrees, as listed in the individual tank descriptions. Prior to closure of the tanks, they must undergo a specific sequence of events. The first step (initial stabilization, also called primary stabilization) is the removal of all free standing liquid within the tank (i.e., all liquid on top of the sludge and/or salt cake). The second step is interim stabilization where all of the liquid, both interstitial and free standing, is removed through 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. A tank is considered interim stabilized if it contains less than 189,000 L (50,000 gal) of drainable interstitial liquid and less than 19,000 L (5,000 gal) of supernatant liquid (Hanlon 1992). The third step is the interim isolation of the tank by sealing all accesses to the tank that are not required for long term surveillance. After all of these steps have been taken, the tank is ready for the final process of closure. Tanks are classified as "Assumed Leakers" if it cannot be determined with 99% confidence that the tank is sound.~~

~~**2.3.2.1 241-A Tank Farm.** The 241-A Tank Farm consists of six buried single-shell tanks that contain mixed waste. It is located approximately 396 m (1,300 ft) northeast of the 202-A Building, directly south of the 241-AX Tank Farm. The surface elevation of the tank farm is approximately 210 m (689 ft) above mean sea level (msl), and the depth to groundwater below the tank farm is approximately 87 m (287 ft) (WHC 1991a).~~

~~The tanks were placed in service during the mid-1950's and were retired in the early 1970's or 1980's. Figure 2-1 shows the individual tanks in the 241-A Tank Farm and their operational history. They are numbered 241-A-101 through 241-A-106. All of the tanks are currently inactive and each has undergone initial stabilization and has a status of either partial interim isolation or interim isolation (WHC 1991a).~~

~~Currently, the entire tank farm, including diversion boxes 241-A-151, 241-A-152, 241-A-A, and 241-A-B, and catch tank 241-A-350, is surrounded by a chain link fence, topped with three strands of barbed wire. The tank farm is covered with gravel. Surface contamination placards are placed on the chain link fence.~~

~~The tanks are carbon steel lined, with a reinforced concrete shell, dome, and base, less than 1 m (2 ft) thick. They are 14 m (45 ft) high with a 23 m (75 ft) diameter and have a capacity of 3,785,000 L (1,000,000 gal). The dome is generally located 2 m (7 ft) below grade, and the bottom of the tanks are 15 m (50 ft) below grade. The tanks are fourth generation in design. This means they have a increased operating depth to 9 m (31 ft) and a flat bottom compared to previous generations which had less operating depth and a dished bottom. The tanks are surrounded by radiation monitoring wells.~~

~~The tank farm was constructed to receive high level, self boiling waste from the PUREX plutonium recovery process. The three major types of wastes contained in the tank farm are aluminum cladding waste, organic wash waste, and PUREX acid waste. Lesser quantities of several other types of waste were also deposited in the tank farm. These include waste fractionization waste, ion exchange waste, sluicing waste, and waste generated by the waste solidification program, such as evaporator bottoms (WHC 1991a). In addition, the vapors from the 241-A tanks are combined with those from the 241-AZ tanks and processed in the 241-AX-152DS Diverter Station and the 241-AX-155 Diversion Box. The resultant condensate is routed to the 216-A-8 Crib and the 216-A-24 Crib, or returned to 241-A or 241-AX tanks (WHC 1991a).~~

~~Table 2-4 provides a description of the tank farms in the PUREX Plant Aggregate Area and the volume of total waste and drainable waste present in each tank. Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A Tank Farm and other PUREX Plant Aggregate Area tank farms are also used to monitor subsurface conditions.~~

~~The following sections describe in greater detail the location of the waste management units, a description of the waste management unit itself, the duration of operation, and information concerning the waste types received.~~

~~2.3.2.1.1 241-A-101 Single-Shell Tank.~~ ~~The 241-A-101 Single-Shell Tank is the southwestern most tank in the 241-A Tank Farm. This tank is surrounded by thirteen active radiation monitoring wells. The tank is also equipped with automatic temperature sensors and air-lift circulators.~~

~~The tank is classified as an inactive waste management unit. It operated from January 24, 1956 until November 21, 1980. The tank received PUREX carbonate wash waste; PUREX organic wash waste; PUREX high-level waste; B Plant high-level waste (waste fractionization); and supernatant containing B Plant high level waste, PUREX high-level waste, double-shell slurry feed, and complexed and non-complexed waste from the 241-A, 241-AX, 241-BX, and 241-SX Tank Farms (WHC-1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,596,000 L (950,000 gal) of salt cake and 11,350 L (3,000 gal) of sludge. This tank is considered "sound" and is partially interim isolated. This tank has a potential for hydrogen or flammable gas accumulation above its flammability limit.~~

~~2.3.2.1.2 241-A-102 Single-Shell Tank.~~ ~~The 241-A-102 Single-Shell Tank is directly to the east of the 241-A-101 Single-Shell Tank in the 241-A Tank Farm. This tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and automatic liquid level gage, and a radiation detection measurement system beneath the tank. The radiation detection system consists of a tube that runs beneath the tank through which a radiation monitor can be lowered.~~

~~The tank is classified as an inactive waste management unit. It operated from March 22, 1956 until November 21, 1980. The tank received PUREX carbonate wash waste; PUREX high level waste; B Plant high level waste (waste fractionization); and supernatant containing PUREX high level waste, B Plant high level waste, PUREX sludge supernatant, evaporator waste, complexed waste, and double shell tank slurry feed from the 241-A, 241-AX, 241-AY, and 241-SX Tank Farms (WHC-1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 83,270 L (22,000 gal) of salt cake, 15,140 L (4,000 gal) of supernate, and 56,775 L (15,000 gal) of sludge. This tank is considered "sound" and is partially interim isolated.~~

~~2.3.2.1.3 241-A-103 Single-Shell Tank.~~ ~~The 241-A-103 Single-Shell Tank is the eastern most tank laying directly to the east of the 241-A-102 Single-Shell Tank. This tank is surrounded by eight active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air-lift circulators, and an automatic liquid level gage.~~

The tank is classified as an inactive waste management unit. It operated from May 17, 1956 until August 14, 1980. The tank received PUREX carbonate wash waste; PUREX organic wash waste; PUREX high level waste; B Plant high level waste (waste fractionization); and waste fractionization ion exchange waste; and supernatant containing B Plant high level waste, waste fractionization ion exchange waste, PUREX high level waste, PUREX sludge supernatant, evaporator waste, complexed waste, and double slurry feed from the 241-A, 241-AX, 241-BY, and 241-C Tank Farms and 244-AR and 244-CR Vaults (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 15,120 L (4,000 gal) of supernate and 1,383,480 L (366,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.

2.3.2.1.4 241-A-104 Single-Shell Tank. The 241-A-104 Single-Shell Tank is the northwestern most tank laying directly to the north of the 241-A-101 Single-Shell Tank. This tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air-lift circulators, and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1958 until 1975. The tank received PUREX carbonate wash waste; PUREX organic wash waste; PUREX high level waste; B Plant high level (waste fractionization) and ion exchange waste; and supernatant containing PUREX sludge supernatant from the 241-A Tank Farm and the 244-AR Vault (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 105,840 L (28,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.

2.3.2.1.5 241-A-105 Single-Shell Tank. The 241-A-105 Single-Shell Tank is east of the 241-A-104 Single-Shell Tank. This tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1962 until 1971. The tank received PUREX inorganic wash waste and supernatant containing PUREX high level waste from the 241-A Tank Farm (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 71,820 L (19,000 gal) of sludge. The tank has a high heat load of 50,000 Btu/h. This tank is considered an "assumed leaker" and is interim isolated.

~~**2.3.2.1.6 241-A-106 Single-Shell Tank.** The 241-A-106 Single-Shell Tank is the northeastern-most tank lying east of the 241-A-105 Single-Shell Tank. This tank is surrounded by eight active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and an automatic liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from 1957 until August 14, 1980. The tank received PUREX organic and inorganic wash waste; PUREX carbonate wash waste; PUREX high level waste; B Plant high level waste; and supernatant containing PUREX high level waste, B Plant high level waste, and complexed concentrate from the 241-A Tank Farm, 244-AR Vault, and the B-302 Tanks (WHC 1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 472,500 L (125,000 gal) of sludge. The tank is considered "sound" and is interim isolated.~~

~~**2.3.2.2 241-AN Tank Farm.** The 241-AN Tank Farm consists of seven buried double shell steel tanks that contain mixed wastes. The tank farm is located immediately north of the AZ Tank Farm and is approximately 100 m (328 ft) southeast of the 241-C Tank Farm. The surface elevation of the tank farm is approximately 197 m (645 ft) above msl, and the depth to groundwater below the tank farm is 74 m (243 ft).~~

~~The tanks were placed in service in 1981 and are still active. Figure 2-1 shows the individual tanks in the 241-AN Tank Farm and their operational history. They are numbered 241-AN-101 through 241-AN-107. The seven 241-AN tanks are essentially identical in design except for tank 241-AN-101, which has two additional concrete pits, and tank 241-AN-107, which has 21 airlift circulator assemblies installed in the tank. The 241-AN Tank Farm consists of:~~

- ~~Seven 3.78 million liter (1.0 million gal) double-shell tanks~~
- ~~Associated primary tank (central) pump pits, annulus pump pits, and leak detection well pump pits~~
- ~~Two valve pits~~
- ~~Raw water service and flush pit~~
- ~~241-AN-271 Instrument Building~~
- ~~241-AN-701 Compressor Building.~~

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~~The double shell tanks are fabricated as three concentric tanks. The free standing primary tank contains the waste material. The primary tank is comprised of carbon steel 23 m (75 ft) in diameter and 14 m (45 ft) high at the domed center. The maximum capacity is 4,309,200 L (1.14 million gal). The primary tank rests upon a 20 cm (8 in.) layer of insulating concrete, which protects the structural concrete foundation from excessive temperature during annealing. The secondary tank, 2 m (5 ft) larger in diameter than the primary tank, creates a surrounding space called the annulus. The completely enclosed annulus serves as the containing barrier for primary tank leaks, thus preventing uncontrolled release of radionuclides to the environment. The annulus is ventilated and constantly monitored for evidence of primary tank leakage. The annulus is equipped with a continuous air monitor which is read daily and electronic leak detectors on the bottom of the tank annulus. The third tank is a concrete shell enclosing the primary and secondary tanks. The concrete shell rests on a concrete foundation 27 m (89 ft) in diameter. The foundation contains drain slots for the removal of any liquid that might leak from the secondary tank. Any liquid that reaches the foundation will drain through the slots to a leak detection well.~~

~~The 241 AN Tank Farm is used to store PUREX generated, low heat wastes which includes double shell slurry feed, decladding waste, organic wash waste, cell drainage, laboratory waste, and salt well liquors pumped from single shell tanks. Table 2 4 provides a summary of the total waste, drainable waste, flammable gas generation, and integrity of each tank. The majority of waste stored in the tank farm is supernatant liquid. One exception is double shell tank 241 AN 103, which contains mostly double shell slurry feed. Figure 2 7 is a schematic of a typical double shell tank.~~

~~Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241 A, AN, AP, AW, AX, AY, and AZ Tank Farms are also used to monitor subsurface conditions.~~

~~All of the tanks within the 241 AN Tank Farm are equipped with leak detection systems. These systems include automatic and manual liquid level tapes in the primary tank and annulus; three sets of 17 point conductivity probes in the annulus; an annulus exhaust radiation monitoring system; and weight factor, specific gravity, and radiation monitoring instrumentation in the leak detection pit. Annulus riser access is also available for investigative photos or swab sampling.~~

~~**2.3.2.2.1 241 AN 101 Double Shell Tank.** The 241 AN 101 Double Shell Tank is the southeastern most tank near Canton Avenue. The tank started operating in September 1981 and is currently active. The unit receives 100/300 Area customer waste, salt well liquor, and dilute noncomplexed waste.~~

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 2,275,032 L (601,000 gal) of supernatant liquid. The tank is considered sound.

2.3.2.2.2 241-AN-102 Double-Shell Tank. The 241-AN-102 Double-Shell Tank is west of the 241-AN-101 Double-Shell Tank.

The tank started operating in September 1981 and is currently active. The unit receives dilute and concentrated complexant waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,798,900 L (1,005,000 gal) of supernatant liquid and 3,798,900L (89,000 gal) of sludge. The tank is considered sound.

2.3.2.2.3 241-AN-103 Double-Shell Tank. The 241-AN-103 Double-Shell Tank is west of the 241-AN-102 Double-Shell Tank.

The tank started operating in September 1981 and is currently active. The unit receives salt well liquor and dilute noncomplexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 52,920 L (14,000 gal) of supernatant liquid and 3,541,860 L (937,000 gal) of double shell slurry feed. The tank is considered sound; however, the tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 177°C (350°F) (DOE 1980).

2.3.2.2.4 241-AN-104 Double-Shell Tank. The 241-AN-104 Double-Shell Tank is north of the 241-AN-101 Double-Shell Tank just west of Canton Avenue. The tank started operating in September 1981 and is currently active. The unit receives dilute noncomplexed waste and double-shell slurry feed.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,024,000 L (800,000 gal) of supernatant liquid and 997,920 L (264,000 gal) of sludge. The tank is considered sound; however, the tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 177°C (350°F) (DOE 1980).

2.3.2.2.5 241-AN-105 Double-Shell Tank. The 241-AN-105 Double-Shell tank is west of the 241-AN-104 Double-Shell Tank and north of the 241-AN-102 Double-Shell Tank. The tank started operating in September 1981 and is currently active. The unit receives dilute noncomplexed waste and double-shell slurry feed.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 4,263,840 L (1,128,000 gal) of supernatant liquid. The tank is considered sound; however, the tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 177°C (350°F) (DOE 1980).

2.3.2.2.6 241-AN-106 Double-Shell Tank. The 241-AN-106 Double-Shell Tank is west of the 241-AN-105 Double-Shell Tank and north of the 241-AN-103 Double-Shell Tank. The tank started operating in September 1981 and is currently active. The unit receives dilute and concentrated phosphate waste from the 100-N Area.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,780,000 L (1,000,000 gal) of supernatant liquid and 64,260 L (17,000 gal) of sludge. The tank is considered sound.

2.3.2.2.7 241-AN-107 Double-Shell Tank. The 241-AN-107 Double-Shell Tank is north of the 241-AN-106 Double-Shell Tank. The tank started operating in September 1981 and is currently active. The unit receives dilute and concentrated complexant wastes.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,556,980 L (941,000 gal) of supernatant liquid and 506,520 L (134,000 gal) of sludge. The tank is considered sound.

2.3.2.3 241-AP Tank Farm. The 241-AP Tank Farm consists of eight buried double-shell steel tanks. The tank farm is located just east of the GTF, in the center of the 4th Street Loop. The surface elevation of the tank farm is approximately 207 m (679 ft) above msl, and the depth to groundwater below the tank farm is 84 m (274 ft).

The tanks were placed in service in 1986 and are still active. Figure 2-1 shows the individual tanks in the 241-AW Tank Farm and their operational history. They are numbered 241-AP-101 through 241-AP-108. The tank farm consists of:

- Eight 3.78 million L (1.0 million gal) double-shell tanks
- Associated primary tank (central) pump pits, annulus pump pits, and leak detection well pump pits
- 241-AP Valve Pit
- Two vent pits
- Raw water service and flush pit

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- Annulus Exhaust Station Building
- Primary Exhaust Station Building
- 241-AP-271 Instrument Building
- 241-AP-701 Compressor Building.

The double-shell tanks are fabricated as three concentric tanks. The free standing primary tank contains the waste material. The primary tank is comprised of carbon steel 23 m (75 ft) in diameter and 14 m (45 ft) high at the domed center. The maximum capacity is 4,309,200 L (1.14 million gal). The primary tank rests upon a 20 cm (8 in.) layer of insulating concrete which protects the structural concrete foundation from excessive temperature during annealing. The secondary tank, 2 m (5 ft) larger in diameter than the primary tank, creates a surrounding space called the annulus. The completely enclosed annulus serves as the containing barrier for primary tank leaks, thus preventing uncontrolled release of radionuclides to the environment. The annulus is ventilated and constantly monitored for evidence of primary tank leakage. The third tank is a concrete shell enclosing the primary and secondary tanks. The concrete shell rests on a concrete foundation 27 m (89 ft) in diameter. The foundation contains drain slots for the removal of any liquid that might leak from the secondary tank. Any liquid that reaches the foundation will drain through the slots to a leak detection well.

The 241-AP Tank Farm is used to store PUREX generated, low heat wastes which includes double shell slurry feed, decladding waste, organic wash waste, cell drainage, laboratory waste, and salt well liquors pumped from single shell tanks. Table 2-4 provides a summary of the total waste, drainable waste, flammable gas generation, and integrity of each tank. The waste stored in the tank farm is supernatant liquid. Figure 2-5 is a schematic of a typical double shell tank.

Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A, -AN, -AP, -AW, -AX, -AY, and -AZ Tank Farms are also used to monitor subsurface conditions.

All of the tanks within the 241-AP Tank Farm are equipped with leak detection systems. These systems include automatic and manual liquid level tapes in the primary tank and annulus; three sets of 17 point conductivity probes in the annulus; an annulus exhaust radiation monitoring system; and weight factor, specific gravity, and radiation monitoring instrumentation in the leak detection pit. Annulus riser access is also available for investigative photos or swab sampling.

~~**2.3.2.3.1 241-AP-101 Double-Shell Tank.** The 241-AP-101 Double-Shell Tank is the northwestern tank just south of 4th Street. The tank started operating in October 1986 and is currently active. The unit receives PUREX ammonia scrubber feed waste.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 4,070,107 L (1,062,000 gal) of supernatant liquid. The tank is considered sound.~~

~~**2.3.2.3.2 241-AP-102 Double-Shell Tank.** The 241-AP-102 Double-Shell Tank is east of the 241-AP-101 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit is the GTF feed tank. Initially, waste transferred to this unit will be dilute noncomplexed customer waste.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 503,460 L (133,000 gal) of supernatant liquid. The tank is considered sound.~~

~~**2.3.2.3.3 241-AP-103 Double-Shell Tank.** The 241-AP-103 Double-Shell Tank is south of the 241-AP-101 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit receives PUREX ammonia scrubber feed waste.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 4,296,442 L (1,135,000 gal) of supernatant liquid. The tank is considered sound.~~

~~**2.3.2.3.4 241-AP-104 Double-Shell Tank.** The 241-AP-104 Double-Shell Tank is east of the 241-AP-103 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit is designated as a Grout Feed Tank. The unit receives dilute noncomplexed waste.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 75,708 L (20,000 gal) of supernatant liquid. The tank is considered sound.~~

~~**2.3.2.3.5 241-AP-105 Double-Shell Tank.** The 241-AP-105 Double-Shell Tank is south of the 241-AP-103 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit receives double shell slurry feed.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,122,965 L (825,000 gal) of supernatant liquid. The tank is considered sound.~~

2.3.2.3.6 241-AP-106 Double-Shell Tank. The 241-AP-106 Double-Shell Tank is east of the 241-AP-105 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit receives neutralized cladding removal waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 4,288,872 L (1,133,000 gal) of supernatant liquid. The tank is considered sound.

2.3.2.3.7 241-AP-107 Double-Shell Tank. The 241-AP-107 Double-Shell Tank is south of the 241-AP-105 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit receives dilute, non-complexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 4,258,588 L (1,125,000 gal) of supernatant liquid. The tank is considered sound.

2.3.2.3.8 241-AP-108 Double-Shell Tank. The 241-AP-108 Double-Shell Tank is east of the 241-AP-107 Double-Shell Tank. The tank started operating in October 1986 and is currently active. The unit receives dilute, non-complexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,346,304 L (884,000 gal) of supernatant liquid. The tank is considered sound.

2.3.2.4 241-AW Tank Farm. The 241-AW Tank Farm consists of six buried double-shell steel tanks. It is located just west of the 241-AP Tank Farm and south of 4th Street. The surface elevation of the tank farm is approximately 212 m (695 ft) above msl, and the depth to groundwater below the tank farm is 84 m (274 ft).

The tanks were placed in service in 1980 and are still active. Figure 2-1 shows the individual tanks in the 241-AW Tank Farm and their operational history. They are numbered 241-AW-101 through 241-AW-106. The tank farm consists of:

- Six 3.78 million L (1.0 million gal) double-shell tanks
- Associated primary tank (central) pump pits, annulus pump pits, and leak detection well pump pits
- Two valve pits
- Three vent pits

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- Raw water service and flush pit
- Heating ventilation and air conditioning pad
- Annulus Exhaust Station Building
- Primary Exhaust Station Building
- An electrical substation building
- 241-AW-271 Instrument Building
- 241-AW-701 Compressor Building.

The double-shell tanks are fabricated as three concentric tanks. The free standing primary tank contains the waste material. The primary tank is comprised of carbon steel 23 m (75 ft) in diameter and 14 m (45 ft) high at the domed center. The maximum capacity is 4,309,200 L (1.14 million gal). The primary tank rests upon a 20 cm (8 in.) layer of insulating concrete, which protects the structural concrete foundation from excessive temperature during annealing. The secondary tank, 2 m (5 ft) larger in diameter than the primary tank, creates a surrounding space called the annulus. The completely enclosed annulus serves as the containing barrier for primary tank leaks, thus preventing uncontrolled release of radionuclides to the environment. The annulus is ventilated and constantly monitored for evidence of primary tank leakage. The third tank is a concrete shell enclosing the primary and secondary tanks.

The 241-AW Tank Farm is used to store PUREX generated, low heat wastes which includes double shell slurry feed, decladding waste, organic wash waste, cell drainage, laboratory waste, and salt well liquors pumped from single shell tanks. Table 2-4 provides a summary of the total waste, drainable waste, flammable gas generation, and integrity of each tank. The waste stored in the tank farm is primarily supernatant liquid.

Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A, -AN, -AP, -AW, -AX, -AY, and -AZ Tank Farms are also used to monitor subsurface conditions.

All of the tanks within the 241-AW Tank Farm are equipped with leak detection systems. These systems include automatic and manual liquid level tapes in the primary tank and annulus; three sets of 17 point conductivity probes in the annulus; an annulus exhaust radiation monitoring system; and weight factor, specific gravity, and radiation monitoring

instrumentation in the leak detection pit. Annulus riser access is also available for investigative photos or swab sampling.

2.3.2.4.1 241-AW-101 Double-Shell Tank. The 241-AW-101 Double-Shell Tank is the northwestern tank just south of 4th Street. The tank started operating in July 1980 and is currently active. The unit receives double-shell slurry feed and dilute noncomplexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,934,980 L (1,040,000 gal) of supernatant liquid and 317,520 L (84,000 gal) of sludge. The tank is considered sound.

2.3.2.4.2 241-AW-102 Double-Shell Tank. The 241-AW-102 Double-Shell Tank is east of the 241-AW-101 Double-Shell Tank. The unit is designated as the 242-A Evaporator feed tank. Any waste designated for concentration is pumped to the 241-AW-102 feed tank for transfer to the 242-A Evaporator. In addition to the central pump pit, annulus pump pit, and lead detection pit, which are associated with all the 241-AW tanks, the 241-AW-102 tank has a feed pump pit and a drain pit. To provide a uniform feed to the 242-A Evaporator, tank 241-AW-102 has airlift circulators for mixing tank contents. The tank also has a dip tube assembly installed to read specific gravity.

The tank started operating in 1980 and is currently active. The tank receives double-shell tank slurry feed.

The *Tank Farm Surveillance and Waste Status Report for December1991* (Hanlon 1992) indicates that the tank contains 3,900,960 L (1,034,000 gal) of supernatant liquid and 3,780 L (1,000 gal) of sludge. The tank is considered sound.

2.3.2.4.3 241-AW-103 Double-Shell Tank. The 241-AW-103 Double-Shell Tank is south of the 241-AW-101 Double-Shell Tank. The tank started operating in 1980 and is currently active. The unit receives PUREX decladding supernate and TRU sludge.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 1,084,860 L (287,000 gal) of supernatant liquid and 1,372,140 L (363,000 gal) of sludge. The tank is considered sound.

2.3.2.4.4 241-AW-104 Double-Shell Tank. The 241-AW-104 Double-Shell Tank is east of the 241-AW-103 Double-Shell Tank. The tank started operating in 1980 and is currently active. The unit receives double-shell slurry feed and dilute noncomplexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,160,080 L (836,000 gal) of supernatant liquid,

676,620 L (179,000 gal) of sludge, and 419,580 L (111,000 gal) of salt cake. The tank is considered sound.

2.3.2.4.5 241-AW-105 Double-Shell Tank. The 241-AW-105 Double-Shell Tank is south of the 241-AW-103 Double-Shell Tank. The tank started operating in 1980 and is currently active. The unit receives supernate and TRU-PUREX decladding sludge.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 2,290,680 L (606,000 gal) of supernatant liquid and 1,122,660 L (297,000 gal) of sludge. The tank is considered sound.

2.3.2.4.6 241-AW-106 Double-Shell Tank. The 241-AW-106 Double-Shell Tank is east of the 241-AW-105 Double-Shell Tank. The tank started operating in 1980 and is currently active. The unit is designated as the 242-A Evaporator receiver tank. Waste received in this unit may be complexed or noncomplexed waste.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 922,320 L (244,000 gal) of supernatant liquid, 748,440 L (198,000 gal) of sludge, and 321,300 L (85,000 gal) of salt cake. The tank is considered sound.

2.3.2.5 241-AX Tank Farm. The 241-AX Tank Farm consists of four buried single-shell steel tanks that contain mixed waste. It is located approximately 533 m (1,750 ft) northeast of the 202-A Building, east of the 241-AY Tank Farm, and between the 241-A and 241-AZ Tank Farms. The surface elevation of the tank farm is approximately 207 m (680 ft) above msl, and the depth to groundwater below the tank farm is approximately 80 m (262 ft) (WHC 1991a).

The tanks were placed in service during the mid-1960's and retired in the early 1980's (Table 2-2). Figure 2-1 shows the individual tanks in the 241-AX Tank Farm and their operational history. They are numbered 241-AX-101 through 241-AX-104. All the tanks are inactive and each has undergone initial stabilization and has a status of either partial interim isolated or interim isolated (WHC 1991a). Currently, many structures in the tank farm, including diversion boxes 241-AX-151, 241-AX-152DS, and catch tank 241-AX-152CT have been stabilized. The tanks are covered with gravel, generally at the level of the surrounding grade.

The tanks are carbon steel lined, with a reinforced concrete shell, dome, and base, less than 1 m (2 ft) thick. The structures are 14 m (45 ft) high and have a capacity of 3,785,000 L (1,000,000 gal). The domes are located 2 m (7 ft) below grade and the bottom of the tanks are 16 m (52 ft) below grade. These are fifth generation tank in design. The fifth

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generation tanks differ from the previous generation (241-A Single-Shell Tanks) in that an additional grid of drain slots were added beneath the bottom steel liner.

Table 2-4 provides a description of the tank farms in the PUREX Plant Aggregate Area and the volume of total waste and drainable waste present in each tank. Generally, most of the waste present is salt cake with relatively minor drainable liquid.

Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A, 241-AX, 241-AY, and 241-AZ Tank Farms are also used to monitor subsurface conditions.

2.3.2.5.1 241-AX-101 Single-Shell Tank. The 241-AX-101 Single-Shell Tank is the northeastern tank in the 241-AX Tank Farm. The tank is surrounded by eight active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1965 until November 12, 1980. The tank received fission product waste; PUREX organic wash waste; PUREX high level and low level waste; B Plant high level waste (waste fractionization); and supernatant containing fission product waste, PUREX sludge supernatant, organic wash waste, and double shell slurry feed from the 241-A and 241-AX Tank Farms (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 11,355 L (3,000 gal) of sludge and 3,591,000 L (950,000 gal) of salt cake. This tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 204 °C (400 °F) (Geier 1976). The tank is considered "sound" and is partially interim isolated.

2.3.2.5.2 241-AX-102 Single-Shell Tank. The 241-AX-102 Single-Shell Tank is the southeastern tank. The tank is surrounded by 10 active radiation monitoring wells and 1 inactive well. The tank is also equipped with automatic temperature sensors, air lift circulators, and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1966 until September 8, 1980. The tank received PUREX high level and low level waste; PUREX organic wash waste; B Plant high level waste (waste fractionization); and supernatant containing PUREX high level waste, complexant concentrate, B Plant high level waste, and complexed waste from the 241-A, 241-AX, and 241-C Tanks, 244-AR Vault, and TK-417 (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 26,495 L (7,000 gal) of sludge, 11,355 L (3,000 gal) of, supernate and 109,765 L (29,000 gal) of salt cake. The tank is considered an "assumed leaker" and is interim isolated.

2.3.2.5.3 241-AX-103 Single-Shell Tank. The 241-AX-103 Single-Shell Tank is the northwestern tank. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1965 until September 8, 1980. The tank received PUREX high level and low level waste; PUREX organic and inorganic wash waste; B Plant high level and low level waste (waste fractionization); and supernatant containing PUREX high level waste and sludge supernatant from 241-A, 241-AX, 241-AZ, and 241-C Tanks, 244-AR Vault, and 241-AX 152 Tank (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 7,570 L (2,000 gal) of sludge and 416,350 L (110,000 gal) of salt cake. This tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 204 ºC (400 ºF) (Geier 1976). The tank is considered "sound" and is interim isolated.

2.3.2.5.4 241-AX-104 Single-Shell Tank. The 241-AX-104 Single-Shell Tank is the southwestern tank. The tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with automatic temperature sensors, air lift circulators, and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1966 until 1976. The tank received PUREX high level and low level waste; PUREX organic and inorganic wash waste; B Plant high level waste (waste fractionization); and supernatant containing PUREX high level waste and sludge supernatant from the 241-A and 241-AX Tanks, and 244-AR 002 Tank (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 26,460 L (7,000 gal) of sludge. This tank has a potential for hydrogen or flammable gas accumulation above its flammability limit of 204 ºC (400 ºF) (Geier 1976). The tank is considered "sound" and is interim isolated.

2.3.2.6 241-AY Tank Farm. The 241-AY Tank Farm consists of two buried double shell steel tanks. It is located west of the 241-AX Tank Farm and east of Buffalo Avenue. The

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surface elevation of the tank farm is approximately 206 m (676 ft) above msl, and the depth to groundwater below the tank farm is 80 m (262 ft).

The tanks were placed in service in 1971 and are still active. Figure 2-1 shows the individual tanks in the 291-AY Tank Farm and their operational history. They are numbered 241-AY-101 and 241-AY-102. The tank farm consists of:

- Two 3.78 million L (1.0 million gal) double-shell tanks
- Associated primary tank (central) pump pits, annulus pump pits, and leak detection well pump pits
- Four sluice pump pits (2 per tank)
- 241-AY-801 Instrument Building
- 241-AY-101A and B Dual Leak Detection Pit
- 241-AY-501 Diversion Box.

The double-shell tanks are fabricated as three concentric tanks. The free standing primary tank contains the waste material. The primary tank is comprised of carbon steel 23 m (75 ft) in diameter and 14 m (45 ft) high at the domed center. The maximum capacity is 4,309,200 L (1.14 million gal). The primary tank rests upon a 20 cm (8 in.) layer of insulating concrete which protects the structural concrete foundation from excessive temperature during annealing. The secondary tank, 2 m (5 ft) larger in diameter than the primary tank, creates a surrounding space called the annulus. The completely enclosed annulus serves as the containing barrier for primary tank leaks, thus preventing uncontrolled release of radionuclides to the environment. The annulus is ventilated and constantly monitored for evidence of primary tank leakage. The third tank is a concrete shell enclosing the primary and secondary tanks.

The 241-AY Tanks (also known as aging waste tanks) are used to store high-level radioactive wastes. Currently, the 241-AY Tanks do not contain aging waste. Table 2-4 provides a summary of the total waste, drainable waste, flammable gas generation, and integrity of each tank. The waste stored in the tank farm is supernatant liquid and sludge.

Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A, -AN, -AP, -AW, -AX, -AY, and -AZ Tank Farms are also used to monitor subsurface conditions.

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All of the tanks within the 241-AW Tank Farm are equipped with leak detection systems. These systems include automatic and manual liquid level tapes in the primary tank and annulus; three sets of 17-point conductivity probes in the annulus; an annulus exhaust radiation monitoring system; and weight factor, specific gravity, and radiation monitoring instrumentation in the leak detection pit. Annulus riser access is also available for investigative photos or swab sampling.

2.3.2.6.1 241-AY-101 Double-Shell Tank. The 241-AY-101 Double-Shell Tank is the north tank. The tank started operating in 1971 and is currently active. The unit receives strontium and cesium depleted, neutralized, high-level waste from B Plant, dilute noncomplexed waste from single-shell tanks, dilute complexed waste, PUREX high-level waste and supernatant consisting of complexed waste from the 241-A and 241-AX Tank Farms.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,163,860 L (837,000 gal) of supernatant liquid and 313,740 L (83,000 gal) of sludge. The tank is considered sound.

2.3.2.6.2 241-AY-102 Double-Shell Tank. The 241-AY-102 Double-Shell Tank is the southern tank. The tank started operating in 1972 and is currently active. The unit receives neutralized high-level waste, double-shell slurry feed, dilute noncomplexed waste, and supernatant consisting of double-shell slurry feed and noncomplexed waste from the 241-A and 241-BX Tank Farms.

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,345,300 L (885,000 gal) of supernatant liquid and 120,960 L (32,000 gal) of sludge. The tank is considered sound.

2.3.2.7 241-AZ Tank Farm. The 241-AZ Tank Farm consists of two buried double-shell steel tanks. It is located just south of the 241-AZ Tank Farm. The surface elevation of the tank farm is approximately 203 m (666 ft) above msl, and the depth to groundwater below the tank farm is 84 m (274 ft).

The tanks were placed in service in 1976 and are still active. Figure 2-1 shows the individual tanks in the 291-AZ Tank Farm and their operational history. They are numbered 241-AZ-101 and 241-AZ-102. The tank farm consists of:

- Two 3.78 million L (1.0 million gal) double-shell tanks
- Associated primary tank (central) pump pits, annulus pump pits, and leak detection well pump pits

- 241-AZ-801A Instrument Building

- Eight sluice pump pits (4 per tank)

- 241-AZ-101/102 Dual Leak Detection Pit

- 241-AZ-152 Diversion Box

- 241-AZ-155 Contaminated Storage Pit

- 241-AZ-154 Condensate Pump Pit.

The double shell tanks are fabricated as three concentric tanks. The free standing primary tank contains the waste material. The primary tank is comprised of carbon steel 23 m (75 ft) in diameter and 14 m (45 ft) high at the domed center. The maximum capacity is 4,309,200 L (1.14 million gal). The primary tank rests upon a20 cm (8 in.) layer of insulating concrete which protects the structural concrete foundation from excessive temperature during annealing. The secondary tank, 2 m (5 ft) larger in diameter than the primary tank, creates a surrounding space called the annulus. The completely enclosed annulus serves as the containing barrier for primary tank leaks, thus preventing uncontrolled release of radionuclides to the environment. The annulus is ventilated and constantly monitored for evidence of primary tank leakage. The third tank is a concrete shell enclosing the primary and secondary tanks.

The 241-AZ Tanks (also known as aging waste tanks) are used to store high level radioactive waste. Currently, both of the 241-AZ tanks contain aging waste. Table 2-4 provides a summary of the total waste, drainable waste, flammable gas generation, and integrity of each tank. The waste stored in the tank farm is supernatant liquid and sludge.

Several dry wells within the tank farm are used to monitor the soil for radioactivity, and serve as one form of leak detection. In addition, groundwater monitoring wells around the 241-A, -AN, -AP, -AW, -AX, -AY, and -AZ Tank Farms are also used to monitor subsurface conditions.

All of the tanks within the 241-AW Tank Farm are equipped with leak detection systems. These systems include automatic and manual liquid level tapes in the primary tank and annulus; three sets of 17 point conductivity probes in the annulus; an annulus exhaust radiation monitoring system; and weight factor, specific gravity, and radiation monitoring instrumentation in the leak detection pit. Annulus riser access is also available for investigative photos or swab sampling.

~~2.3.2.7.1 241-AZ-101 Double-Shell Tank. The 241-AZ-101 Double-Shell Tank is the east tank. The tank started operating in 1976 and is currently active. The unit receives dilute high-strontium waste from B Plant, complexed waste, double-shell slurry feed, noncomplexed waste, and supernatant consisting of complexed waste, double-shell slurry feed, and noncomplexed waste from the 241-A, -AX, -BX, -C Tank Farms.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,651,480 L (966,000 gal) of supernatant liquid and 132,300 L (35,000 gal) of sludge. The tank is considered sound.~~

~~2.3.2.7.2 241-AZ-102 Double-Shell Tank. The 241-AZ-102 Double-Shell Tank is the west tank. The tank started operating in 1976 and is currently active. The unit receives dilute high-strontium waste from B Plant, complexed waste, aging waste from PUREX, and supernatant consisting of complexed waste from the 241-AX Tank Farm.~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,689,280 L (976,000 gal) of supernatant liquid and 343,980 L (91,000 gal) of sludge. The tank is considered sound.~~

~~2.3.2.8 241-C Tank Farm. Sixteen buried single-shell tanks make up the 241-C Tank Farm. It is located approximately 914 m (3,000 ft) north of the 202-A Building, and 152 m (500 ft) northwest of the 241-AN Tank Farm. The surface elevation of the tank farm is approximately 197 m (645 ft) above mean sea level, and the depth to groundwater below the tank farm is approximately 74 m (243 ft) (WHC 1991a). The tanks are covered with gravel, generally at the level of the surrounding grade.~~

~~The tanks were placed in service during the mid-1940's and retired in the late 1970's to mid-1980's. They are numbered 241-C-101 through 241-C-112, and 241-C-201 through 241-C-204. All the tanks are currently inactive and each has undergone initial stabilization and has a status of either partial interim isolation or interim isolation (WHC 1991a).~~

~~Currently, the entire tank farm, including diversion boxes 241-C-153, 241-CR-151, 241-CR-152, and 241-CR-153, is surrounded by a chain link fence and topped with three strands of barbed wire. Diversion boxes 241-C-151 and 241-C-152 are outside the perimeter fence of the 241-C Tank Farm. The tank farm is covered with gravel. Surface contamination placards are placed on the chain link fence. The entire tank farm is also designated as a supplied air breathing zone. All individuals who enter the confine of the 241-C Tank Farm must be on supplied fresh air.~~

~~The tanks are carbon steel lined with a reinforced concrete shell. Twelve of the tanks (241-C-101 through 241-C-112) have a capacity of over 2,017,000 L (533,000 gal). The domes are generally 2 m (7 ft) below grade, and the bottom of the tanks are generally 11 m~~

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~~(37 ft) below grade. These are first generation tanks in design. This means they have an operating depth of 5 m (17 ft) and dished bottoms.~~

~~Four of the sixteen tanks in the 241-C Tank Farm are smaller than the other tanks within the farm. These tanks (241-C-201 through 241-C-204) are also carbon steel lined with a reinforced concrete shell. Their structure is 8 m (25 ft) tall with a capacity of 208,000 L (55,000 gal). The domes are located less than 4 m (11 ft) below grade, and the bottom of the tanks are 11 m (37 ft) below grade. The four smaller tanks are first generation design tanks. First generation design tanks have operating depths of 5 m (17 ft) and dished bottoms.~~

~~The tanks are arranged in groups of three that are designed to cascade from the southwest to the northeast, so that the bulk of the solid waste is contained in the first tank of a cascading series. Cooling of the waste material, precipitation, and gravity settling of particulate material occur in each tank. Thus, the bulk of the radionuclides collect in the bottom of a tank. Air-cooled reflux condensers were installed to prevent the heating up of the wastes. The condensate from the condensers was returned to the tank and any non-condensible gasses were vented directly to the atmosphere (Stenner et al. 1988; WHC 1991a).~~

~~The waste stream received by the tank farm was generated largely from the bismuth phosphate process used in the 221-B Building, which operated until 1956. During this period, small amounts of waste from Building 201-C (Semiworks) were also sent to the tank farm. The 201-C Building was built in 1949 and used as a pilot plant for the reduction-oxidation process development, and later for "bench scale" PUREX process development. Laboratory waste from the 209-E Building (Critical Mass Laboratory) was also sent to the 241-C Tanks (WHC 1991a).~~

~~Between 1956 and 1972 the PUREX Plutonium Recovery Process operated at the 221-U Building and some of the organic wash waste, coating waste, and tributyl phosphate waste from this extraction process was routed to the 241-C Tank Farm. In addition, all the wastes from the two thorium campaigns run at PUREX, one in 1966 and another in 1970, were sent to the 241-C Tank Farm (WHC 1991a).~~

~~Table 2-4 provides a description of the tank farms in the PUREX Plant Aggregate Area and the volume of total waste and drainable waste present in each tank. Generally, most of the waste present is salt cake with relatively minor drainable liquid.~~

~~Several dry wells within the tank farm are used to monitor the soil for radioactivity and serve as one form of leak detection. In addition, groundwater monitoring wells around the area are also used to monitor subsurface conditions.~~

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~~An incident report was filed on August 16, 1989 regarding the 241-C Tank Farm. On that morning a Radiation Protection Technologist was performing routine work in the tank farm and noticed a musty smell. The technologist held his breath and walked upwind past the 241-C Tank Farm. After exiting the tank farm, the individual experienced a headache and nausea. A similar incident occurred in January of 1989; however, unlike the previous incident, first aid was not required.~~

~~In order to characterize the situation, single shell tanks 241-C-102 and -103 were sampled for ammonia and organic vapors. In addition, the entire tank farm was designated as a supplied air breathing zone.~~

~~**2.3.2.8.1 241-C-101 Single Shell Tank.** The 241-C-101 Single Shell Tank is the southern most tank, and is the first tank in a three tank cascade comprised of 241-C-101, 241-C-102, and 241-C-103. Wastes flowed first into 241-C-101, next overflowed into 241-C-102, and finally flowed into 241-C-103. The tank is surrounded by four active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from 1946 until 1970. The tank received bismuth phosphate metal waste; tributyl phosphate waste; and PUREX coating waste (WHC 1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 332,640 L (88,000 gal). This tank has a potential for hydrogen or flammable gas accumulation above its flammability limit. The tank is considered "sound" and is interim isolated.~~

~~**2.3.2.8.2 241-C-102 Single Shell Tank.** The 241-C-102 Single Shell Tank is northeast of the 241-C-101 Single Shell Tank, and is the second tank in a three tank cascade comprised of 241-C-101, 241-C-102, and 241-C-103. Wastes flowed first into 241-C-101, next overflowed into 241-C-102, and finally flowed into 241-C-103. The tank is surrounded by radiation monitoring wells, however, none of the wells are active. The tank is also equipped with temperature sensors and an automatic liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from May 1946 until 1976. The tank received bismuth phosphate metal waste; tributyl phosphate waste; and PUREX coating waste; thorium high level waste; PUREX organic wash waste; and supernatant containing organic wash wastes and coating wastes from 241-A, -AX, and -C tanks (WHC 1991a).~~

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 1,602,720 L (424,000 gal) of sludge. The tank is considered "sound" and is partially interim isolated.

2.3.2.8.3 241-C-103 Single-Shell Tank. The 241-C-103 Single-Shell Tank is northeast of 241-C-102, and is the third tank in a three-tank cascade comprised of 241-C-101, 241-C-102, and 241-C-103. Wastes flowed first into 241-C-101, next overflowed into 241-C-102, and finally flowed into 241-C-103. The tank is surrounded by five active radiation monitoring wells. The tank is also equipped with temperature sensors and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It is uncertain when this tank started operating. Operation of the tank ceased in 1979. The tank received PUREX coating waste; tributyl phosphate waste; and supernatant containing tributyl phosphate waste, coating, waste PUREX high level waste, B Plant high level waste, B Plant waste fractionization low level waste, PUREX sludge supernatant, PUREX low level waste, waste fractionization PUREX sludge, PUREX organic wash waste, laboratory waste, decontamination waste, REDOX ion exchange waste, REDOX high level waste, noncomplexed waste, waste fractionization ion exchange waste, N Reactor waste, Pacific Northwest Laboratory (PNL) waste, and evaporator bottoms from 241-A, 241-B, 241-BX, and 241-C Tank Farms. This unit was used as the receiver for operating p-10 saltwater systems within the 241-C Tank Farm (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 234,360 L (62,000 gal) of sludge and 503,405 L (133,000 gal) of supernate. The tank is considered "sound" and is partially interim isolated.

2.3.2.8.4 241-C-104 Single-Shell Tank. The 241-C-104 Single-Shell Tank is northwest of 241-C-101, and is the first tank in a three-tank cascade comprised of 241-C-104, 241-C-105, and 241-C-106. Wastes flowed first into 241-C-104, next overflowed into 241-C-105, and finally flowed into 241-C-106. The tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with temperature sensors and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from October 1946 until 1980. The tank received PUREX coating waste; bismuth phosphate metal waste; PUREX low-level and high-level waste; thorium low-level and high-level waste; PUREX organic wash waste; and supernatant containing metal waste, PUREX organic wash waste, PUREX low-level and high-level waste, coating waste, complexed waste, PNL waste, N Reactor complexed waste, waste fractionization ion exchange waste, decontamination waste, B Plant low-level and high-level waste, evaporator bottoms; REDOX high-level waste, and

tributyl phosphate waste from 241-A, 241-AX, 241-C, 241-BY, 241-TY, and 241-U Tanks (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 1,115,100 L (295,000 gal) of sludge. This tank is considered "sound" and is partially interim isolated.

2.3.2.8.5 241-C-105 Single-Shell Tank. The 241-C-105 Single-Shell Tank is northeast of the 241-C-104 Single-Shell Tank and is the second tank in a three tank cascade comprised of 241-C-104, 241-C-105, and 241-C-106. Wastes flowed first into 241-C-104, next overflowed into 241-C-105, and finally flowed into 241-C-106. The tank is surrounded by eight active radiation monitoring wells. The tank is also equipped with temperature sensors and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It is uncertain whether this tank started operating in 1946 or in 1947. Operation of the tank ceased in 1979. The tank received PUREX coating waste; tributyl phosphate waste; PUREX sludge supernatant; REDOX supernatant; and supernatant containing tributyl phosphate waste, coating waste, PUREX sludge supernate, REDOX supernatant, PUREX high level waste, REDOX high level waste, noncomplexed waste, B Plant waste fractionization low level and metal wastes from 241-A, 241-AX, 241-AY, 241-B, 241-C, and 241-TX Tank Farms; and solids containing PUREX sludge supernate, coating waste, and cesium feet from 241-AX and 241-A Tank Farms (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 567,000 L (150,000 gal) of sludge. This tank is considered "sound" and is partially interim isolated.

2.3.2.8.6 241-C-106 Single-Shell Tank. The 241-C-106 Single-Shell Tank is northeast of the 241-C-105 Single-Shell Tank, and is the third and last tank in a three tank cascade comprised of 241-C-104, 241-C-105, and 241-C-106. Wastes flowed first into 241-C-104, next overflowed into 241-C-105, and finally flowed into 241-C-106. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It is uncertain whether this tank started operating in June of 1947 or in 1951. Operation of the tank ceased in 1979. The tank received PUREX coating waste; B Plant low level waste (waste fractionization); supernatant containing PUREX high level waste, and tributyl phosphate waste from the 241-A and 241-C Tanks; and solids containing PUREX sludge supernatant from 241-A Tanks (WHC 1991a).

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The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 745,650 L (197,000 gal) of sludge and 121,120 L (32,000 gal) of supernate. The tank has a high heat load of 150,000 Btu/h. This tank is considered "sound" and is partially interim isolated.

2.3.2.8.7 241-C-107 Single-Shell Tank. The 241-C-107 Single-Shell Tank is northwest of the 241-C-104 Single-Shell Tank, and is the first tank in a three tank cascade comprised of 241-C-107, 241-C-108, and 241-C-109. Wastes flowed first into 241-C-107, next overflowed into 241-C-108, and finally flowed into 241-C-109. The tank is surrounded by seven active radiation monitoring wells. The tank is also equipped with temperature sensors and an automatic liquid level gage.

The tank is classified as an inactive waste management unit. It operated from April 1946 until 1978. The tank received bismuth phosphate first cycle waste; hot 201-C Building (Semiworks) waste; tributyl phosphate; PUREX coating waste; Hanford Laboratory Operations waste; and supernatant containing PUREX coating waste, PNL waste, N Reactor waste, laboratory waste, decontamination waste, waste fractionization ion exchange waste, and evaporator bottoms waste from the 241-C and 241-BX Tanks (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 1,273,860 L (337,000 gal) of sludge. This tank is considered "sound" and is partially interim isolated.

2.3.2.8.8 241-C-108 Single-Shell Tank. The 241-C-108 Single-Shell Tank is northeast of 241-C-107, and is the second tank in a three tank cascade comprised of 241-C-107, 241-C-108, and 241-C-109. Wastes flowed first into 241-C-107, overflowed into 241-C-108, and finally flowed into 241-C-109. The tank is surrounded by three active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from September 1947 until 1976. The tank received bismuth phosphate first cycle waste; PUREX coating waste; tributyl phosphate waste; hot 201-C Building (Semiworks) waste; and supernatant containing tributyl phosphate waste, coating waste PUREX organic wash waste, fractionization ion exchange waste, PNL waste; N Reactor waste, laboratory waste, decontamination waste, and REDOX high level waste from the 241-C Tanks (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 249,480 L (66,000 gal) of sludge. The tank contains ferrocyanide. This tank is considered "sound" and is interim isolated.

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2.3.2.8.9 241-C-109 Single-Shell Tank. The 241-C-109 Single-Shell Tank is northeast of the 241-C-108 Single-Shell Tank, and is the third and last tank in a three-tank cascade comprised of 241-C-107, 241-C-108, and 241-C-109. Wastes flowed first into 241-C-107, next overflowed into 241-C-108, and finally flowed into 241-C-109. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It is uncertain whether this tank started operating in April 1948 or in 1952. Operation of the tank ceased in 1976. The tank received bismuth phosphate first cycle waste; tributyl phosphate waste; hot 201-C Building (Semiworks) waste, PUREX coating waste; and supernatant containing PUREX coating waste, hot Semiworks waste, evaporator bottoms, and ion exchange waste from the 241-C Tanks (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 234,670 L (62,000 gal) of sludge and 15,140 L (4,000 gal) of supernatant. The tank contains ferrocyanide. This tank is considered "sound" and is interim isolated.

2.3.2.8.10 241-C-110 Single-Shell Tank. The 241-C-110 Single-Shell Tank is northwest of the 241-C-107 Single-Shell Tank, and is the first tank in a three-tank cascade comprised of 241-C-110, 241-C-111, and 241-C-112. Wastes flowed first into 241-C-110, next overflowed into 241-C-111, and finally flowed 241-C-112. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from May 1946 until 1976. The tank received tributyl phosphate waste; bismuth phosphate first cycle waste; and supernatant containing PUREX organic wash waste, ion exchange waste, coating waste, evaporator bottoms, and REDOX ion exchange waste (WHC 1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 740,880 L (196,000 gal) of sludge. This tank is considered an "assumed leaker" and is partially interim isolated.

2.3.2.8.11 241-C-111 Single-Shell Tank. The 241-C-111 Single-Shell Tank is northeast of the 241-C-110 Single-Shell Tank, and is the second tank in a three-tank cascade comprised of 241-C-110, 241-C-111, and 241-C-112. Wastes flowed first into 241-C-110, and then overflowed into 241-C-111 Single-Shell Tank and then flowed into 241-C-112. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from August 1946 until 1976. The tank received bismuth phosphate first cycle waste; PUREX organic wash waste; tributyl phosphate waste; PUREX coating waste; evaporator bottoms; hot 201-C Building (Semiworks) waste; and supernatant containing evaporator bottoms, coating waste, and tributyl phosphate waste from the 241-B and 241-C Tanks (WHC-1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 215,460 L (57,000 gal) of sludge. The tank also contains ferrocyanide. This tank is considered an "assumed leaker" and is interim isolated.

2.3.2.8.12 241-C-112 Single-Shell Tank. The 241-C-112 Single-Shell Tank is northwest of the 241-C-111 Single-Shell Tank, and is the last tank in a three-tank cascade comprised of 241-C-110, 241-C-111, and 241-C-112. Wastes flowed first into 241-C-110, next overflowed into 241-C-111, and finally flowed into 241-C-112. The tank is surrounded by six active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It is uncertain whether this tank started operating in November 1946 or in 1952. Operations ceased in 1976. The tank received tributyl phosphate waste; PUREX coating waste; hot 201-C Building (Semiworks) waste; and supernatant containing coating waste, tributyl phosphate waste, and ion exchange waste from the 241-C Tanks (WHC-1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 393,120 L (104,000 gal) of sludge. This tank also contains ferrocyanide. This tank is considered "sound" and is partially interim isolated.

2.3.2.8.13 241-C-201 Single-Shell Tank. The 241-C-201 Single-Shell Tank is north of 241-C-103, and is the first tank in a four-tank cascade comprised of 241-C-201, 241-C-202, 241-C-203, and 241-C-204. Wastes flowed first into 241-C-201, then into 241-C-202, then into 241-C-203, and then into 241-C-204. The tank is surrounded by radiation monitoring wells, however, none are currently active. The tank is also equipped with temperature sensors and a manual liquid level gage.

The tank is classified as an inactive waste management unit. It operated from 1953 until 1977. The tank received bismuth phosphate metal waste and strontium 201-C Building (Semiworks) waste (WHC-1991a).

The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 7,560 L (2,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.

~~**2.3.2.8.14 241-C-202 Single-Shell Tank.** The 241-C-202 Single-Shell Tank is northwest of the 241-C-201 Single-Shell Tank, and is the second tank in a four tank cascade comprised of 241-C-201, 241-C-202, 241-C-203, and 241-C-204. Wastes flowed first into 241-C-201, then into 241-C-202, then into 241-C-203, and then into 241-C-204. The tank is surrounded by radiation monitoring wells, however, none are currently active. The tank is also equipped with temperature sensors and a manual liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from 1953 until 1977. The tank received bismuth phosphate metal waste, strontium 201-C Building (Semiworks) waste, and supernatant containing bismuth phosphate metal waste from the 241-C-201 Single-Shell Tank (WHC 1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 3,780 L (1,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.~~

~~**2.3.2.8.15 241-C-203 Single-Shell Tank.** The 241-C-203 Single-Shell Tank is north of the 241-C-102 Single-Shell Tank, and is the third tank in a four tank cascade comprised of 241-C-201, 241-C-202, 241-C-203, and 241-C-204. Wastes flowed first into 241-C-201, next into 241-C-202, then into 241-C-203, and finally into 241-C-204. The tank is surrounded by radiation monitoring wells, however, none are currently active. The tank is also equipped with temperature sensors and a manual liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from 1953 until 1976. The tank received PUREX high level waste (WHC 1991a).~~

~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 18,900 L (5,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.~~

~~**2.3.2.8.16 241-C-204 Single-Shell Tank.** The 241-C-204 Single-Shell Tank is north of the 241-C-203 Single-Shell Tank, and is the last tank in a four tank cascade comprised of 241-C-201, 241-C-202, 241-C-203, and 241-C-204. Wastes flowed first into 241-C-201, next into 241-C-202, then into 241-C-203, and finally into 241-C-204. The tank is surrounded by two active radiation monitoring wells. The tank is also equipped with temperature sensors and a manual liquid level gage.~~

~~The tank is classified as an inactive waste management unit. It operated from 1953 until 1977. The tank received PUREX high level waste (WHC 1991a).~~

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~~The *Tank Farm Surveillance and Waste Status Report for December 1991* (Hanlon 1992) indicates that the tank contains 11,340 L (3,000 gal) of sludge. This tank is considered an "assumed leaker" and is interim isolated.~~

~~2.3.2.92~~ 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-302~~B~~A Catch Tank started operating in 1956 and is still active ~~and ceased operating in 1980~~. It is designed to contain leaks from transfers and drainage from operation within the 241-A-151 Diversion Box. ~~The volumes of waste received varied according to specific plant operations.~~ It currently contains 13,645 L (3,605 gal) of waste.

No unplanned releases are associated with this unit.

~~2.3.2.102~~ 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. ~~The volumes of waste received varied depending on the specific plant operations.~~ It currently contains 12,306 L (3,240 gal) of waste.

No unplanned releases are associated with this unit.

2.3.2.~~113~~ **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. 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 volumes of waste received varied depending on the specific plant operations.~~

No unplanned releases are associated with this unit.

2.3.2.~~124~~ **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 Basins condensate.

No unplanned releases are associated with this unit.

~~2.3.2.13 241-AX-152CT Catch Tank. The 241-A-152CT Catch Tank and the 241-AX-152 Diverter Station are the same waste management unit. The 241-A-152CT Catch Tank is scheduled for deletion from the WIDS system (WHC 1991a). The unit is approximately 3 m (10 ft) inside the 241-AX Tank Farm west perimeter fence.~~

~~This active unit was constructed in 1965 and consists of two diverter tanks in a common cell with a stainless steel liner on the floor that extends about 0.3 m (1 ft) up the walls. There is also a pump pit that does not have a stainless steel liner. The cell and the pump pit drain to the catch tank below.~~

~~The unit transfers waste solutions and drainage from processing operations within the 241-A-151 Diversion Box. It currently contains 10,053 L (2,656 gal) of waste.~~

2.3.2.~~14~~5 241-C-301C Catch Tank. The 241-C-301C Catch Tank is located ~~southwest of~~ the 241-C-252 Diversion Box and west of the 241-C-204 Single-Shell Tank. The unit is near the ~~southwest~~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. ~~Volumes of waste varied depending on plant operations.~~ It currently holds 120,600 L (31,900 gal) of the 207-A Retention Basins condensate.

No unplanned releases are associated with this unit.

2.3.2.~~15~~6 244-~~Lift Station~~A Receiving Vault. The 244-A Lift Station~~Receiving Vault~~ is located approximately ~~396 m (1,300 ft)~~ north of the 202-A Building. The unit~~, also known as the 244-A Receiver Tank,~~ began operating in 1975 and is still active. The ~~vault~~lift station is 6 m (19 ft) long and 5 m (15 ft) in diameter. The 244-A ~~Receiving Vault~~Lift Station, constructed ~~of~~a carbon steel tank having, ~~has~~ a capacity of 61,538 L (16,280 gal) and ~~sits~~which vertically inside a reinforced concrete, steel-lined vault with 0.3 m (1 ft) thick

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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.

No unplanned releases are associated with this unit.

2.3.2.~~167~~ 244-AR Vault~~/UPR-200-E-59 and UPR-200-E-70~~. 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 1990jb); 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.

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 1990jb). 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. ~~This~~These wastes consists of cladding removal waste enroute to B Plant and ~~transuranic~~TRU waste from B Plant/WESF to the tank farms.

~~Two~~ One unplanned releases ~~(UPR-200-E-59)~~ are is associated with the 244-AR Vault. ~~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.~~

2.3.2.~~178~~ 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.

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The 244-CR Vault was used ~~to transport~~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 all designed to inject or percolate wastewater into the ground without exposing it to the open air. The locations of cribs and drains in the aggregate area are shown on Figure ~~2-6~~2-8. A typical crib is illustrated in Figure 2-9. ~~The c~~Cribs ~~in the PUREX Plant Aggregate Area~~ are ~~generally~~ shallow excavations that are either backfilled with permeable material or held open by wooden structures. Both types of cribs are covered with an impermeable layer. ~~; contain vertical concrete pipes or horizontal perforated pipes; have inlet pipes and a vent structure; and have a sisalkraft paper liner separating gravel from backfill. The cribs are also equipped with risers, which are open-ended pipes that allow atmospheric pressure to influence liquid movement.~~ 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~~ The cribs and drains received low-level waste for disposal. Most cribs, drains, and trenches were designed to receive liquid until the ~~crib's~~ 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). ~~A typical crib is illustrated in Figure 2-7. French drains and reverse wells inject wastewater into the ground at a varying depths. They are generally constructed of steel or concrete pipe and may either be open or filled with gravel. A typical french drain is illustrated in Figure 2-8. The PUREX Plant Aggregate Area contains 24 cribs and 16 french drains. The cribs and drains typically received low level waste for disposal.~~ The following sections describe each crib and drain in the PUREX Plant Aggregate Area ~~individually~~.

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 (1,134 m^2, [3,720 ft^2]) separating the gravel fill from the backfill. The side slope from the surface to 2 m (7 ft) deep is 1:1.5, 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. There is a layer about 1.8 m (6 ft) deep (300 m^3 [11,000 ft^3]) of coarse rock in the excavation bottom. Effluent entered the crib from overground piping. ~~The distance from waste release point to the site bottom is 5 m (17 ft).~~ 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; two layers of sisalkraft paper (a natural fiber media); 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 include the 216-A-1 Sampler Pit #3.

This crib was only active from November to December of 1955. During this time the ~~site~~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 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 ~~then~~is backfilled 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 ~~4.65~~ 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 ~~(natural fiber media)~~ 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 (156 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 the 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 ~~site~~crib received uranyl nitrate hexahydrate ~~S~~storage ~~P~~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. ~~Between 1967 and 1970, the unit discontinued receiving discharge from silica gel regeneration wastes.~~ The above wastes ~~are~~were reworked through the uranium cycle and any resulting waste with low radioactivity ~~are~~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~~/UN-200-E-13~~. 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 ~~an excavation area of~~ 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 ~~m~~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 ~~4.6~~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 ~~(a natural fiber media)~~ separating the gravel from the backfill. Ancillary equipment include the 216-A-4 Sample Pit, the 216-A-Tank #1, and 216-A-Tank #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. ~~In December 1958, the unit became plugged and flooded an area between the unit and the 291-A Stack, contaminating the ground surface (UN 200 E 13). The contamination was removed to a trench along the south boundary of the unit and covered with a foot of soil.~~ The waste management unit was deactivated by blanking the effluent piping when the unit reached its specific retention

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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. ~~Over the years~~ While active, the crib received approximately 1,630,000,000 L (431,000,000 gal) of acidic waste. The crib was deactivated by ~~valving out~~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~~/UPR-200-E-21, UPR-200-E-29~~. 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 ~~feet~~) 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 at the bottom.

The crib started operating in 1955 and ceased operating in 1970. From November 1955 to January 1961, this waste management unit received the ~~SCD~~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 Distributor 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.

~~This waste management unit has a known release, UPR-200-E-21, which occurred on March 20, 1959. It was an overflow from the crib that contaminated the soil adjacent to the crib. On January 20, 1961 unplanned release UPR-200-E-29 occurred. This release was also an overflow from the crib. After both of these incidents the ground surface was covered with 15 cm (6 in.) of sand and topped with plastic sheeting to act as a plant root barrier. The sheeting was covered with 46 cm (18 in.) of sand and 10 cm (4 in.) of gravel in July 1972. In November 1972, the five liquid level risers were cut off 1 m (2 ft) below grade and filled with concrete. Currently, the crib and valve station on the southwest side, are enclosed in a wood and box wire fence. The valve station has a light chain barricade with surface contamination placards posted.~~

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. 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 ~~site~~ 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~~~~soltrol~~ organic inventory from the 202-A Building. The unit was ~~then~~ deactivated in November 1966, by blanking off the effluent pipeline from the 241-A-152 Diversion Box. ~~Throughout the years~~ 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.

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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 (ID Number 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 #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 ~~fill~~ 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 ~~tent~~ 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 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 ~~take~~ due to high radiation alarms. In March 1984, the unit was reactivated for the same effluent as in October ~~of~~ 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 ~~Milestone~~ Tri-Party Agreement milestone M-17-28, all discharge to the 216-A-8 Crib ~~was to~~ 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) ~~is 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 410 cm (~~104~~ 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 ~~was in operation~~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 ~~(CSL)~~. 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 consists of an 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 an original distribution pipe, the new distribution pipe 9.1 m (30 ft) below grade, 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

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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 ~~for~~to support the risers ~~to rest on~~.

The unit started operation in 1957 and was taken out of service in June of 1958 when a 15 cm (6 in.) clay distribution pipe failed. A new distribution system was installed, the unit was brought vitrified 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~~/UN-200-E-56~~. 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 ~~over~~to grade. The crib is broken into 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 total length of the crib is approximately 488 m (1,600 ft). 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. Anciliary equipment include the 216-A-524 Diversion Box. Although the bypass capability would appear to exist, note that this is only a 5 cm (2 in.) pipe which would be a fairly poor conductor of effluent.

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 ~~1990~~1988 the surface of the unit was stabilized. It is currently about 1 m (2 ft) above grade and there are numerous concrete marking posts ~~lying~~ around the unit. ~~The 216-A-24 Crib adjoins unplanned release UN-200-E-56. This unplanned release occurred in 1979 when contaminated moisture was encountered in an excavation east of the 200 East Area perimeter fence. While digging from clear fill for the 241-AN Tank Farm, beta contaminated moisture was found that had migrated laterally over the surface of a 10 cm (4 in.) crust of hard pan approximately 5 m (15 ft) below the surface (Maxfield 1979).~~

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 ~~over~~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 an 20 cm (8 in.) diameter well extending from a concrete pad, an 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 ~~crib~~ 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

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216-A-30 Crib has one 38 cm (15 in.) corrugated perforated distribution pipe running ~~1.2~~ 2.1 m (4~~7~~ ft) below grade, ~~just to the center of the crib~~for the first 220 m (700 ft) of crib. Another 41 cm (16 in.) steel distribution pipe parallels the first perforated pipe, ~~1.2~~2.1 m (4~~7~~ ft) below grade, ~~just to the center of the crib,~~ then angles 45 degrees 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 (ID Number is Diversion Box #2) on the 216-A-30 Crib ~~is~~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 ~~SCD~~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 bacuase 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. ~~This unit had been receiving~~ The 216-A-30 Crib was reactivated in 1970 to receive the above effluent because the 216-A-6 Crib was deactivated ~~in January 1970~~. 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-17-27A, discharge of the PUREX Plant ~~SCD~~ steam condensate to the 216-A-30 Crib ~~is to cease as of June 1992.~~ was shut down in February 1991 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 has been backfilled with a side slope of 1:1.5. 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 ~~only~~ 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 1.5 m (5 ft) (200 m^3 [6,000 ft^3]) of gravel fill with a side slope of 1:1.5.

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 ~~that is 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% ~~Soltrol (a brand of kerosene)~~ kerosene diluent in this crib. To ~~this~~ date, this proposed disposal has not been confirmed as having taken place. The crib is inactive ~~and will not receive any more waste~~.

No unplanned releases are associated with this unit.

2.3.3.17 216-A-36A Crib. The 216-A-36A Crib is located ~~230~~190 m (~~750~~600 ft) south of the 202-A Building and 350 m (1,150 ft) west of Canton Avenue. The ~~site~~crib dimensions of the bottom of the crib are ~~304.8~~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 has 1 m (2 ft) (130 m^3 [4,500 ft^3]) of gravel fill, and the ~~site~~unit has been backfilled to grade. The crib contains a 15 cm (6 in.) perforated pipe placed horizontally 6.4 m (21 ft) below grade, an 20 cm (8 in.) gage well extending from the bottom to 0.6 m (2 ft) above grade, a plastic barrier between gravel and backfill, a concrete dam separating this unit from 216-A-36B, and two 5 cm (2 in.) grout wells extending from the bottom.

This unit was only active ~~for seven months, between~~ September 1965 ~~to~~and March 1966. During this time the crib received 1,070,000 L (280,000 gal) of ammonia scrubber waste from the 202-A Building. The waste is low salt and neutral/basic. The ~~site~~unit was deactivated soon after initial operation when it became too radioactively contaminated for further use. A concrete dam was installed and the pipeline was extended to 216-A-36B.

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No unplanned releases are associated with this unit.

2.3.3.18 216-A-36B Crib. The 216-A-36B Crib is located ~~370~~220 m (~~1,200~~700 ft) south of the 202-A Building. The ~~site~~crib dimensions of the bottom 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 excavation has 1 m (3 ft) (620 m^3 [22,000 ft^3]) of gravel fill and backfilled. The unit is a gravel structure with a 10 cm (4 in.) perforated pipe placed horizontally 7 m (23 ft) below grade. 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. The 216-A-36B Crib is an extension of the 216-A-36A Crib. A concrete dam was constructed between the cribs and a 10 cm (4 in.) perforated pipe was extended into the 216-A-36B Crib. This crib is a RCRA TSD facility.

Beginning in March 1966, the ~~site~~crib received the ammonia scrubber waste from the 202-A Building. Then 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. Over 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 ~~was to cease~~ 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 ~~south~~east end of the crib and a vent is located at the ~~north~~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. ~~This~~The connection was never used due to the fact that the 216-A-37-1 Crib use for evaporator process condensate started in 1977. ~~discharge but the 202-A Building did not restart until and~~ The pipe was removed prior to PUREX restart in 1983.

This unit ~~became~~ began ~~active~~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

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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. There are two 20 cm (8 in.) steel drain pipes: one is perforated and runs the length of the unit, the other is not perforated and runs from west to east only to the center of the unit 3 m (10 ft) below grade. A 15 cm (~~1~~6 in.) flow meter is located in a shallow caisson ~~o~~nat the crib's head end. The 216-A-37-2 Crib has one 38 cm (15 in.) corrugated perforated distribution pipe running ~~1.22~~ 1 m (4~~7~~ ft) below grade, just to the center of the crib. Another 41 cm (16 in.) steel distribution pipe parallels the first perforated pipe, ~~1.22~~ 1 m (4~~7~~ ft) below grade, just to the center of the crib, then angles 45 degrees 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 ~~(PVC)~~ 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 and received one-third of all steam condensate sent to the diversion box number 2 and the 216-A-30 Crib.

According to Tri-Party Agreement ~~M~~milestone M-17-22A, discharge of the PUREX Plant ~~SCD~~ steam condensate to the 216-A-37-2 Crib ~~is to cease in~~ 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 ~~over~~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 liquid waste discharged to the 2~~61~~16-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. 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 20 L (5.3 gal) of floor drainage from the 241-AX-801-B Building. Currently, the unit is a level gravel-paved area with no markers ~~of~~for indications of a surface spill.

No unplanned releases are associated with this unit.

2.3.3.23 216-A-41 Crib. The 216-A-41 Crib is located about 30 m (100 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 18 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. 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 ~~Building~~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 ~~site~~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 ~~M~~milestone M-17-20A, all discharge to the 216-A-45 Crib was ~~to cease~~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. ~~The unit is expected to contain less than 50 Ci total beta activity.~~ An identification marker post was the only visible surface manifestation of this site.

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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 (30,0000 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 ~~common with~~ the ~~underground~~same radiation zone ~~associated with~~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 assuming to have a 1:1 side slope ~~for excavation~~. 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 east of the ~~431-A~~241-A-431 Ventilation Building. The drain is 5 m (17 ft) deep and 1.1 m (3.5 ft) in diameter, and is assuminged 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

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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/~~UPR-200-E-17~~. 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 pipe that is vertical is not visible from 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.

~~The 216-A-14 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.~~ 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, south 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 ~~water~~-sealing the pipe ~~the piping leading to it.~~

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, south of the 241-A-431 Ventilation Building. The french drain is 2 m (7 ft) deep with 1.1 m (3.5 ft) diameter, assuming a 1:1 side slope. 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 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 ~~water~~-sealing ~~the piping leading to it~~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 ~~it~~ was shut down in 1991. The waste management unit ~~has been receiving the~~ received low salt neutral floor drainage ~~a low salt neutral waste,~~ from the 291-A Fan Control House~~, which is a low salt neutral waste~~.

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 ~~for~~that the diameter is only 1 m (3 ft).

This french drain ~~was in operation~~ 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-26B

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French Drain encasement. This unit cannot be distinguished from the 216-A-26 French Drain from indications ~~at the surface~~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 (~~9 ft~~31 m^3 [1,100 ft^3]) of gravel fill and ~~then~~ 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 ~~were~~ 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 ~~site~~ 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 ~~considered~~ 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. ~~near the 216-A-8 Crib.~~ 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 ~~C~~cooling ~~W~~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 ~~is~~ 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 24~~1~~4-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 an 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-~~C Building~~ 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 ~~Building~~ Control House. ~~There is a cave-in potential at the unit because of a 1.2 m (4 ft) diameter and 23 cm (9 in.) deep depression.~~

No unplanned releases are associated with this unit.

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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 ~~three 6.1 m (20 ft) sections and one 1.5 m (5 ft) section of~~ 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 ~~4,000~~ 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 ~~low-level~~ wastewater ~~from various sources~~ 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-~~9~~11. A ditch is a long, open, unlined excavation used to transfer low-level liquid wastes from process facilities to ponds. Trenches are unlined 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 be conservative and ensure that liquid did not reach groundwater (Haney and Honstead 1958). There are two ditches and four trenches in the PUREX Plant Aggregate Area. ~~Trenches are commonly used for the disposal of high salt waste or waste containing complexed radionuclides. Many of Hanford's trenches are designated "specific retention" trenches. 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). Generally, for soil column disposal, a target of 10% of the specific retention capacity of the unit was utilized in an effort to be conservative and ensure that liquid did not reach groundwater. Trenches 216-A-18, 216-A-19, and 216-A-20 were specific retention trenches. Ditches were also used as a means to transport low level waste to a waste management unit (i.e., trench, pond). The following sections describe the ditches and trenches present 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 ~~C~~cooling ~~W~~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 waste management unit began operation in November 1955 and was shut down in October 1991. The unit is a man-made, uncovered earthen ~~trench~~ 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 ~~CSL~~ chemical sewer line is at the northeast corner of the 241-AP Tank Farm. The ~~CSL~~ 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 releases for flow control. The first 3 m (10 ft) from the point of influent is 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 flows to 216-B-3 Pond. Until December 1957, the waste management unit received chemical sewer liquid effluent and cooling water ~~and chemical sewer liquid effluent~~ 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

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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 unit received the chemical sewer liquid effluent from the 202-A Building, and acid fractionator condensate from the 202-A Building. From December 1963 until January 1966, the unit received the chemical sewer liquid effluent from the 202-A Building and 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 in October 1991. South of the GTF perimeter fence the ditch has been filled to grade, surrounded with a light chain barricade, and posted with underground contamination placards. North of the perimeter fence the ditch has been completely backfilled and stabilized as of October 1991.

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 (2 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. ~~When pipeline trenches were being dug for the Liquid Effluent Retention Facility, the 216-A-34 pipeline was encountered and had contamination levels up to 6,000 ct/min.~~ 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 ~~Ditch~~ 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 ~~ditch~~ 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 ~~Ditch~~ 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 ~~ditch~~ 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 ~~Ditch~~ 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 ~~ditch~~ 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/~~UPR-200-E-59~~. The 216-A-40 ~~Ditch~~ 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.

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This waste management unit operated from January 1968 until May 1979 and is inactive. The ~~ditch~~ 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 ~~seated~~ 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 trench received the diverted ~~CWL and SCD~~ cooling water and steam condensate from the 244-AR Vault. Currently, the ~~ditch~~ trench is enclosed within a box-wire fence and several tumbleweeds fill the ~~ditch~~ trench bottom.

One unplanned release (UPR-200-E-59) is associated with the 216-A-40 ~~Ditch~~ Trench. ~~The exact location of the unplanned release was on the eaves of the 244-AR Vault and the walls of the 216-A-40 Ditch. Contaminated mud and tumbleweeds from the ditch were used to make bird nests at the vault. The mud had readings of ^{137}Cs at 10,000 ct/min and ^{60}Co at 20,000 ct/min. The nests and tumbleweeds were removed from the ditch, packaged, and placed in the burial ground. The sides of the 216-A-40 Ditch were washed and the contaminated mud was removed.~~

2.3.6 Septic Tanks and Associated Drain Fields

The location of the septic tanks and drain fields are shown on Figure 2-~~10~~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 ~~0.06 m^3~~60 L/day (~~2 ft^3~~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 ~~0.45 m^3~~450 L/day (~~16 ft^3~~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 ~~0.28 m^3~~ 28 L/day (~~9 ft^3~~ 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 ~~0.17 m^3~~ 170 L/day (~~6 ft^3~~ 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 ~~0.32 m^3~~ 320 L/day (~~11 ft^3~~ 85 gal/day).

No unplanned releases are associated with this unit.

2.3.6.6 2607-EL Septic Tank and Drain Field. The ~~WIDS database (WHC 1991a) suggests that this~~ 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 ~~7.9 m^3~~ 7,900 L/day (~~280 ft^3~~ 2,100 gal/day).

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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 ~~43.5 m^3~~43,500 L/day (~~1,536 ft^3~~11,500 gal/day).

No unplanned releases are associated with this unit.

2.3.7 Transfer Facilities, Diversion Boxes, and Pipelines

High-level ~~transfer Facilities~~ 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. ~~Process~~ 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 ~~Transfer F~~facilities that they connect are shown on ~~Plate 1 and~~ Figure 2-~~11~~13. The ~~process lines~~ high-level waste pipelines are not waste management units according to the Tri-Party Agreement and will be addressed in detail under ~~a separate Surplus Facilities~~ the Decommissioning and RCRA Closure Program. ~~However, because of the physical nature of the process lines and their installation, there is a possibility of leakage along the entire right-of-way; therefore, the process lines will be discussed further in Section 9.0.~~

~~Sewer pipelines connecting the liquid waste stream generating facilities to their soil column disposal sites are sometimes constructed of sectional vitreous clay or corrugated metal pipes and are expected to leak to some degree. The pipeline right-of-ways are, therefore, expected to be contaminated to levels equal to or higher than the soil column sites and may require extensive characterization as part of the soil column disposal facility's investigation.~~

~~Process lines, constructed for inter-facility transfers (i.e., generator to tank farm) of highly contaminated solutions between the 200 Areas, 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 transfer facilities that they serve are shown on Plate 1 and Figure 2-11. The process lines are not waste management units according to the Tri-Party Agreement and will be addressed in detail under a separate Surplus Facilities Program. Therefore, the process lines will be discussed further in Section 9.0.~~

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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 ~~18~~27 diversion boxes, ~~and 12~~ valve pits, and 1 control structure in the PUREX Plant Aggregate Area.

2.3.7.1 241-A-A Diversion Box. The 241-A-~~B~~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 m (14 ft) long, 3.7 m (12 ft) wide, and 2.3 m (7.5 ft) deep~~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 ~~m (14 ft) long, x~~ 3.7 ~~m (12 ft) wide, and x~~ 2.3 m ~~(7.5 ft)~~ (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~~, UN-200-E-68~~) are associated with the 241-A-151 Diversion Box. ~~Leakage from the box~~

~~contaminated an area southwest of the PUREX 202-A Building. More detailed information regarding unplanned releases is in Sections 2.3.10.~~

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 m (61 ft) long, 7.2 m (23.5 ft) wide, and 5.6 m (18.5 ft) deep~~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 m (17 ft) long, 4 m (9.5 ft) wide, and 4 m (13 ft) deep~~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 m (14 ft) long by 4 m (14 ft) wide by 2 m (7 ft) deep~~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 ~~supernatant~~ 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 ~~T~~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 m (14 ft) long by 4 m (14 ft) wide by 2 m (7 ft) deep~~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 ~~supernatant~~ supernate from other tank farms to the 241-AN ~~T~~tanks, between tanks within the 241-AN Tank Farm and to forward material to other tank farms from the 241-AN ~~T~~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 m (61 ft) long by 5 m (16 ft) wide by 2 m (8 ft) deep~~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 (18 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 ~~D~~double-~~S~~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.

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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 m (14 ft) long by 4 m (12 ft) wide by 2 m (7 ft) deep~~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 ~~supernatant~~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 m (14 ft) long by 4 m (12 ft) wide by 2 m (7 ft) deep~~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 ~~supernatant~~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 m (14 ft) long, 3.7 m (12 ft) wide, and 2.3 m (7.5 ft) deep~~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 m (14 ft) long, 3.7 m (12 ft) wide, and 2.3 m (7.5 ft) deep~~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 ~~Plant~~ 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 m (44 ft) long, 3 m (10 ft) wide, and 7.6 m (25 ft) deep~~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.

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The 241-AX-152DS Diversion Box is ~~8 m (25 ft) long, 3 m (9 ft) wide, and 8.8 m (29 ft) deep~~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-~~155~~ 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. ~~pump pit and 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. ~~It is unclear when the unit started operating.~~ The concrete diversion box is ~~3 m (9 ft) long by 2 m (7 ft) wide by 3 m (10 ft) deep~~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 ~~and~~ stopped operating in 1985 and is considered inactive. ~~A transfer box is different from a diversion box in that a transfer box connects a common transfer line to each of several other lines one at a time.~~ The reinforced concrete diversion box is ~~5 m (17 ft) long by 5 m (15 ft) wide by 3 m (10 ft) deep~~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 ~~GA~~ 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. ~~A transfer box is different from a diversion box in that a transfer box connects a common transfer line to each of several other lines one at a time. The 241-AZ-152 Diversion Box (Sluice Transfer Box) is the only active transfer box in the Double-Shell Tank Farm System.~~ The inside dimensions of the concrete diversion box are ~~6 m (18 ft) long by 3 m (11 ft) wide by 2 m (6 ft) deep~~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.

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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 m (20 ft) long, 3 m (9 ft) wide, and 3.5 m (11.5 ft) deep~~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 contamination release incident occurred in January 1985. The diversion box site was stabilized with weatherproofing foam. More detailed information regarding unplanned releases can be found in Sections 2.3.10 and 4.1.8.~~

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

~~On January 11, 1985 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 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.~~

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 m (28 ft) long, 3 m (9 ft) wide, and 3.5 m (11.5 ft) deep~~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. ~~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 Tank to the 221-B Building. More detailed information regarding unplanned releases is in Sections 2.3.10 and 4.1.8.~~

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 ~~(34 ft) long, 3 m (9 ft) wide, and 3.2 m (10.5 ft) deep~~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 ~~(36 ft) long, 3 m (9 ft) wide, and 4.6 m (15 ft) deep~~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. ~~A puddle of contaminated liquid was discovered near the 241-CR-151 Diversion Box in October 1969.~~ More detailed information regarding unplanned releases is presented in Table 2-6 and Section 4.0. ~~Sections 2.3.10 and 4.1.8.~~

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.

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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 within the 216-A-524 Crib area. The ~~WIDS database~~ coordinates place this structure north of the 216-A-24 Crib (WHC 1991a). Environmental protection records contain a work order mandating the disassembly of the 216-A-524 Control Structure, located at the southwest side of the crib. Currently, there is no sign of this structure on or near the crib. 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 m (4 ft) by 4 m (12 ft)~~ 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

~~Basins are rubber-lined, open, settling ponds where wastewater was held before overflowing into a ditch.~~ Retention basins were used for intermittent storage of liquid waste before it was 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-~~12~~14.

2.3.8.1 207-A Retention Basins. The 207-A Retention Basins ~~lie~~ is directly east of the 242-A Evaporator.

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

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

No unplanned releases are associated with this unit.

2.3.8.2 216-A-42 Retention Basin ~~/UPR-200-E-66~~. The 216-A-42 Retention Basin ~~lies~~ 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 ~~104.2 m (342 ft) long, 9.1 m (30 ft) wide,~~ 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, ~~C~~cooling ~~W~~water ~~L~~line, and ~~C~~chemical ~~S~~sewer ~~L~~line. Waste from these lines is directed to the basin when online beta, gamma, or alpha monitors detect contamination in the line. The ~~C~~chemical ~~S~~sewer ~~L~~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-

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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. ~~In November 1984, wind spread contamination 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.~~

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-~~13~~15.

2.3.9.1 200-E Burning Pit~~/UPR-200-E-62 and UPR-200-E-106~~. The burning pit is located in the large excavation east of the ~~site~~ 218-E-8 ~~b~~Burial ~~g~~Ground. The ~~site~~ burning pit is 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 ~~site~~.

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.

Three enclosures are located within the basin. South of ~~site~~ 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.

~~This unit has two unplanned releases associated with it: UN-200-E-62 and UPR-200-E-100. Unplanned release UPR-200-E-106 consisted of contaminated paper towels from the control laboratory.~~

2.3.9.2 218-E-1~~/UPR-200-E-53~~ Burial Ground. The 218-E-1 Burial Ground ~~218-E-1~~ 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.

~~This unit has an~~ There is one unplanned release ~~(UPR-200-E-53)~~ associated with this unit ~~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 218-E-1 Burial Ground. Currently, there are no signs indicative of an unplanned release.~~

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 ~~Old~~ 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 ~~transuranic~~ 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~~/UPR-200-E-24, UPR-200-E-30~~. The 218-E-12A Burial Ground is located 50 m (150 ft) northwest of the 241-C Tank Farm. The burial ground is approximately ~~362 x 12.2~~341 x 341 m (~~1,188 x 40~~1,200 x 1,200 ft) 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. A ditch from B Plant cuts along the north perimeter, which has surface contamination signs posted. The ditch empties into a pipe on the northeast corner of the burial ground.

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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 trenches surfaces have settled ~~and created due to~~ voids created by ~~in~~ 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. ~~Earlier practices required the process operator to make the initial cover by hand shovel.~~

This burial ground has two unplanned releases associated with it: UPR-200-E-24 and UPR-200-E-30. ~~Unplanned release UPR-200-E-24 occurred on June 17, 1960. 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 km (2 mi). Unplanned release UPR-200-E-30 occurred on April 20, 1961. Another burial box collapsed during burial operations spreading contamination throughout the burial ground.~~

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 bBurial gGrounds 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 ~~yr~~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).

~~This~~ While no designated unplanned releases are associated with this unit, the waste management unit ~~has an unplanned~~ 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-~~14~~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~~; however,~~ 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-~~5~~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 10 (WHC 1988a). If the available data indicate that the release is significant, it will be submitted for listing as an official unplanned release. ~~It is described in the following paragraph.~~

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.

~~In 1985 a release of fission products to the environment was detected in the eastern section of the 200 East Area. The source of the release was a deactivated diversion box,~~

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~~241-C-151, in the 241-C Tank Farm. The release, estimated at less than 500 mCi ^{90}Sr, spread detectable contamination over about a 5 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.~~

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. 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 ~~waste~~ 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 River and condensed steam. Added to this mixture are (1) minute traces of 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

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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 1990h). 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 2-67 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 2-78; Table 2-89 lists the chemicals used in the 202-A Building Analytical Laboratory; and Table 2-910 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 2.4.5 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

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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 ~~(PDD)~~, cooling water, PUREX steam condensate, chemical sewer, and ammonia scrubber distillate ~~(ASD)~~. The ~~PDD~~ 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 ~~PDD~~ process condensate stream. The ~~PDD~~ 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 ~~ASD~~ 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 ~~ASD~~ ammonia scrubber distillate stream. The ~~ASD~~ 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 ~~back-up~~ Offgas Treatment facility, which removes nitrogen oxides from the dissolver offgas stream ~~then~~ 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 ~~(EC)~~ 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 Basins.

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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 ~~Trench~~.

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 ~~(PFP)~~ 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.

~~Several PUREX Plant waste management units have received wastes from the surrounding aggregate areas. The 216-A-8 Crib received condensate from the 241-AY and -AZ Tank Farms. The 216-A-9 Crib received N Reactor decontamination waste. The 241-A Tank Farm received various wastes including B Plant high level waste, complexed and non-complexed waste from the 241-BX, -SX tanks, double shell slurry feed from 241-AY, -AZ, -BX, -BY, and -SX tanks. The 241-AX Tank Farm received B Plant high level waste, and sludge supernatant from the 241-AZ Tank Farm. The 241-C Tank Farm received B Plant high level waste, B Plant waste fractionization low level waste, REDOX high level~~

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~~waste, N Reactor waste, PNL waste, Hanford Laboratory operations waste, Semiworks waste, evaporator bottoms from 241-B, BX Tank Farms, tributyl phosphate waste from 241-BY, -TY, and -U tanks, and metal wastes from 241-AY, and -TX tanks.~~

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. ~~Aggregate Area Management Study.~~

2.6 INTERACTION WITH RESOURCE CONSERVATION AND RECOVERY ACT PROGRAM

Appendixes B and C of the Tri-Party Agreement ~~(Ecology et al. 1990)~~ list RCRA TSD facilities on the Hanford Site ~~which~~ 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 ~~29~~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
- Nuetralizaion Tank U3
- Neutralization Tank U4
- E-F11 Concentrator
- Ammonia Distillate Treatment System (future tank)
- Waste Piles
- 204-AR Waste Unloading Station
- Grout Treatment Facility

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- 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, B-FI1 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.

~~Table 2-10 lists the RCRA regulated facilities, the operable unit where they are located, and the planned action (closure or operating permit).~~

2.7 INTERACTIONS WITH OTHER HANFORD PROGRAMS

~~In addition to RCRA, there are several o~~Other ongoing programs include the Single-Shell Tank Closure Program (part of RCRA), the Decommissioning and RCRA Closure Program, the RARA Program, ~~that affect buildings and waste management units in the PUREX Plant Aggregate Area. These programs include: the Hanford Surplus Facilities Program, the Radiation Area Remedial Action (RARA) Program, the Hanford Site Single-Shell Tank Program,~~and the ~~Defense~~ Waste Management Program.

~~At the Hanford Site, the programmatic responsibility within the Westinghouse Hanford Environmental Restoration Program for the surveillance maintenance and decommissioning of surplus facilities belongs to the Surplus Facilities and RCRA Closures 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. ~~The~~ This program is also responsible for managing the RCRA closure ~~and RARA~~ activities. ~~The program~~ 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, ~~and RARA~~ 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 Program is conducted as part of the Surplus Facilities Program.~~ The RARA is responsible for the surveillance, maintenance, decontamination, and/or interim stabilization of inactive burial grounds, cribs, ponds, trenches, and unplanned releases at the Hanford Site. A major concern associated with these requirements is the management and control of surface soil contamination. All of the controlled access surface radiation zones in the PUREX Plant Aggregate Area are covered by this program. Table 2-~~12~~ ~~11~~ lists the waste management units in the PUREX Plant Aggregate Area that are monitored by this program.

The ~~Hanford Site~~ 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 ~~Defense~~ 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. ~~Table 2-12 summarizes the units monitored by this program.~~

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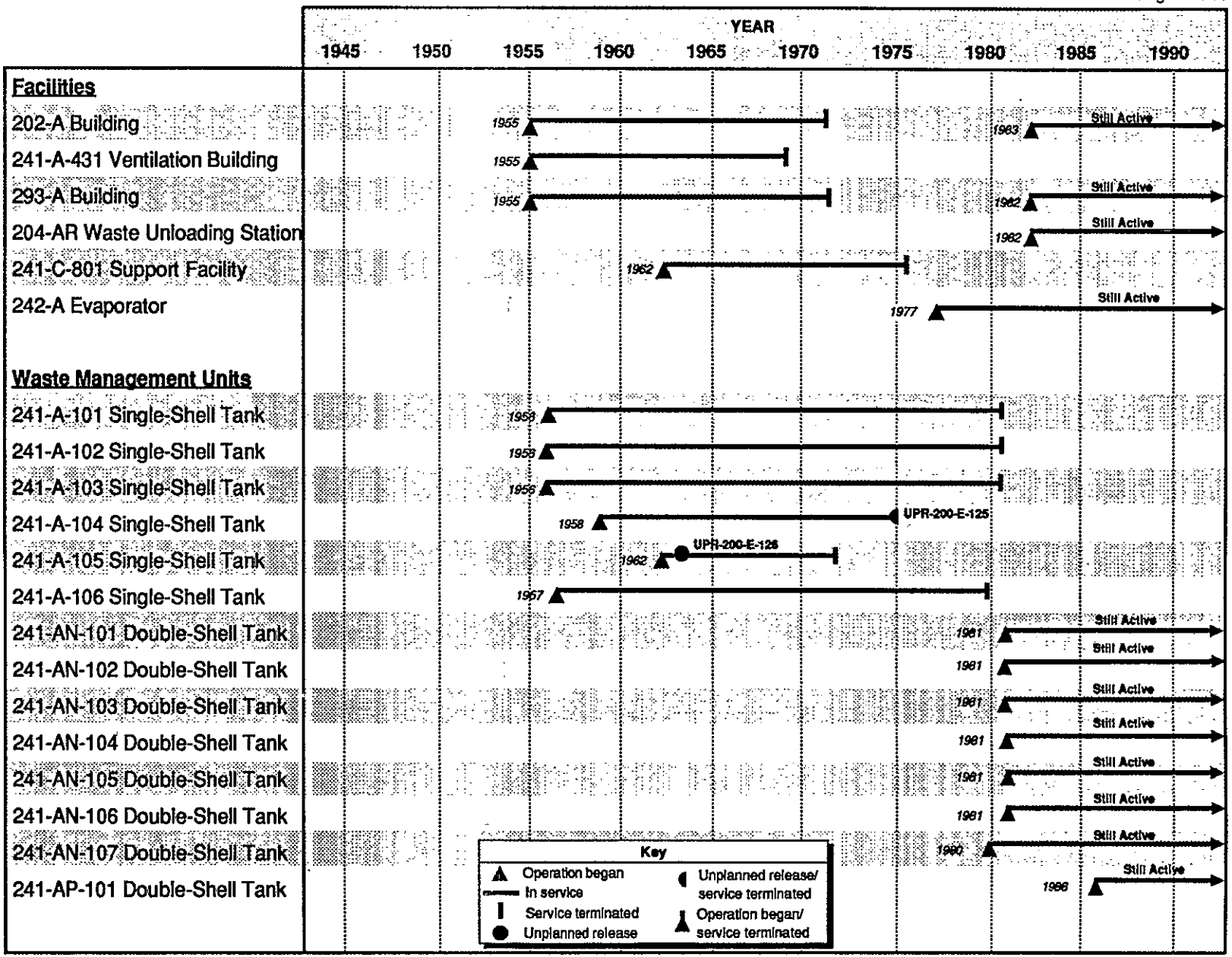

Figure 2-1. Operational and Waste-Related History.

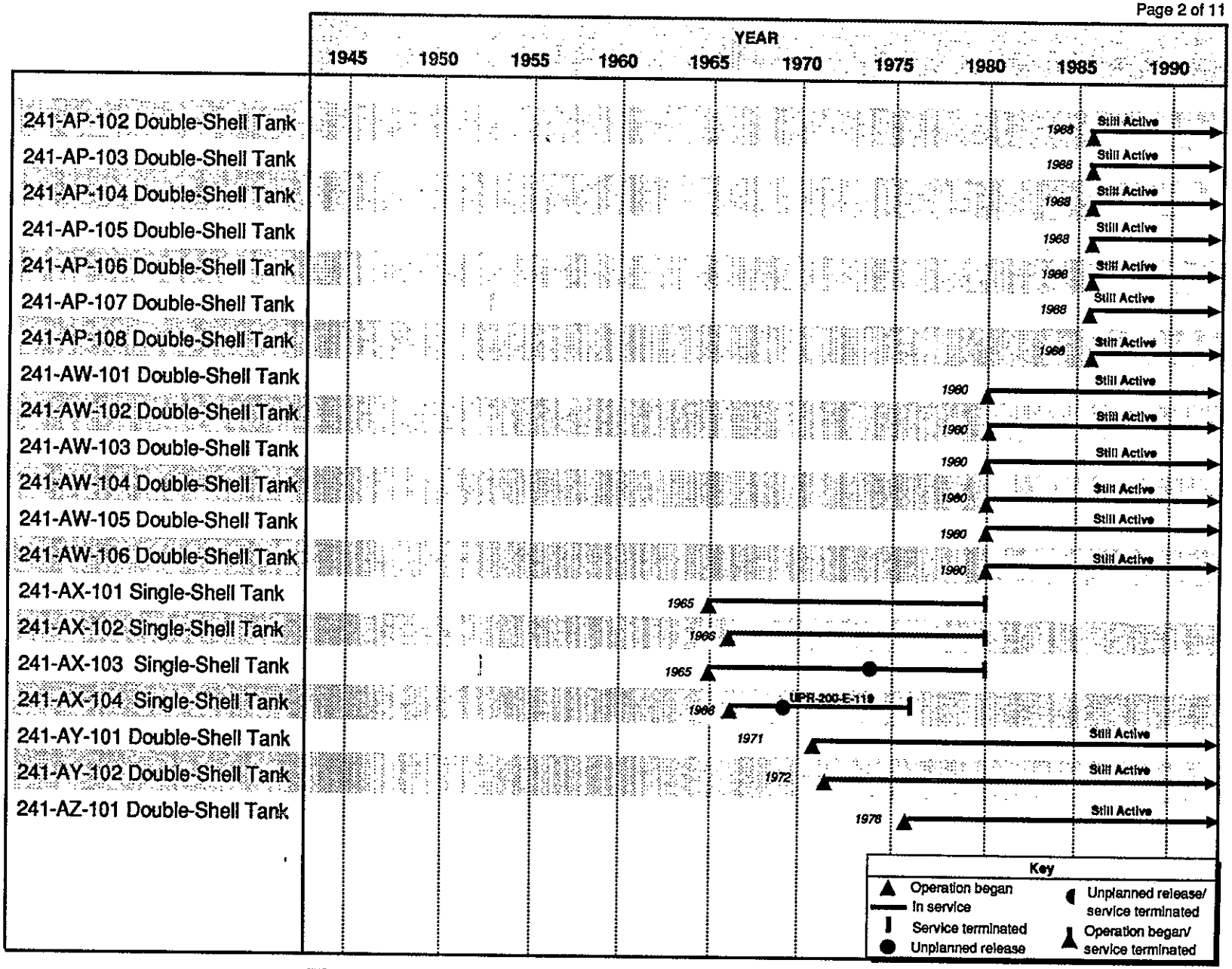

Figure 2-1. Operational and Waste-Related History (continued).

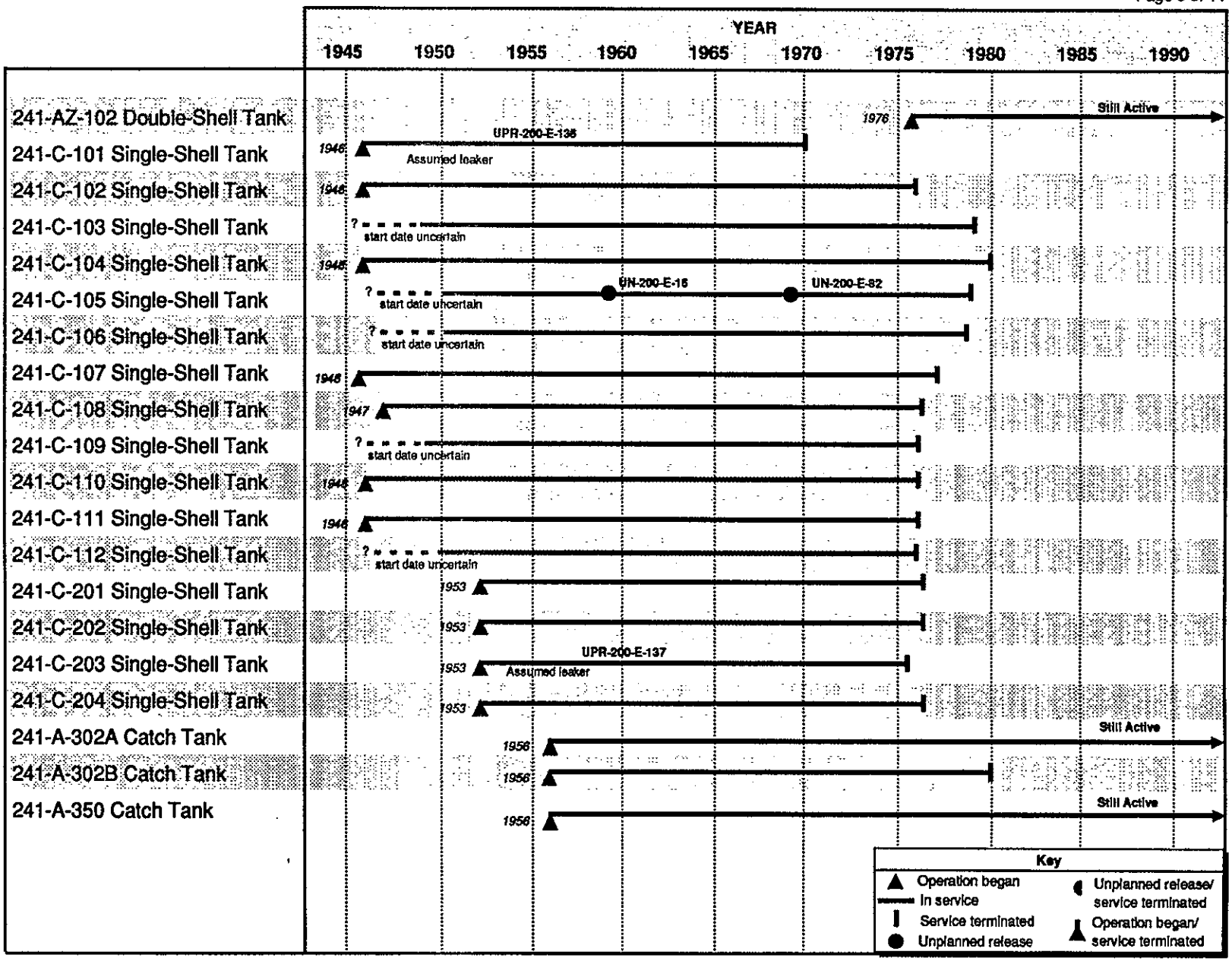

Figure 2-1. Operational and Waste-Related History (continued).

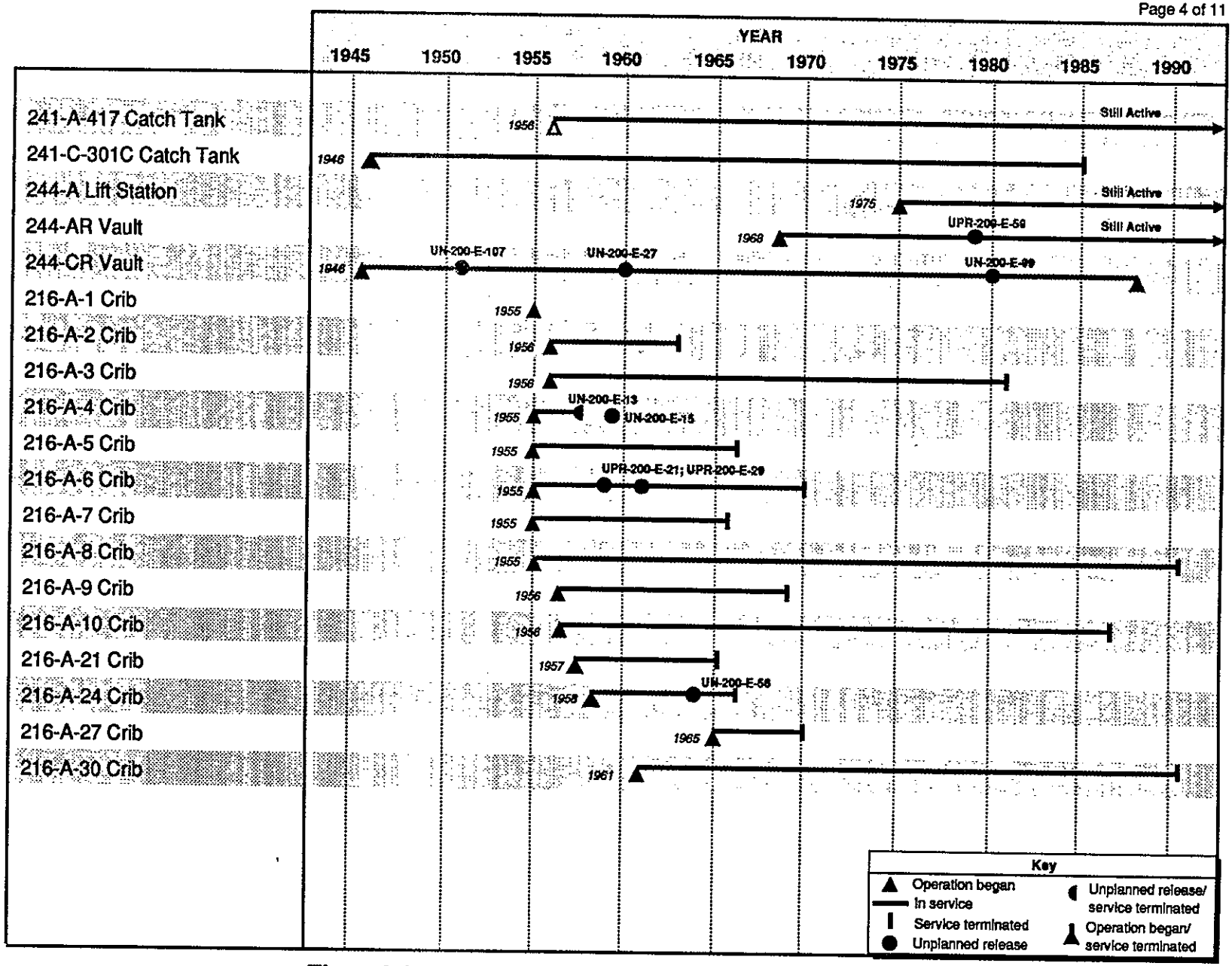

Figure 2-1. Operational and Waste-Related History (continued).

Figure 2-1. Operational and Waste-Related History (continued).

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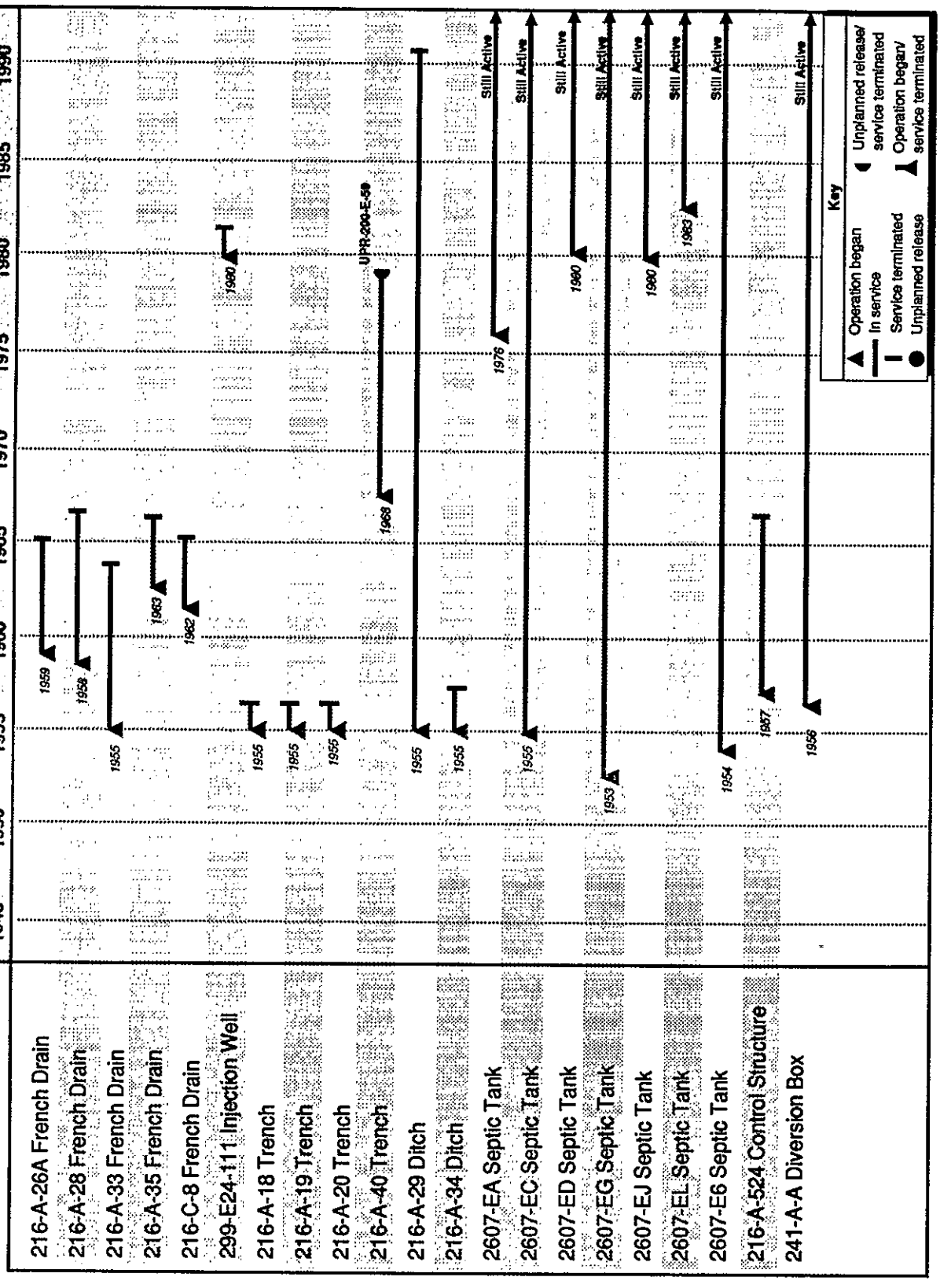

Figure 2-1. Operational and Waste-Related History (continued).

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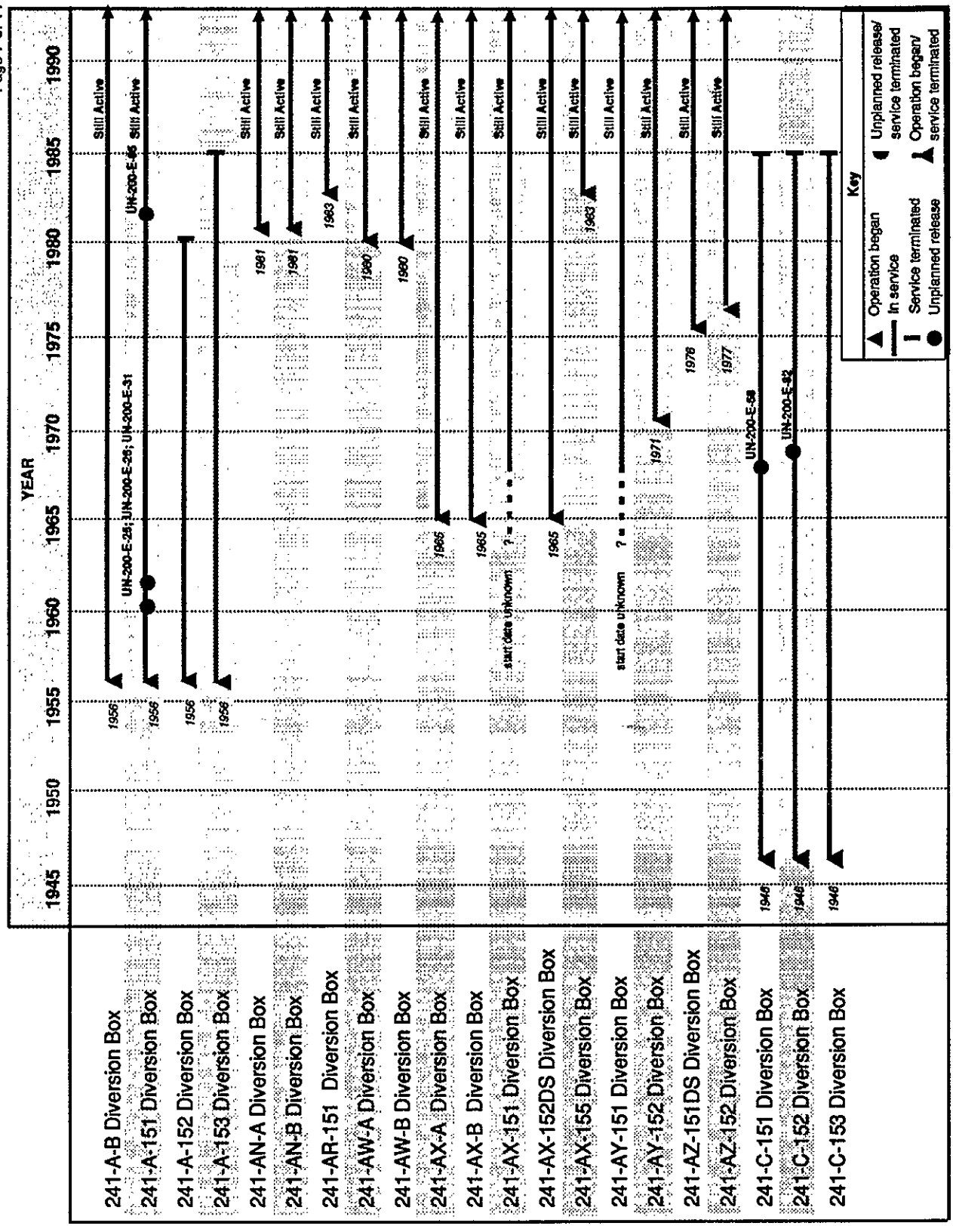

Figure 2-1. Operational and Waste-Related History (continued).

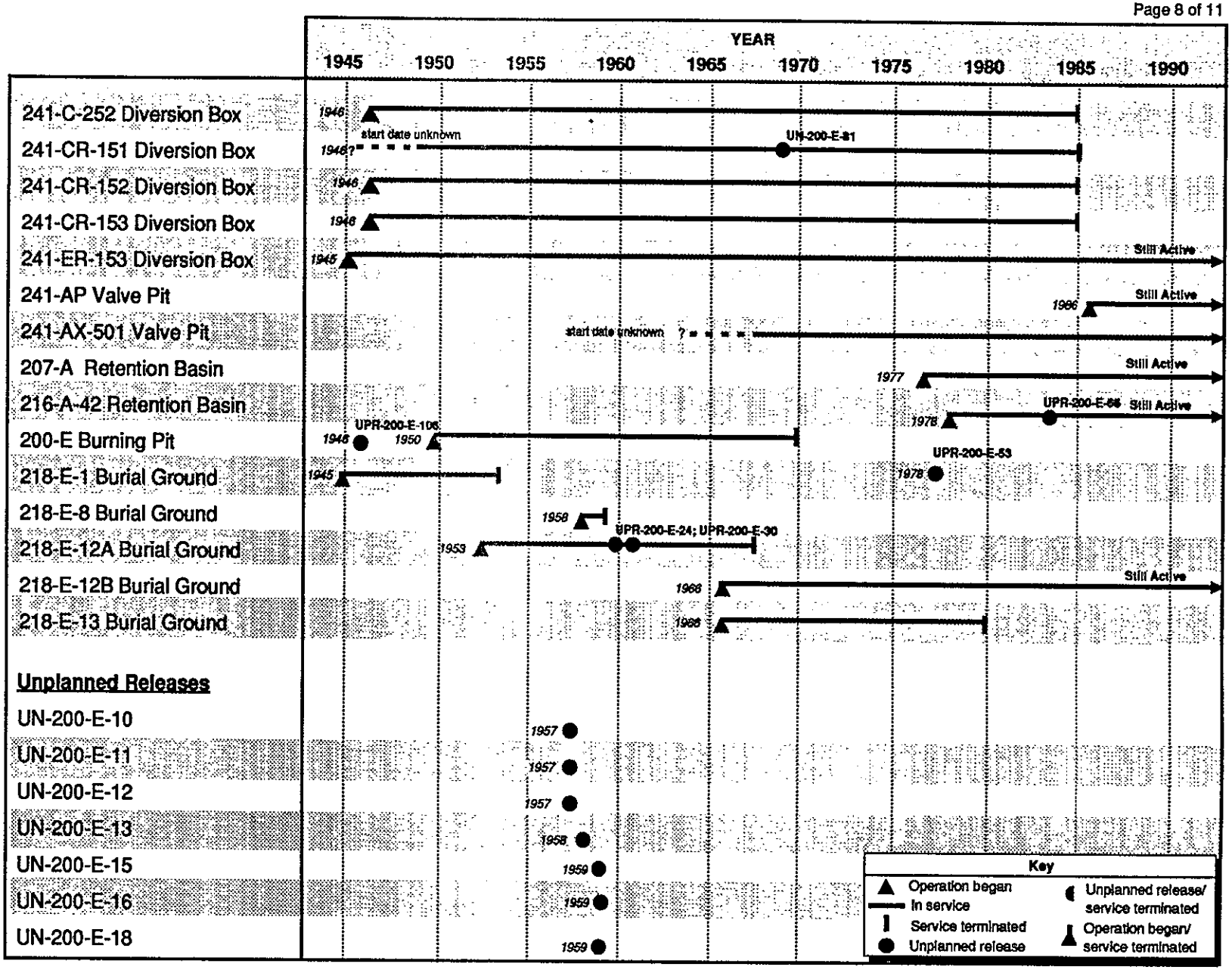

Figure 2-1. Operational and Waste-Related History (continued).

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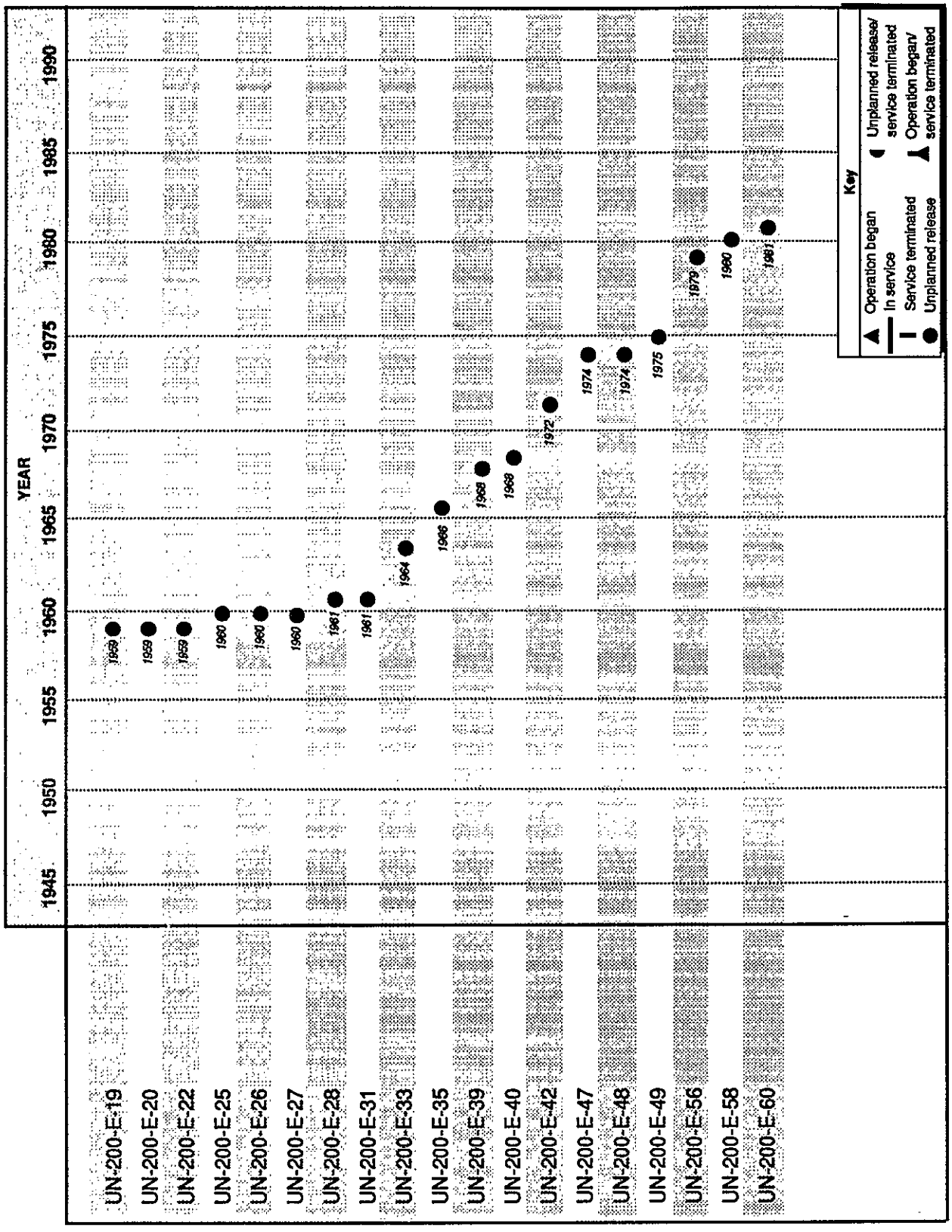

Figure 2-1. Operational and Waste-Related History (continued).

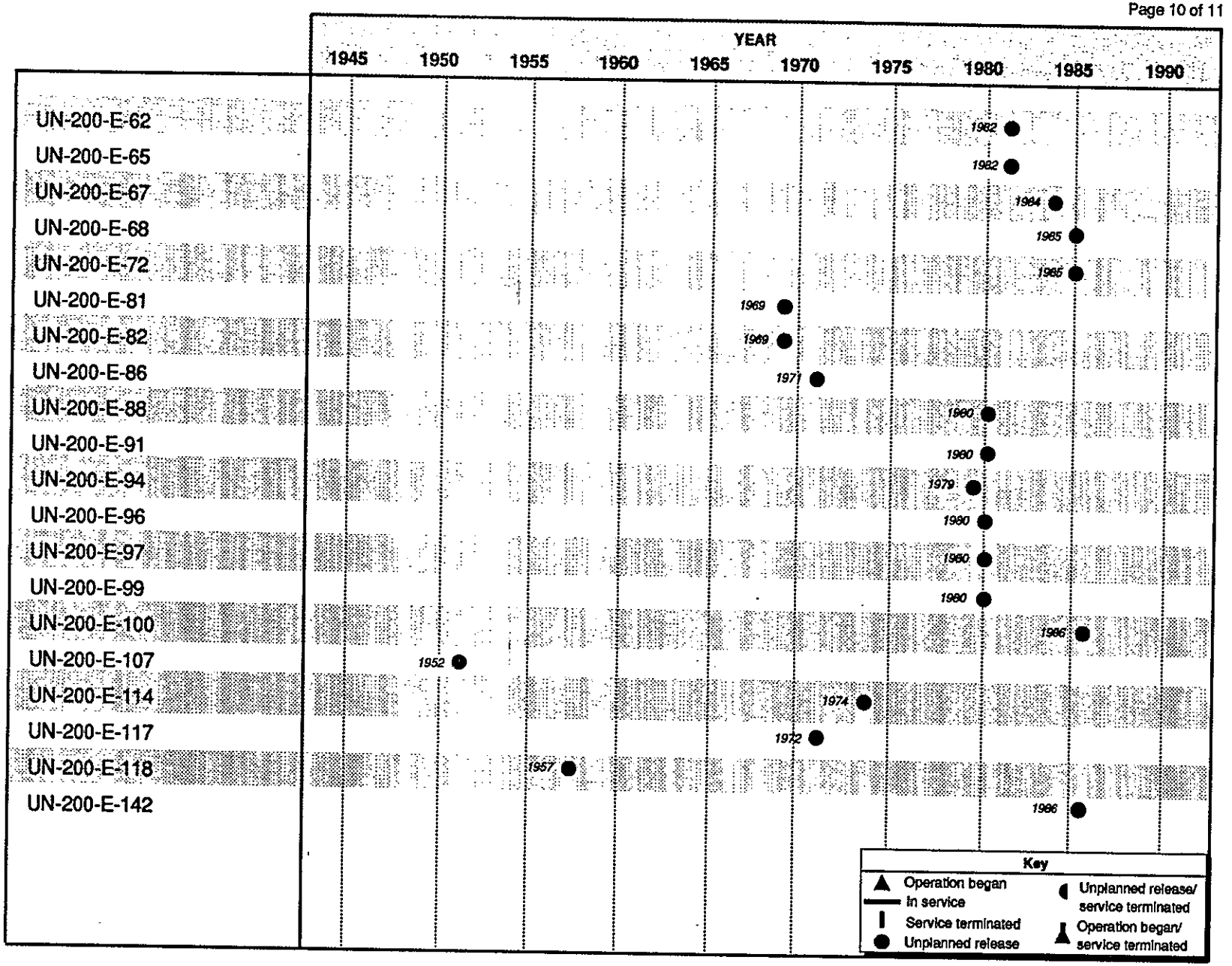

Figure 2-1. Operational and Waste-Related History (continued).

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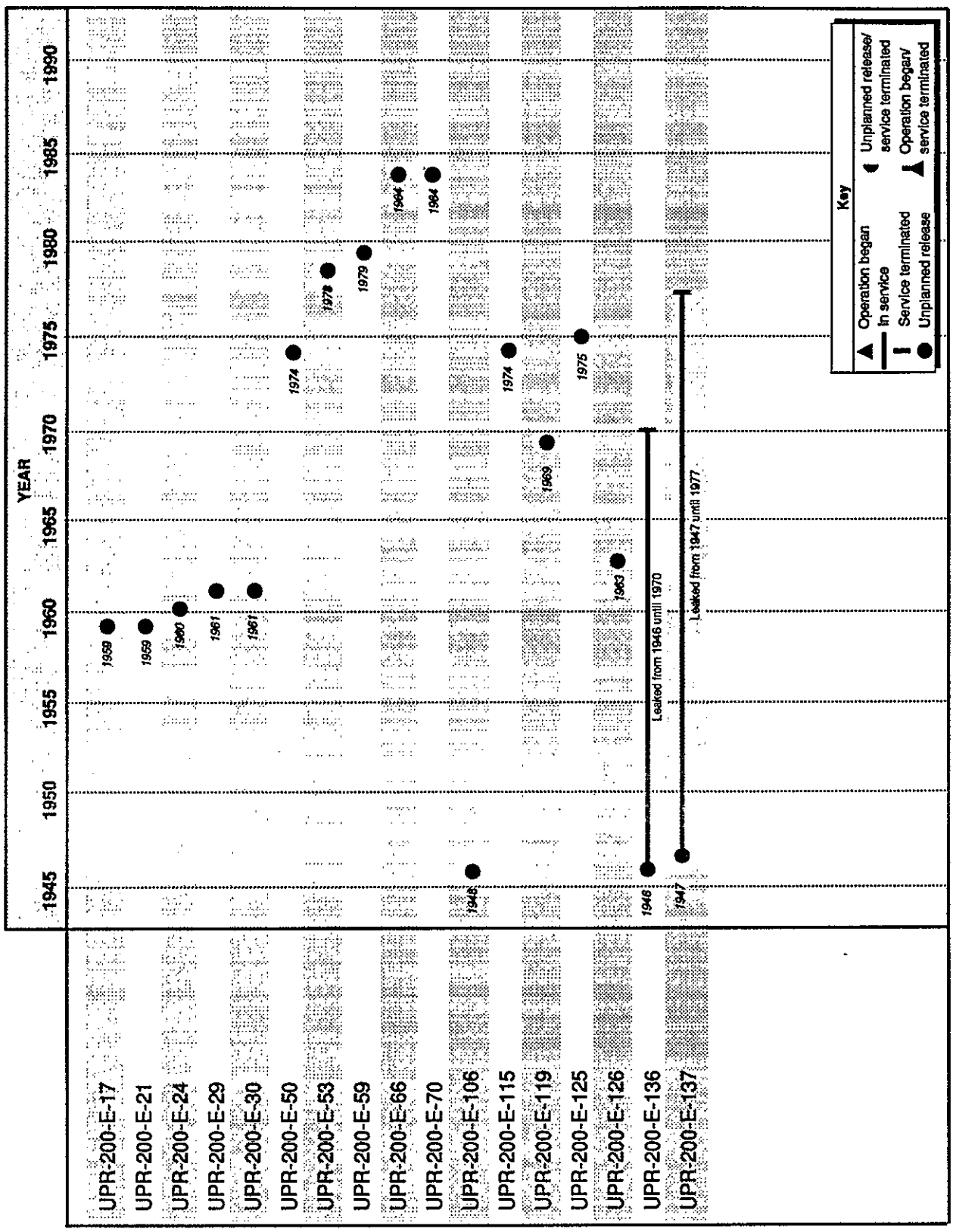
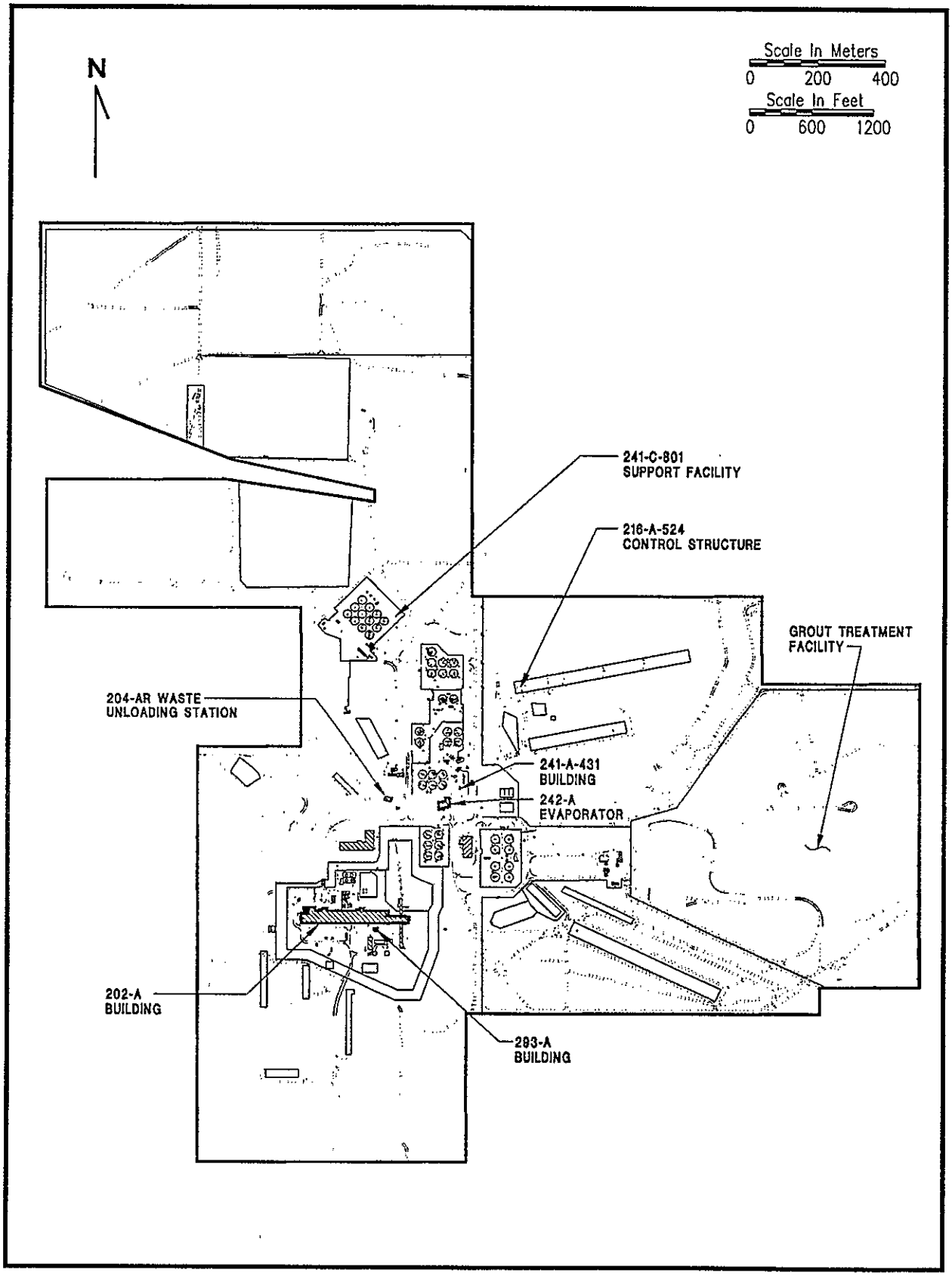


Figure 2-1. Operational and Waste-Related History (continued).



T920080B

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

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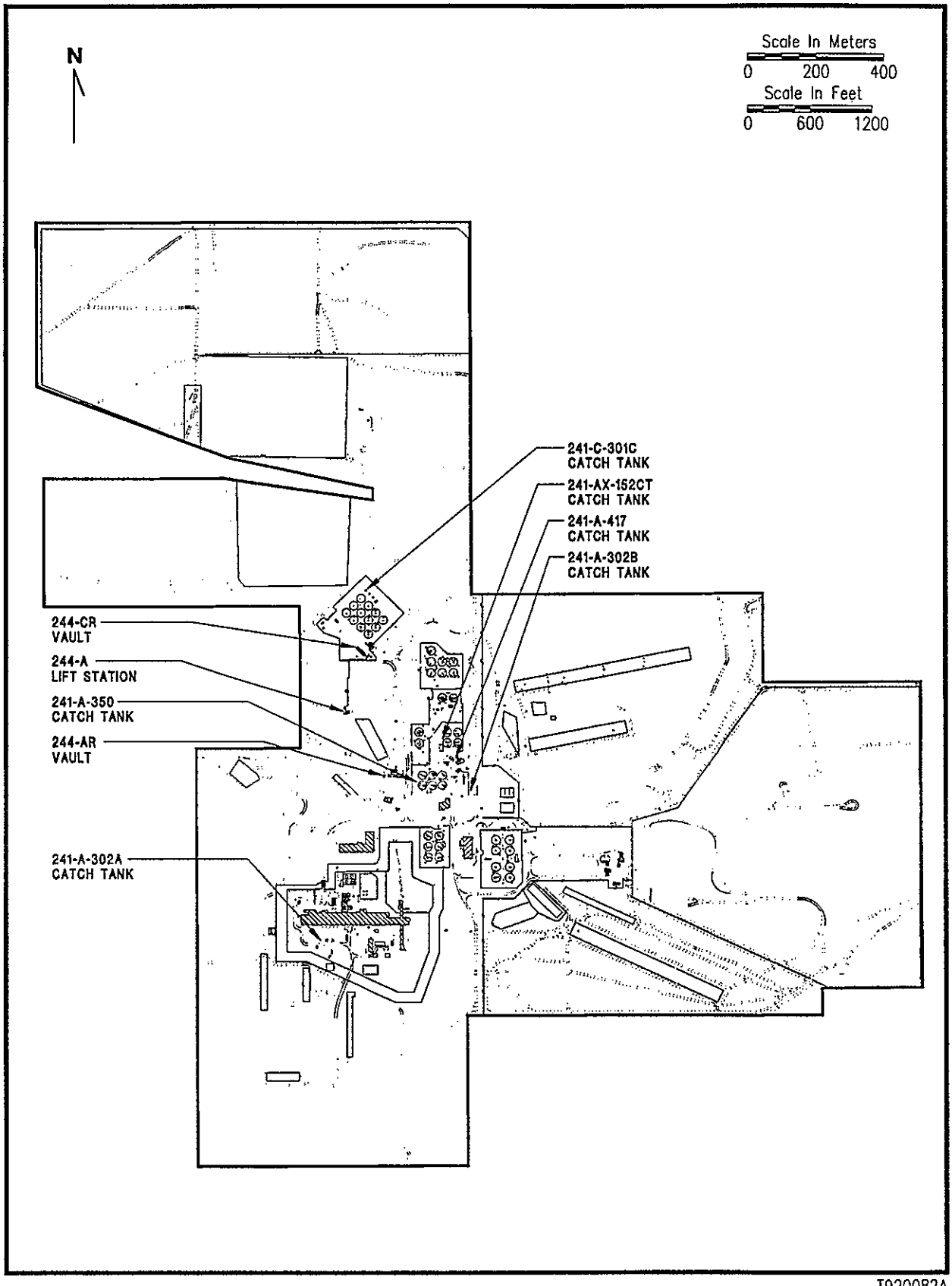
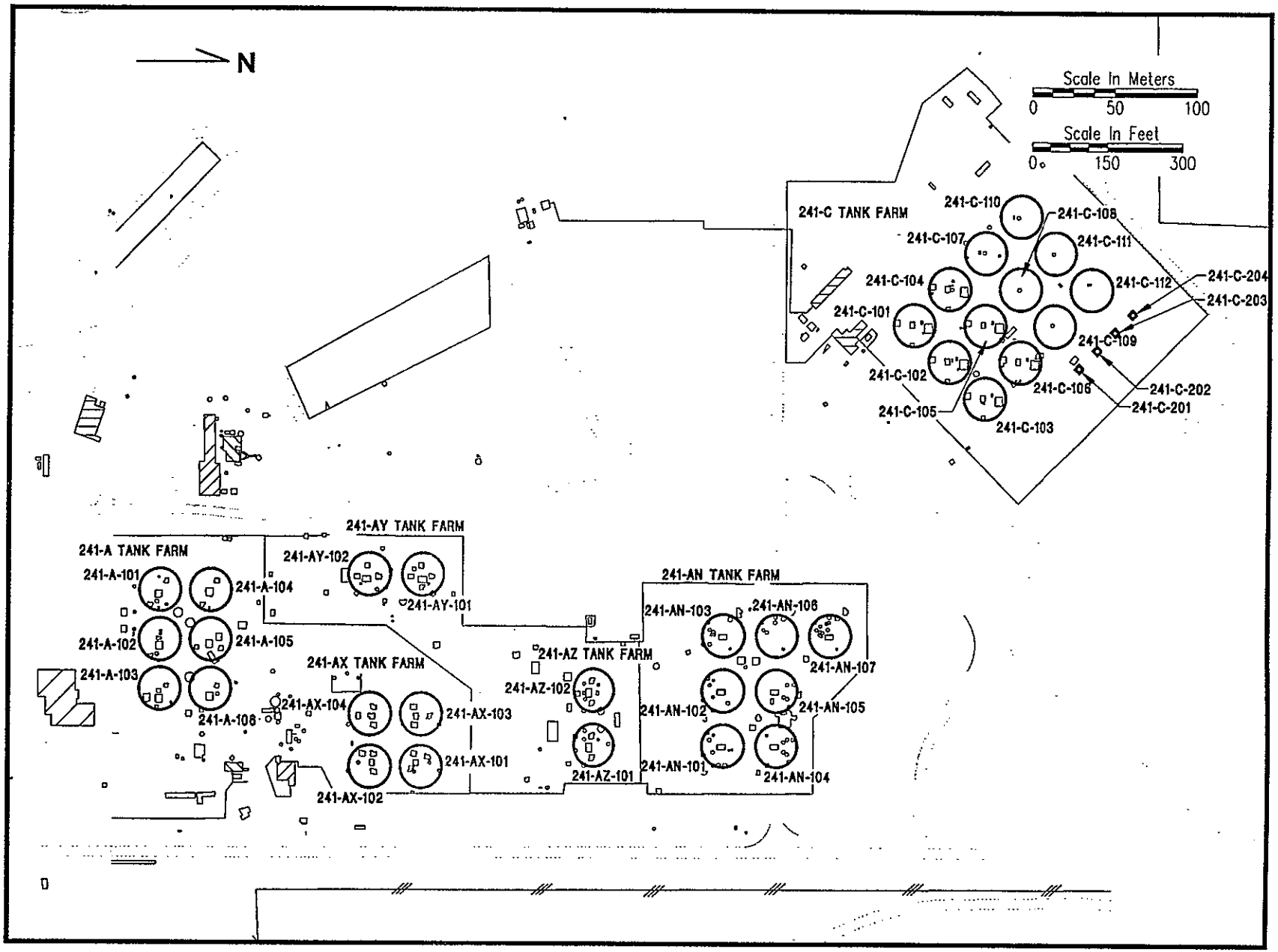


Figure 2-3. Location of Tanks and Vaults.

9 2 1 2 6 3 0 6 2 2



t920081b

Figure 2-4. Tank Farm Detail.

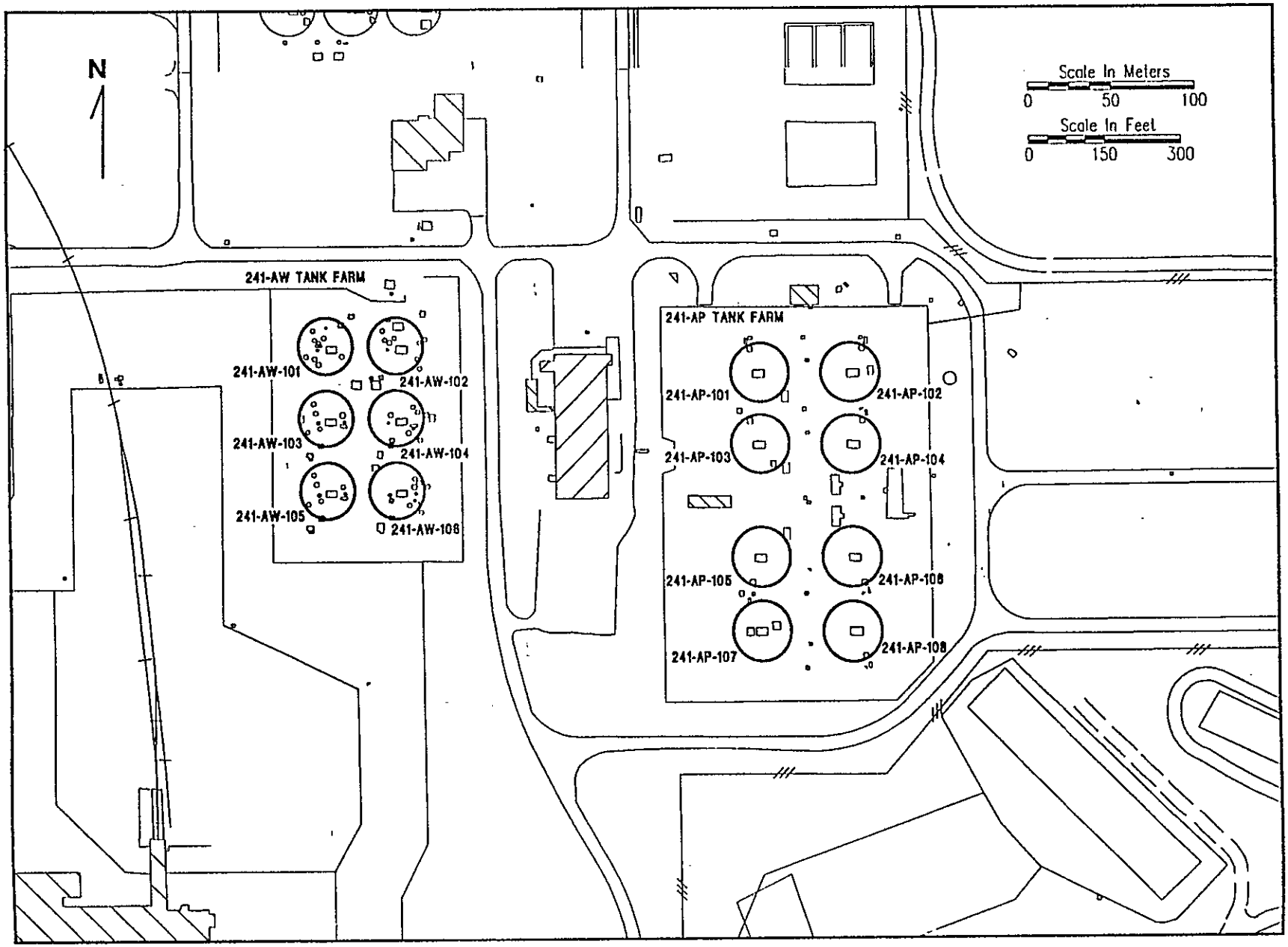


Figure 2-5. Location of 241-AP and 241-AW Tank Farms.

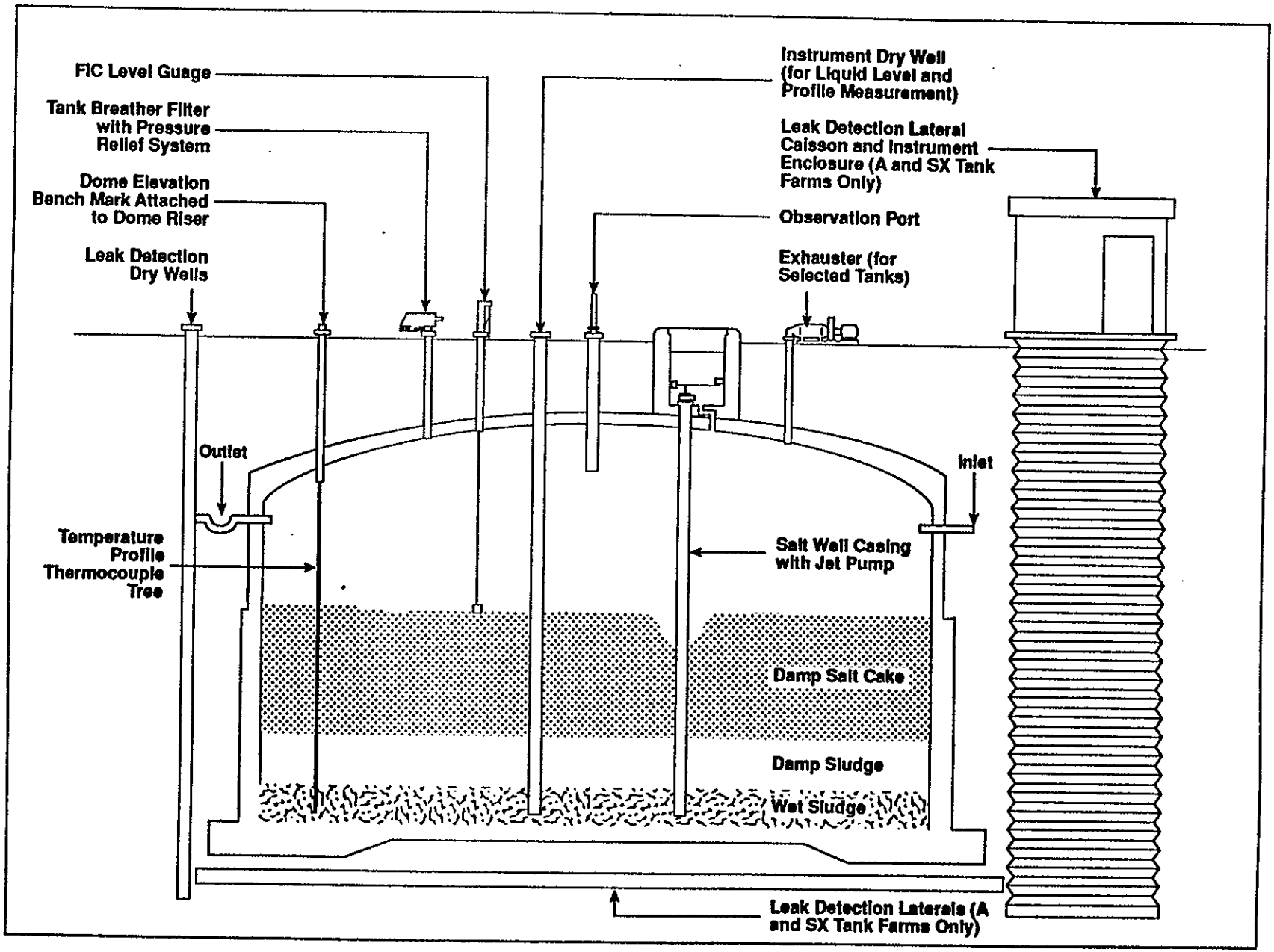


Figure 2-6. Typical Single-Shell Tank.

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PS-90-132

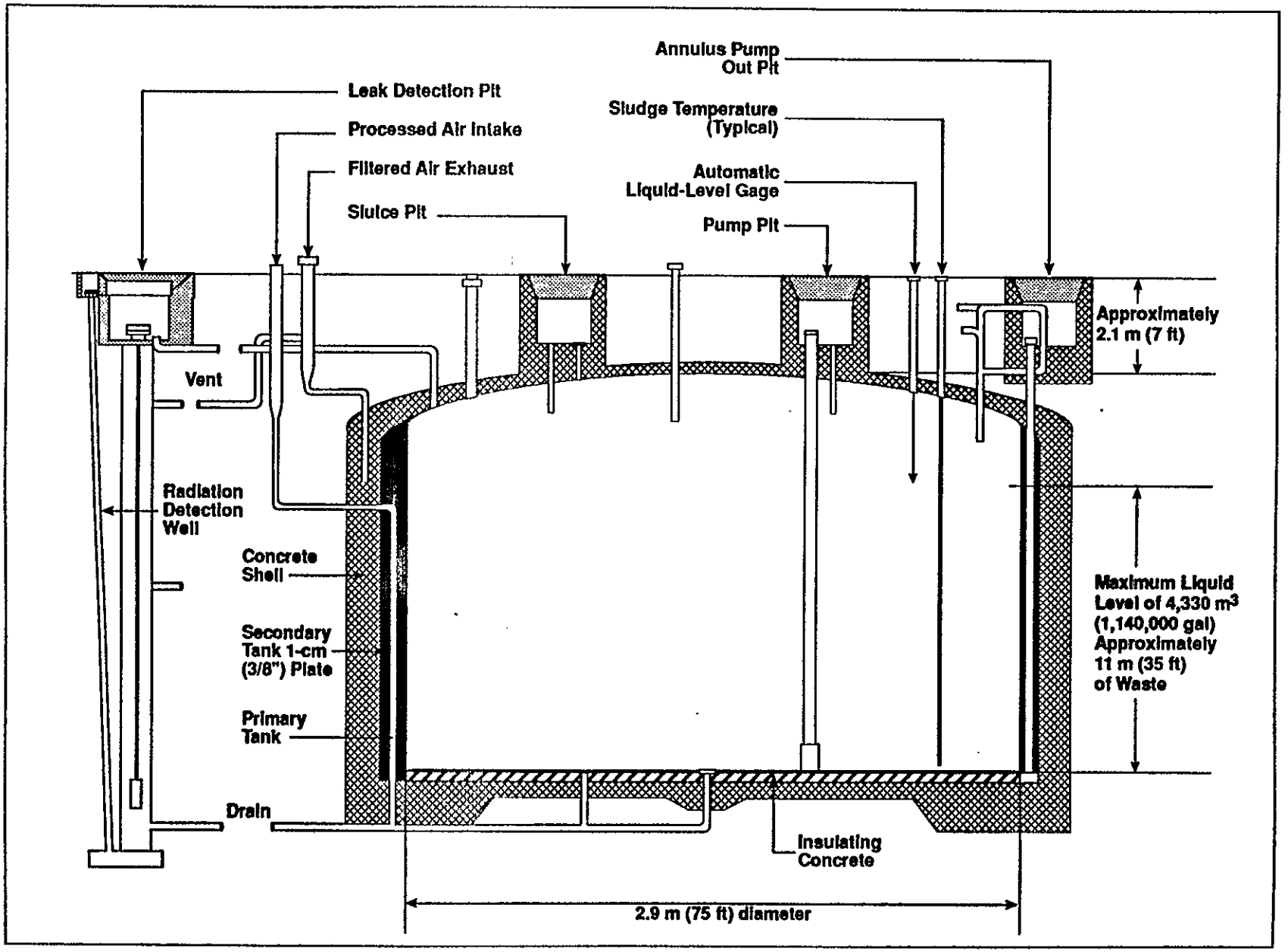

Figure 2-7. Typical Double-Shell Tank.

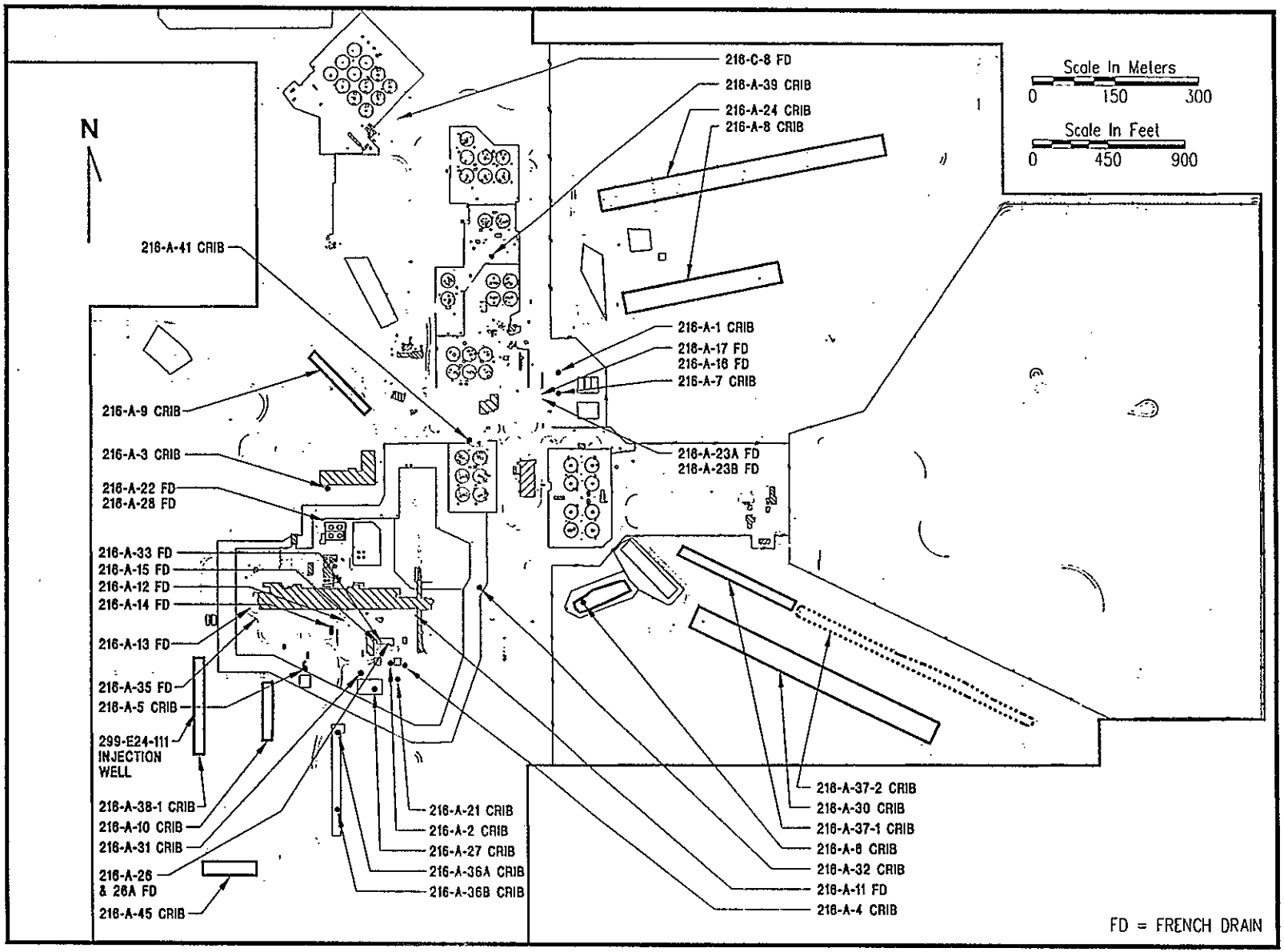

Figure 2-8. Location of Cribs, Drains, and Reverse Wells.

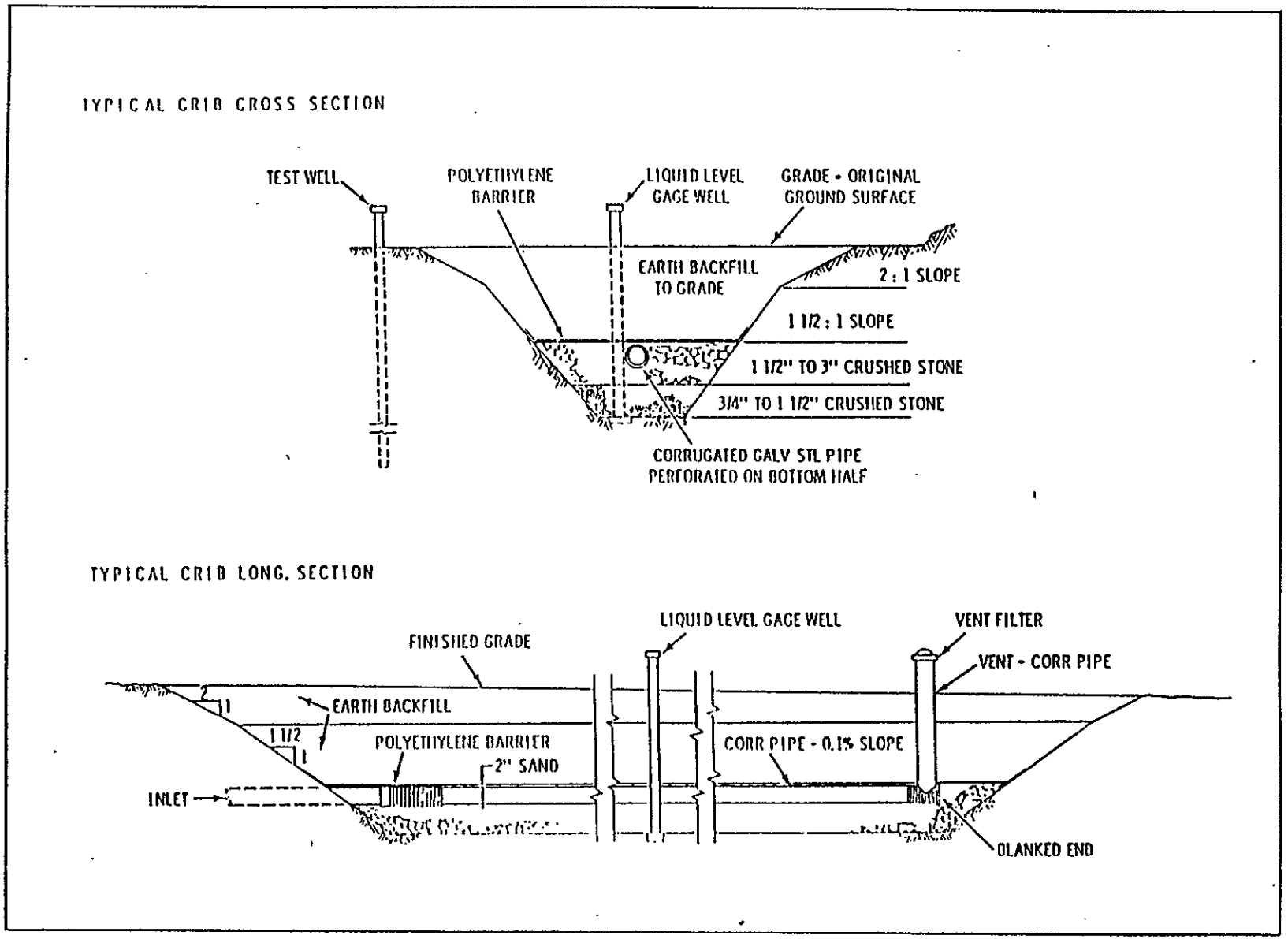

Figure 2-9. Typical Crib.

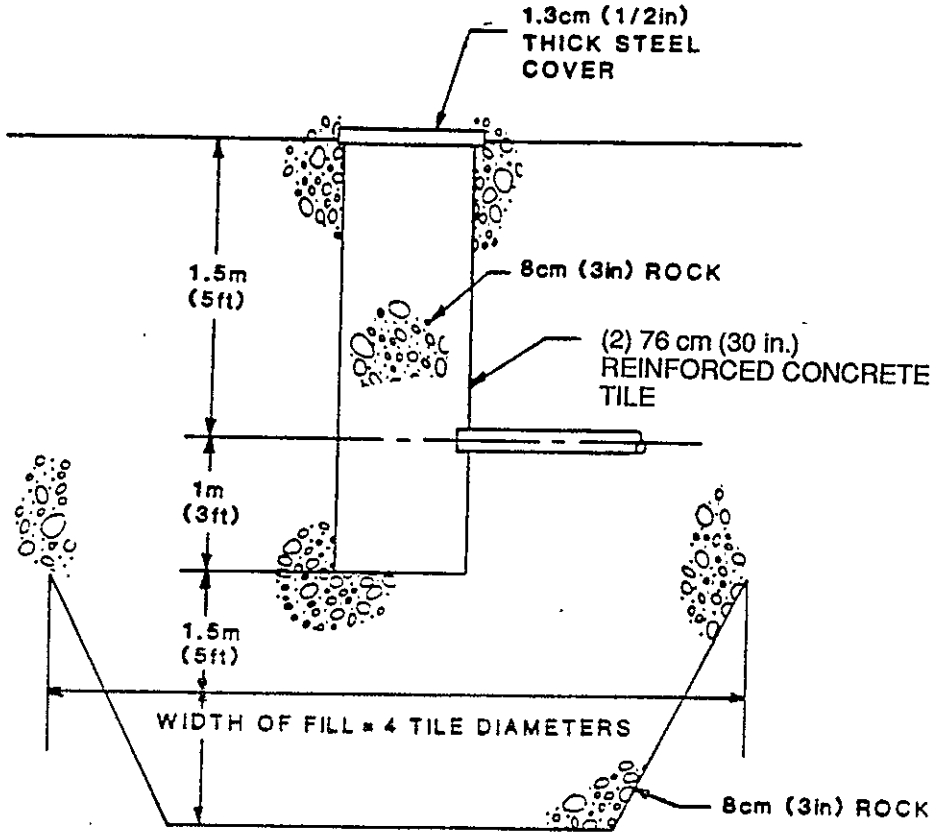

Figure 2-10. Typical French Drain.

9 2 1 2 6 3 0 5 2 9

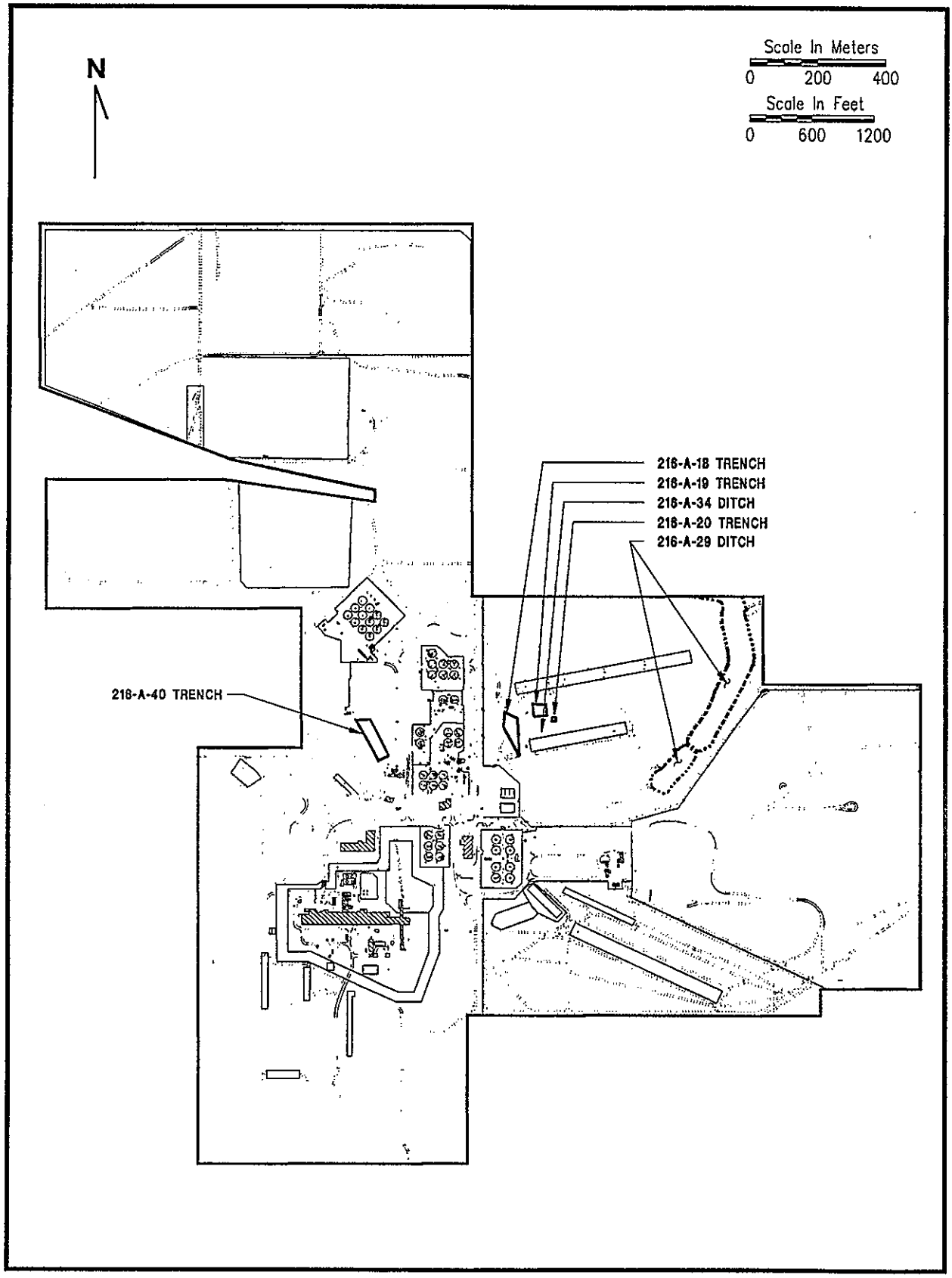

Figure 2-11. Location of Ditches and Trenches.

9 2 1 2 6 3 0 6 3 0

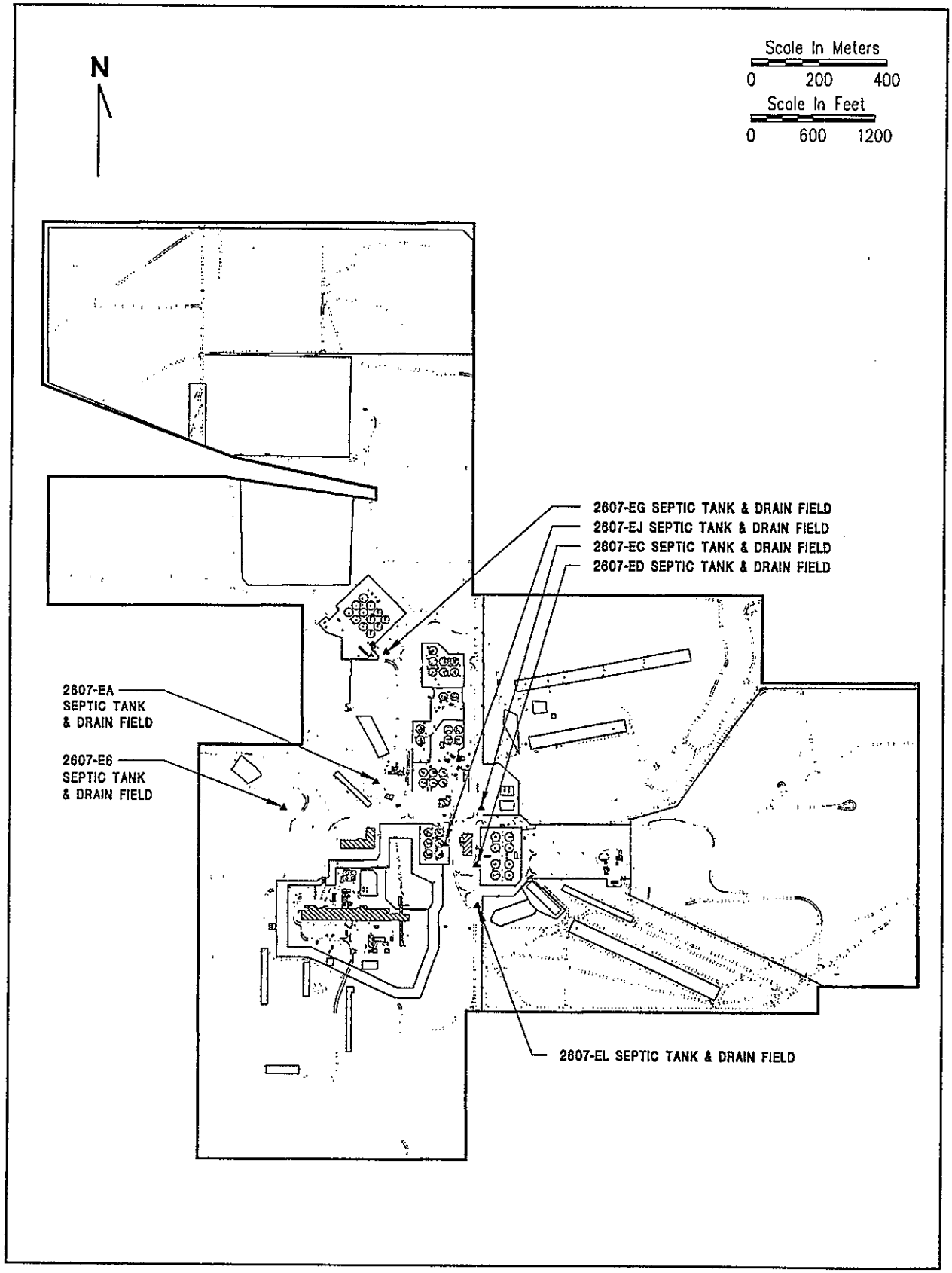

Figure 2-12. Location of Septic Tanks and Associated Drain Fields. T920085

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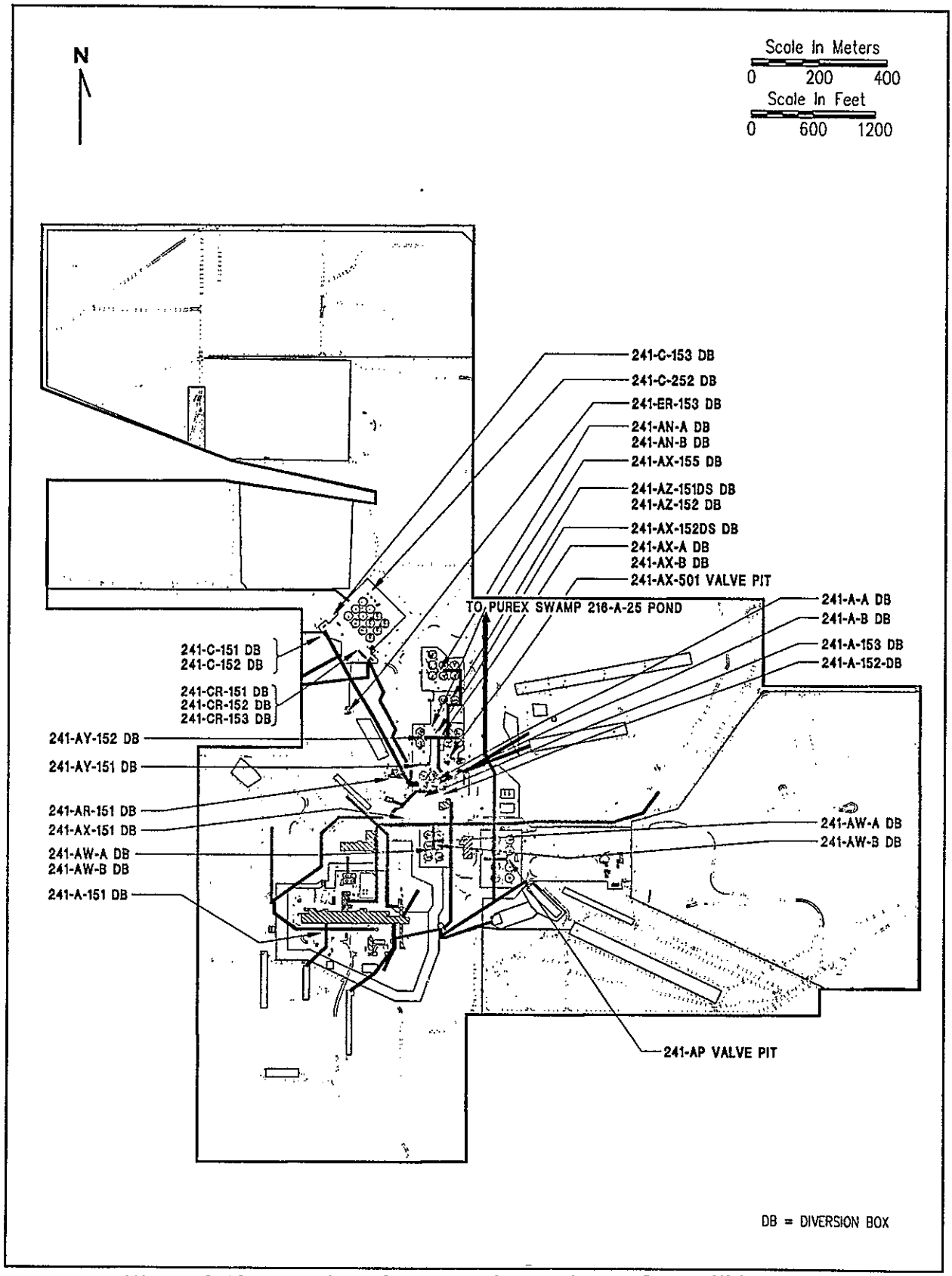

Figure 2-13. Location of Process Lines and Transfer Facilities. T920086A

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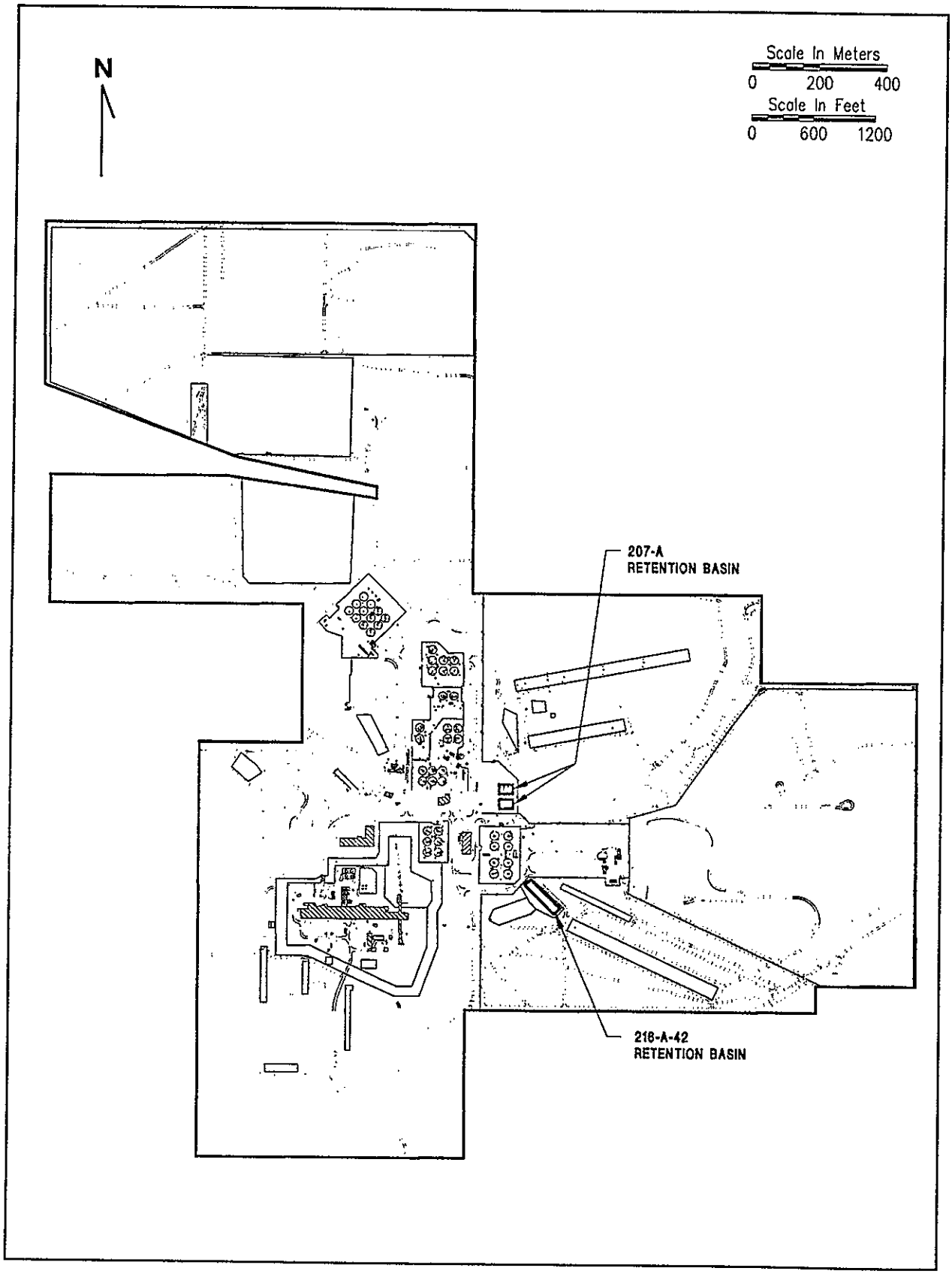

Figure 2-14. Location of Basins.

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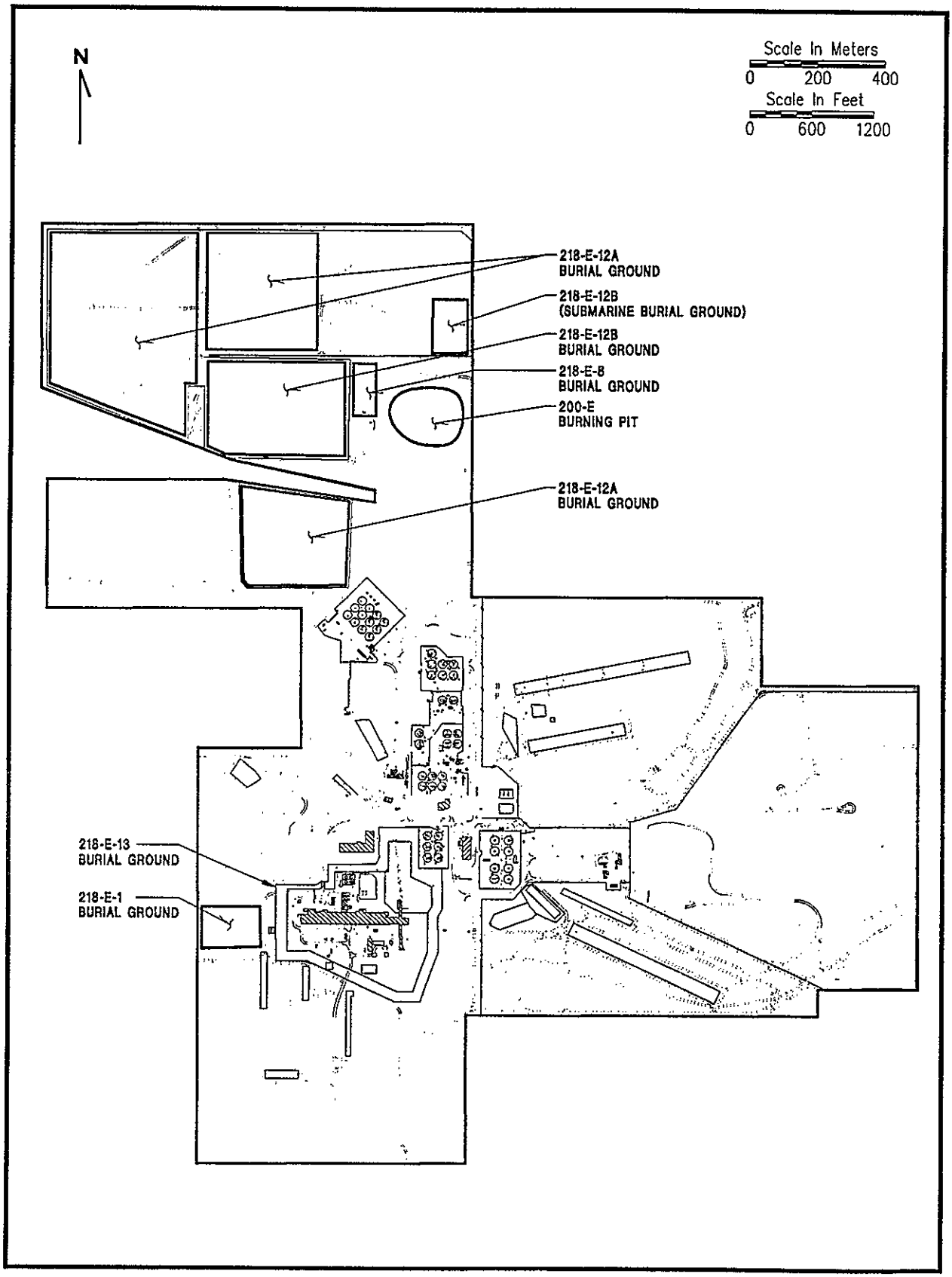

Figure 2-15. Location of Burial Sites and Burning Pits.

T920088

9 2 1 2 6 3 0 6 3 4

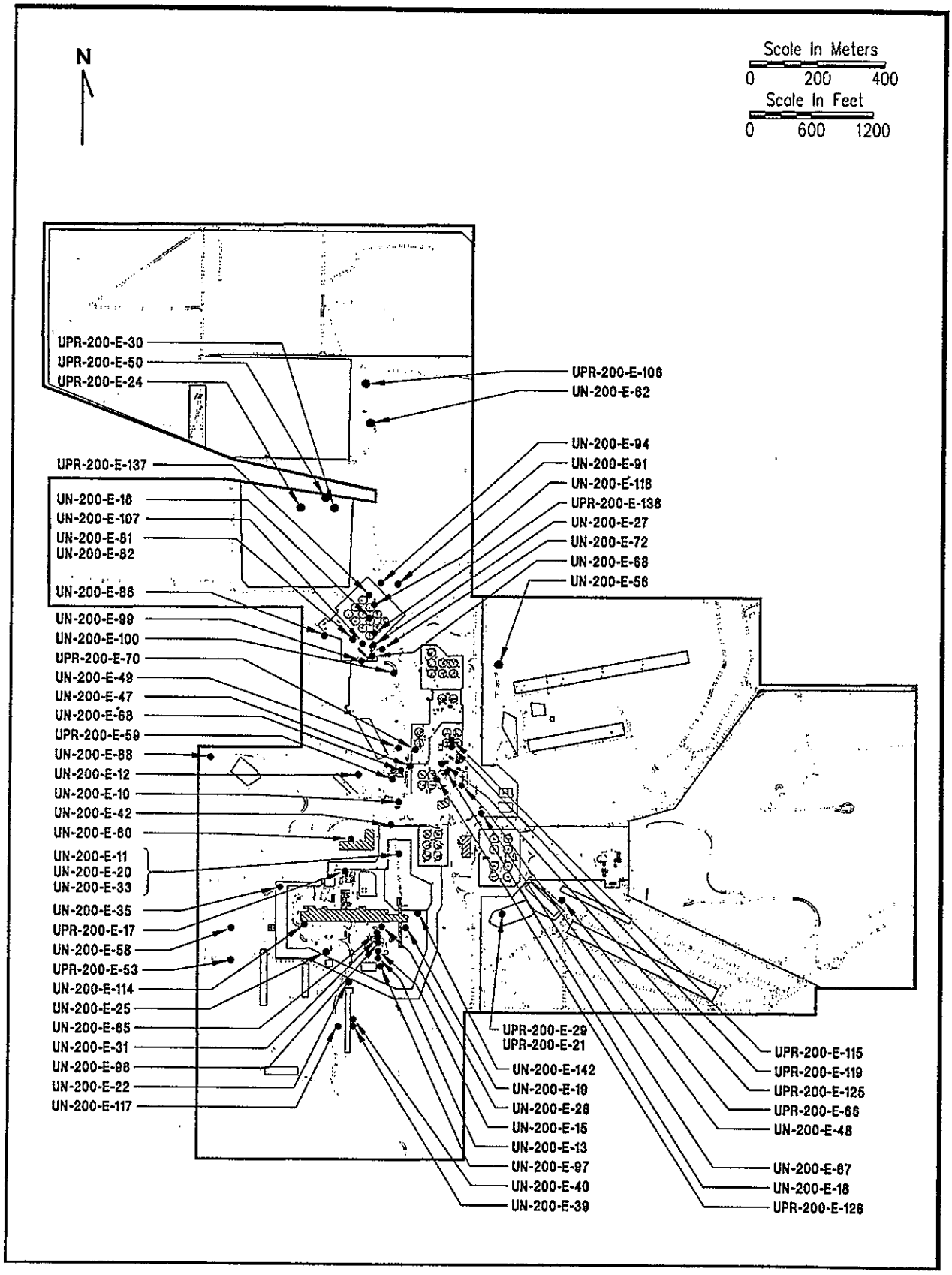

Figure 2-16. Location of Unplanned Releases.

9212263063 5

Table 2-1. Summary of Waste Management Units.[a/]

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 fratibnization 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 Waste Management Units.[a/]

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 Waste Management Units.[a/]

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 Waste Management Units.[a/]

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 Waste Management Units.[a]

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 Waste Management Units.[a/]

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

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Table 2-1. Summary of Waste Management Units.[a/]

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 Waste Management Units.[a/]

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 Waste Management Units.[a/]

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 Waste Management Units.[a]

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 Waste Management Units.[a/]

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 Waste Management Units.[a/]

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 Waste Management Units.[a/]

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

Table 2-2. Radionuclide Waste Inventory Summary.

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.

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.

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.

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.

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.

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.

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.

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 2-12. 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

9 2 1 2 6 3 0 6 9 0

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

9 2 1 2 6 3 0 6 8 9

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

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

9212306398

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

RADIONUCLIDES

Actinium-225
Actinium-227
Americium-241
Americium-242
Americium-242m
Americium-243
Antimony-126
Antimony-126m
Astitine-217
Barium-135m
Barium-137m
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
Ammonium carbonate
Ammonium fluoride
Ammonium nitrate
Arsenic
Barium
Beryllium
Bismuth
Bismuth phosphate
Boron
Cadmium
Cadmium nitrate
Calcium
Carbonate
Cerium
Chloride
Chromium
Copper
Cyanide
Ferric cyanide
Ferric nitrate
Ferrous sulfamate
Fluoride
Gold
Hydrazine
Hydrogen peroxide
Hydroxide
Hydroxylamine nitrate
Iron
Lanthanum
Lead
Magnesium
Manganese
Mercury
Nickel
Nitrate
Nitric acid
Nitrite
Phosphate
Potassium
Potassium fluoride
Potassium hydroxide
Potassium permanganate
Selenium
Selenium tetroxide
Silicon trioxide
Silver
Silver nitrate
Sodium
Sodium carbonate
Sodium dichromate

9 2 1 2 6 3 0 6 3 7

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

9 2 1 2 6 3 0 6 3 6

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

9 2 1 2 6 3 0 6 3 5

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 2-6. Summary of Unplanned Releases.

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 2-6. Summary of Unplanned Releases.

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.

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.

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. Page 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.

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. Page 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.

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.

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 ^{103}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.

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.

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.

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.

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.

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.

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.

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 2-5. General Information Reference Locator. Page 2 of 2

Desired Single-Shell Tank Information	Reference Document
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
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

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Table 2-5. General Information Reference Locator. Page 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

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

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

9 2 1 2 6 3 0 6 6 5

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

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

9 2 1 2 6 3 0 6 4

Table 2-3. Chemical Waste Inventory Summary.

Waste Management Unit Number	Quantity of Reported Chemicals (kg) a/									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
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 2-3. Chemical Waste Inventory Summary.

Waste Management Unit Number	Quantity of Reported Chemicals (kg)									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
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	--	--	--	--	--	--	--	--	--	--
218-E-8	--	--	--	--	--	--	--	--	--	--
218-E-12A	--	--	--	--	--	--	--	--	--	--
218-E-12B	--	--	--	--	--	--	--	--	--	--

Table 2-3. Chemical Waste Inventory Summary.

Waste Management Unit Number	Quantity of Reported Chemicals (kg) [a]									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
216-A-34	--	--	--	--	--	--	--	--	--	--
216-A-18	730	--	--	--	--	--	--	--	--	--
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	--	--	--	--	--	--	--	--	--	

Table 2-3. Chemical Waste Inventory Summary.

Waste Management Unit Number	Quantity of Reported Chemicals (kg) [a]									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
216-A-36B	--	331	350	1.99	178	--	0.0569	--	0.558	--
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	--	--	--	--	--	--	--	--	--	

Table 2-3. Chemical Waste Inventory Summary.

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-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	--	--	--	--	--	--	--	--	--	

Table 2-2. Radionuclide Waste Inventory Summary.

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 2-2. Radionuclide Waste Inventory Summary.

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	--	--	--	--	--	--	--	--	--

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

9 2 1 2 3 0 6 9 1

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.

9 2 1 2 6 3 0 6 9 3

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 x 10^{11} m^3 (8.7 x 10^7 acre-ft) at the USGS gage and 1.6 x 10^{11} m^3 (1.3 x 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 x 10^7 m^3/yr (2.5 x 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 System. The only existing manmade surface water bodies are the ~~207-U~~ 207-A Retention Basins and 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 that terminates at the 216-B-3 Pond. During the fall 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 Basins presents no threat of flooding because the north ~~basins~~ cells discharge ~~into~~ the ~~Gable Mountain B~~ Pond ~~pipeline~~ and the south cells ~~basins~~ 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 Subprovinces.

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

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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

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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 1991a).

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.

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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, and 3-13). 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 variation of~~ and the suprabasalt sediments in the 200 East Area. The subsection discusses ~~sections discuss~~ notable stratigraphic characteristics, ~~sediment~~ thickness variations, and the geometric relationships of the sediments, ~~dip trends, and other features such as areas where formations are known or suspected to be absent. Also, s~~Stratigraphic variations pertinent to the PUREX Plant Aggregate Area are ~~identified where applicable, and are~~ presented in the overall context of stratigraphic trends throughout the 200 East Area. ~~The following sections are based on Lindsey et al. (1992) and a review of boring logs from wells in the PUREX Plant Aggregate Area (Chamness et al. 1992).~~

Geologic cross-sections depicting the distribution ~~stratigraphy and the relative thickness~~ 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~~AAMS~~. 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 ~~The uppermost basalt unit~~ beneath most of the 200 East ~~Aggregate~~ Area, ~~is the Elephant Mountain Member of the Saddle Mountains Basalt.~~ At one location north of the 200 East Area, the Elephant Mountain Member is absent 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

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sequences. Mineralogic and geochemical data were not used in differentiating units because of the lack of a comprehensive mineralogic and geochemical data set. Studying the distribution of these facies types and identifying similarities in lithologic succession from borehole to borehole across the 200 East Area indicates the Hanford formation can be divided into three stratigraphic sequences. These sequences are designated the: (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 ~~Holocene~~ Surficial Deposits. ~~Holocene age s~~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 was 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

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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

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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 (313 ft) near the 202-A Building in the 200 East Area. The saturated thickness of the unconfined aquifer ranges from approximately

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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 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 $\pm$ 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.

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- 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 (Separations) Areas, groundwater elevations in the 200 East Area may have been as much as 18 m (55 ft) lower in 1944 than at present. As seen in Figure 3-35, a distinct groundwater

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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 ~~Grout Treatment Facility (GTF)~~ baseline and site characterization study, several groundwater monitor wells were drilled (Swanson et al. 1988). The data collected from the drilling of these wells (299-E25-25, 299-E25-26, 299-E25-27 and 299-E25-28) provided information pertaining to the vadose zone east of the 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 ~~dependent on the~~ grain size/stratigraphy and the occurrence of intercalated lenses, perched ~~the~~ water zones are ~~is~~ 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. ~~Higher infiltration rates are also expected~~ 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

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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

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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 has 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

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(*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.

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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 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 West 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.

3.7.3 Historical Resources

The only historic site in 200 East Area is the old White Bluffs freight road which to the northwest. This site is not considered to be eligible for the National Register.

3.7.4 Community Involvement

A Community Relations Plan ~~(CRP)~~ (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.

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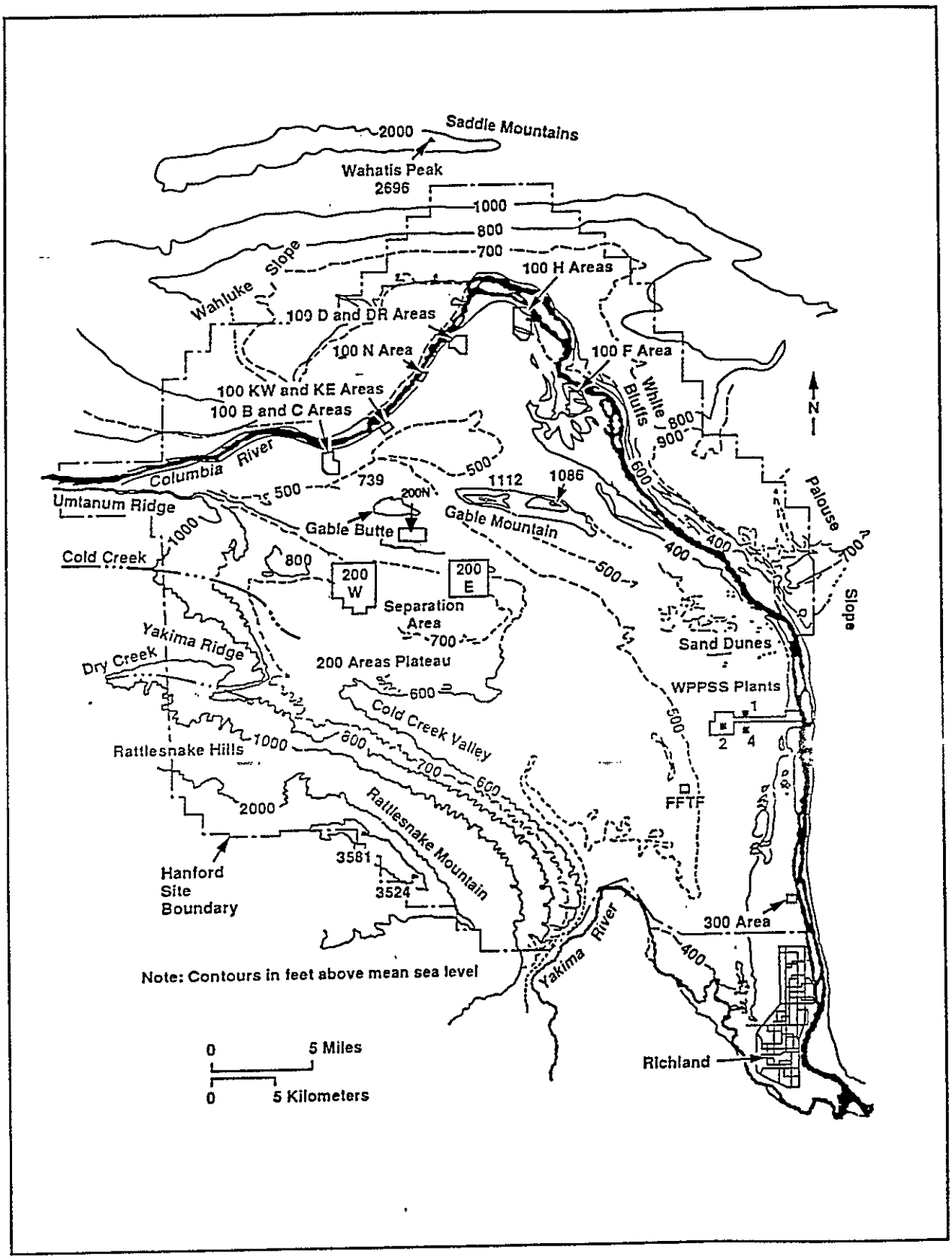

Figure 3-1. Topography and Location Map for the Hanford Site.

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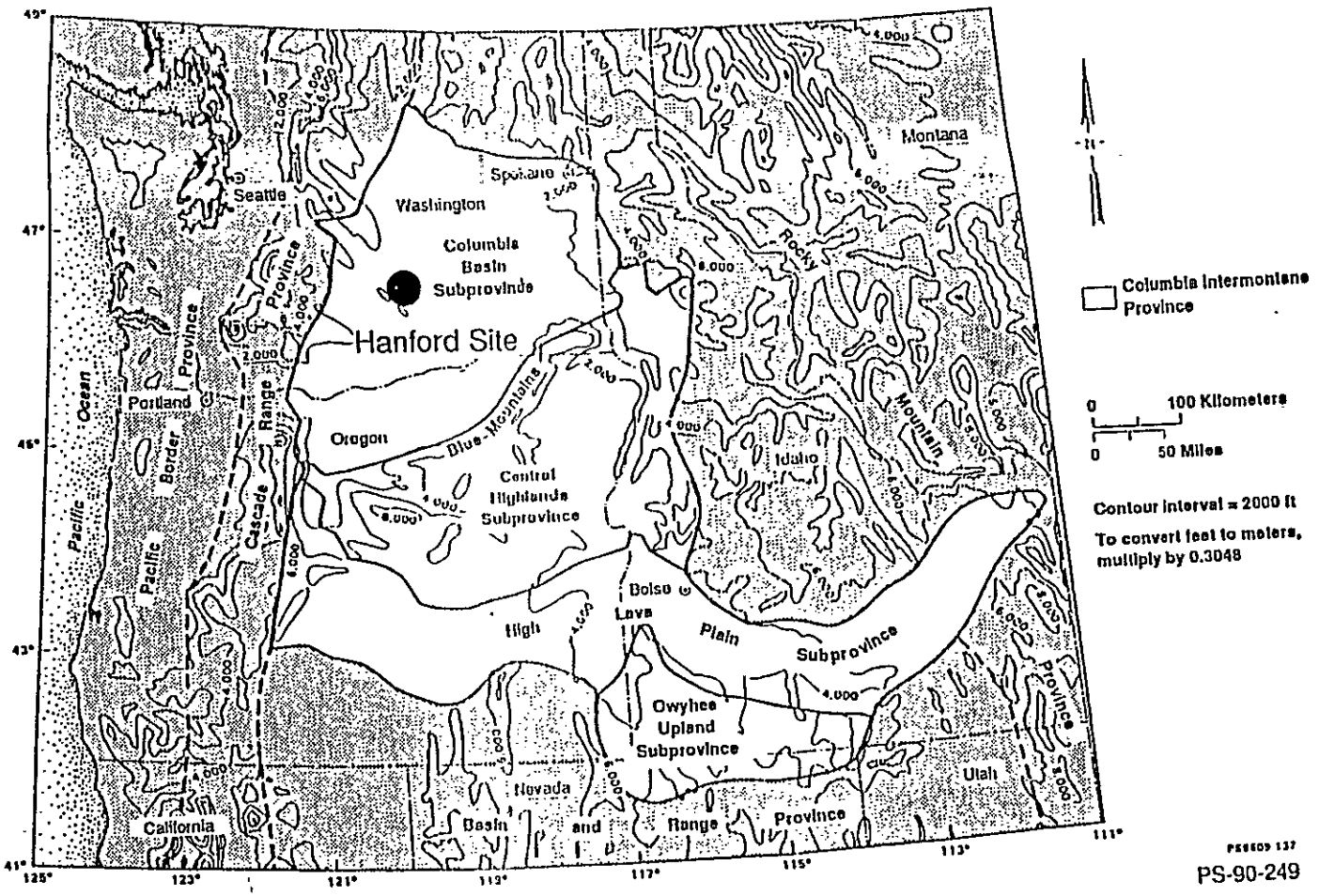

Figure 3-2. Divi[illegible] Columbia Intermontane Province and Adjacent Snake River Plains Province.

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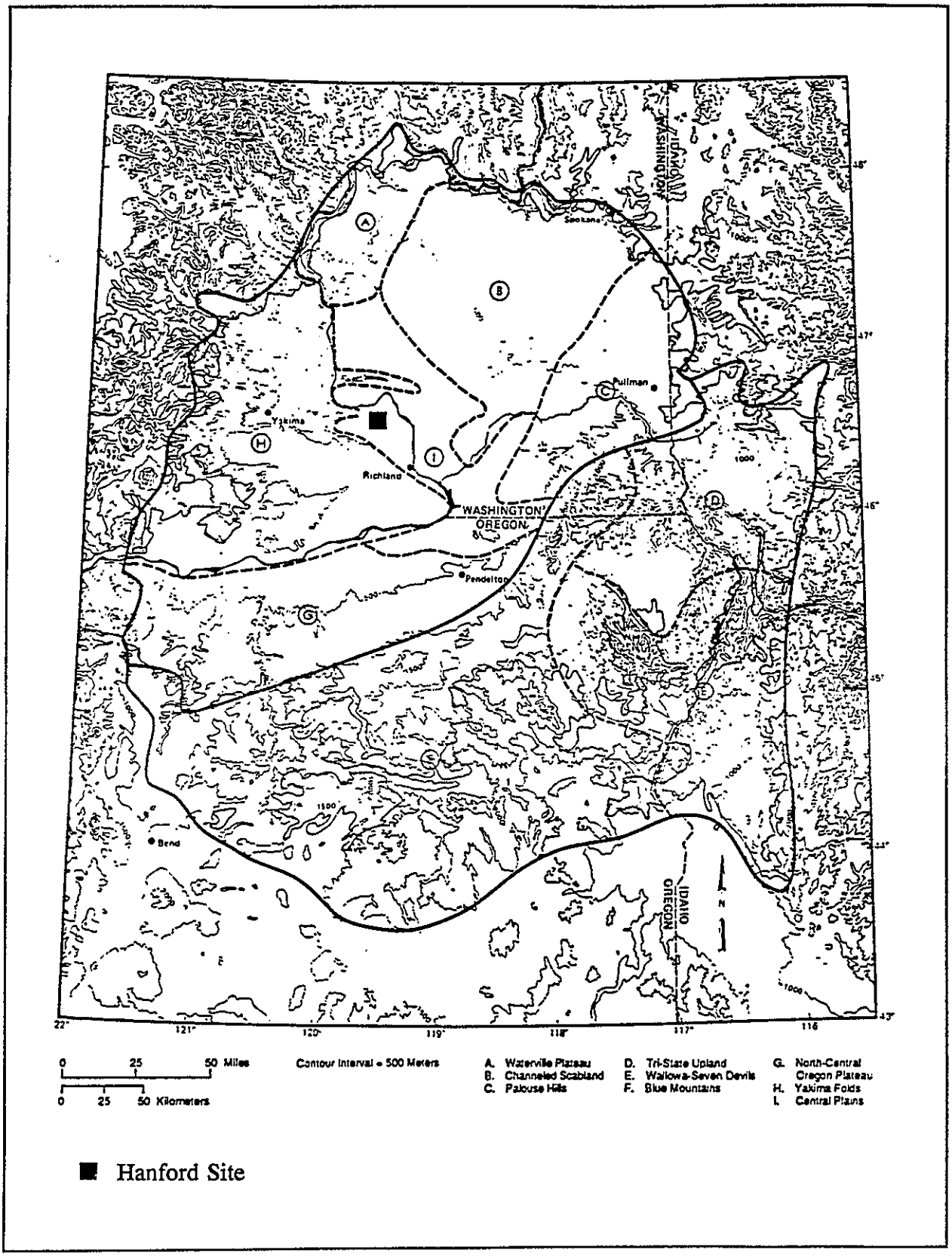

Figure 3-3. Geomorphic Units within the Central Highlands and Columbia Basin Subprovinces that Contain the Columbia River Basalt Group (after Thornbury 1965) (Last et al. 1989).

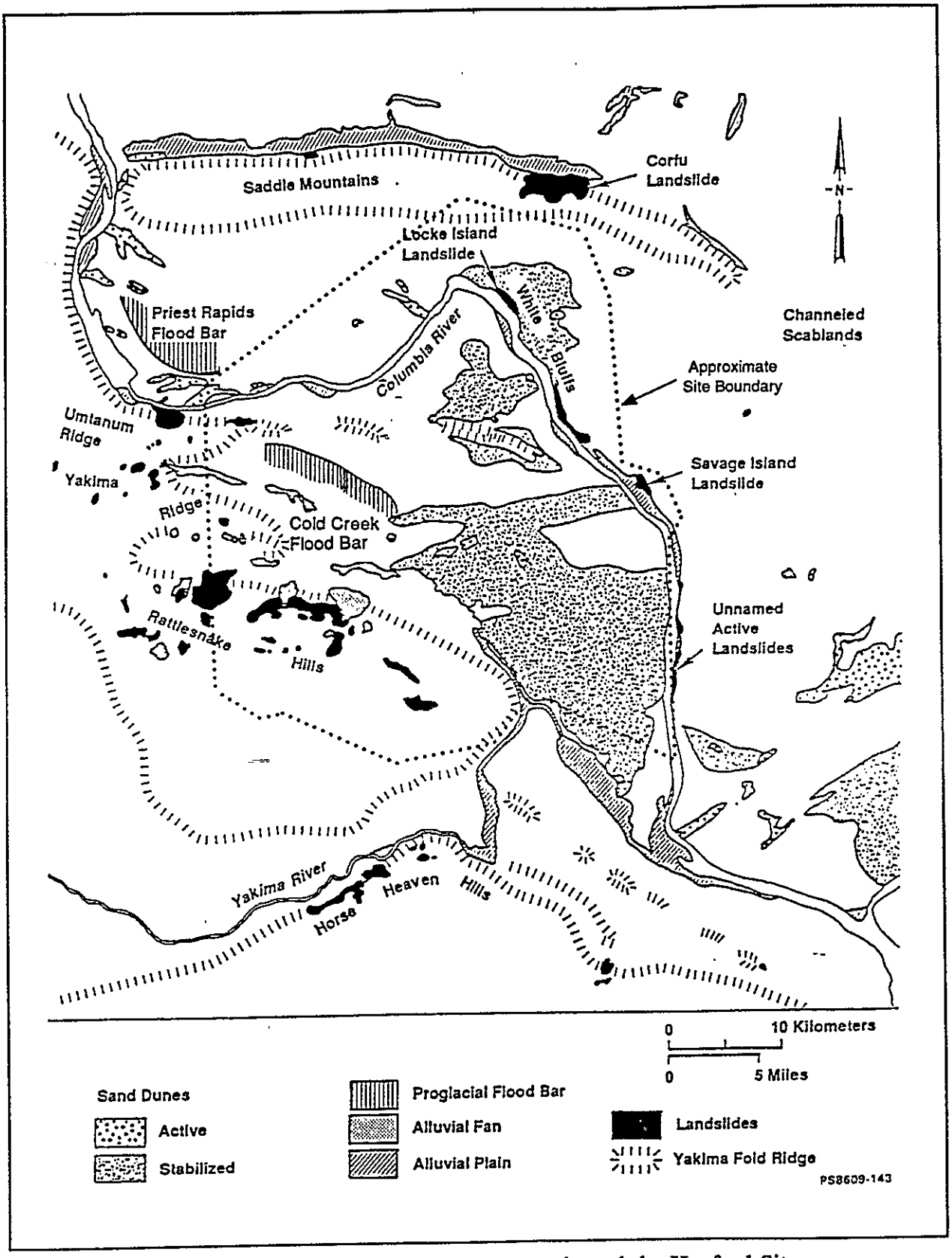

Figure 3-4. Landforms of the Pasco Basin and the Hanford Site.

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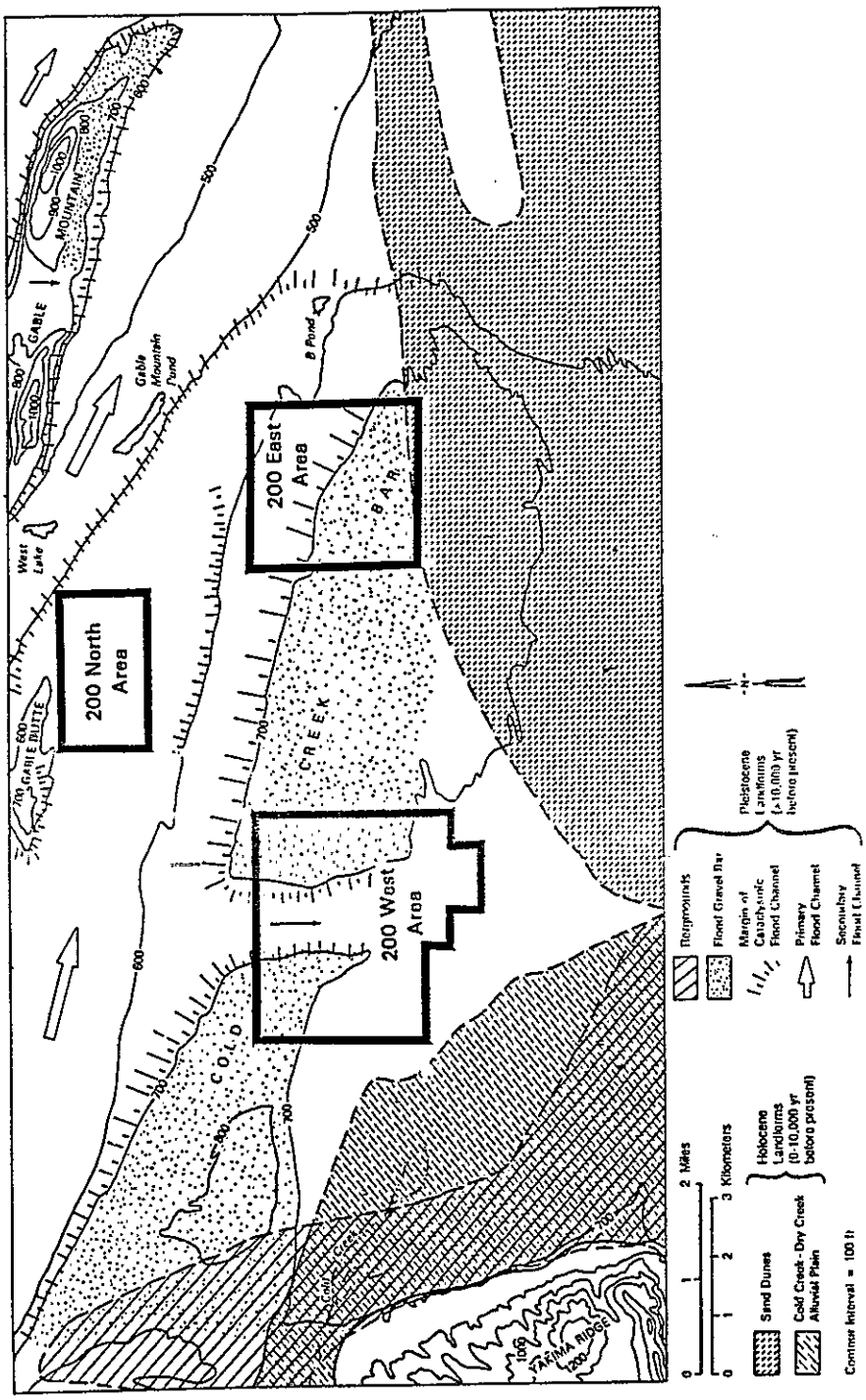
9 2 1 2 6 3 3 0 7 3 4



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

Figure 3-5. Geomorphic Features Surrounding the 200 Areas (Last et al. 1989).

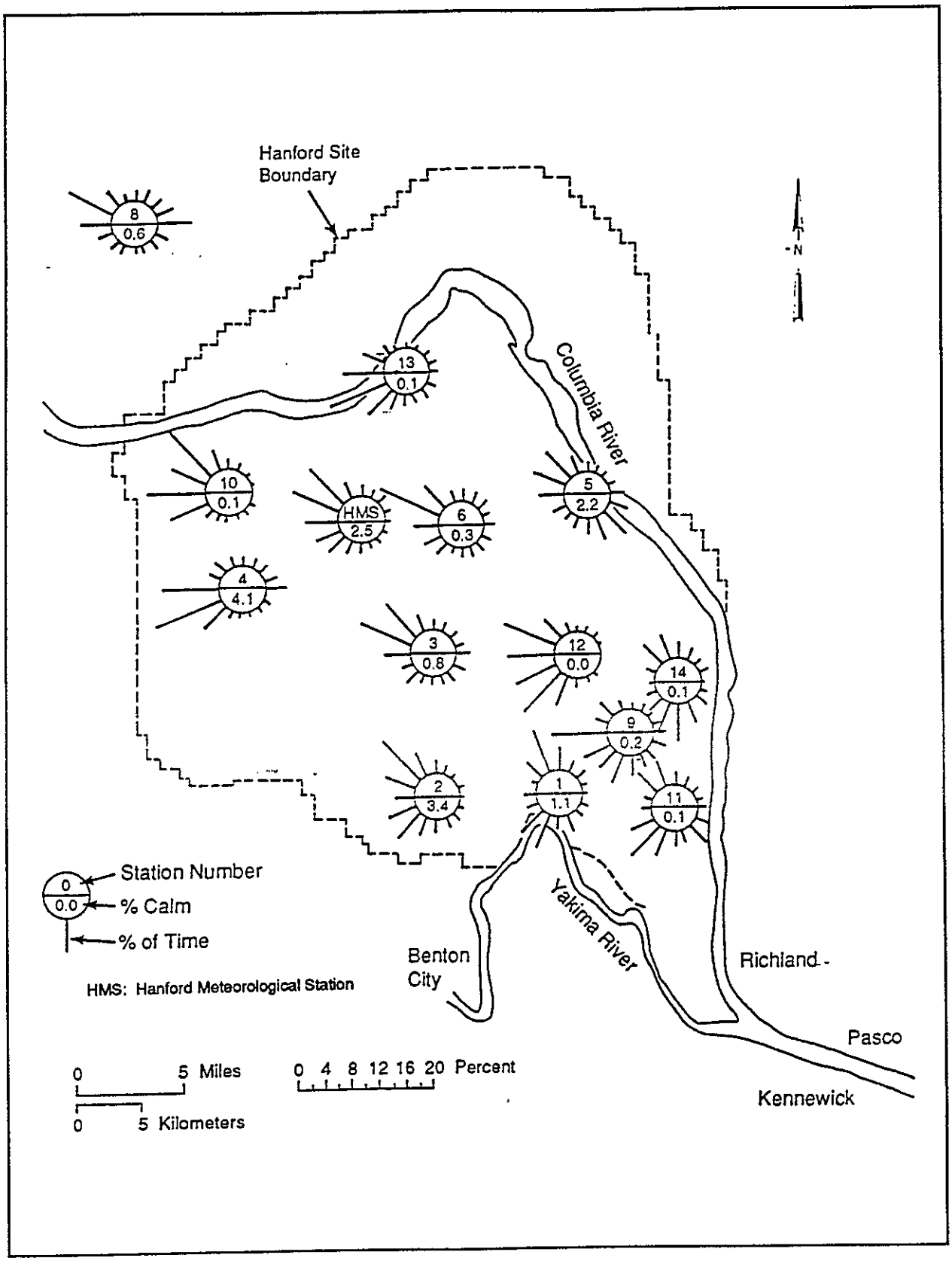


Figure 3-6. Hanford Site Wind Roses, 1979 through 1982 (Stone et al. 1983).

9 2 1 2 6 3 0 7 3 5

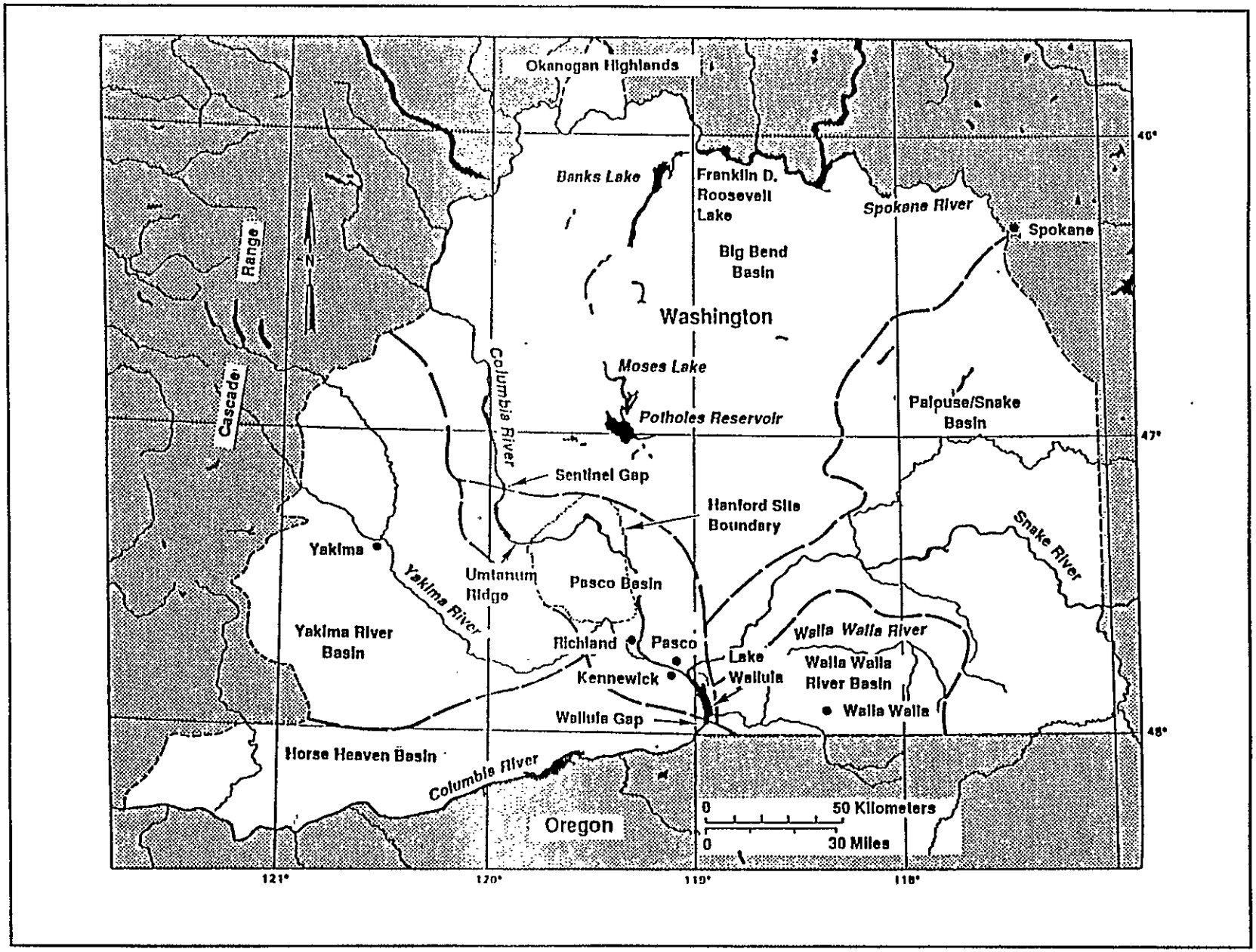


Figure 3-7. [illegible]gic Basins Designated for the Washington State Portion of the Columbia Plateau (DOE 1988b).

9 2 1 2 6 3 0 7 3 7

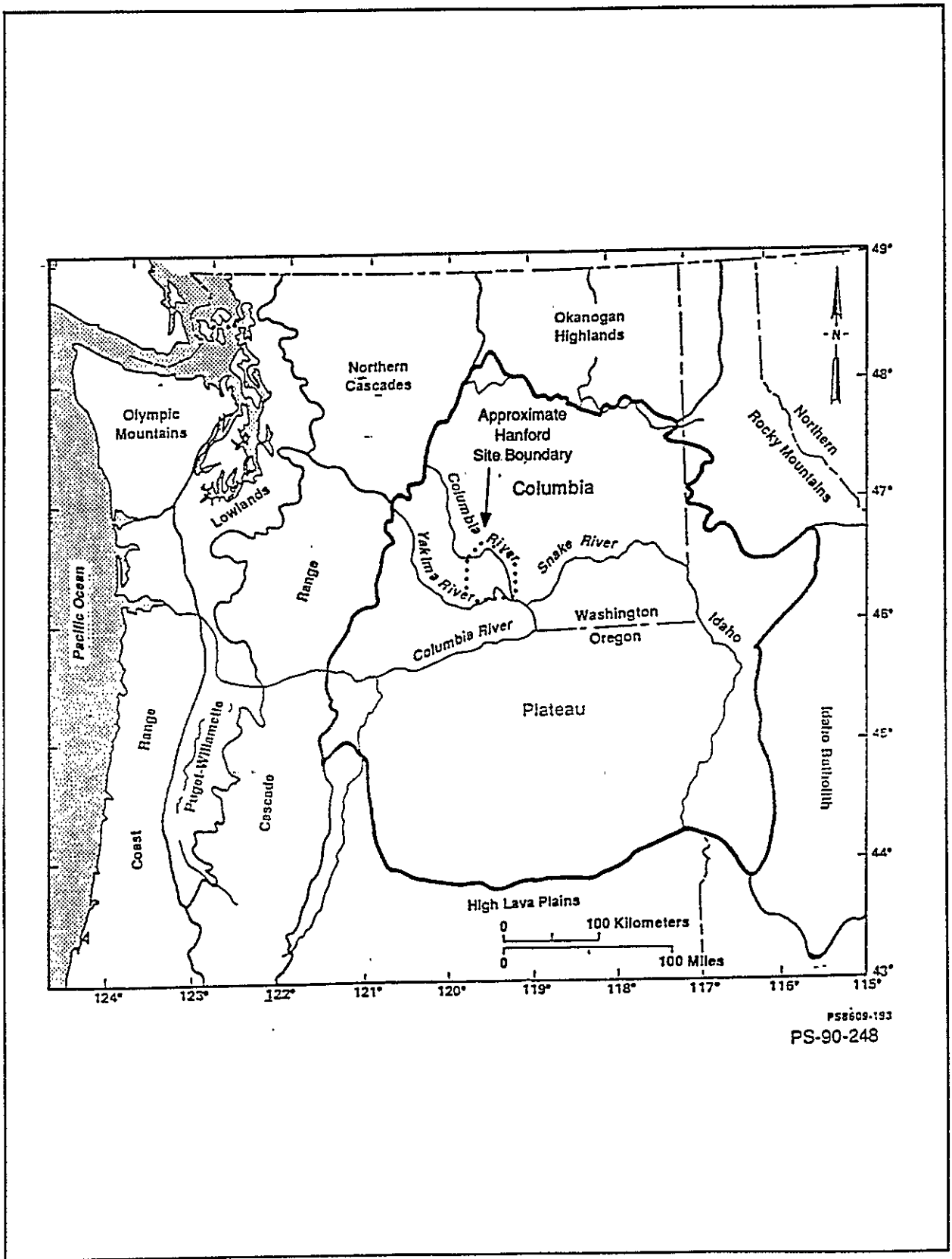


Figure 3-8. Columbia Plateau and Surrounding Structural Provinces.

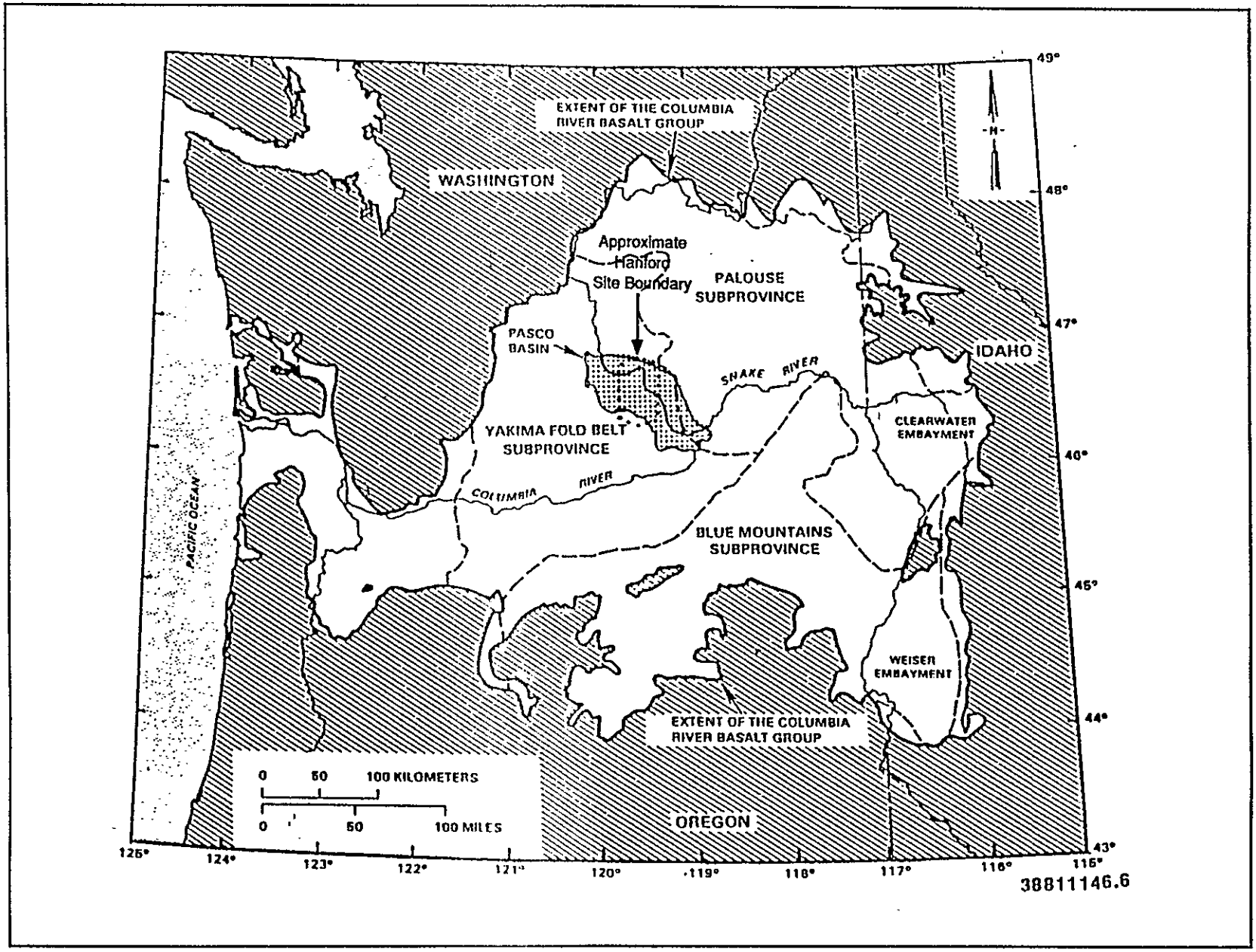


Figure 3-9. Structural [illegible] provinces of the Columbia Plateau (DOE 1988b).

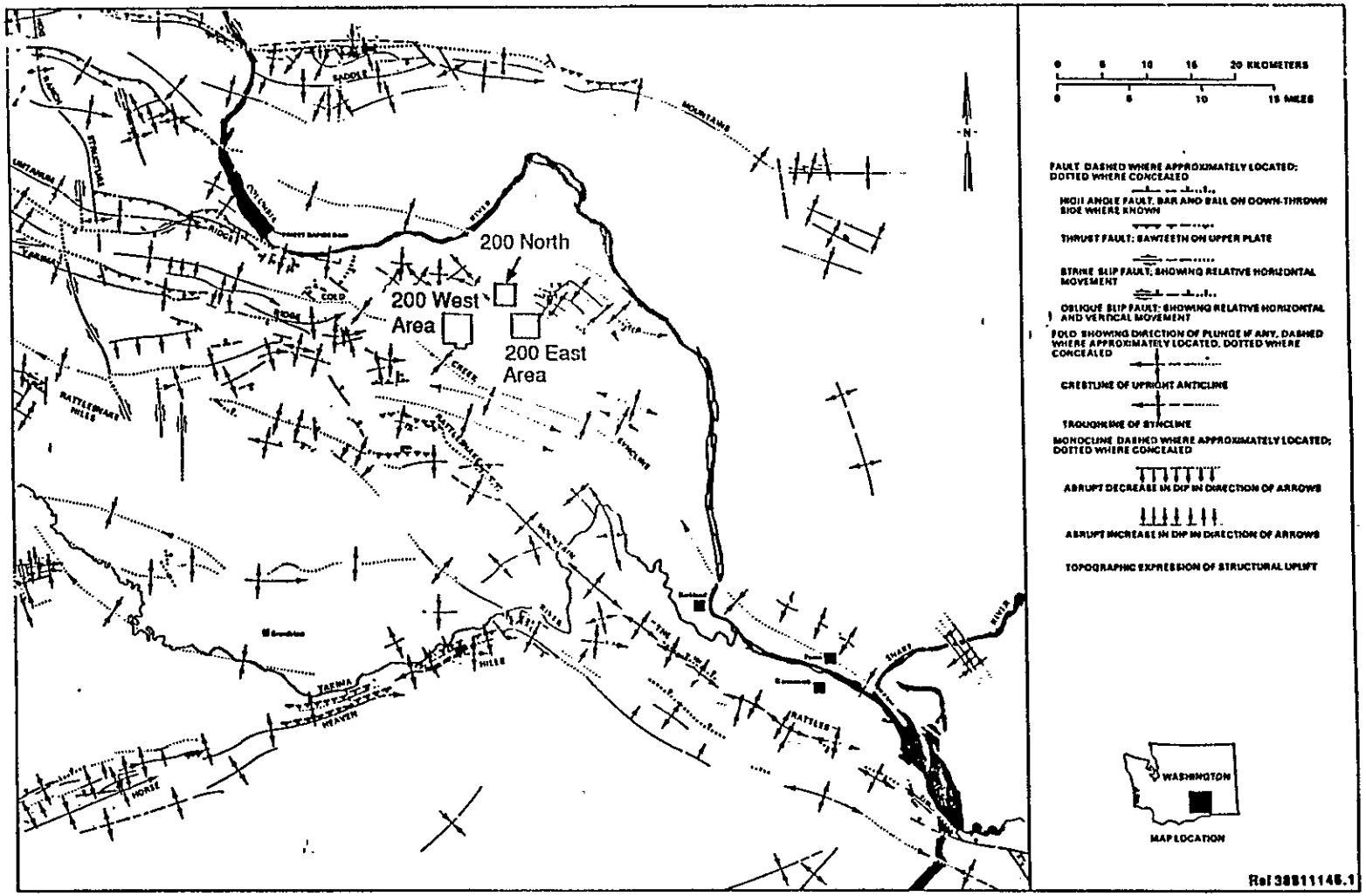


Figure 3-10. Structured Elements of the Yakima Fold Belt Subprovince (Last et al. 1989).

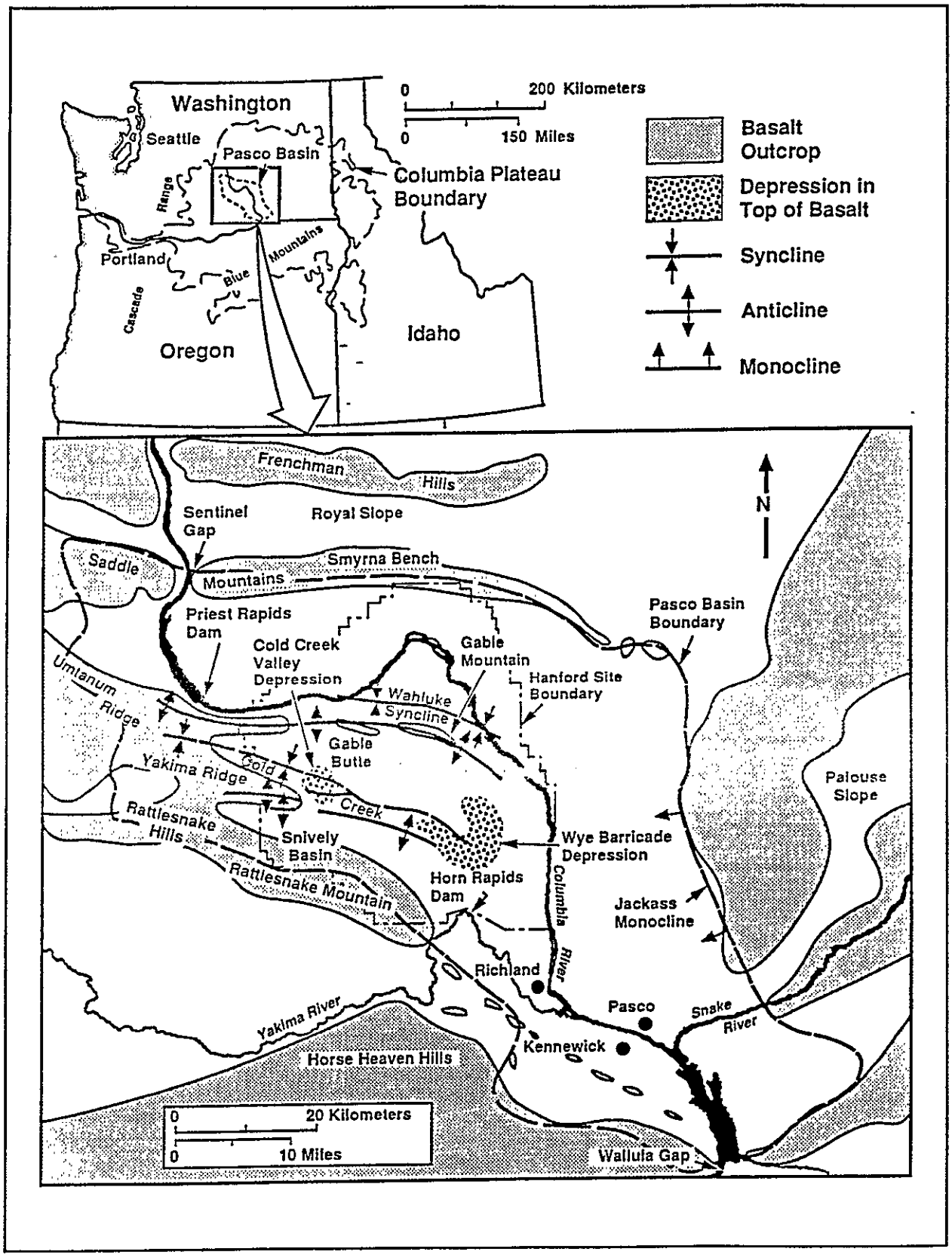


Figure 3-11. Geologic Structures of the Pasco Basin and the Hanford Site.

9 2 1 2 6 3 0 7 1 0

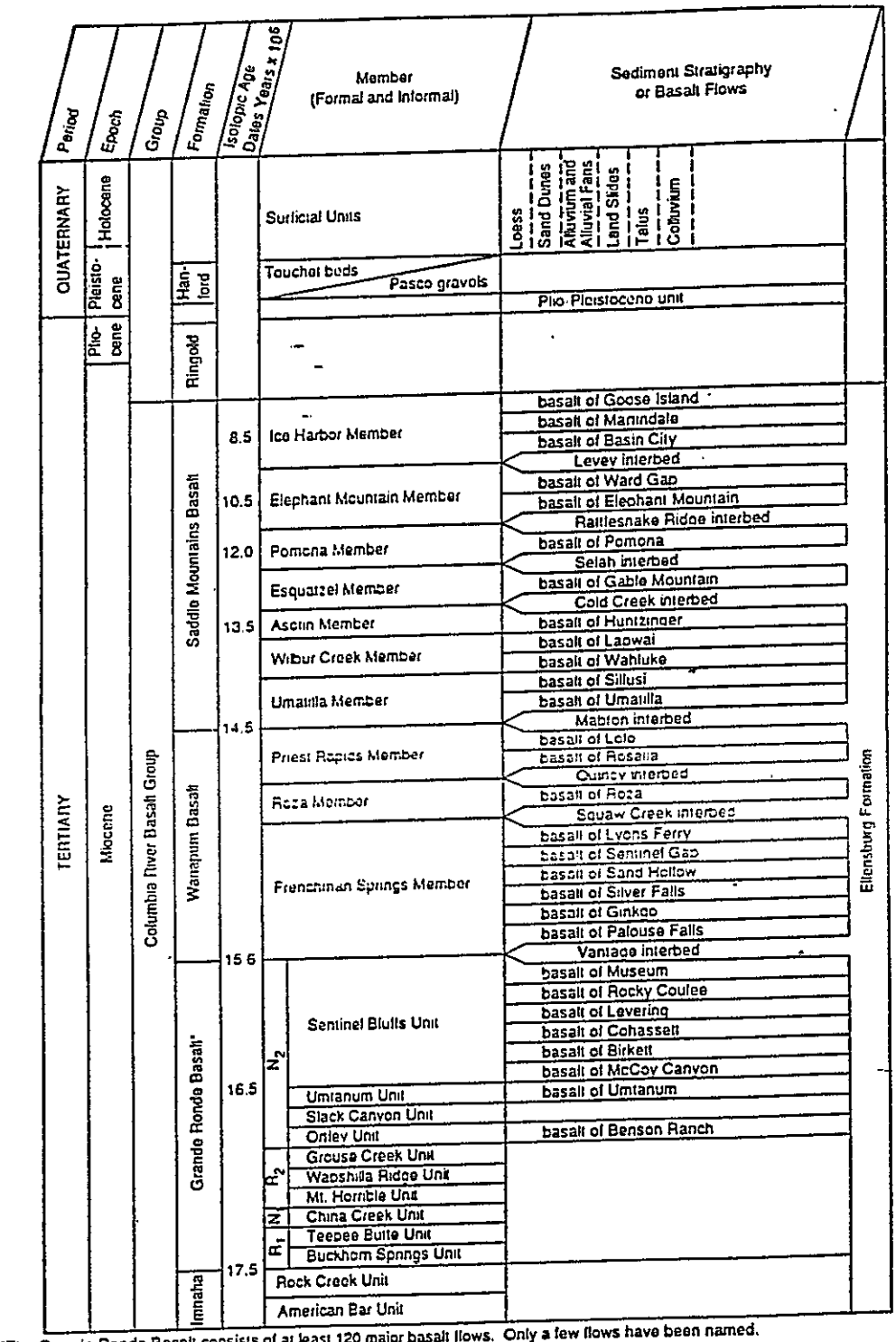


Figure 3-12. Generalized Stratigraphy of the Hanford Site.

9 2 1 2 6 3 0 7 4 1

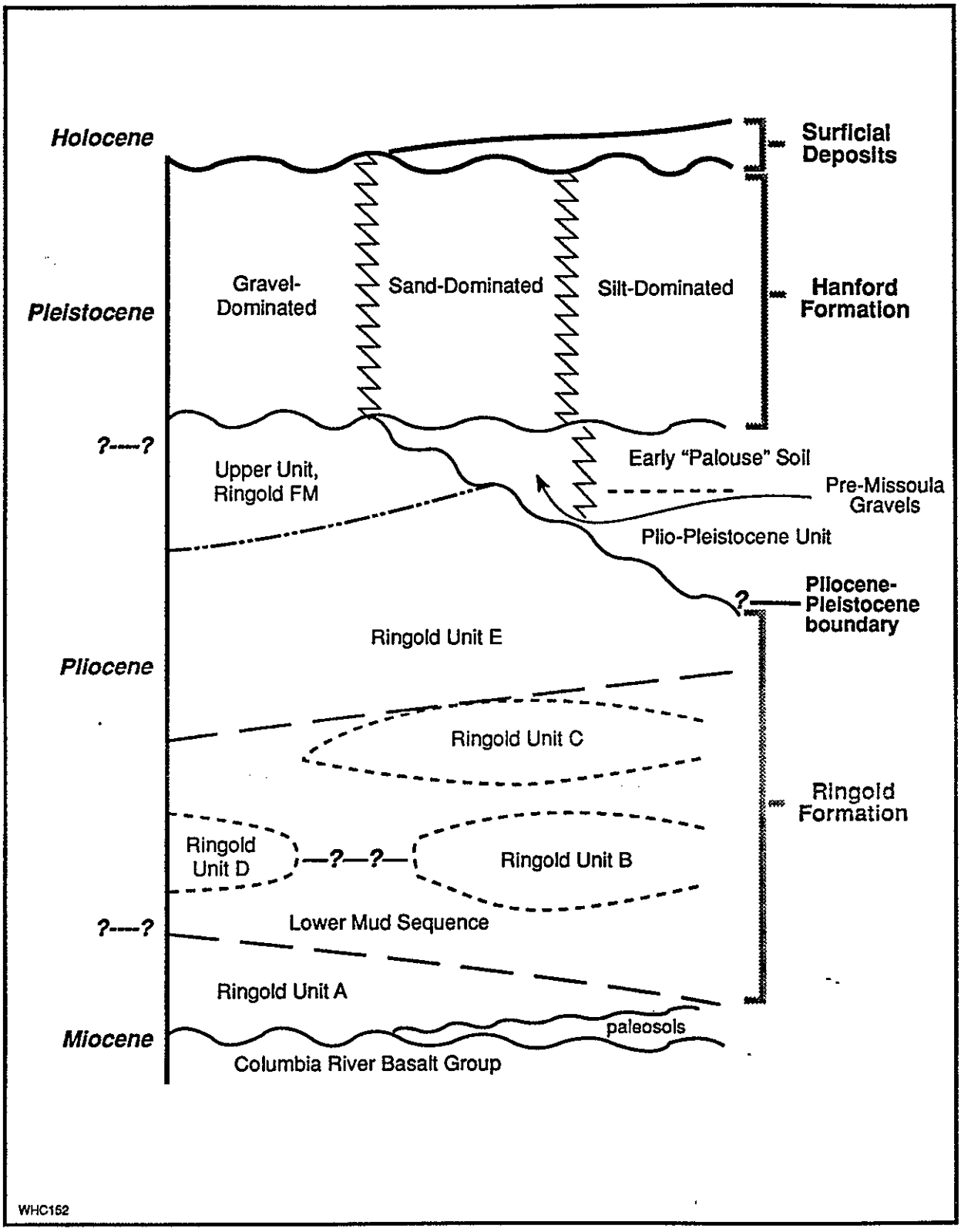


Figure 3-13. Generalized Stratigraphy of the Superbasalt Sediments Beneath the Hanford Site.

9 2 1 2 6 3 0 7 4 2

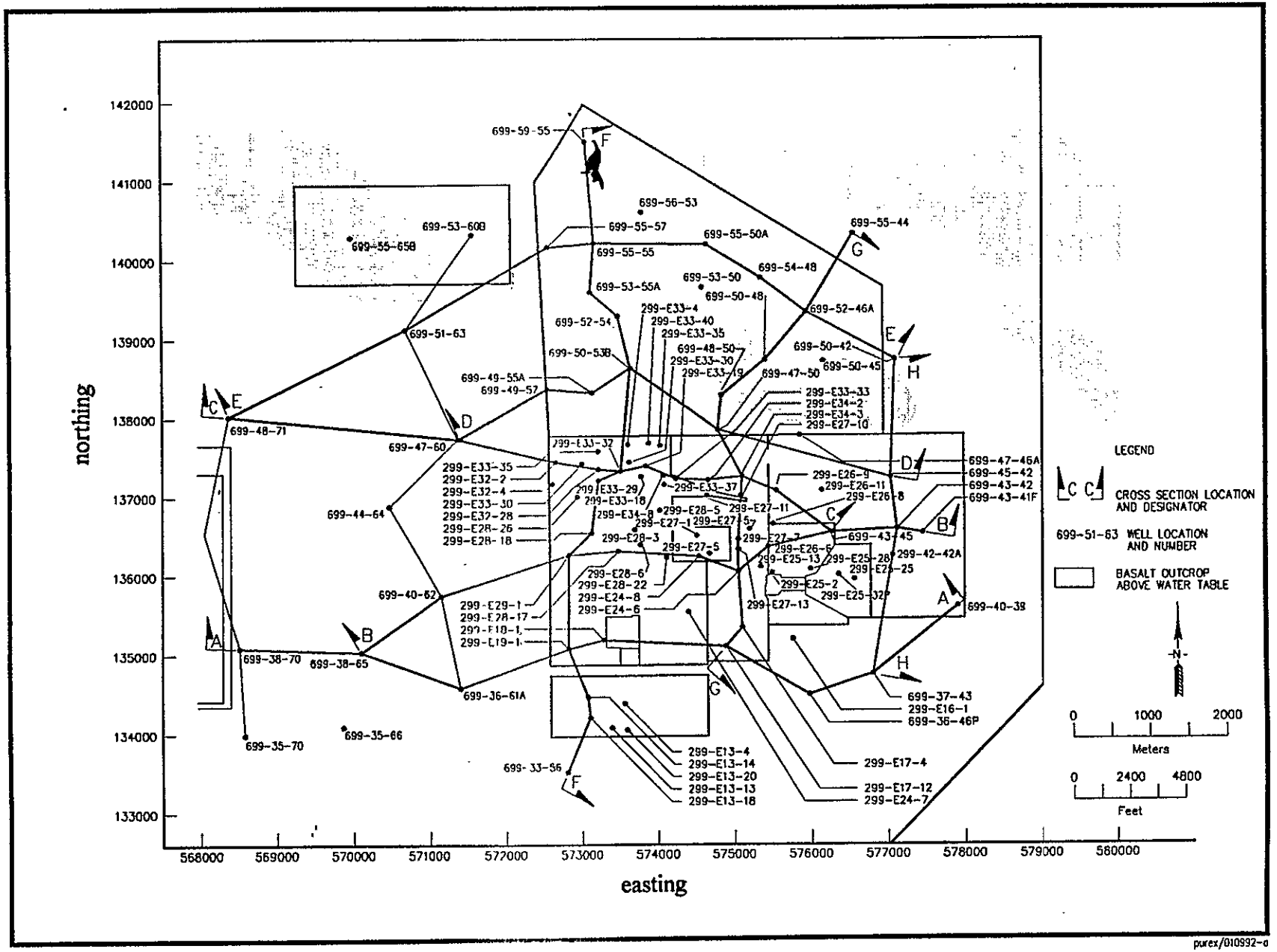


Figure 3.11. Legend for Cross-Sections.

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Unit Abbreviations

Hun	Hanford Undifferentiated
Hc	Upper Coarse Unit, Hanford Formation
Hf	Lower Fine Unit, Hanford Formation
EP	Early "Palouse" Soil
PP	Plio-Pleistocene Unit
UR	Upper Unit, Ringold Formation
E	Gravel Unit E, Ringold Formation
LM	Lower Mud Sequence, Ringold Formation
A	Gravel Unit A, Ringold Formation

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

NOTES:

1. Refer to Figure 3-14 for cross section locations and designation. Cross sections presented on Figures 3-16 through 3-19.
2. Figures based on Lindsey et al. 1991 and Airhart et al. 1990.
3. Units predominantly consisting of Sand are indicated by blank spaces.

Figure 3-15. Legend for Cross-Sections.

9 2 1 2 6 · 3 0 7 4 5

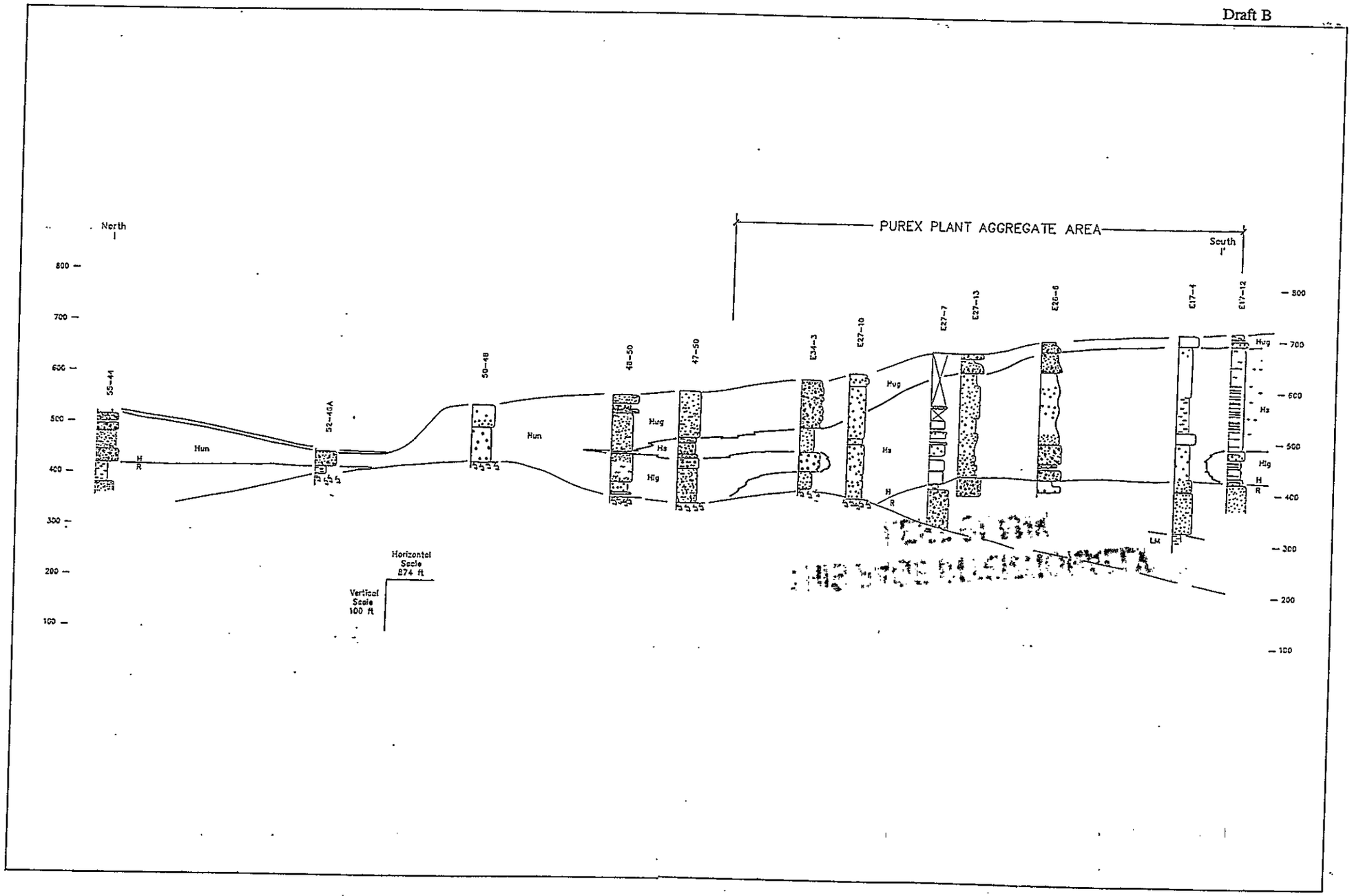

Figure 3-16. Geologic Cross-Section - I-I'.

9 2 1 2 6 3 0 7 4 6

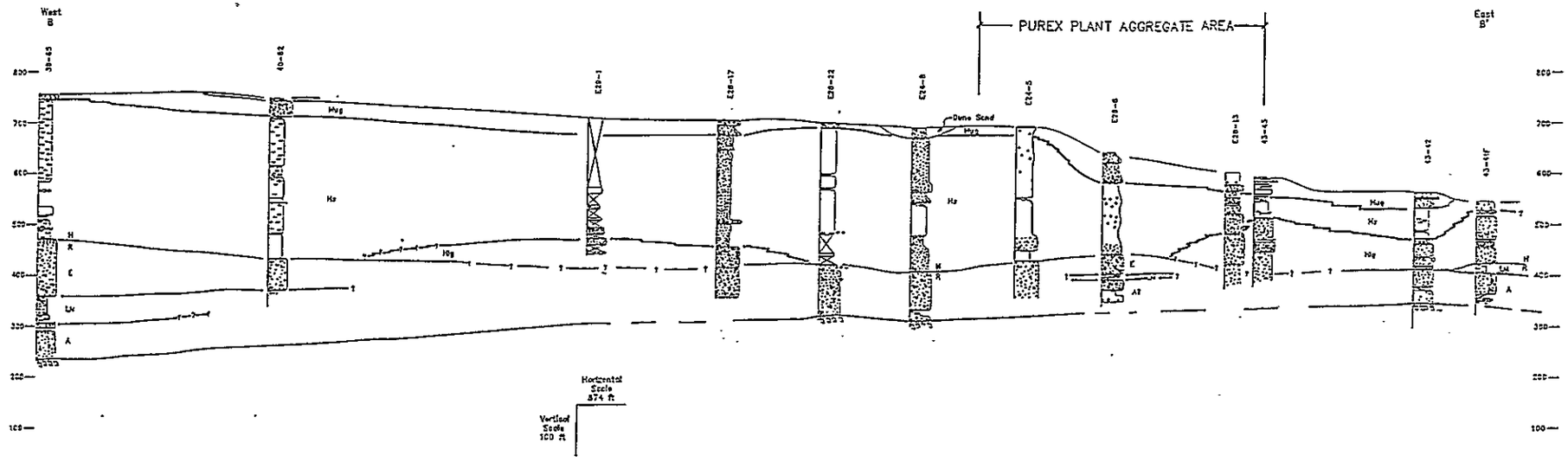

Figure 3-17. Geologic Cross-Section - B-B'.

9 2 1 2 6 _ 3 0 7 4 7

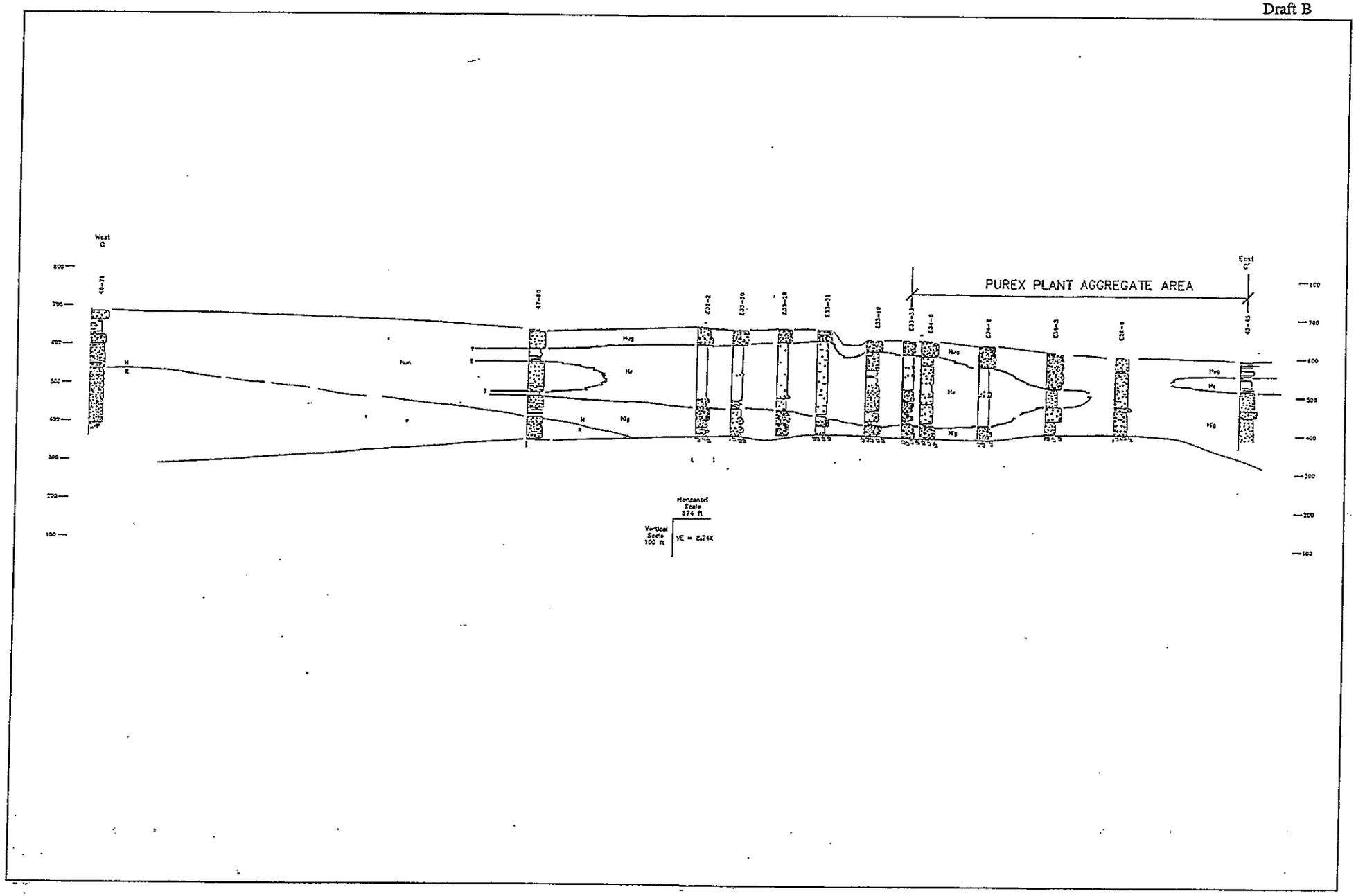

Figure 3-18. Geologic Cross-Section - C-C'.

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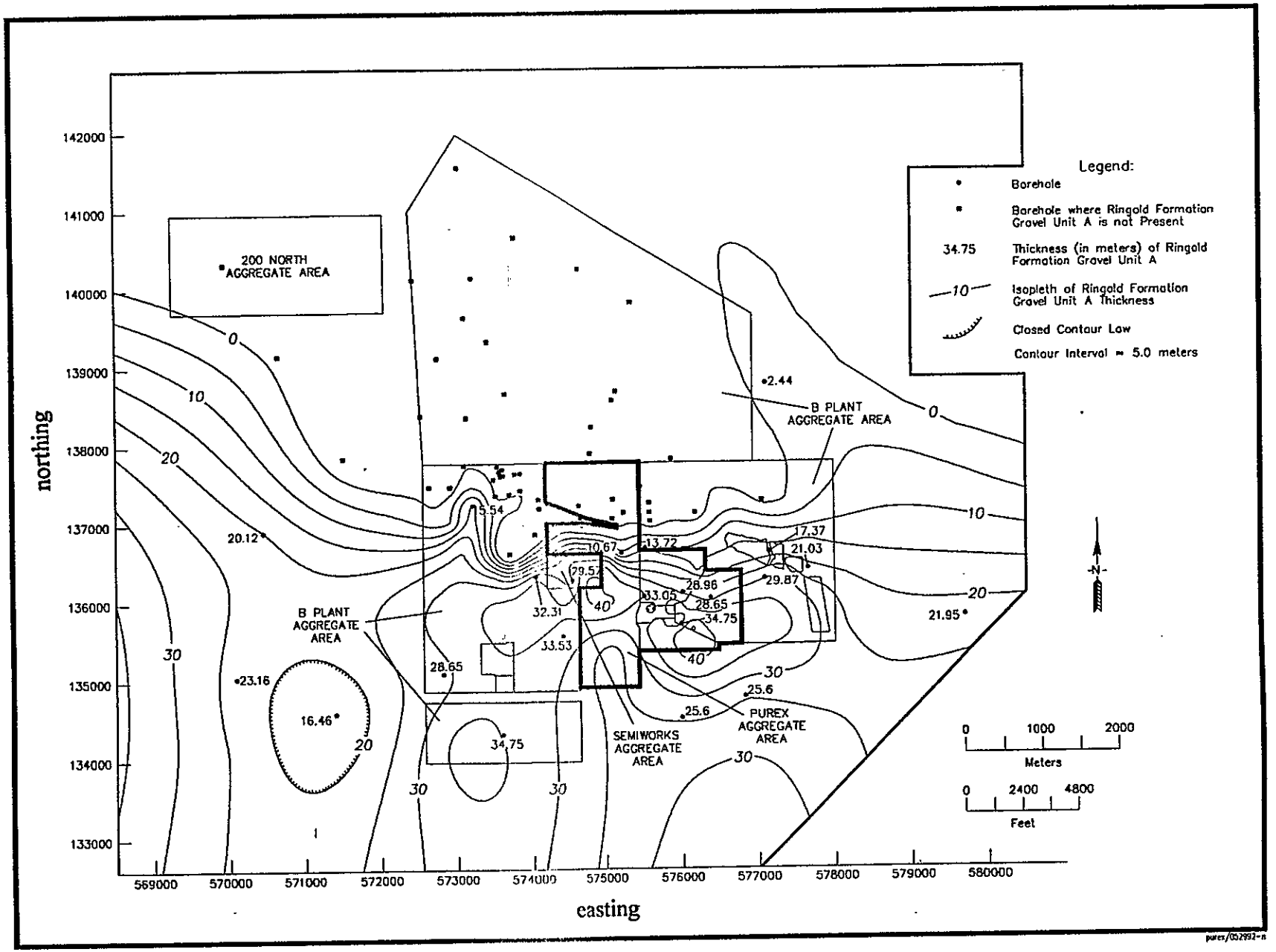


Figure 3-19. Isopach map of the top of the Ringold Gravel Unit A.

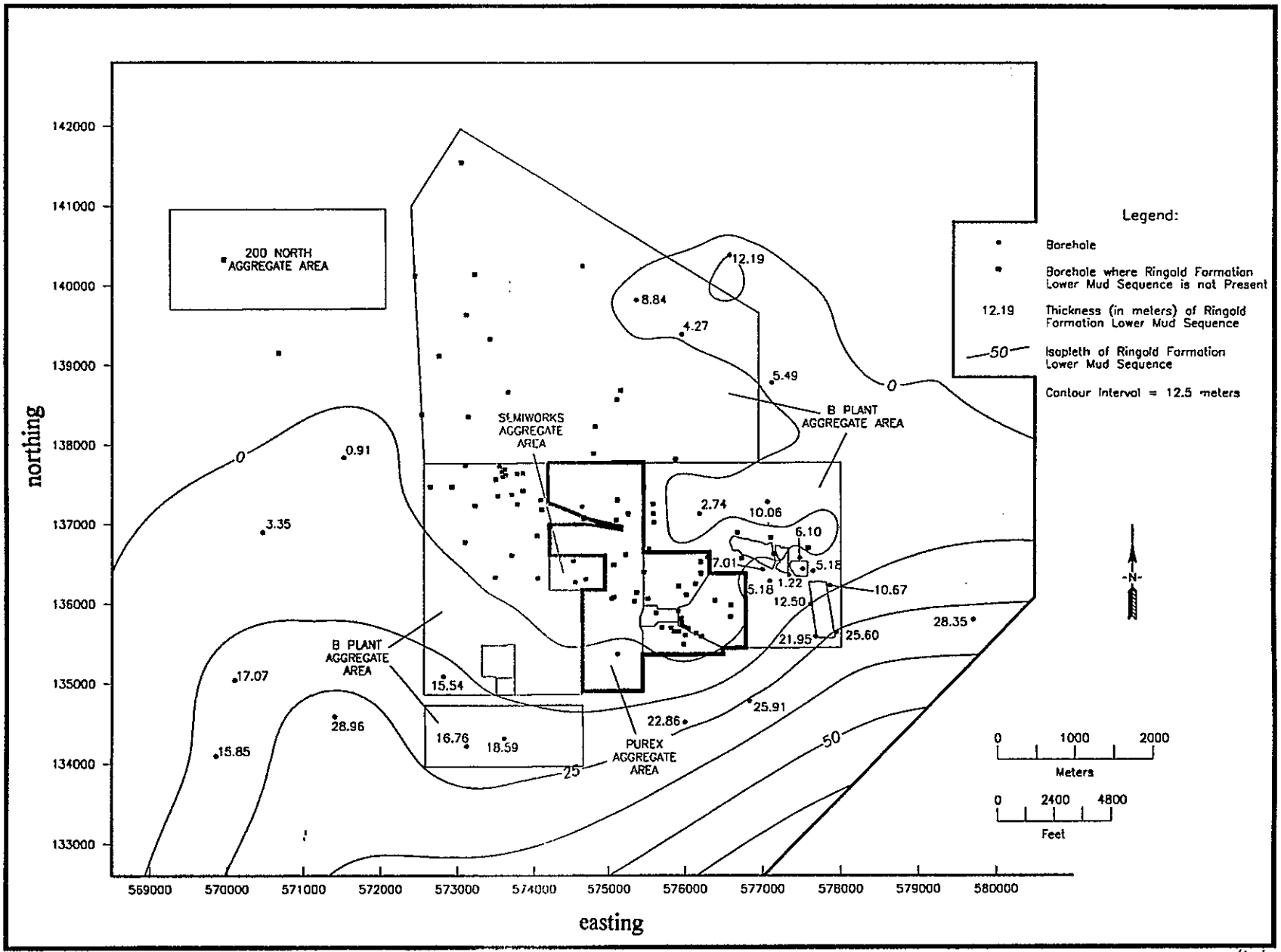


Figure 3-21. Isopach Map of the Lower Mud Sequence, Ringold Formation.

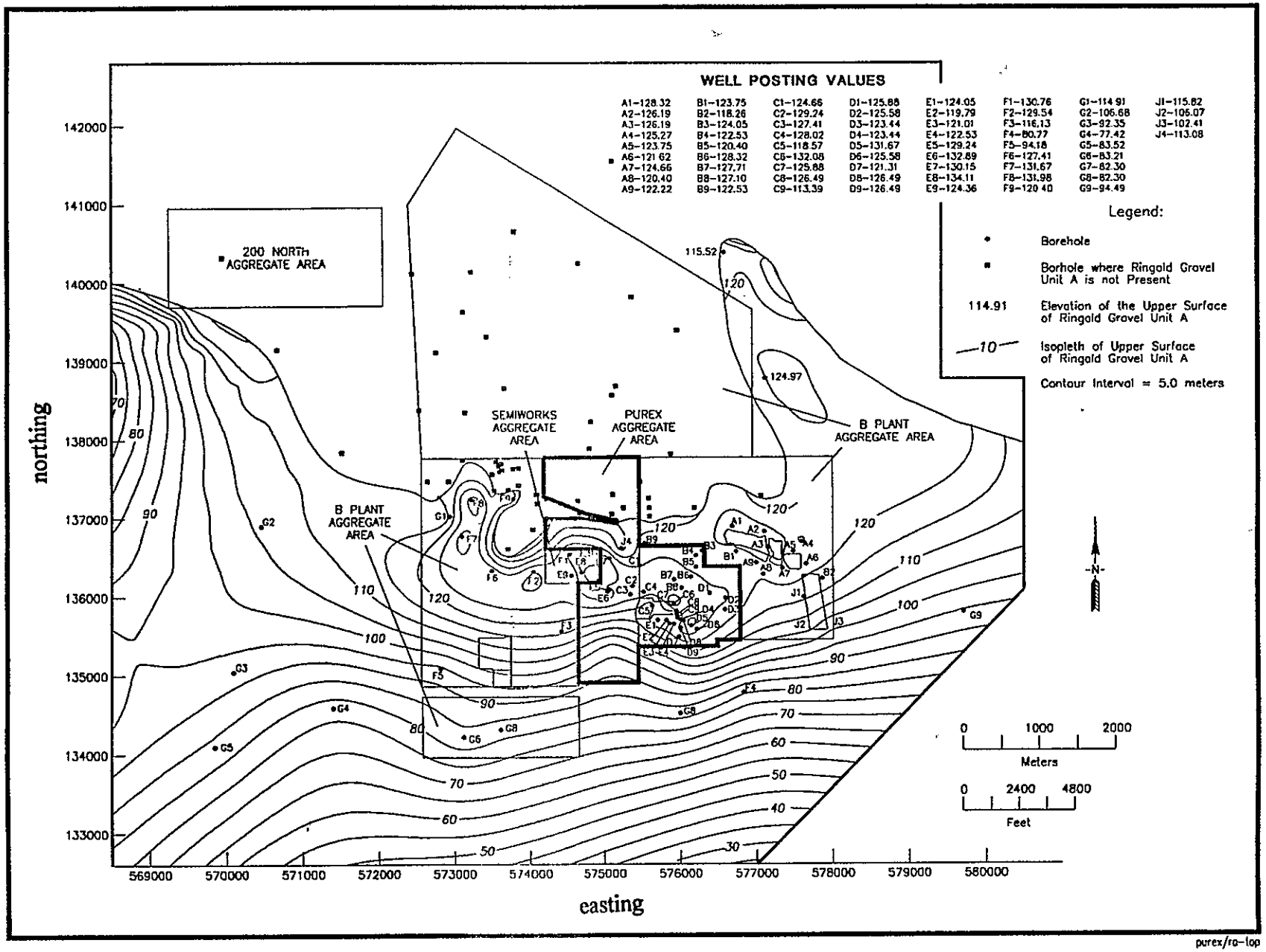


Figure 3-20. Structure map of the top of the Ringold Gravel Unit A.

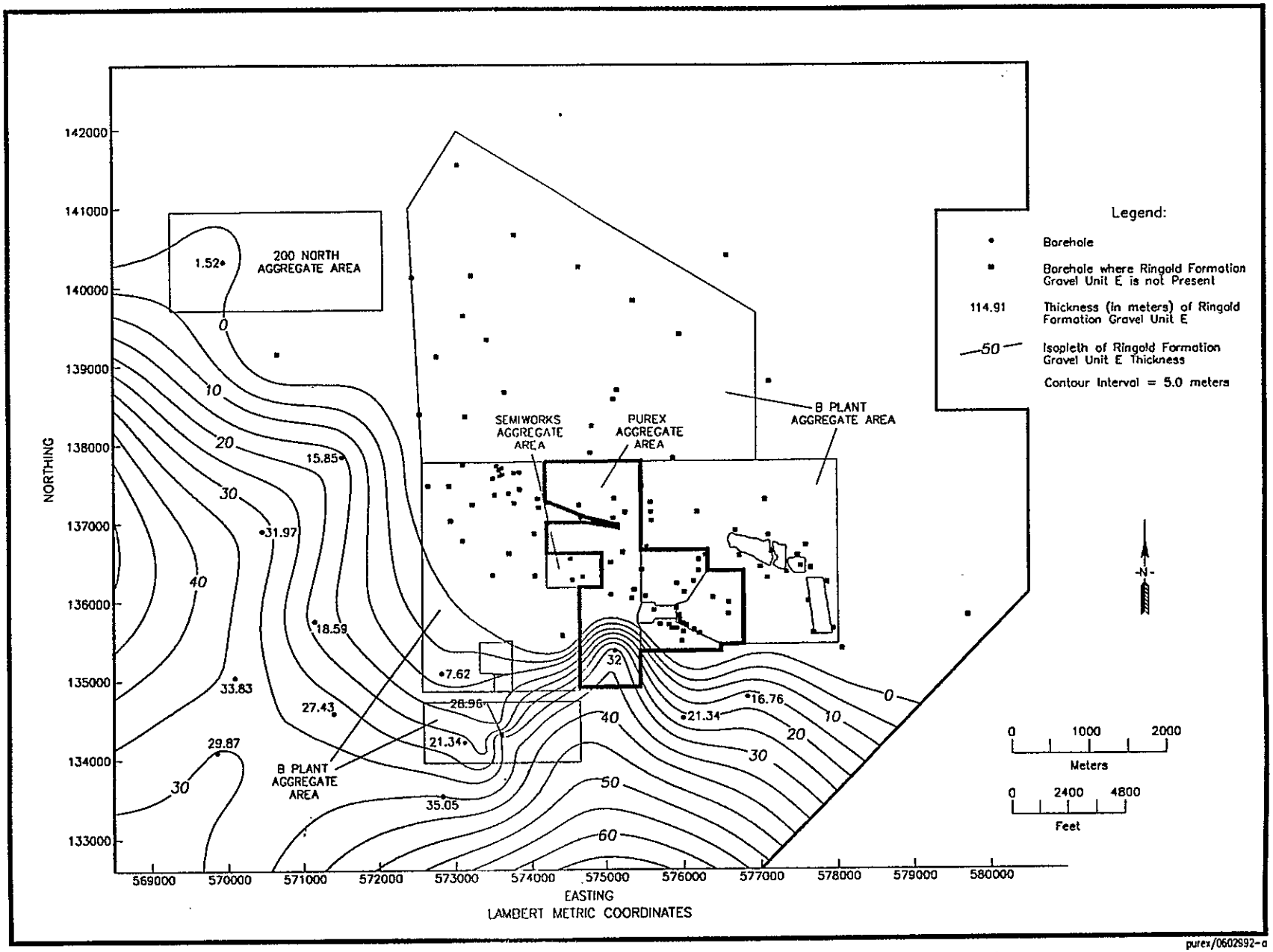


Figure 3-23. Isopleth Map of the Ringold Gravel Unit E.

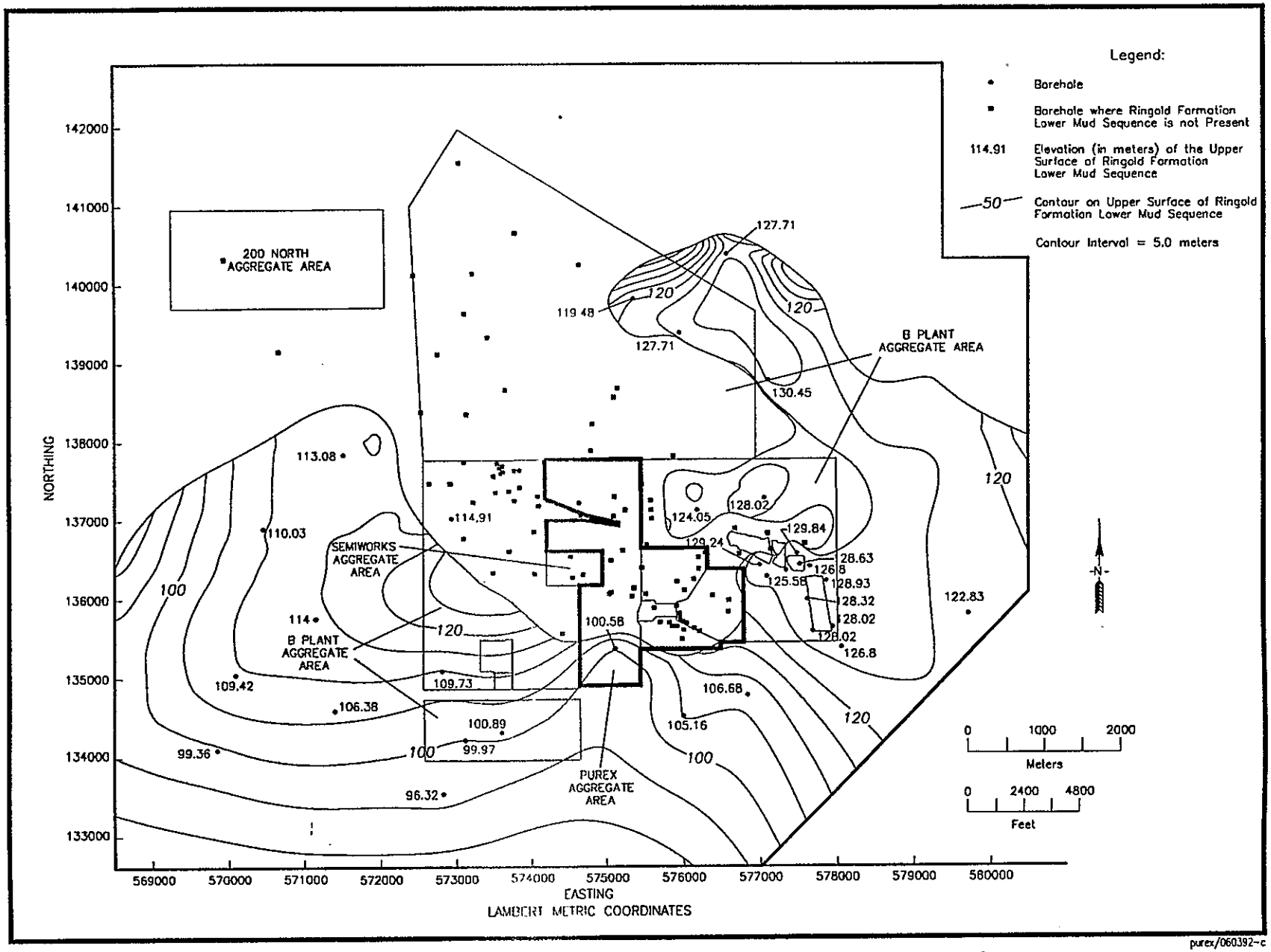


Figure 3-22. Structure Map of the Lower Mud Sequence, Ringold Formation.

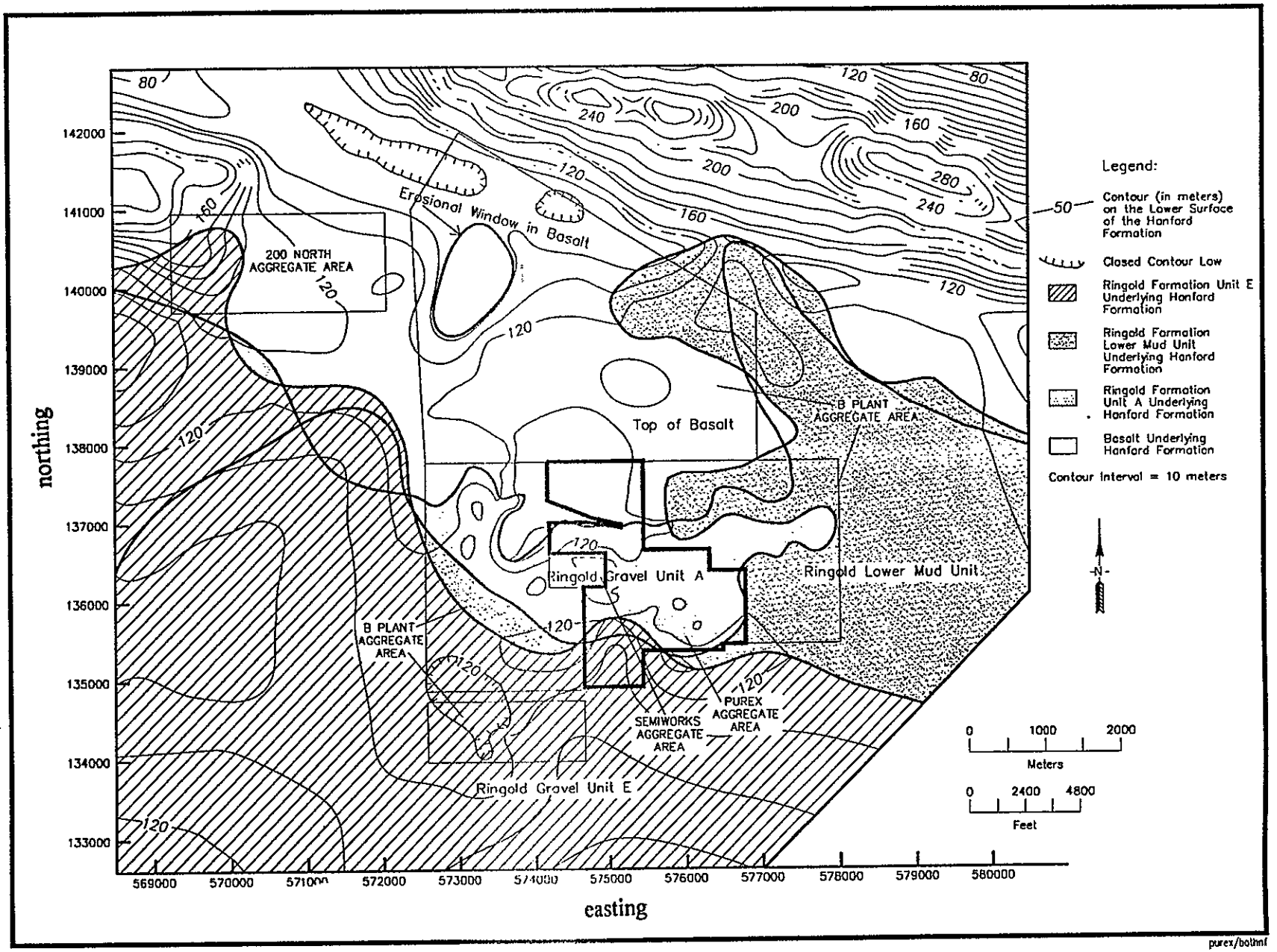


Figure 3-25. Structure Map of the Ringold Formation.

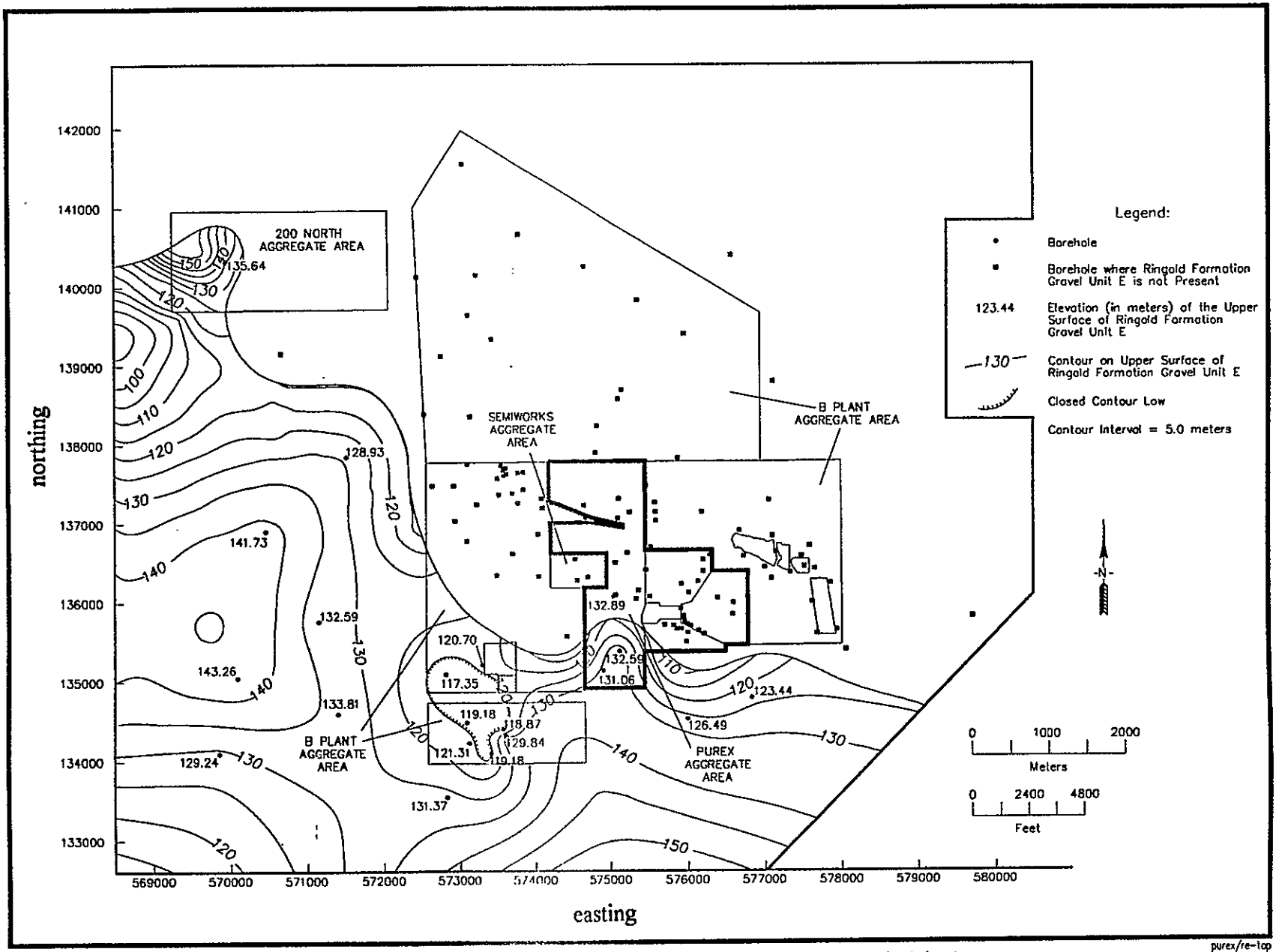


Figure 3-24. Structure Map of the top of the Ringold Gravel Unit E.

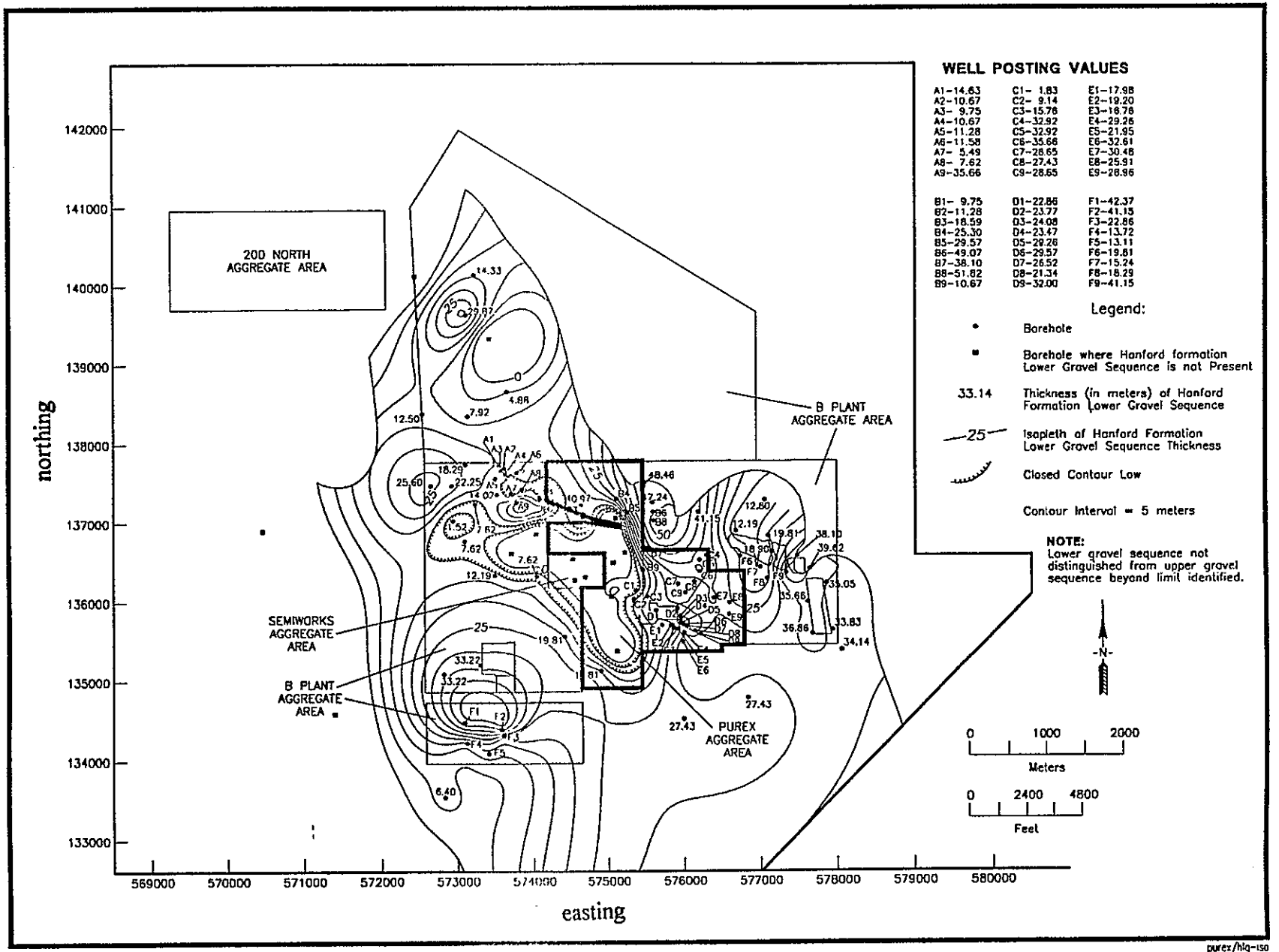


Figure 3-26. Isopach Map of the top of the Lower Gravel Sequence, Hanford Formation.

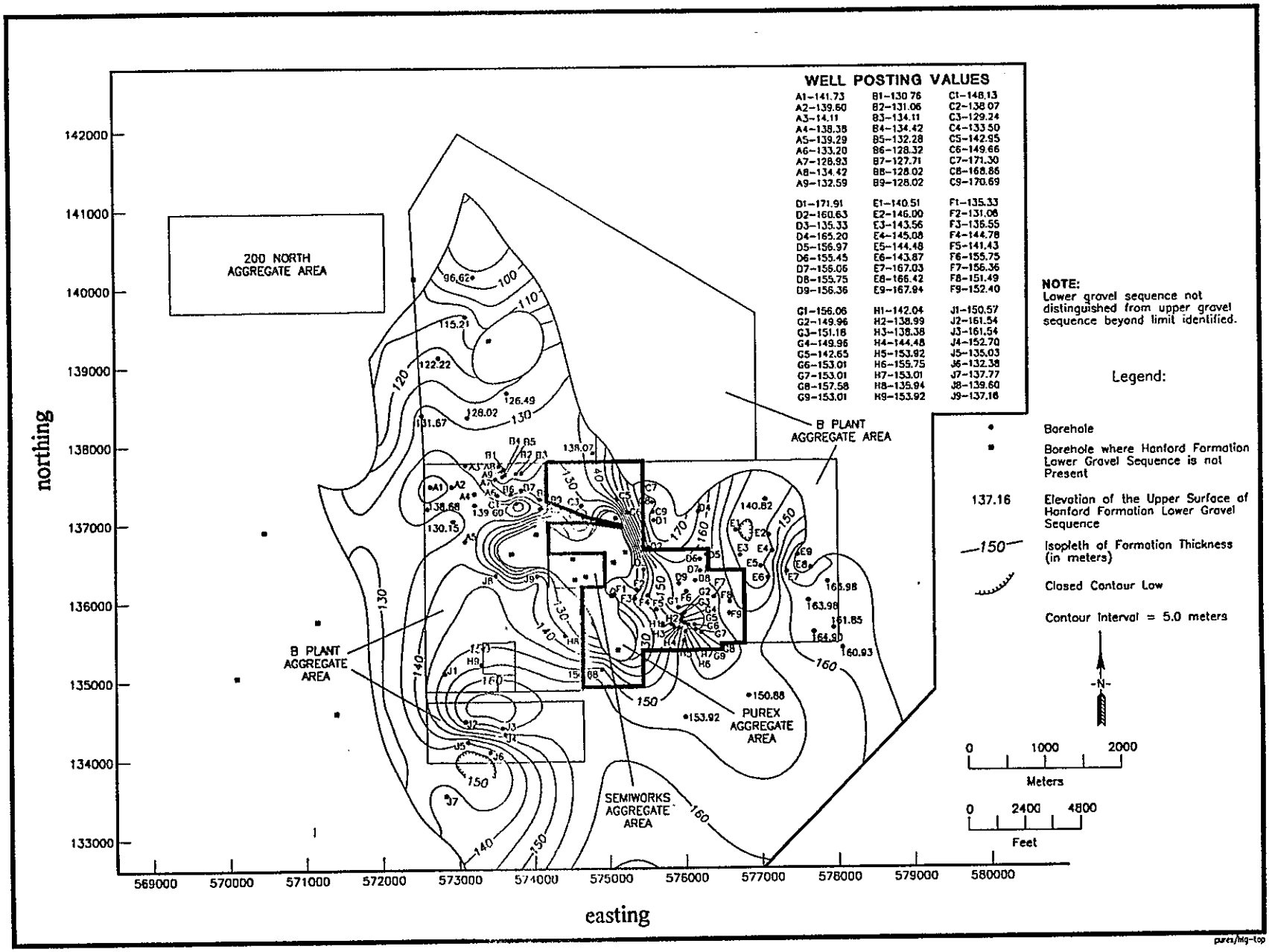


Figure 3-27. Structure Map of the top of the Lower Gravel Sequence, Hanford Formation.

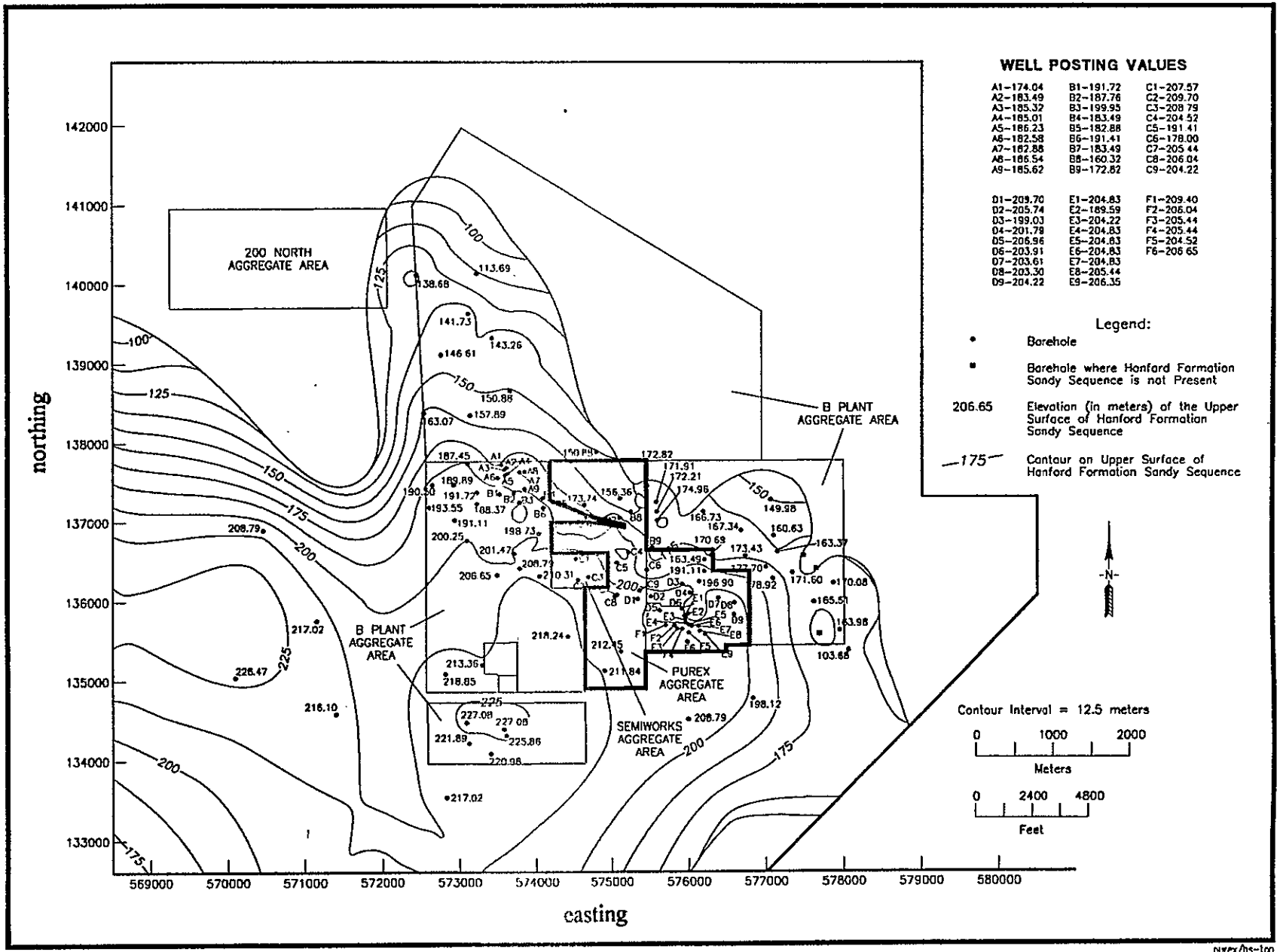


Figure 3-29. Structure Map of the top of the Sandy Sequence, Hanford Formation.

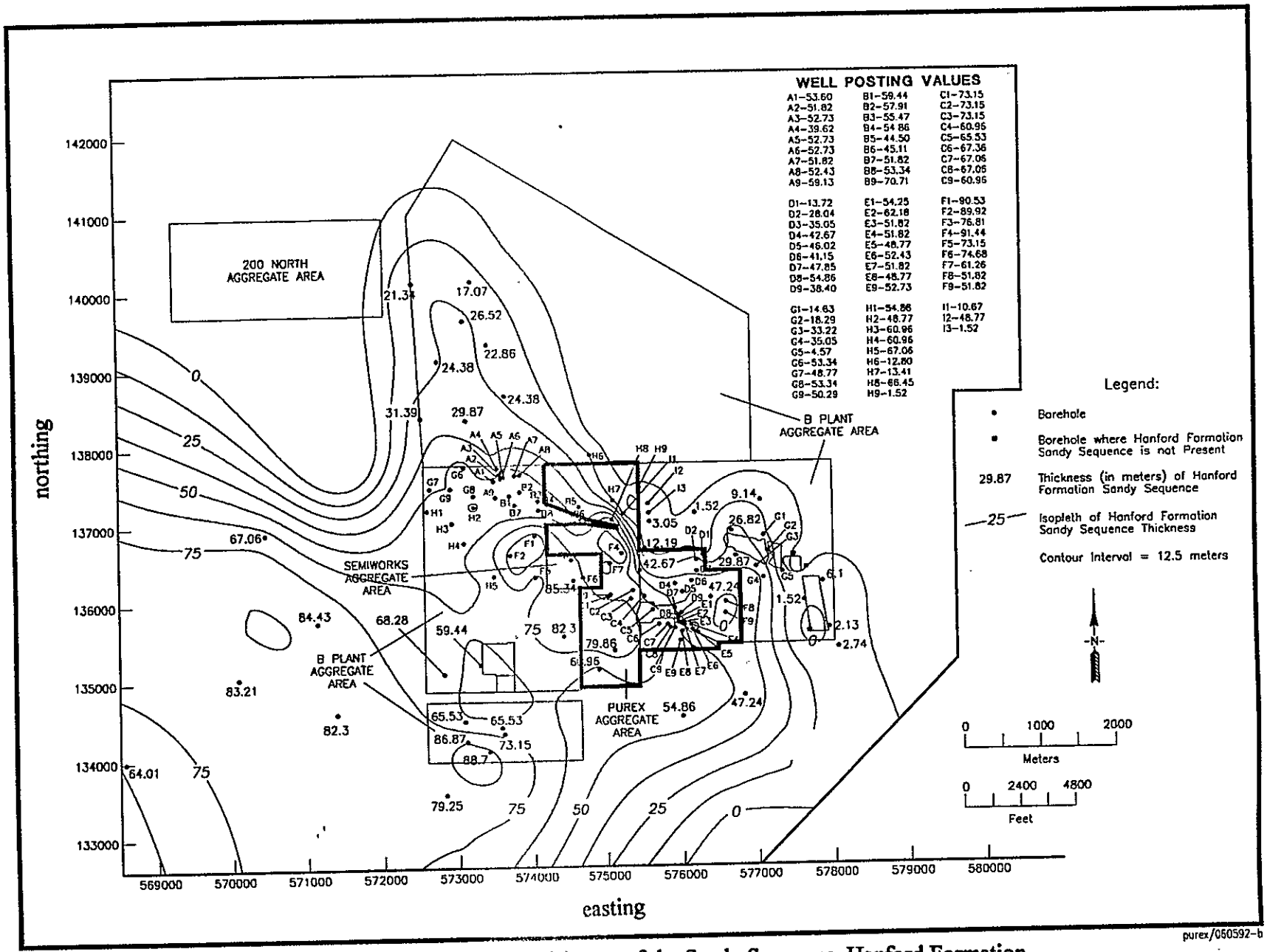


Figure 3-28. Isopach Map of the top of the Sandy Sequence, Hanford Formation.

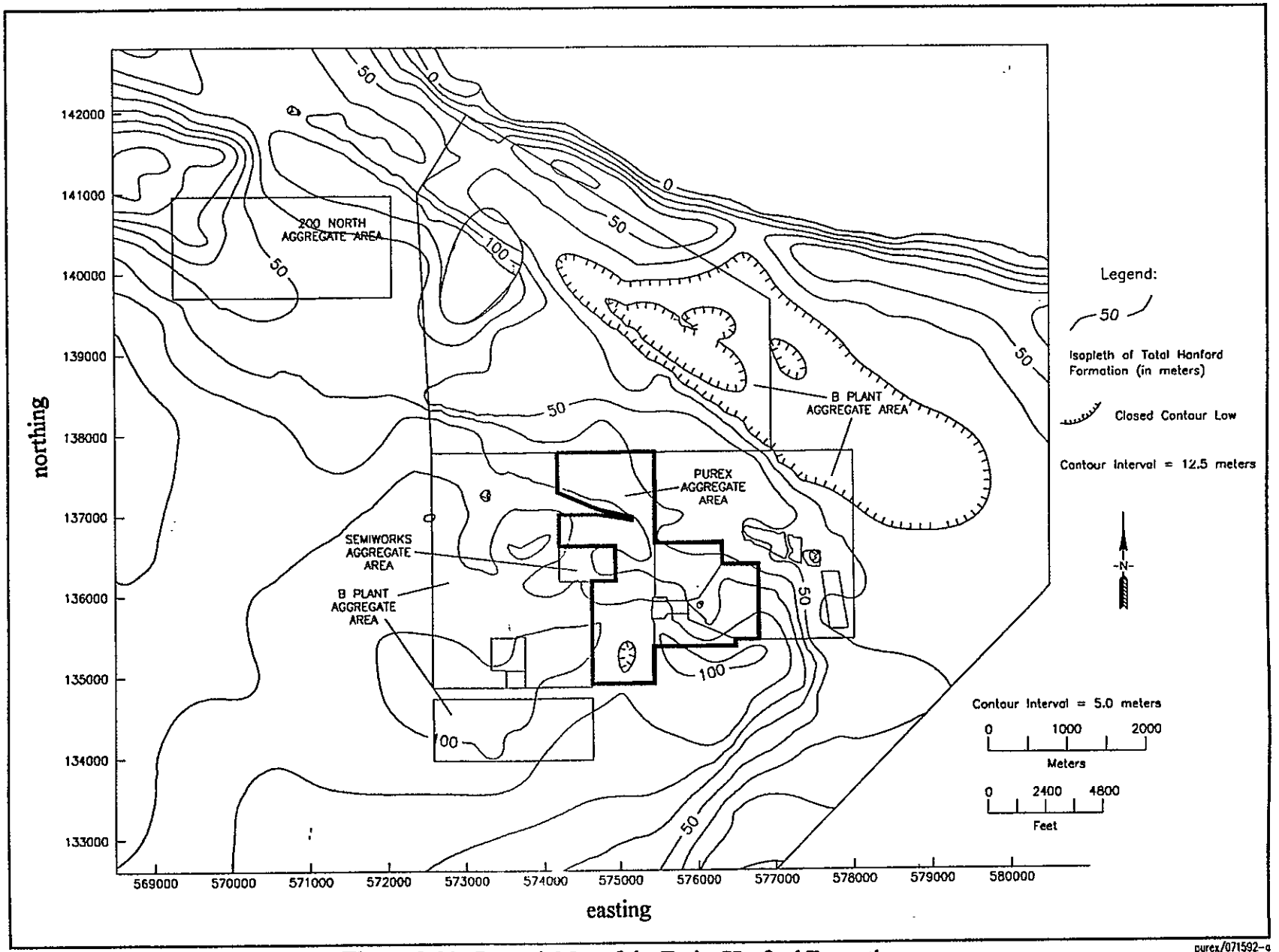


Figure 3-31. Isopach Map of the Entire Hanford Formation.

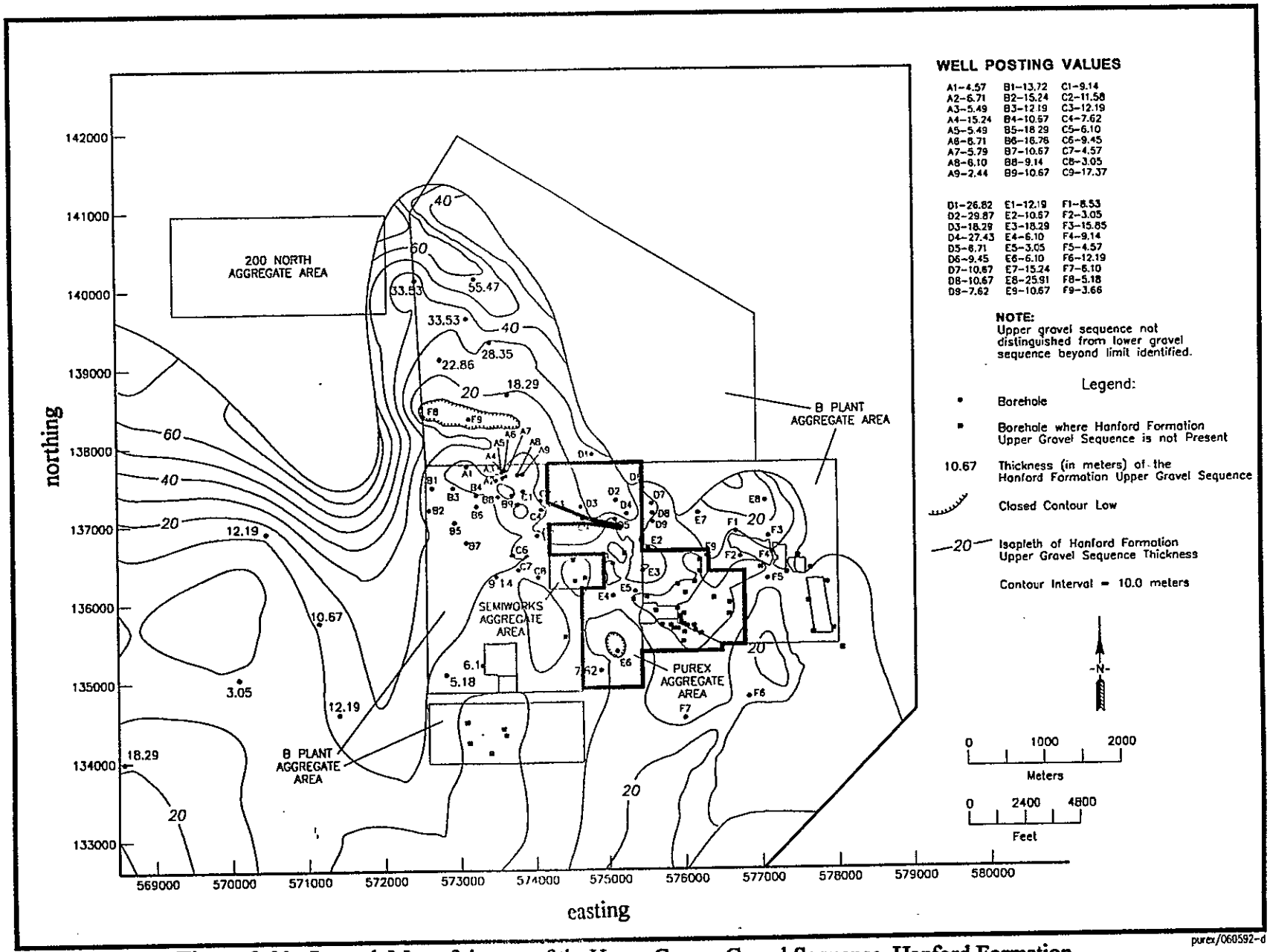


Figure 3-30. Isopach Map of the top of the Upper Coarse Gravel Sequence, Hanford Formation.

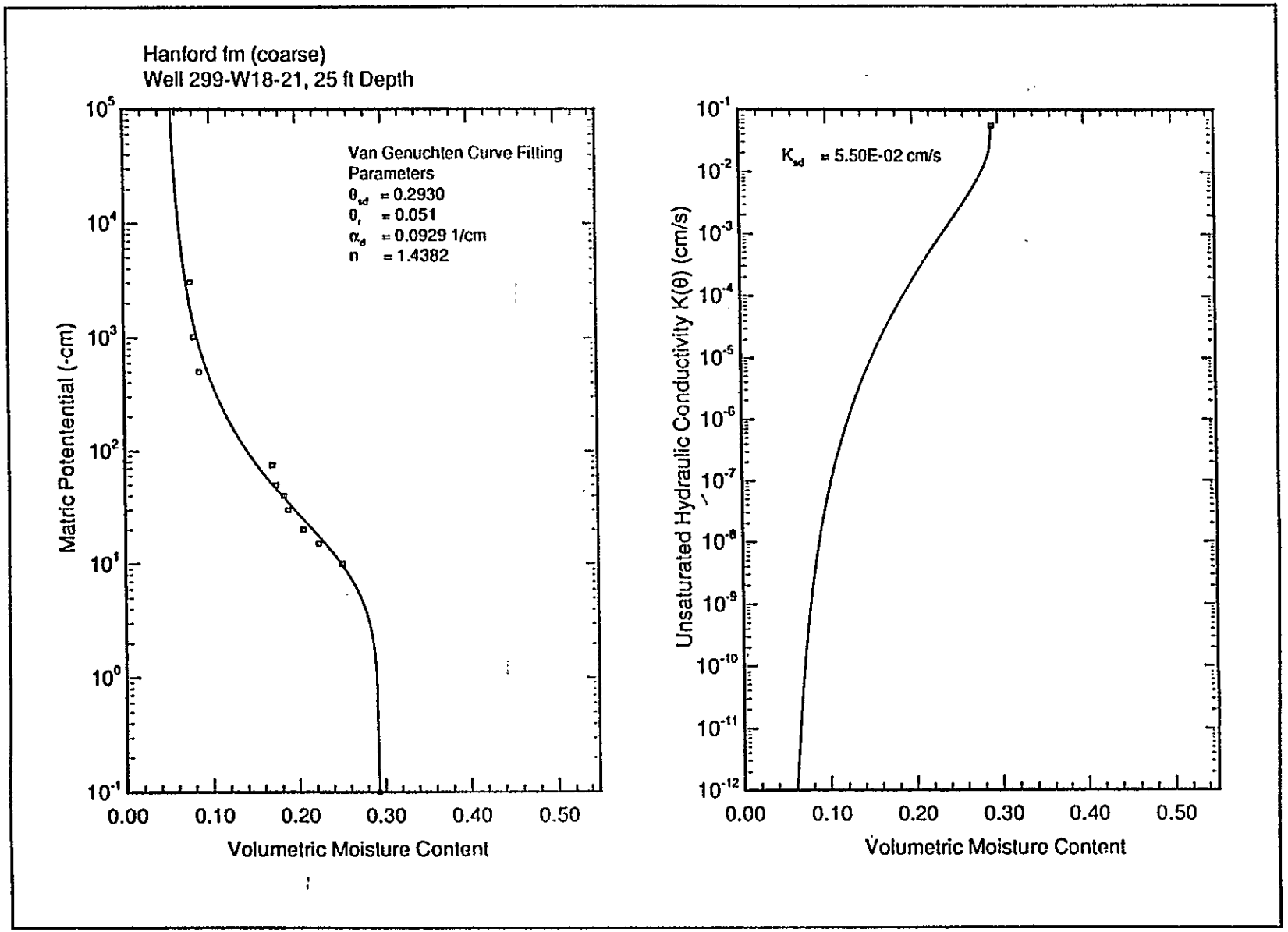


Figure 3-33. Wetting and Drying Curves for Well 299-W18-21.

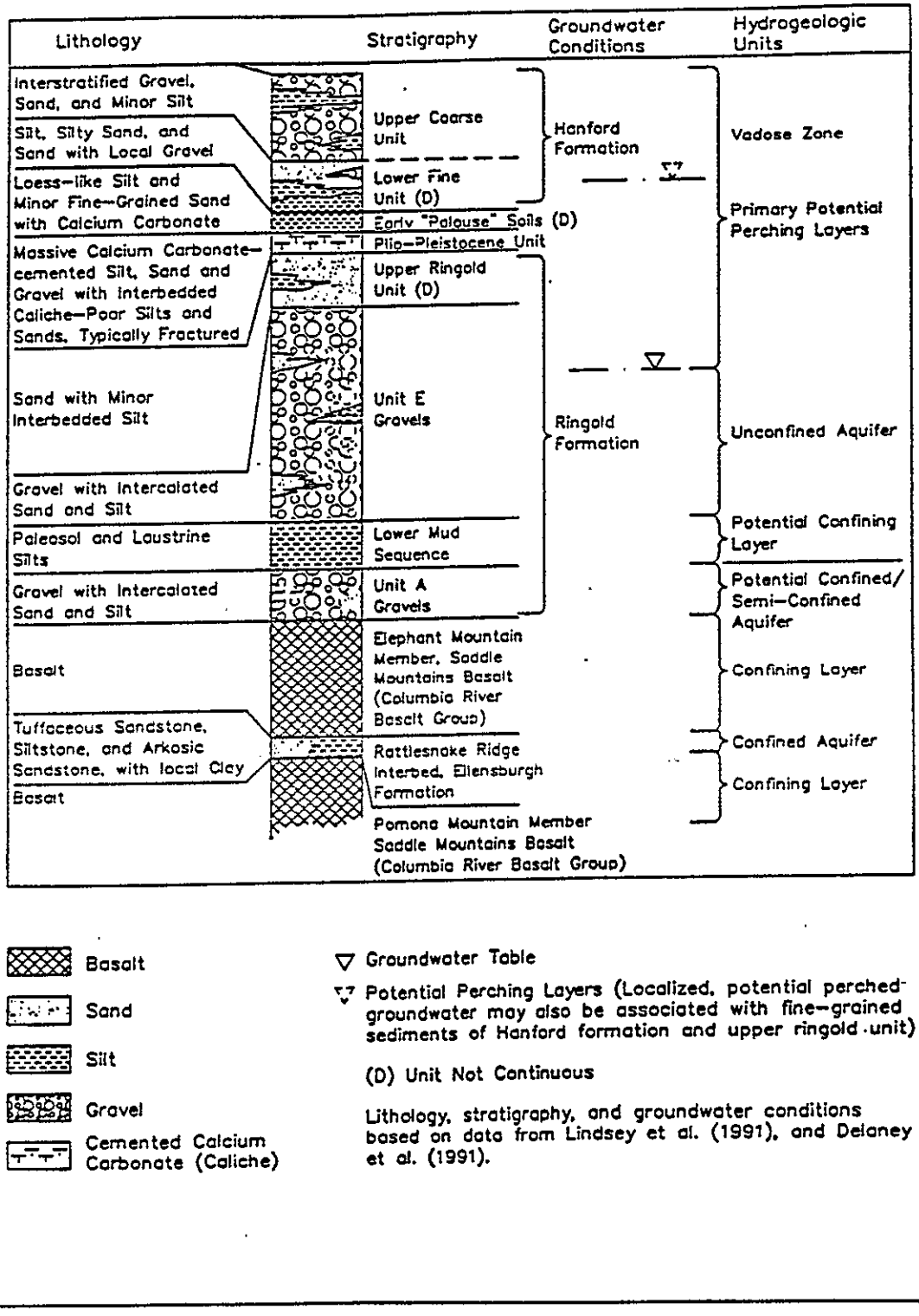
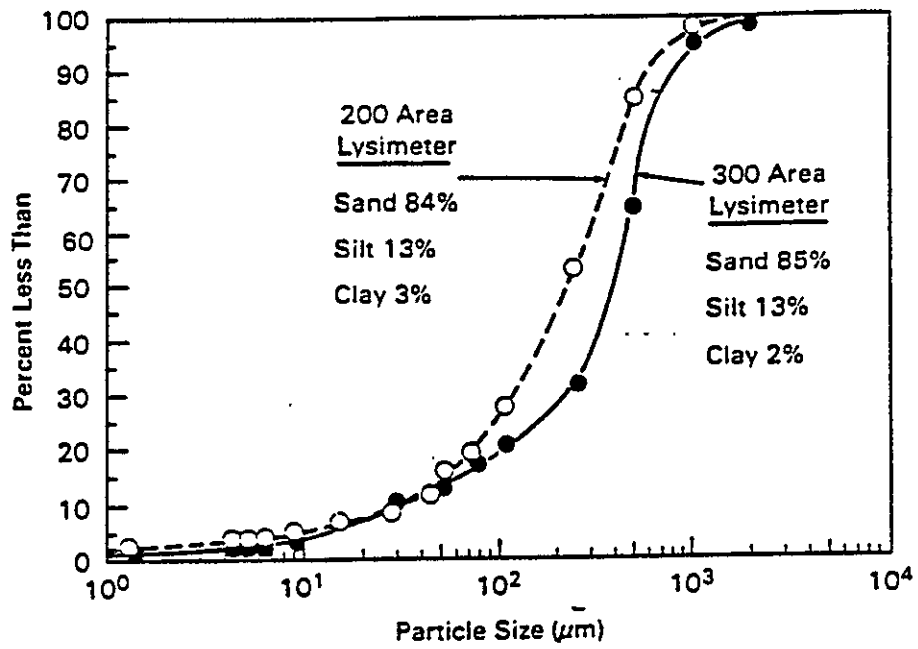
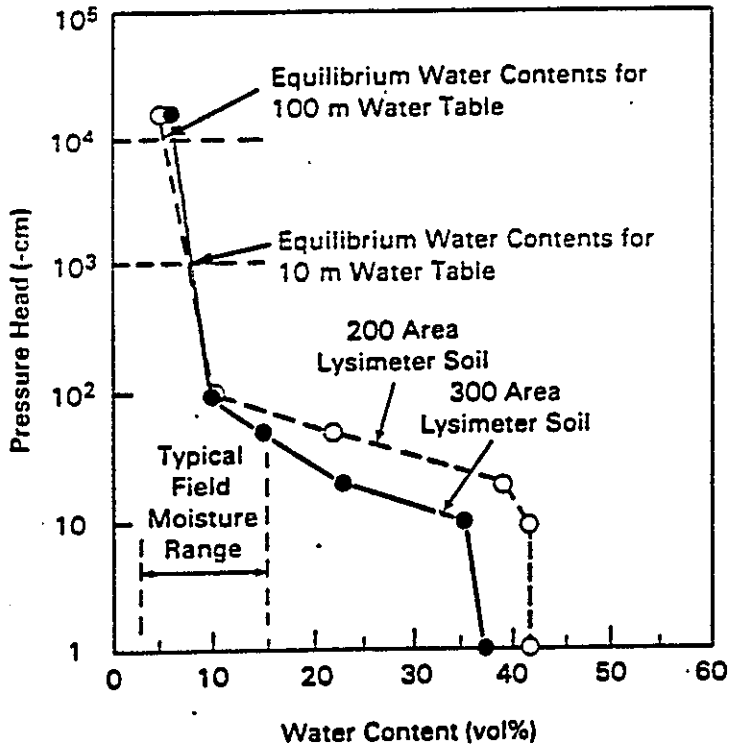


Figure 3-32. Conceptual Geologic Hydrocolumn for the Hanford Site.

9212307.61



a. Particle-Size Distribution



b. Water Retention Characteristics

Figure 3-34. Particle Size Distribution and Water Retention Characteristics of Soils From Hanford Site Lysimeters.

9 2 1 2 6 3 0 7 6 3

9 2 1 2 6 3 0 7 6 4

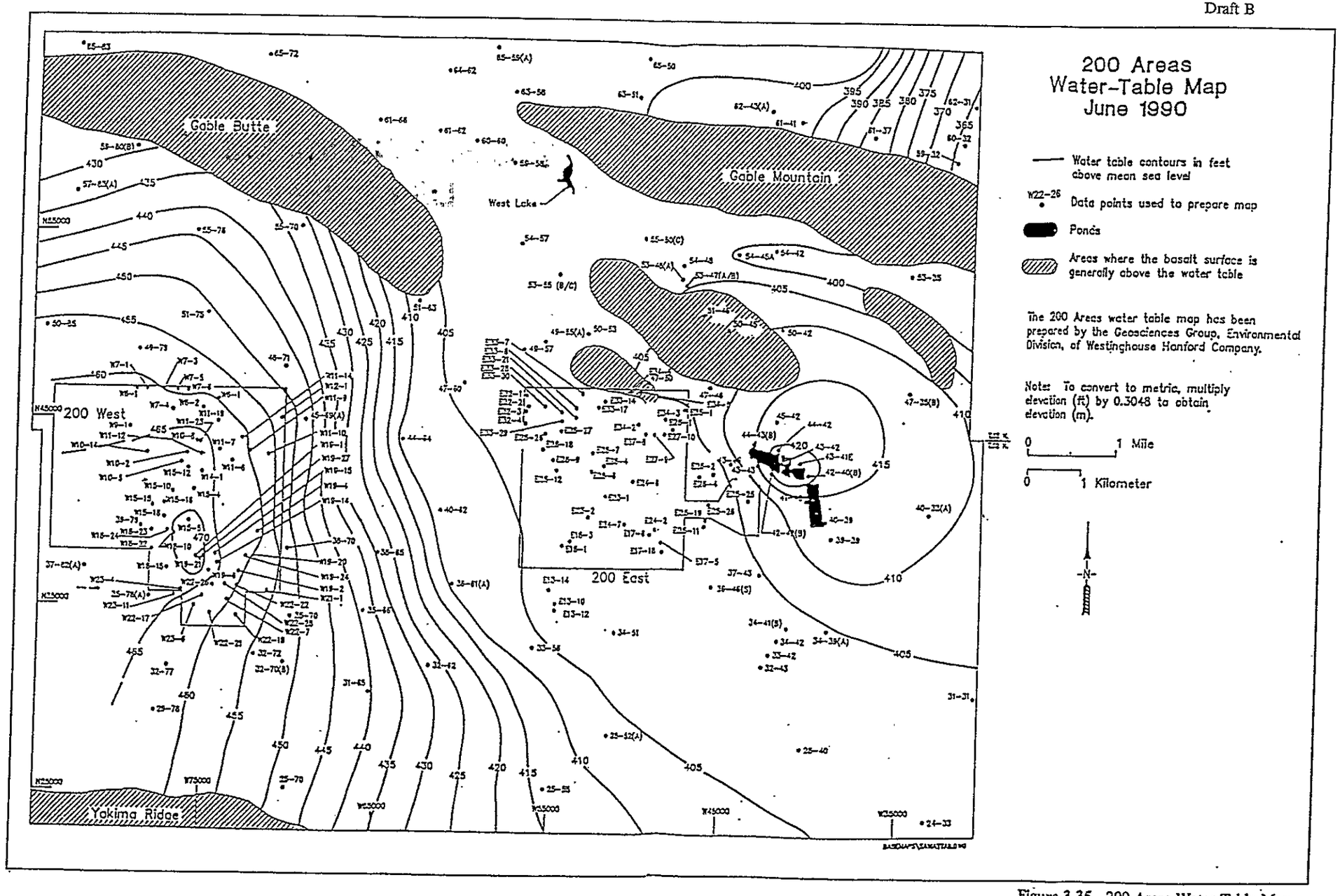


Figure 3-35. 200 Areas Water Table Map, June 1990. (Kasza et al. 1990)

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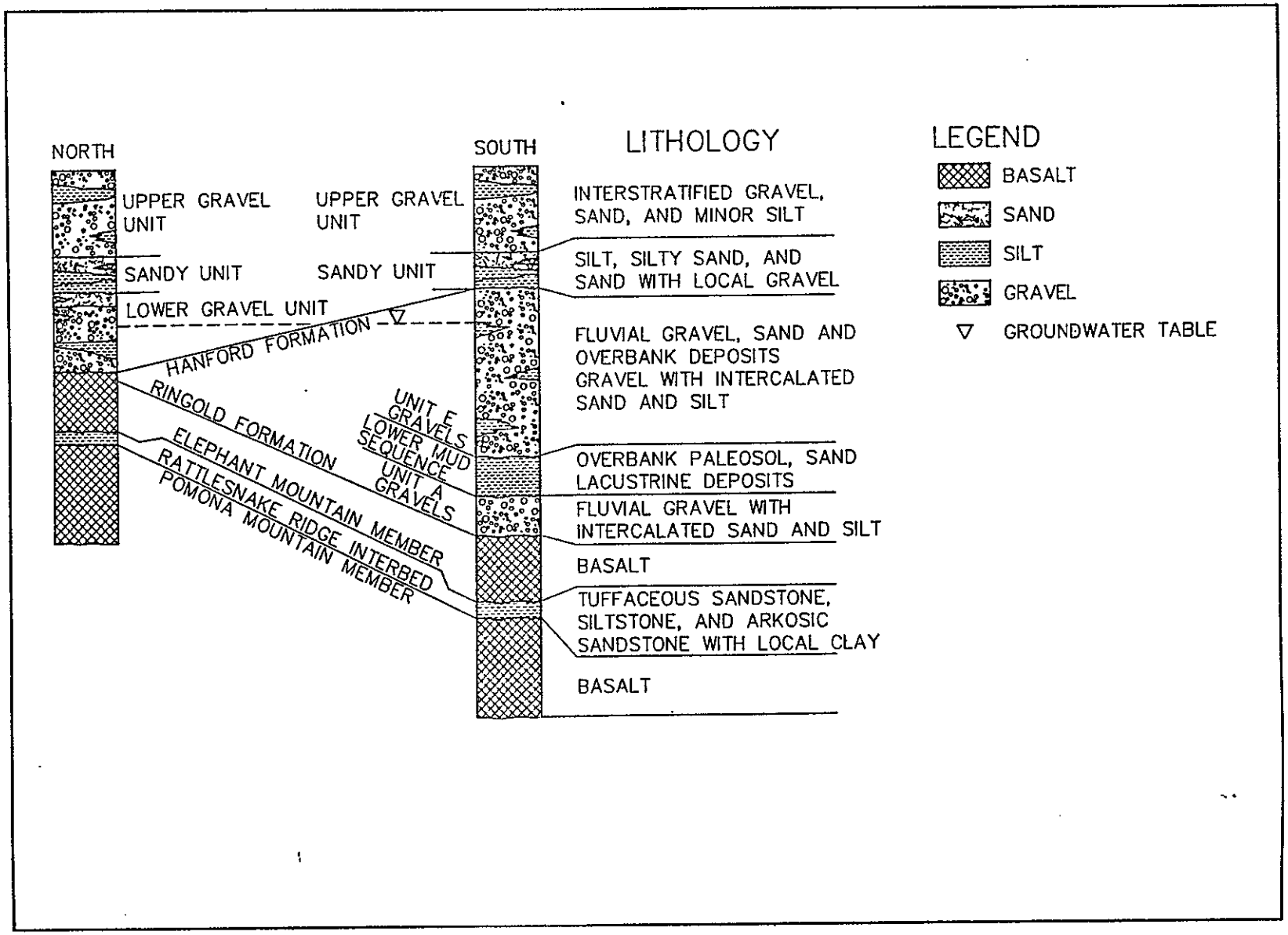

Figure 3-36. Conceptual Hydrogeologic Column for the PUREX Plant Aggregate Area. (Lindsey et al.; Delaney et al. 1991)

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

9 2 1 2 6 3 0 7 3 6 6

Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments.

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

9 2 1 2 6 3 0 7 5 7

Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments.

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)	Field Saturation	Loam sand over sand	Grass Site; 3 km of BWTF	Guelph permeameter field measurements
9.2×10^{-3} (Lower Soil, arithmetic mean of 4 measurements)	Field Saturation	na		
8×10^{-7}	16	Loam to sandy loam	McGee Ranch:NW of 200 West Area on State Rt. 240	Unsteady drainage-flux field measurements.
9×10^{-4}	40			
9×10^{-4} (arithmetic mean of 9 measurements	Field Saturation	na		Guelph permeameter field measurements.
5×10^{-3} (sat)	50	Sand, Gravel	Sediment types are idealized to represent stratigraphic layers commonly encountered below 200 Areas liquid disposal sites.	K_{sat} values derived from idealized moisture content curves.
1×10^{-3} (sat)	50	Coarse Sand		
5×10^{-4} (sat)	40	Fine Sand		
1×10^{-4} (sat)	40	Sand, Silt		
5×10^{-5} (sat)	40	Caliche		
1.2×10^{-5} (sat)	19.6 to 18.9	Hanford formation	Well 299-W7-9, 218-W-5 Burial Ground	van Genuchten equation fitted to moisture characteristic curves for Well 299-W7-9 soil samples
6.7×10^{-6} to 2.8×10^{-1} (sat)	37.6 to 41.4	Early "Palouse" Soils		
1.10×10^{-3} (sat)	18.3 to 21	Upper Ringold		
1.80×10^{-4} to 3.00×10^{-4} (sat)	24 to 25	Middle Ringold		

Notes:

na - Not identified in source.
sat - Value for saturated soil.
field saturation - Equilibrium water content after several days of gravity drainage.

9 2 1 2 6 3 0 7 5 8

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.

9 2 1 2 6 3 0 7 6 9

Table 3-4. Federal and State Classifications 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.

9212603770

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

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or quantity. These concerns are addressed in Section 8.0. The unit-specific information is presented for each waste management unit in Section 4.1.2.

Although groundwater issues are considered outside the scope of this study, some groundwater data have been included. Groundwater contaminant plumes ~~that are~~ known to have originated from specific waste management units are described because they offer insight into the distribution of contaminants within the 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 samplers contain filters that collect particles entrained in the air.~~ The air samples are collected by drawing samples through a 47-mm, open-face 3 µm filter at about 1 m (~~2~~3 ft) above the ground with a flowrate of 0.2 m^3/min (2 ft^3/min ~~flowrate~~). 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

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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. 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 (~~23~~ ft) above the ground surface. Figure 4-1 presents the gross count data (~~ct/s~~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 nearly impossible to convert these gross gamma counts to a meaningful exposure rate because of the complex distribution of radionuclides on the site.~~

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/AW/AX/AZ~~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. ~~Only ^{137}Cs and ^{60}Co were identified in the aggregate area.~~ 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

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- 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):

- ~~On~~ The northeast side of the 241-C Tank Farm

- Small patches north and south of 8th Street

- ~~On~~ 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 ~~maximum value reported on 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 ~~results, posting requirements according to WHC-CM-4-10, or~~ 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 ~~Tank Farms (-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 ~~site~~location.

In 1990, new sampling locations were established giving the PUREX Plant Aggregate Area ~~only~~ twenty-five dosimeter sites. 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 ~~are~~, 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 ~~610~~ 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 ~~and~~, 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 ~~2.3.7.22~~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

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are 18 new sample locations within or adjacent to the PUREX Plant Aggregate Area. ~~Currently, no analytical data are available for these new sample locations.~~

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 ~~site~~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-~~10~~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 ~~sample types~~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 ~~sites~~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 1989~~from 1985 through 1991 are compiled on Tables 4-12 and 4-~~11~~13. The complete data set from this sampling is presented in Appendix A.2.

Vegetation samples have ~~generally had~~ radionuclide concentrations that are slightly elevated above regional background, 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. ~~There have been no statistically significant trends in vegetation radionuclide concentration since 1979 (Schmidt et al. 1990).~~

4.1.1.5 Vadose Zone. The extent of contamination in the vadose zone has been most extensively studied by geophysical well logging. ~~Geophysical well logging~~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-~~12~~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 ~~not been consistent~~evolved over time. ~~Attempts made to normalize data collected at different times met with limited success, and quantitative interpretations were not possible.~~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 ~~can be~~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 ~~greater~~larger than the soil column ~~field capacity calculated using 0.1 as the standard~~ pore volume, then it is likely that wastewater would reach the groundwater. These calculations are summarized on Table 4-~~13~~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 ~~area~~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 ~~or precipitation~~; and (3) the average ~~pore volume~~porosity of the soil column is between 0.10 and 0.30 (the upper and lower ~~pore volumes~~ estimates shown on Table 4-~~13~~15). If the amount of waste received was greater

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than the ~~most conservative pore volume~~ porosity (0.1) ~~than~~then the waste management unit was considered to have the potential to migrate to the groundwater. According to these calculations, ~~twenty five~~265 waste management units had~~have~~ 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~~Grout Treatment Facility~~ GTF has five locations for soil and vegetation sampling, and two 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 4-11). The external radiation monitoring TLDs averaged ~~95 and 107~~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

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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. ~~The TLDs are located nearest to the 241-A, -AN, -AW, -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 ~~dose rates~~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 ~~dose rate~~ survey rate observed in the 241-AN Tank Farm was 20,000 dis/min between ~~tanks 104-AN and 105-AN~~ 241-AN-104 and 241-AN-105 Single-Shell Tanks, and a contact reading of 50 mrem/h on the ~~105-AN~~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 ~~101-AW~~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 ~~101-AZ~~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).

~~4.1.2.2.1.1~~ **Inventory Studies.** Chemical inventories for the single-shell tanks have been modeled with the Tracks Radioactive Components (TRAC) computer code~~, developed by Westinghouse Hanford.~~ This program calculated tank inventories for 68 radioactive constituents and 29 chemical constituents. The estimates were based on 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-~~14~~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 ~~unstabilized~~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).

~~4.1.2.2.1.2~~ **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-~~15~~17 through 4-~~23~~25. Table 4-~~15~~17 contains the results of analysis of supernatant liquid from ~~Tank~~ 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 ~~Tank~~241-AX-102 Single-Shell Tank are ^{137}Cs and ^{90}Sr. Table 4-~~16~~18 shows the results of analysis of volatile priority pollutants in vapor samples taken from ~~tanks~~ 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-~~17~~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-~~D~~dichloroethene, ~~T~~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-~~18~~20, 4-~~19~~21, and 4-~~20~~22 are results of an analysis of a core sample from~~single-shell tanks~~ the 241-C-103, 241-C-104, and 241-C-105 Single-Shell Tanks, respectively. ~~These tables include the total, maximum and drainable liquor.~~ Tables 4-~~21~~23 (McCown 1988) and 4-~~22~~24 (Walker 1977) show the results of an analysis of a sludge sample~~s~~ from ~~tanks~~ the 241-C-106~~5~~ and 241-C-105~~6~~ Single-Shell Tanks, respectively. The sludge was analyzed for organics and radionuclides. Finally, Table 4-~~23~~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.

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~~4.1.2.2.1.3 Chemical Explosion Potential. The two most significant flammable materials generated in Hanford single-shell and double-shell tanks are ferrocyanide and hydrogen. Four of the 241-C Tank Farm tanks (241-C-108, 241-C-109, 241-C-111, and 241-C-112) are suspected of having a ferrocyanide problem (Hanlon 1992). A watch list has been generated to monitor any increasing trends in temperature. The monitoring of these tanks includes ferrocyanide quantity (g mole), estimated heat load and highest temperature reading for the month. The highest temperature readings ranged from 25 to 30 °C (78 to 87 °F) and ferrocyanide quantity ranged from 9,000 to 70,000 g moles. A watch list has also be generated that ranks tanks according to their potential for flammable gas generation. Six tanks within the 241-A, 241-AN, and 241-AX Tank Farms are on the hydrogen gas watch list (241-A-101, 241-AN-103, 241-AN-104, 241-AN-105, 241-AX-101, and 241-AX-103). The single-shell tanks had highest temperature readings of 49 to 69 °C (120 to 156 °F), and the double-shell tanks had highest temperature readings of 96 to 69 °C (114 to 120 °F). The temperatures for the single-shell tanks are on the higher end of the scale for the 23 tanks that are monitored. All six tanks are assumed to be of sound integrity.~~

~~4.1.2.2.1.4~~ **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-~~24~~26 summarizes the borehole geophysical data available for each tank

~~4.1.2.2.1.5~~ **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-~~25~~27. ~~The vertical and lateral distribution of each of the tank leaks can be estimated from the borehole geophysics data (Table 4-24).~~

4.1.2.2.2 Catch Tanks, ~~and~~ 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 no~~is little volume, chemical, or radiological data available for these units.

~~4.1.2.2.2.1 241-A-302A Catch Tank. This is an active waste management unit. It is currently reported to contain 13,645 L (3,605 gal) of waste.~~

~~**4.1.2.2.2.2 241-A-302B Catch Tank.** This is an inactive waste management unit. It is currently reported to contain 12,263 L (3,240 gal) of waste.~~

~~**4.1.2.2.2.3 241-A-350 Catch Tank.** This is an active waste management unit. Volumes were variable according to specific plant operations.~~

~~**4.1.2.2.2.4 241-A-417 Catch Tank.** This is an active waste management unit. It is currently reported to contain 120,590 L (31,860 gal) of waste.~~

~~**4.1.2.2.2.5 241-AX-152CT Catch Tank.** This is an active waste management unit. It is currently reported to contain 10,053 L (2,656 gal) of waste.~~

~~**4.1.2.2.2.6 241-C-301 Catch Tank.** This is an inactive waste management unit. It is currently reported to contain 120,590 L (31,860 gal) of waste.~~

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~~tank farm~~. Contamination spread to the ground and equipment during a transfer installation in the 100-CR Tank. Approximately ~~18,971.4 L (71,418.9~~ gal) of contaminated tributyl phosphate waste from the 221-U Building was discharged before the pump could be shut off. A maximum ~~dose of~~reading of 4.2 rem/h at the surface and 200 mR/h at a depth of 5 cm (~~2.54~~ in.) was observed for the ground contamination.

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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~~, and drain fields~~ 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-~~11~~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 (~~792,602~~ 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,~~687~~000 gal) of laboratory cell drainage waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. ~~In 1958 t~~

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. ~~The contamination was removed, and in a 1990 radiological survey surface contamination was not detected.~~ 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 (~~430,647,292~~ 431,000,000 gal) of acidic waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. Data from Wells 299-E24-1, 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 (~~898,282,695~~ 900,000,000 gal) of waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. The radiation zone denoting this ~~site~~crib was enlarged to include the contaminated ground surface northeast of the unit.

This waste management unit has an ~~a known~~ 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 ~~known~~unplanned release

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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-~~11~~12). The greatest radionuclide concentration detected in the grid soil sampling was ^{40}K at 13.5 pCi/g (Table 4-8).

Site ~~2E30~~ 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,~~129~~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 (~~303,830,912~~ 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 1990. 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 ~~S~~sampling and ~~A~~analysis ~~P~~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,~~180,978~~000,000 gal) of waste containing the following radionuclides: ^{137}Cs, ^{106}Ru, and ^{90}Sr. The monitoring Wells 299-E24-3 and 299-E24-4 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 30,000 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 4-11). 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,~~084,544~~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).

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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-~~11~~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. ~~The crib adjoins the area of unplanned release UN-200-E-56.~~

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/gDW and those for ^{90}Sr averaged 0.316 nCi/gDW. 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-~~11~~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.

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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% ~~Soltrol (a brand of kerosene)~~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 ~~(ASD)~~ as, came from the PUREX fuel-element decladding operations. The crib operated until 1987 when sampling and analysis of the ~~ASD~~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-~~26~~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-~~27~~29 is a list of the waste inventory for the 216-A-36B Crib. The inventory includes volume, Pu, ~~B~~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-~~28~~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-~~29~~31 shows groundwater parameters

measured in Wells 299-E17-5 and 299-E17-9. The parameters measured ~~for~~ 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 ~~p/m~~ppm, and TOC ranged from 0.414 to 0.763 ~~p/m~~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 detected 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).

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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 200 dis/min (beta). ~~The WIDS hardfiles indicate that~~ 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 waste discharged to the 261-A-10 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 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 french drain extends 9 m (30 ft) deep into the ground and is 0.8 m (2.5 ft) in diameter.~~ The ~~PNL~~ Hazardous Ranking System Migration Score for this drain is 1.04. 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). ~~The unit is 10 m (33 ft) deep and 0.8 m (2.5 ft) in diameter.~~ 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 drain extends 5.5 m (18 ft) deep into the ground and is 0.9 m (3 ft) in diameter.~~ 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 drain is 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).~~ 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. ~~The drain is 13 m (44 ft) deep and 1.2 m (4 ft) in diameter. The drain also includes an inlet pipe entering at 10 m (33 ft) below grade and a 5 cm (2 in.) riser extending 1.2 m (4 ft) above grade.~~ 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). ~~The drain is 5.1 m (17 ft) deep and 1.1 m (3.5 ft) in diameter.~~ 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). ~~The site is 5.1 m (17 ft) deep with a 1.1 m (3.5 ft) diameter. The site 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.~~

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 site is made up of two 10 cm (4 in.) effluent pipes; one is vertical, the other~~

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~~enters horizontally 2.4 m (8 ft) below grade. The vertical pipe is not visible from grade.~~ 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). ~~The unit is 4 m (13 ft) deep and 1.1 m (3.5 ft) in diameter. The site also has a carbon steel vent riser extending from the top to 0.9 m (3 feet) above grade, and an inlet pipe entering at 2.7 m (9 ft) below grade.~~

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). ~~The unit is 2.1 m (7 ft) deep with a 1.1 m (3.5 ft) diameter. The site also contains an inlet pipe entering at 2.7 m (9 ft) below grade.~~

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 drain is accessed by a subsurface feeder pipe and is constructed 4.6 m (15 ft) deep with 1.2 m (4 ft) diameter.~~ 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. ~~The unit is 3.4 m (11 ft) deep with a grade diameter of 6.1 m (20 ft) and a bottom diameter of 3 m (10 ft). The unit also contains a perforated pipe extending horizontally 1.2 m (4 ft) below grade.~~

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 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.~~ 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 unit is 4.9 m (16 ft) deep and 1.8 m (6 ft) in diameter. There is an inlet pipe located 3.2 m (10.5 ft) below grade. This 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~~ as in the same ~~radiological unit~~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-CR Building. The waste is expected to contain less than 10 Ci total beta (WHC 1991a). ~~The unit is 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 in a 4.9 m (16 ft) deep excavation. The drain also has an inlet pipe from the 271-C Building. Currently, the drain is marked by a gooseneck pipe in a 3 x 3 m (10 x 10 ft) area stabilized with sand.~~ The 1988 survey identified 2,000 ct/min contamination on the surface. The ~~site~~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. ~~It is an inactive waste management unit that is 4.6 m (15 ft) deep, has 32 observation wells, and has a 5,678 L (1,500 gal) mixing tank.~~ 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. ~~Since the well was not used as a waste disposal site,~~ nNo analytical data are available.

~~The area is enclosed within the PUREX surface contaminated area, which is paved with asphalt or covered with gravel. Two enclosures are present at the well site; one light chain~~

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~~enclosure marked with surface contamination, and one marked underground contamination, enclosing a vertical pipe assumed to be the injection well and one monitoring well. Wells drilled for monitoring the injection well are marked by 15.2 cm (6 in.) tall pipes with steel caps.~~

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 ~~site~~ditch was surface stabilized in October 1991. The depth of the ditch varies from 0.6 to 4.6 m (2 to 15 ft). This unit receives discharge from PUREX Plant chemical sewer that ~~is~~ was composed of acid fractionator condensate, demineralizer recharge effluents, nonprocess steam condensate, and chemical storage tank overflows. The waste from the PUREX Plant ~~is~~ was directed to the 216-B-3-3 Ditch which leads to the 216-B-3 Pond, which is active. The flow rates ~~may vary~~varied from approximately 378 to 5,290 L/min (100 to 1,400 gal/min). Average flow ~~is~~ was about ~~970 gal/min (3,670 L/min)~~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) 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 trunk of the tree. 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 5.5E-02 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. Aquate 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 is 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

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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 is 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 is 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. ~~Currently, t~~The ~~ditch~~trench is enclosed within a box-wire fence. ~~and several tumbleweeds fill the ditch bottom.~~

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.

~~**4.1.2.6.1 2607-EA Septic Tank and Drain Field.** This unit is still active and receives 0.06 m^3 (2 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.2 2607-EC Septic Tank and Drain Field.** This unit is still active and receives an estimated 0.45 m^3 (16 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.3 2607-ED Septic Tank and Drain Field.** This unit is still active and receives an estimated 0.28 m^3 (10 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.4 2607-EG Septic Tank.** This unit is still active and receives an estimated 0.17 m^3 (6 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.5 2607-EJ Septic Tank.** This unit is still active and receives an estimated 0.32 m^3 (11 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.6 2607-EL Septic Tank.** This unit is still active and receives an estimated 7.9 m^3 (279 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are available.~~

~~**4.1.2.6.7 2607-E6 Septic Tank and Drain Field.** This unit is still active and receives an estimated 43.5 m^3 (1,536 ft^3) of sanitary wastewater and sewage per day. It is not thought to have received any hazardous waste and no chemical or radiological data are 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.

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~~No chemical or radiological data are available for the diversion boxes in the PUREX Plant Aggregate Area. Some of the process sewer lines are thought to have leaked; however, no inventory or sampling data are available to estimate the magnitude of these leaks.~~

The 241-A-151 Diversion Box has four unplanned releases associated with it. On September 5, 1960 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). On September 30, 1960 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 form 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.

~~One diversion box, 241-CR-151, has an unplanned release associated with it. A puddle of contaminated liquid was discovered near the diversion box. More detailed information regarding the unplanned release is in Section 2.3.10.~~

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 ^{106}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.

On January 11, 1985 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.

Unplanned Release UN-200-E-68 occurred on January 11, 1985 when wind-borne contamination spread from the 241-C-151 Diversion Box. 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. During a site visit conducted in 1992 the 216-A-524 Control Structure was not present at its designated location.

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 Basins. This ~~These are~~is an active waste management units. The ~~retention basins~~cells are constructed to a depth of 2.1 m (7 ft). No inventory data are available for ~~these units~~this unit. In the past ~~they have~~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. 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.

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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 ~~two~~one unplanned release associated with it: ~~UN-200-E-62 and~~ 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 4-11). 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.

~~**UPR-200-E-53.**~~ 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.

~~**4.1.2.9.4.1 Unplanned Releases UPR-200-E-24 and UPR-200-E-30.**~~ 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

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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 ~~yr~~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 4-11). 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-~~5~~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.

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 without liners, reverse wells, and some disposal trenches. Also in this group are unplanned releases that involved waste material released to the soil. For this group of waste management units, if discharges to the unit contained contaminants of concern, it can be assumed that soils underlying the waste management unit are contaminated. The first task in developing a

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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 (^{3}H, 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 ~~offsite~~ 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 or 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 ~~60~~61 m (200 ft) below ground surface. These factors are discussed in the following sections.

4.2.2.1.1 Depth of Release. ~~W~~As a general rule, for a given volume, waste management units that released wastes at a greater depth below the surface ~~are more likely~~have a higher potential to contaminate groundwater than waste management units where the release was shallow. ~~The 299-E24-111 Injection Well is a primary example of a deep~~

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release at the PUREX Plant Aggregate Area. However, since the injection well only received test solutions and did not receive waste, it is not suspected of transporting contaminants to the groundwater. Other possible contributors to the groundwater are units with membranes, such as the 216-A-10 Crib which is believed to have released effluent to the ground. 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, although the potential exists. 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 ~~in~~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 anisotrophy is expected, i.e., vadose zone soils are likely to be more permeable in the horizontal direction than in the vertical. This vertical anisotrophy 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

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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 is 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-~~29 Ditch~~42 and ~~the~~ 207-A Retention Basins. ~~The 216-A-29 Ditch has been active since 1955 and has received waste liquids from a variety of sources (Section 4.1). The portion of the ditch south of the grout treatment facility perimeter fence has recently been backfilled to grade with gravel.~~ 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; 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 ~~sites~~management groups, and are shown on Figure 4-3 as dashed lines with "U" designations.

From these waste management units, ~~various~~ contaminants may have been released ~~mechanisms may have transported contamination~~ via several mechanisms to the potentially

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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 ~~seeped~~infiltrated/percolated into the vadose zone, or ~~deposited into~~sorbed to the sediments in the ditch. The 207-A Retention Basins 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~~13 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, Appendix A), 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

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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-~~30~~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-~~31~~33 summarizes the types of known or suspected contamination that are thought to exist at the individual waste ~~sites~~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 ~~occur~~have occurred at a ~~site~~unit based upon historical practices ~~or~~, chemical associations~~, or in growth during radiological decay of discharged radionuclides~~. 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-~~30~~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

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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 2-910. This list includes chemicals in the process wastes as well as chemicals that were detected at elevated levels in wastewater. Since these waste streams are known to have been disposed of directly to the soil column in some waste management units, it is probable that the chemicals on this list have affected environmental media.

Based on ~~the WIDS data~~ (WHC 1991a), radionuclides that are known to have been disposed of to 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-~~27~~36 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-~~33~~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 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-~~33~~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-~~35~~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-~~37~~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 1991). 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).

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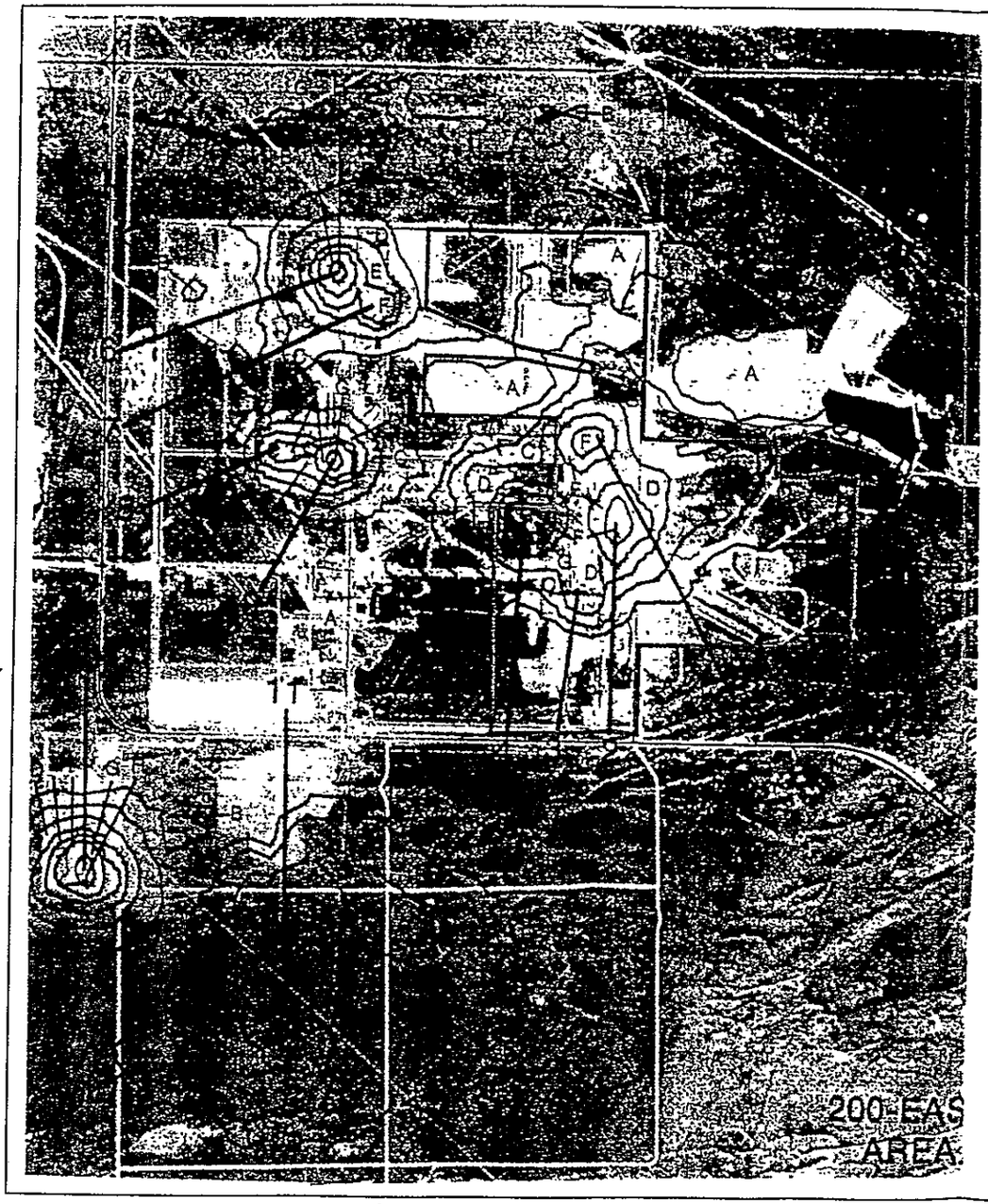

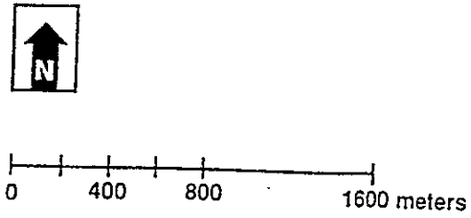

Zone A = <700 ct/s
Zone B = 700 to 2,200 ct/s
Zone C = 2,200 to 7,000 ct/s
Zone D = 7,000 to 22,000 ct/s
Zone E = 22,000 to 70,000 ct/s
Zone F = 70,000 to 220,000 ct/s
Zone G = 220,000 to 700,000 ct/s
Zone H = 700,000 to 2,200,000 ct/s
2 = 241-A Tank Farm
3 = 202-A Building
4 = Railroad spur northwest 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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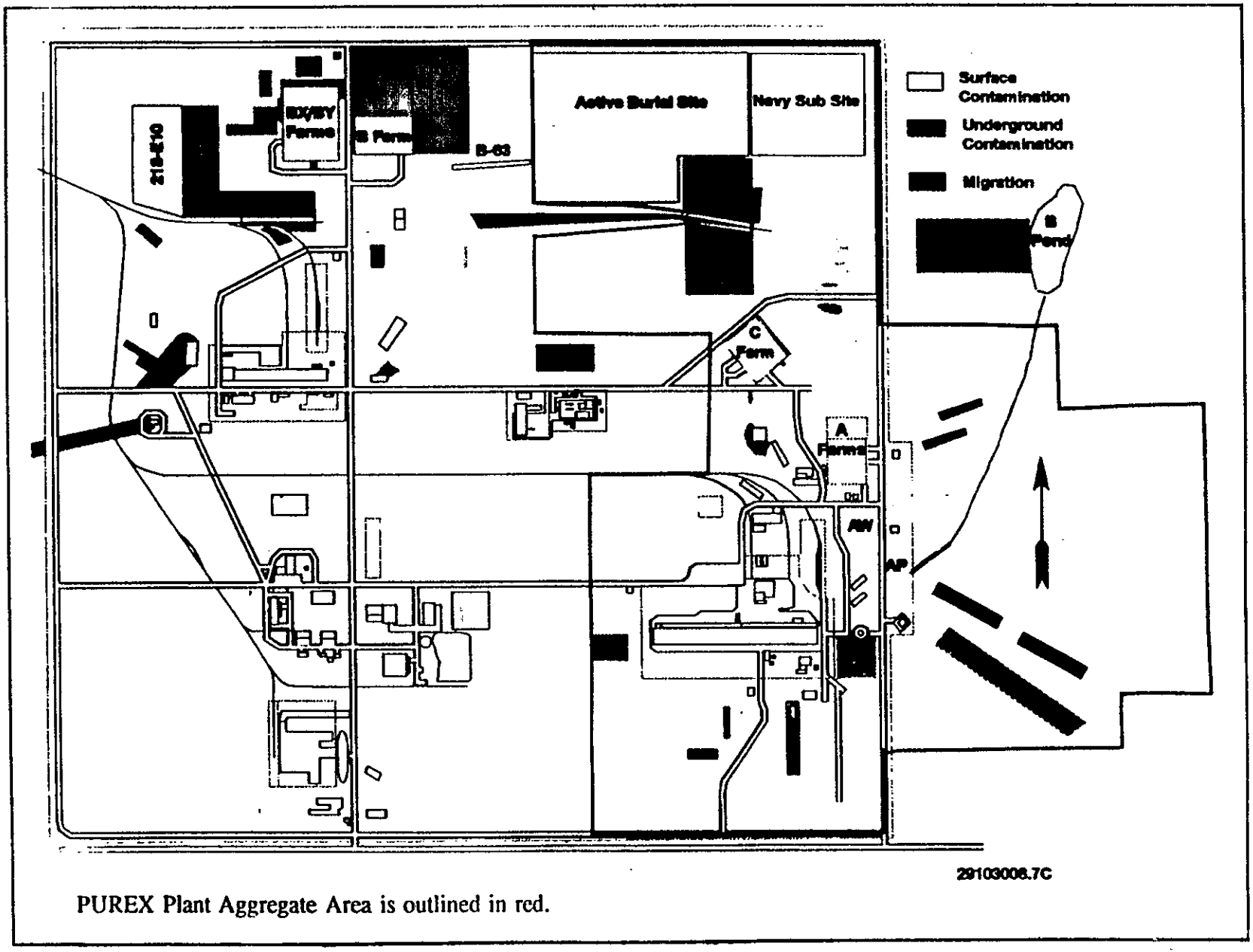

PUREX Plant Aggregate Area is outlined in red.

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

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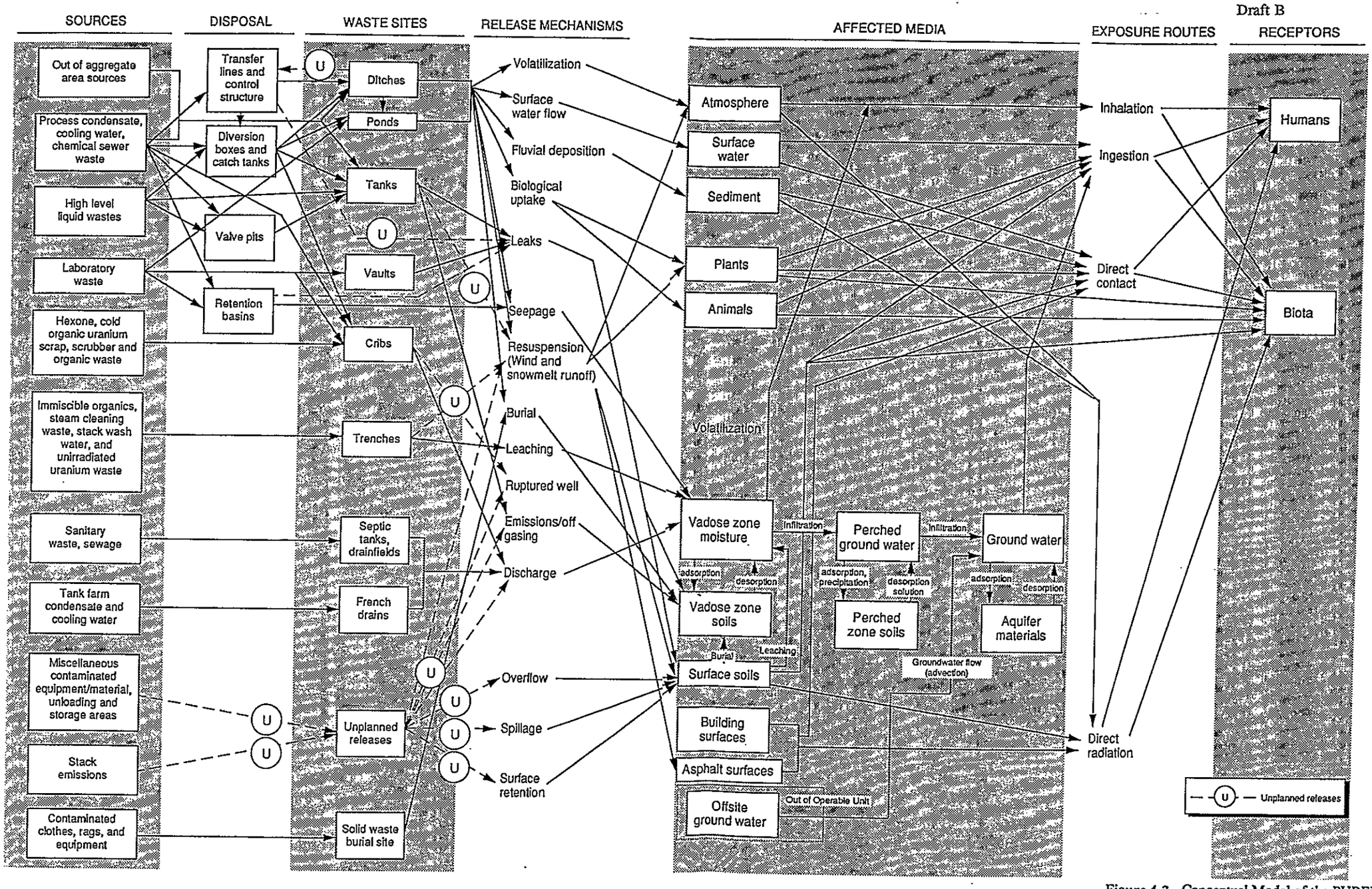

Figure 4-3. Conceptual Model of the PUREX Plant Aggregate Area.

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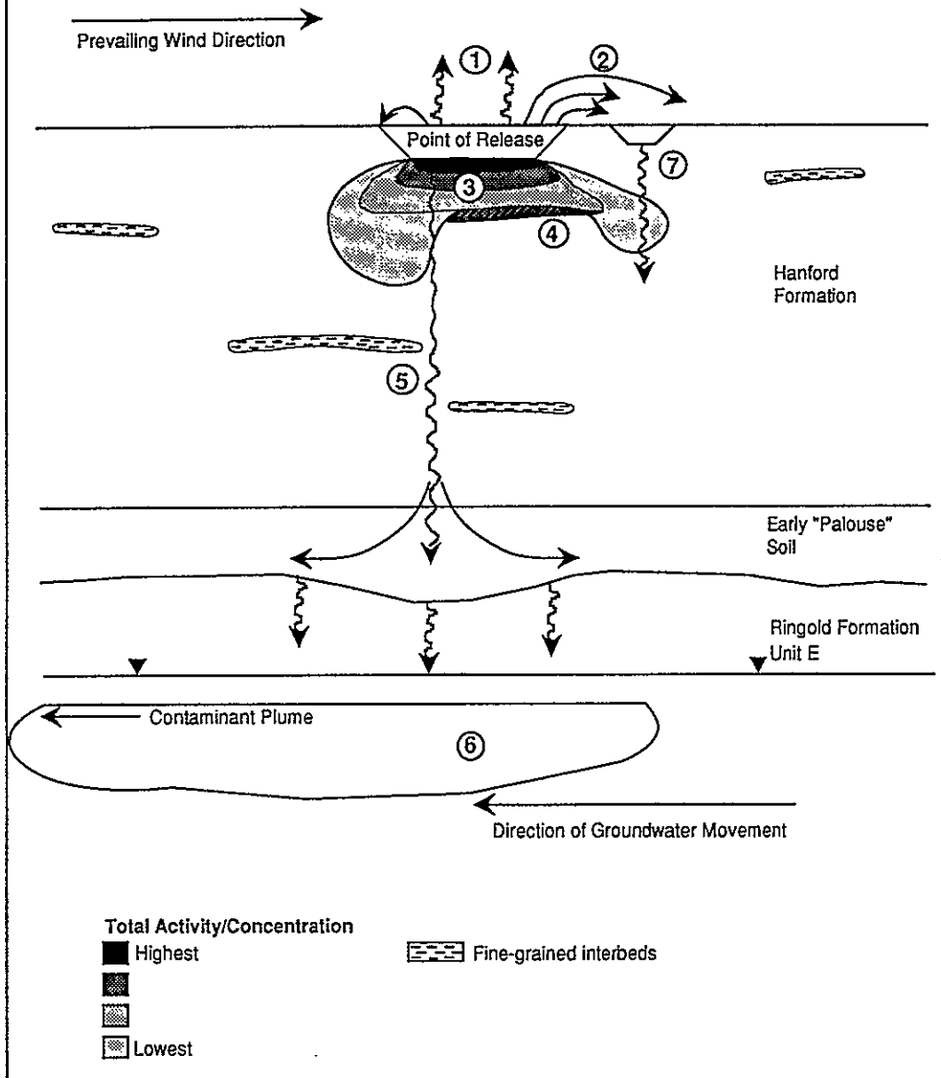

① Some contaminants may volatilize and enter the atmosphere after release.

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

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

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

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

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

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

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

Table 4-1. Summary of Known and Suspected Radionuclide Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 Contamination.

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 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

Table 4-1. Summary of Known and Suspected Radionuclide Contamination.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
218-E-8 Burial Ground	--	S	--	K	S	
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	

Table 4-1. Summary of Known and Suspected Radionuclide Contamination.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-27	--	S	--	--	S	
UN-200-E-28	--	S	--	--	S	
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?	--	--	--	

Table 4-1. Summary of Known and Suspected Radionuclide Contamination.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-72	--	--	--	--	--	
UN-200-E-81	--	S	--	--	S	
UN-200-E-82	--	R	--	--	--	
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	

Table 4-1. Summary of Known and Suspected Radionuclide Contamination.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UPR-200-E-24	--	S	--	--	S	
UPR-200-E-29	--	S	--	--	S	
UPR-200-E-30	--	R?	--	--	--	
UPR-200-E-50	--	S	--	--	S	
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.

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

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	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AN-106 Double-Shell Tank	--	--	--	--	--	
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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AX-103 Single-Shell Tank	--	--	--	--	--	UPR-200-E-115
241-AX-104 Single-Shell Tank	--	S	--	--	S	
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	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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
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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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	
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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

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	--	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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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
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

Table 4-35. Soil-Water Distribution Coefficient K_d for Radionuclides and Inorganics of Concern at PUREX Plant Waste Management Units. Page 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
Nickel	--	15	12.2
Niobium	--	--	50
Nitrate/nitric acid	--	--	0
Plutonium	100 - 1,000 < 1 at pH 1 - 3	100	10
Polonium	--	--	5.9
Potassium	--	--	--
Protactinium	--	--	0
Radium	--	20	24.3
Ruthenium	20 - 700 (<2 at >1 M nitrate)	--	274
Samarium	--	--	228
Silver	--	20	0.4
Strontium	5 - 100 3 - 5 (acidic conditions) 200 - 500 (w/phosphate or oxalate)	10	24.3
Technetium	0 - 1	0	3
Thallium	--	--	0
Thorium	--	50	100
Tritium	0	0	0
Uranium	--	0	0
Vanadium	--	--	50
Yttrium	--	--	278
Zinc	--	15	12.7
Zirconium	--	30	50

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 Environmental Pollution Assessment System

9 2 1 2 6 3 0 9 5 1

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

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 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

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	--	--	--	--	--	
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	--	--	--	--	--	
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

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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	
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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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	
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	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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	--	--	--	--	--	
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	

Table 4-2. Summary of Chemical Contamination in Various Affectd Media for PUREX Plant Aggregate Area.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
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	--	--	--	--	--	
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.

Table 4-3. Types of Data Available for Each Waste Management Unit.

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
241-AN-107 Double-Shell Tank	--	R	R	--	--	R

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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
241-AY-101 Double-Shell Tank	--	R	R	--	--	R
241-AY-102 Double-Shell Tank	--	R	R	--	--	R

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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
241-C-204 Single-Shell Tank	R,C	R	R	--	--	R
241-A-302A Catch Tank	--	--	--	--	--	--
241-A-302B Catch Tank	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--
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	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--
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	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--	--	--
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	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--	--	--	--	--
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	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--	--	--	--	--
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	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
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	--	--	--	--
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	--	--	--	

Table 4-3. Types of Data Available for Each Waste Management Unit.

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-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	--	--	--	--
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	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit.

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-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	--	--	--	--
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	--	--	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units.

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.

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.

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.

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	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units.

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
216-A-32	Crib	NC	NC	NC	1990	--
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.

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.

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.

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.

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-17	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-21	Unplanned Release	NA	NA	NA	--	--
UN-200-E-22	Unplanned Release	NA	NA	NA	--	--
UN-200-E-23	Unplanned Release	NA	NA	NA	--	--
UN-200-E-24	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	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units.

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
UN-200-E-29	Unplanned Release	NA	NA	NA	--	--
UN-200-E-30	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	--	--
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-49	Unplanned Release	NA	NA	NA	--	--
UN-200-E-50	Unplanned Release	NA	NA	NA	--	--
UN-200-E-53	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	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units.

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
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	--	--
UN-200-E-99	Unplanned Release	NA	NA	NA	--	--
UN-200-E-100	Unplanned Release	NA	NA	5	Oct-91	unknown
UN-200-E-106	Unplanned Release	NA	NA	NA	--	--
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-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	--	--
UPR-200-E-126	Unplanned Release	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units.

Site Name	Site Type	Radiation Surveys				
		ct/min	dis/min	mrem/h	Survey Date	Radiation Type
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

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Table 4-7. Results of External Radiation Monitoring 1990 TLDs (mrem/yr).

Site	Maximum	Minimum	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

9 2 1 2 6 0 3 0 8 3 5

Table 4-8. Summary of Grid Soil Sampling Results From 1985 to 1989 (pCi/g)

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 (pCi/g).

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).

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).

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).

Radionuclide	Sampling Location							
	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).

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. 1991, 1992.
Dashes indicate data is not available.

RM20: 216-A-29 Ditch **Table 4-11.** Results of Surface Water Sampling (pCi/L).

	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											

Table 4-12. Summary of Vegetation Sampling Results (pCi/g).

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).

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. 1991, 1992.
Dashes indicate data are not available.

9 2 1 2 6 3 0 8 9 5

Table 4-14. Summary of Gamma-Ray Logs that were Reviewed.

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)		

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Table 4-14. Summary of Gamma-Ray Logs that were Reviewed.

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

9 2 1 2 6 0 3 0 3 9 7

Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer.

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

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Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer.

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/]

WHC(PUREX-4)/9-24-92/03379T.15

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Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer.

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 Inventories Data.

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

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	A-101 Curies	A-102 Curies	A-103 Curies	A-104 Curies	A-105 Curies	A-106 Curies	AX-101 Curies	AX-102 Curies	AX-103 Curies	AX-104 Curies
23. Nb93m	4E+02	3E+02	9E+01	9E+01	1E-01	2E+02	8E+01	4E+01	3E+00	2E+02
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	4E+04	1E+04	2E+04	7E+03	2E-05	4E+04	7E+02	2E+00	3E+02	8E+02
26. Np237	4E-03	3E-01	1E-02	5E-03	4E-02	1E-03	5E-05	4E-05	2E-02	3E-02
27. Np239	3E-01	2E+00	5E-01	3E-01	4E-09	7E-02	6E-11	1E-17	1E-02	3E-02
28. Pa231	9E-05	2E-04	1E-04	3E-05	4E-06	5E-05	1E-05	5E-07	8E-06	2E-05
29. Pa233	4E-03	3E-01	1E-02	5E-03	4E-02	1E-03	5E-05	4E-05	2E-02	3E-02
30. Pa234m	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01
31. Pb209	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
32. Pb210	3E-10	6E-10	1E-10	1E-10	9E-14	2E-10	5E-11	4E-11	6E-12	9E-11
33. Pb211	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
34. Pb214	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
35. Pd107	0E+00	6E-01	2E-01	1E-19	3E-02	4E-10	3E-11	6E-18	3E-02	8E-02
36. Po210	3E-10	6E-10	1E-10	1E-10	9E-14	2E-10	5E-11	4E-11	5E-12	8E-11
37. Po213	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
38. Po214	3E-09	4E-09	7E-10	1E-09	2E-13	1E-09	3E-10	1E-10	4E-11	5E-10
39. Po215	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
40. Po218	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
41. Pu238	8E+01	1E+01	2E+01	2E+01	4E-04	5E+01	2E+01	9E+00	2E-03	2E+01
42. Pu239	2E+03	3E+02	3E+02	6E+02	2E-06	1E+03	3E+02	1E+02	3E-05	3E+02
43. Pu240	6E+02	8E+01	9E+01	1E+02	1E-05	3E+02	8E+01	4E+01	1E-04	8E+01
44. Pu241	6E+03	7E+02	1E+03	1E+03	2E-06	3E+03	1E+03	7E-02	9E-05	1E+03

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	A-101 Curies	A-102 Curies	A-103 Curies	A-104 Curies	A-105 Curies	A-106 Curies	AX-101 Curies	AX-102 Curies	AX-103 Curies	AX-104 Curies
45. Ra223	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
46. Ra225	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
47. Ra226	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
48. Ru106	4E-01	3E-01	2E+00	4E-02	1E-07	1E+00	8E+00	7E+00	7E-03	6E+00
49. Sb126	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
50. Sb126m	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
51. Se79	0E+00	6E+00	2E+00	2E-18	3E-01	5E-09	2E-10	4E-17	4E-01	8E-01
52. Sm151	4E+04	1E+05	7E+02	3E+04	9E-05	7E+03	7E-08	1E+04	2E+03	6E+04
53. Sn126	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
54. Sr90	3E+06	7E+06	2E+04	4E+06	3E-02	5E-03	3E-06	1E-10	2E+04	9E+06
55. Tc99	0E+00	2E+02	7E+01	6E-17	1E+01	2E-07	2E-08	1E-15	1E+01	3E+01
56. Th227	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	4E-06	9E-06
57. Th229	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
58. Th230	8E-07	5E-07	2E-07	2E-07	3E-12	4E-07	1E-07	4E-08	5E-09	1E-07
59. Th231	3E-01	4E-02	6E-02	8E-02	1E-10	2E-01	5E-02	2E-03	3E-13	6E-03
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01
62. Tl207	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
63. U233	6E-04	7E-05	5E-05	2E-04	4E-06	2E-04	3E-05	5E-06	9E-07	5E-06
64. U234	8E-03	1E-03	2E-03	2E-03	3E-08	4E-03	2E-03	5E-04	6E-08	1E-03
65. U235	3E-01	4E-02	6E-02	8E-02	1E-10	2E-01	5E-02	2E-03	3E-13	6E-03
66. U238	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	A-101 Curies	A-102 Curies	A-103 Curies	A-104 Curies	A-105 Curies	A-106 Curies	AX-101 Curies	AX-102 Curies	AX-103 Curies	AX-104 Curies
67. Y90	3E+06	7E+06	2E+04	4E+06	3E-02	5E-03	3E-06	1E-10	2E+04	9E+06
68. Zr93	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 Inventories Data.

Total (1/1/90)	A-101 Moles	A-102 Moles	A-103 Moles	A-104 Moles	A-105 Moles	A-106 Moles	AX-101 Moles	AX-102 Moles	AX-103 Moles	AX-104 Moles
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
90. Mn	8E+03	2E+04	4E+02	1E+04	7E-01	5E+03	2E+03	9E+02	1E+03	9E+03

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	A-101 Moles	A-102 Moles	A-103 Moles	A-104 Moles	A-105 Moles	A-106 Moles	AX-101 Moles	AX-102 Moles	AX-103 Moles	AX-104 Moles
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 Inventories Data.

Total (1/1/90)	C-101 Curies	C-102 Curies	C-103 Curies	C-104 Curies	C-105 Curies	C-106 Curies	C-107 Curies	C-108 Curies	C-109 Curies	C-110 Curies	C-111 Curies
1. Ac225	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
2. Ac227	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
3. Am241	5E+01	1E+03	1E+02	9E+02	1E+04	4E+02	1E+02	4E+01	1E-01	2E+01	2E+01
4. Am242	3E-02	1E+00	1E-01	1E+00	2E+01	4E-01	7E-02	3E-02	3E-06	4E-04	9E-03
5. Am242m	3E-02	1E+00	1E-01	1E+00	2E+01	4E-01	7E-02	3E-02	3E-06	4E-04	9E-03
6. Am243	1E-02	7E-01	7E-02	7E-01	1E+01	1E-01	3E-02	8E-03	6E-06	2E-04	4E-03
7. At217	3E-07	8E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	2E+05	1E-04	1E-04	4E-05	2E+05	0E+00	8E+03	4E+00	5E+03	1E-06	4E+03
10. Bi210	9E-11	4E-10	2E-10	7E-10	2E-09	2E-10	9E-11	7E-11	1E-11	1E-10	1E-10
11. Bi211	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
12. Bi213	4E-07	9E-09	4E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
13. Bi214	3E-10	2E-09	9E-10	4E-09	8E-09	7E-10	4E-10	3E-10	6E-11	6E-10	4E-10
14. C14	2E+01	1E-03	5E+02	3E-05	5E+02	8E-01	3E+00	3E-01	2E+00	8E-11	8E-01
15. Cm242	2E-02	1E+00	1E-01	9E-01	1E+01	3E-01	6E-02	2E-02	2E-06	3E-04	7E-03
16. Cm244	2E-02	1E-09	9E-11	1E-11	7E+01	0E+00	7E-03	1E-07	6E-04	7E-13	5E-04
17. Cm245	4E-07	9E-14	5E-15	8E-16	4E-03	0E+00	4E-07	4E-12	2E-08	3E-17	1E-08
18. Cs135	7E-01	4E-10	3E-10	2E-10	9E-01	0E+00	3E-02	6E-05	3E-02	6E-12	2E-02
19. Cs137	2E+05	1E-04	1E-04	4E-05	3E+05	0E+00	8E+03	4E+00	5E+03	1E-06	4E+03
20. Fr221	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
21. Fr223	4E-07	2E-06	7E-07	9E-07	1E-05	4E-07	5E-07	2E-07	6E-08	3E-08	2E-07
22. I129	7E-02	5E-11	4E-11	1E-11	2E+00	0E+00	3E-03	2E-06	2E-03	5E-13	2E-03
23. Nb93m	6E+00	5E+01	8E+00	1E+01	3E+02	4E+01	8E+00	5E+00	2E-01	7E-01	3E+00
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00

4T-16g

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-101 Curies	C-102 Curies	C-103 Curies	C-104 Curies	C-105 Curies	C-106 Curies	C-107 Curies	C-108 Curies	C-109 Curies	C-110 Curies	C-111 Curies
25. Ni63	1E+02	3E+03	9E+03	7E+02	5E+04	8E+02	9E+00	5E+02	6E+02	5E-10	5E+02
26. Np237	2E-01	7E-03	9E-04	5E-03	8E-02	2E-03	8E-03	3E-04	6E-03	1E-04	5E-03
27. Np239	1E-02	6E-01	6E-02	7E-01	9E+00	1E-01	3E-02	7E-03	6E-06	2E-04	4E-03
28. Pa231	7E-05	4E-04	2E-04	2E-04	1E-03	7E-05	9E-05	4E-05	9E-06	5E-06	3E-05
29. Pa233	2E-01	7E-03	1E-03	5E-03	8E-02	2E-03	8E-03	3E-04	6E-03	1E-04	5E-03
30. Pa234m	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
31. Pb209	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
32. Pb210	8E-11	4E-10	2E-10	7E-10	2E-09	2E-10	8E-11	7E-11	1E-11	1E-10	9E-11
33. Pb211	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
34. Pb214	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
35. Pd107	1E-01	1E-10	5E-11	3E-11	4E+00	0E+00	6E-03	3E-06	4E-03	6E-13	3E-03
36. Po210	8E-11	4E-10	2E-10	6E-10	2E-09	2E-10	8E-11	7E-11	1E-11	1E-10	9E-11
37. Po213	3E-07	8E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
38. Po214	4E-10	3E-09	1E-09	5E-09	1E-08	9E-10	5E-10	3E-10	7E-11	8E-10	5E-10
39. Po215	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
40. Po218	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
41. Pu238	2E+00	5E+01	9E+00	5E+01	6E+01	7E+00	4E+00	2E+00	1E-01	1E+01	3E+00
42. Pu239	1E+02	2E+03	3E+02	7E+02	1E+03	3E+02	3E+02	9E+01	1E+00	1E+02	7E+01
43. Pu240	3E+01	5E+02	8E+01	2E+02	3E+02	7E+01	6E+01	2E+01	8E-02	3E+01	1E+01
44. Pu241	3E+02	7E+03	1E+03	3E+03	3E+03	7E+02	6E+02	2E+02	1E-01	2E+02	1E+02
45. Ra223	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
46. Ra225	3E-07	9E-09	4E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
47. Ra226	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
48. Ru106	2E-03	1E+00	1E-01	2E+00	3E+00	4E-02	4E-03	1E-03	4E-08	5E-09	3E-05

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-101 Curies	C-102 Curies	C-103 Curies	C-104 Curies	C-105 Curies	C-106 Curies	C-107 Curies	C-108 Curies	C-109 Curies	C-110 Curies	C-111 Curies
49. Sb126	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01
50. Sb126m	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01
51. Se79	1E+00	8E-10	6E-10	4E-10	3E+01	0E+00	6E-02	4E-05	4E-02	1E-11	3E-02
52. Sm151	2E+03	1E+04	2E+03	4E+03	7E+04	1E+04	3E+03	2E+03	1E+02	3E+02	1E+03
53. Sn126	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01
54. Sr90	7E+04	1E+06	4E+05	4E+05	3E+06	5E+05	9E+04	2E+04	7E+01	1E+04	9E+04
55. Tc99	5E+01	3E-08	3E-08	8E-09	1E+03	0E+00	2E+00	1E-03	1E+00	3E-10	1E+00
56. Th227	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	1E-05	4E-06	2E-06	1E-05
57. Th229	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
58. Th230	6E-08	7E-07	2E-07	9E-07	1E-06	1E-07	1E-07	5E-08	1E-08	1E-07	7E-08
59. Th231	8E-02	6E-01	3E-01	4E-01	6E-01	1E-01	1E-01	6E-02	1E-02	6E-03	4E-02
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
62. Tl207	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
63. U233	2E-04	3E-06	2E-04	1E-05	1E-04	1E-04	4E-06	2E-06	6E-06	2E-08	4E-06
64. U234	4E-04	5E-03	2E-03	7E-03	7E-03	8E-04	7E-04	3E-04	5E-05	8E-04	4E-04
65. U235	8E-02	6E-01	3E-01	4E-01	6E-01	1E-01	1E-01	6E-02	1E-02	6E-03	4E-02
66. U238	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
67. Y90	7E+04	1E+06	4E+05	4E+05	3E+06	5E+05	9E+04	2E+04	7E+01	1E+04	9E+04
68. Zr93	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 Inventories Data.

Total (1/1/90)	C-101 Moles	C-102 Moles	C-103 Moles	C-104 Moles	C-105 Moles	C-106 Moles	C-107 Moles	C-108 Moles	C-109 Moles	C-110 Moles	C-111 Moles
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
90. Mn	0E+00	2E+04	3E+03	8E+04	7E+03	9E+03	3E+02	0E+00	0E+00	0E+00	0E+00

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-101 Moles	C-102 Moles	C-103 Moles	C-104 Moles	C-105 Moles	C-106 Moles	C-107 Moles	C-108 Moles	C-109 Moles	C-110 Moles	C-111 Moles
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 Inventories Data.

Total (1/1/90)	C-112 Curies	C-201 Curies	C-202 Curies	C-203 Curies	C-204 Curies
1. AC225	9E-09	1E-11	3E-10	3E-10	5E-14
2. Ac227	1E-05	3E-08	4E-06	4E-07	1E-09
3. Am241	2E+01	1E-02	3E-02	3E-03	9E-06
4. Am242	2E-02	2E-07	5E-07	5E-08	1E-10
5. Am242m	2E-02	2E-07	5E-07	5E-08	1E-10
6. Am243	4E-03	4E-07	1E-06	1E-07	3E-10
7. At217	9E-09	1E-11	3E-10	3E-10	5E-14
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba135m	3E+03	2E+00	4E-13	5E-06	7E-02
10. Bi210	1E-10	1E-12	8E-12	8E-13	3E-15
11. Bi211	1E-05	3E-08	4E-06	4E-07	1E-09
12. Bi213	9E-09	1E-11	3E-10	3E-10	5E-14
13. Bi214	4E-10	4E-12	3E-11	3E-12	1E-14
14. C14	2E+00	5E-05	3E-03	3E-04	2E-06
15. Cm242	2E-02	1E-07	4E-07	4E-08	1E-10
16. Cm244	6E-04	4E-10	1E-22	1E-15	2E-11
17. Cm245	3E-08	5E-15	1E-27	1E-20	2E-16
18. Cs135	1E-02	3E-05	9E-18	8E-11	1E-06
19. Cs137	4E+03	2E+00	4E-13	6E-06	8E-02
20. Fr221	9E-09	1E-11	3E-10	3E-10	5E-14
21. Fr223	2E-07	5E-10	6E-08	6E-09	2E-11
22. I129	1E-03	9E-07	3E-19	3E-12	4E-08

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-112 Curies	C-201 Curies	C-202 Curies	C-203 Curies	C-204 Curies
23. Nb93m	3E+00	1E-02	5E-02	5E-03	1E-05
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	2E+03	7E-04	9E-17	2E-09	3E-05
26. Np237	4E-03	2E-06	4E-07	4E-08	9E-08
27. Np239	4E-03	4E-07	1E-06	1E-07	3E-10
28. Pa231	4E-05	8E-08	9E-06	9E-07	3E-09
29. Pa233	4E-03	2E-06	4E-07	4E-08	1E-07
30. Pa234m	1E+00	2E-03	2E-01	2E-02	9E-05
31. Pb209	9E-09	1E-11	3E-10	3E-10	5E-14
32. Pb210	1E-10	1E-12	7E-12	7E-13	3E-15
33. Pb211	1E-05	3E-08	4E-06	4E-07	1E-09
34. Pb214	4E-10	4E-12	3E-11	3E-12	1E-14
35. Pd107	2E-03	9E-07	2E-19	2E-12	4E-08
36. Po210	1E-10	1E-12	7E-12	7E-13	3E-15
37. Po213	9E-09	1E-11	3E-10	3E-10	5E-14
38. Po214	5E-10	5E-12	4E-11	4E-12	1E-14
39. Po215	1E-05	3E-08	4E-06	4E-07	1E-09
40. Po218	4E-10	4E-12	3E-11	3E-12	1E-14
41. Pu238	1E+00	3E-05	1E-04	2E-05	4E-08
42. Pu239	6E+01	2E-02	6E-02	6E-03	2E-05
43. Pu240	1E+01	2E-03	5E-03	5E-04	2E-06
44. Pu241	1E+02	3E-03	7E-03	7E-04	3E-06

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-112 Curies	C-201 Curies	C-202 Curies	C-203 Curies	C-204 Curies
45. Ra223	1E-05	3E-08	4E-06	4E-07	1E-09
46. Ra225	9E-09	1E-11	3E-10	3E-10	5E-14
47. Ra226	4E-10	4E-12	3E-11	3E-12	1E-14
48. Ru106	5E-04	6E-12	9E-10	8E-11	2E-13
49. Sb126	6E-01	3E-03	8E-03	8E-04	3E-06
50. Sb126m	6E-01	3E-03	8E-03	8E-04	3E-06
51. Se79	3E-02	2E-05	5E-18	5E-11	8E-07
52. Sm151	9E+02	8E+00	2E+01	2E+00	9E-03
53. Sn126	6E-01	3E-03	8E-03	8E-04	3E-06
54. Sr90	4E+04	6E+00	5E-14	6E+02	3E-01
55. Tc99	9E-01	6E-04	2E-16	2E-09	3E-05
56. Th227	1E-05	3E-08	4E-06	4E-07	1E-09
57. Th229	9E-09	1E-11	3E-10	3E-10	5E-14
58. Th230	6E-08	6E-10	5E-09	5E-10	2E-12
59. Th231	6E-02	1E-04	1E-02	1E-03	4E-06
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	1E+00	2E-03	2E-01	2E-02	9E-05
62. Tl207	1E-05	3E-08	4E-06	4E-07	1E-09
63. U233	3E-06	5E-10	7E-08	9E-08	2E-11
64. U234	3E-04	3E-07	3E-05	3E-06	1E-08
65. U235	6E-02	1E-04	1E-02	1E-03	4E-06
66. U238	1E+00	2E-03	2E-01	2E-02	9E-05

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-112 Curies	C-201 Curies	C-202 Curies	C-203 Curies	C-204 Curies
67. Y90	4E+04	6E+00	5E-14	6E+02	3E-01
68. Zr93	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 Inventories Data.

Total (1/1/90)	C-112 Moles	C-201 Moles	C-202 Moles	C-203 Moles	C-204 Moles
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
89. La	0E+00	0E+00	0E+00	0E+00	0E+00
90. Mn	0E+00	0E+00	0E+00	0E+00	0E+00

Table 4-16. TRAC Estimated Waste Tank Inventories Data.

Total (1/1/90)	C-112 Moles	C-201 Moles	C-202 Moles	C-203 Moles	C-204 Moles
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

Table 4-17. Results of Analysis of Supernatant Liquid from 241-AX-102 Single-Shell Tank.

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

9 2 1 2 5 3 0 9 1 8

Table 4-17. Results of Analysis of Supernatant Liquid from 241-AX-102 Single-Shell Tank.

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

9212309.19

Table 4-18. Results of Analysis of Volatile Priority Polluntants 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.

9 2 1 2 6 3 0 9 2 0

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

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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.

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Table 4-21. Results of Analysis 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.

9 2 1 2 6 3 0 9 2 3

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.

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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.

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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

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Table 4-25. Sampling Analysis of Complexed 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.

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 a confirmed 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
241-C-111	5	No	Tank is an assumed leaker

Table 4-26. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results.

Single-Shell Tank	Number of Assoc. Dry Wells	Geophysical Evidence of Leaking?	Comments
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.

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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.

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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.

Table 4-30. Average Concentrations of Radiological Parameters for PUREX Waste Effluent and Groundwater Near the 216-A-36B Crib from 1983 through 1987.

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.

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.

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

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

Table 4-32. Candidate Contaminants of Potential Concern for the PUREX Plant Aggregate Area.

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

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Table 4-32. Candidate Contaminants of Potential Concern for the PUREX Plant Aggregate Area.

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	
Ferric nitrate	Sulfamic acid	Gylcolate
Magnesium	Sulfate	N-(2-hydroxyethyl) ethylenediaminetriacetate (HEDTA)
Nitrate	Sulfuric acid	
Nitric acid	Tungsten	
Nitrite	Zirconium oxide	Oxalate
Phosphate		Oxalic Acid
Potassium fluoride	VOLATILE ORGANICS	Paraffin hydrocarbons
Potassium hydroxide		Sugar (sucrose)
Potassium permanganate	Acetone	Tartaric acid
Silicon trioxide	Chloroform	Tributyl phosphate
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.

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Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

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.

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.

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.

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.

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

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
Septic Tanks and Associated Drain Fields								
2607-EA	Septic Tank	--	--	--	--	--	--	--
2607-EC	Septic Tank	--	--	--	--	--	--	--
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

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
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
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	--	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
218-E-13	Burial Ground	S	S	S	--	--	--	--
200-E	Burning Pit	S	S	S	K	K	K	K
				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	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
UN-200-E-48 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-49 Unplanned Release	S	S	S	S	--	--	--
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	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
UN-200-E-142 Unplanned Release	--	--	--	--	--	K	K
UPR-200-E-17 Unplanned Release	--	--	K	--	--	--	--
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. Page 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
Actinium	--	--	228
Americium	2 100 - 1000 (<1 @ pH 1-3)	100	82
Antimony	--	--	2
Arsenic	--	0	5.86
Barium	--	50	530
Beryllium	--	--	70
Bismuth	--	20	--
Boron	--	--	0.19
Cadmium	--	15	14.9
Carbon (^{14}C)	--	--	0
Cesium	200 - 1,000 1 - 200 (acidic waste)	50	51
Chromium	--	0	16.8
Cobalt	500 - 2000	10	1.9
Copper	--	15	41.9
Curium	100 - >2,000	100	82
Cyanide	--	--	--
Europium	--	--	228
Fluoride	--	--	0
Francium	--	--	--
Hyrdazine	--	--	0
Iodine	<1	0	0
Iron	--	20	15
Lead	--	30	234
Manganese	--	20	16.5
Mercury	--	--	322
Neptunium	<1-5	3	3

9 2 1 2 6 3 0 9 3 0

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	

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Table 4-37. Physical/Chemical Properties of Organic 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. Page 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

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Table 4-38. Radiological Properties of Potential Radionuclides of Concern in PUREX Plant Waste Management Units. Page 2 of 2

Radionuclide	Half-Life	Specific Activity[a/] in Ci/g	Principal Radiation of Concern[b/]
^{210}Pb	22.3 yr	7.6×10^{1}	β
^{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.

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Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area.

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}
^{63}Ni	8.7×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	0

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Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area.

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 $(pCi/g)^{-1}$
^{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}
^{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}

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Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area.

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 $(pCi/g)^{-1}$
^{207}Tl	2.3×10^{-9}	6.6×10^{-10}	3.5×10^{-11}	1.2×10^{-6}
^{233}U	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	3.2×10^{-7}
^{234}U	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	5.6×10^{-7}
^{235}U	1.3×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	9.7×10^{-5}
^{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.

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
ORGANIC CHEMICALS			
Acetone	--	NA; kidney and liver effects	EPA 1991a

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Table 4-40. Potential Chronic Human Health Effects of Chemicals Detected or Disposed of at PUREX Plant Aggregate Area.

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a/]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route	Reference
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.

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5.0 HEALTH AND ENVIRONMENTAL CONCERNS

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

- Contaminants of potential concern are identified for each exposure pathway that is likely to occur within the PUREX Plant Aggregate Area. Selection of contaminants was discussed in Section 4.2. Contaminants of potential concern were selected from the list of candidate contaminants of potential concern presented in Table 4-32. This table includes contaminants that are likely to be present in the environment based on occurrence in the liquid process wastes that were discharged to soils, and also contaminants that have been detected in environmental samples within the aggregate area but have not been identified as components of PUREX Plant Aggregate Area waste streams.

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

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

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The human health concerns and various hazard ranking scores listed above are used to establish whether or not a waste management unit is considered a "high" priority. In the data evaluation process presented in Section 9.0, "high" priority sites are evaluated for the potential implementation of an interim remedial measure (IRM). "Low" priority sites are evaluated to determine what type of additional investigation is necessary to establish a final remedy. Further detail is presented in Section 9.0.

The data used for this evaluation are presented in the earlier sections of this report. The types of data that have been assessed include waste management units histories and physical descriptions (Section 2.0), descriptions of the physical environment of the study area (Section 3.0) and a summary of the available chemical and radiological data for each waste management unit (Section 4.0).

The quality and sufficiency of these data are assessed in Section 8.0. This information is also used to identify potentially applicable or relevant and appropriate requirements (ARARs) (Section 6.0).

5.1 CONCEPTUAL FRAMEWORK FOR RISK-BASED SCREENING

The range of potential human health and environmental exposure pathways at the PUREX Plant Aggregate Area was summarized in Section 4.2. In Section 4.2 the role of biota in transporting contaminants through the environment is also discussed, and biota are included as 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 gap in the PUREX Plant Aggregate Area data is discussed in Section 8.2.3. As a result, the risk-based screening of waste management unit priorities discussed in this section is by necessity limited to potential human health risks.

The U.S. Environmental Protection Agency (EPA 1989a) considers a human exposure pathway to consist of four elements: (1) a source and mechanism for contaminant release, (2) a retention or transport medium (or media), (3) a point of potential human contact, and (4) an exposure route (e.g., ingestion) at the contact point. The probability of the existence of a particular pathway is dependent upon the physical and institutional controls affecting waste management unit access and use. In the absence of unit access controls and other land use restrictions, the identified potential exposure pathways could all occur. For example, it could be hypothesized that an individual could establish a residence within the boundaries of the PUREX Plant Aggregate Area, disrupt the soil surface and contact buried contamination, and drill a well and withdraw contaminated groundwater for drinking water and crop irrigation. However, within the five- to ten-year period of interest associated with

identification and prioritization of remedial actions within the PUREX Plant Aggregate Area, unrestricted access and uncontrolled disruption of buried contaminants have a negligible probability of occurrence.

The conceptual model presented in Section 4.2 was evaluated to identify an appropriate framework for screening waste management units and establishing their remediation priorities based on potential health hazards. Based on the five- to ten-year period of interest for waste unit prioritization, and the presence of site access controls during that period, a screening framework was developed encompassing the range of release mechanisms, affected media, and exposure routes associated with an onsite occupational receptor. The PUREX Plant Aggregate Area is currently an industrial area. While work activities are assumed to include occasional contact with surface soils, it is assumed that no contact with buried contaminants will take place without proper protective measures.

Workers may be exposed via the following routes at the PUREX Plant Aggregate Area:

- Ingestion of surface soils
- Inhalation of volatilized contaminants and resuspended particles
- Direct dermal contact with surface soils
- Direct exposure to radiation from surface soils and airborne resuspended particles.

Since evaluation of migration in the saturated zone is not within the scope of a source aggregate area management study (AAMS), ingestion of or contact with groundwater was not evaluated as exposure pathways. However, since migration of waste constituents within the saturated zone will be addressed in the 200 East Groundwater Aggregate Area Management Study Report (AAMSR), contaminants likely to migrate to the water table and waste management units that have a high potential to impact groundwater will be identified.

5.2 POTENTIAL EXPOSURE SCENARIOS AND HUMAN HEALTH CONCERNS

The routes by which a Hanford Site worker could potentially be exposed to contamination at the waste management units include ingestion, inhalation, direct contact with soils, and direct exposure to radiation. To evaluate the potential for exposure at individual waste management units, it is necessary to have data available for surface soils, air, and radiation levels. Although samples have been collected from each of these media, only the surface radiation survey data (contamination levels and dose rate) are specific to individual waste management units. Therefore, only pathways associated with the surface

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radiological contamination and external dose rates can be evaluated with confidence at this time. Potential exposures by other pathways were evaluated based on available knowledge regarding contaminants disposed to the waste management units and the integrity of engineered barriers.

5.2.1 External Exposure

External dose rate surveys, which are performed on a waste management unit basis, were used as the measure of a unit's potential for impacting human health through direct external radiation exposure. The contaminants of potential concern for this pathway are the radionuclides that emit moderate to high energy penetrating gamma radiation. The measured dose rates at PUREX Plant Aggregate Area waste management units are presented in Table 5-1 from the available survey data. ~~At certain waste management units, the dose was measured over a year's time using a thermoluminescent dosimeter (TLD). In those instances, the measured value in units of mrem/yr was converted to units of mrem/h on the basis of 8,760 h/yr.~~

For ~~53~~42 of the ~~103~~89 PUREX Plant Aggregate Area waste management units, no radiation survey data are available. For those units that do have radiation survey data of some type, 29 were reported as having no contamination detected.

Westinghouse Hanford manual WHC-CM-4-10, Section 7 (WHC 1992) was used as the basis for setting one of the criteria that are used to identify waste management units that can be considered high priority sites. The manual indicates that waste management units with radiation levels of 2 mrem/h be posted with "Radiation Area" signs and undergo access controls for the purposes of personnel protection. With the same objective in mind, the level of 2 mrem/h is recommended as one of the criteria for distinguishing "high priority" from "low priority" sites. The only PUREX Plant Aggregate Area waste management units that exceeded 2 mrem/h were 216-A-40 Trench, and Unplanned Release UN-200-E-100.

High levels of radiation were reportedly associated with some of the unplanned releases that are listed in Table 5-1. However, many of these releases occurred in the early years of the Hanford Site and more recent survey data are not available. Some of the releases were reportedly remediated by removing contaminated soil for disposal in burial grounds, paving or covering the area with soil, or flushing the soil with water. The effectiveness of the various remediation measures is not known, and confirmatory survey measurements are not available. Thus, with the exception of unplanned releases located within engineered waste management units, which are routinely surveyed, information on the amount of radiological status of remediated unplanned releases is deficient and is identified as a data gap in Section 8.0.

5.2.2 Ingestion of Soil or Inhalation of Fugitive Dust

Radionuclides and nonradioactive contaminants of concern for the soil ingestion and fugitive dust inhalation pathways are those that are nonvolatile, persistent in surface soils, and have appreciable carcinogenic or toxic affects by ingestion or inhalation. However, little information is available to evaluate the levels of specific radionuclides or nonradioactive contaminants in surface soils. Available gross contamination survey data for the PUREX Plant Aggregate Area waste management units are provided in Table 5-1.

The Westinghouse Hanford Environmental Protection Group policies state that the presence of any smearable alpha constitutes a potential threat to human health and qualifies a waste management unit for a high remediation priority (Huckfeldt 1991b). Waste management units that exhibit elevated alpha readings in radiological surveys can be presumed to have surface contamination, since alpha radiation cannot penetrate solids.

Westinghouse Hanford manual *Radiation Protection* (WHC 1992) was also used to set criteria for identifying waste management units that can be considered high remediation priority sites. The manual indicates that waste management units with a level of 100 ct/min (1,000 dis/min) above background beta/gamma and/or 20 dis/min alpha be posted with "Surface Contamination Area" signs and undergo access controls for purposes of personnel protection. With the same objective in mind, the levels of 100 ct/min above background beta/gamma and 20 dis/min alpha are recommended as two of the criteria for identifying high priority waste management units. For those beta/gamma survey readings that are in units of dis/min, a conversion was made to ct/min assuming a survey detector efficiency of 10%.

It should be noted that these radiation readings may indicate transient conditions (e.g., presence of contaminated vegetation) and that routine stabilization of surface contamination is carried out under the auspices of the Westinghouse Hanford Radiation Area Remedial Action (RARA) Program.

5.2.3 Inhalation of Volatiles

As summarized in Section 4.1, the distribution of volatile organics in soils is not well-defined in the PUREX Plant Aggregate Area. Although several semivolatile compounds, such as tributyl phosphate and paraffin hydrocarbons, have been disposed of in the cribs, no information is available on whether these compounds are still present in the near surface soil column for transport to the soil surface.

The primary volatile radionuclide of concern is tritium. Exposure to tritium (as tritiated water vapor) and the potential for tritium release via radiolytic production of

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hydrogen from aqueous radioactive wastes is of concern. The mode of disposal of this material can not be determined from available information.

5.2.4 Migration to Groundwater

Risks that could potentially occur due to migration of contaminants in groundwater to existing or potential receptors will be addressed in the 200 East Groundwater AAMSR and thus, will not be discussed in the PUREX Plant AAMSR. However, the potential for individual units to impact groundwater has been discussed in Section 4.1.

5.3 ADDITIONAL SCREENING CRITERIA

In addition to determining human health concerns for a worker at each of the waste management units, previously developed site ranking criteria were investigated for the purpose of setting priorities for waste management units and unplanned releases. These criteria are the CERCLA HRS scores assigned during preliminary assessment/site inspection (PA/SI) activities performed for the Hanford Site (DOE/RL 1988), and the rankings assigned by the Westinghouse Hanford Environmental Protection Group to prioritize units needing remedial actions for radiological control (Huckfeldt 1991b).

Both of these ranking systems take into account some measure of hazard and environmental mobility and are thus appropriate to consider for waste management unit prioritization. The HRS ranking system evaluates sites based on their relative risk, taking into account the population at risk, the hazardous waste constituent toxicity and concentration at the facility, the potential for contamination of the environment, the potential risk of fire and explosion, and the potential for exposure associated with humans or animals that come into contact with the waste management unit inventory. The HRS is, thus, appropriate to consider for screening waste management units.

The PA/SI screening was performed using the EPA's HRS and the mHRS. The HRS (40 CFR 300) is a site ranking methodology that was designed to determine whether sites should be placed on the CERCLA National Priorities List (NPL) based on chemical contamination history. The EPA has established the criteria for placement on the NPL to be a score of 28.5 or greater. The HRS criteria used in PA/SI have been revised (December 14, 1990). The HRS scores are only used as available indicators of relative risk; therefore, the revision will not impact the evaluation process. The mHRS is a ranking system developed by the Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE) that uses the basic methodology of the old (pre-December 1990) HRS; however, it more accurately predicts the impacts from radionuclides. The mHRS takes into account

concentration, half-life, and other chemical-specific parameters that are not considered by the old HRS. The mHRS has not been accepted by EPA as a ranking system.

Many of the PUREX Plant Aggregate Area waste management units were ranked in the PA/SI using both the HRS and mHRS. For those waste management units that were not ranked in the PA/SI, unit type and discharge history were evaluated in comparison with ranked units for the purpose of setting priorities. If a waste management unit that has been ranked exhibits similar characteristics (e.g., construction, waste type, and volume), the value for the ranked unit was applied to the unit without an HRS or mHRS score. If no ranked waste management units exhibit similar characteristics, then the unit was not ranked; however, a high or low score was determined qualitatively through evaluation of unit configuration and contamination history.

Table 5-1 lists the HRS and mHRS rankings, as well as scores that were assigned for unranked waste management units, based on their similarity to ranked units in terms of type, construction, and quantity of waste disposed ~~of~~. If no similar waste management units were available for comparison, the units were not ranked but were assigned a qualitative indicator of migration potential. Table 5-1 also lists the units scored by the Westinghouse Environmental Protection Group (Huckfeldt 1991b). A score of 7 or greater results in the assignment of a "high" priority to the unit. A value of 7 was chosen to represent the approximate midpoint of the scoring range.

For the HRS ranking, 11 units of the ~~10~~389 PUREX Plant Aggregate Area waste management units were given a score of 28.5 or greater. For the mHRS ranking, 11 units were given a score of 28.5 or greater (all of which had HRS scores greater than 28.5). ~~Five~~Six units received a qualitative "high" score and ~~5~~140 units received a qualitative "low" score. Each of the units that received a qualitative "high" HRS and mHRS score (four cribs, one control structure, and one ditch) were ~~was~~ given such a rating based on their discharge history of large quantities of hazardous materials, which could potentially have been transported to the groundwater. The units that received "low" scores (four cribs, one french drain, one reverse well, seven septic tanks and drain fields, two retention basins, and twenty-five unplanned releases) were given such a ranking because there is no known history of liquid hazardous material disposal that could affect groundwater beneath the PUREX Plant Aggregate Area.

~~Five~~Three of the ~~10~~389 units were assigned Westinghouse Environmental Protection Group scores of 7 or greater, indicating the need for remedial action.

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5.4 SUMMARY OF SCREENING RESULTS

The screening process was used to sort ~~sites~~ units as either high priority or low priority. Table 5-1 lists the PUREX Plant Aggregate Area waste management units that exceeded one or more of the screening criteria identified in the preceding Sections. In total, ~~26~~25 units were identified as high priority.

Radiation survey results (dose rate and/or contamination) were available for ~~50~~47 of the ~~103~~89 waste management units and unplanned releases. Twenty-nine were reported as having no detectable results. Of the remaining ~~21~~18 units, ~~17~~16 had survey results that exceeded one or more of the criteria (2 mrem/h, 100 ct/min beta/gamma, and 20 ~~et~~ dis/min alpha).

For the HRS scores, 11 waste management units were given scores of 28.5 or greater. For the mHRS, the same 11 units received a score of 28.5 or greater. ~~Three~~Six units received qualitative "high" scores. ~~Five~~Three of the ~~103~~89 units were assigned Westinghouse Environmental Protection Group scores of 7 or greater, indicating the need for remedial action. Some of the sites were designated as high priority for 2 or more of the criteria, hence only ~~26~~25 total ~~sites~~units are designated high priority.

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	Radiation Surveys dis/min	Radiation Surveys mrem/h	Environmental Protection Score	Priority
			Cribs and Drains					
216-A-1	Crib	1.03	0.71	NC	NC	NC	--	No
216-A-2	Crib	4.39	3.19	NC	NC	NC	--	No
216-A-3	Crib	Low	Low	NC	NC	NC	--	No
216-A-4	Crib	47.81	47.81	NC	NC	NC	--	Yes
216-A-5	Crib	60.40	50.42	NC	NC	NC	--	Yes
216-A-6	Crib	47.81	42.14	500[a/]	NA	NA	--	Yes
216-A-7	Crib	57.88	42.79	3,000[a/]	NA	NA	7	Yes
216-A-8	Crib	High	High	NC	NC	0.01	8	Yes
216-A-9	Crib	57.88	42.79	3,000[a/]	NA	NA	--	Yes
216-A-10	Crib	High	High	NC	NC	NC	--	Yes
216-A-21	Crib	57.88	57.88	1,500[a/]	NA	NA	--	Yes
216-A-24	Crib	57.88	48.67	NC	NC	NC	--	Yes
216-A-27	Crib	57.88	59.63	NC	NC	NC	--	Yes
216-A-30	Crib	High	High	NC	NC	0.01	--	Yes
216-A-31	Crib	1.03	1.42	NC	NC	NC	--	No
216-A-32	Crib	0.00	0.00	NC	NC	NC	--	No
216-A-36A	Crib	50.33	32.62	NC	NC	NC	--	Yes
216-A-36B	Crib	High	High	NC	NC	NC	--	Yes
216-A-37-1	Crib	Low	Low	NC	NC	NC	--	No
216-A-37-2	Crib	Low	Low	20[a/]	500	NA	--	Yes

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	Radiation Surveys dis/min	Radiation Surveys mrem/h	Environmental Protection Score	Priority
216-A-38-1	Crib	NU	NU	NC	NC	NC	--	No
216-A-41	Crib	1.03	0.71	NA	NA	NA	--	No
216-A-45	Crib	Low	Low	NC	NC	NC	--	No
216-A-11	French Drain	1.03	0.71	NC	NC	NC	--	No
216-A-12	French Drain	1.03	0.71	NC	NC	NC	--	No
216-A-13	French Drain	0.71	0.71	NC	NC	NC	--	No
216-A-14	French Drain	1.03	0.71	2,000[a/]	56,000	NA	--	Yes
216-A-15	French Drain	1.03	0.55	NC	NC	NC	--	No
216-A-22	French Drain	1.96	1.31	NC	NC	NC	--	No
216-A-26	French Drain	Low	Low	NC	NC	NC	--	No
216-A-26A	French Drain	2.07	1.42	NC	NC	NC	--	No
216-A-28	French Drain	47.81	32.72	1,000[a/]	2,300	NA	--	Yes
216-A-33	French Drain	0.00	0.00	NC	NC	NC	--	No
216-A-35	French Drain	1.03	0.71	NC	NC	NC	--	No
			Reverse Wells					
299-E24-111	Injection Well	Low	Low	NA	NA	NA	NA	No
			Ponds, Ditches and Trenches					
216-A-29	Ditch	High	High	NA	NA	NA	--	Yes
216-A-34	Ditch	1.09	0.76	NC	NC	NC	--	No
216-A-18	Trench	1.03	0.71	NC	NC	NC	--	No

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	Radiation Surveys dis/min	Radiation Surveys mrem/h	Environmental Protection Score	Priority
216-A-19	Trench	2.18	1.63	NC	NC	NC	--	No
216-A-20	Trench	2.07	1.42	NC	NC	NC	--	No
216-A-40	Trench	32.71	32.71	--	--	4	11	Yes
Septic Tanks and Associated Drain Fields								
2607-EA	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-EC	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-ED	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-EG	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-EJ	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-EL	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
2607-E6	Septic Tank/Drain Field	Low	Low	NA	NA	NA	--	No
Transfer Facilities, Diversion Boxes, and Pipelines								
216-A-524	Control Structure	High	High	10,000	NA	0.7	--	Yes
Basins								
207-A	Retention Basin	Low	Low	1,500	NA	NA	--	Yes
216-A-42	Retention Basin	Low	Low	20,000[a/]	NA	NA	--	Yes

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	dis/min	mrem/h	Environmental Protection Score	Priority
			Burial Sites					
218-E-1	Burial Ground	0.70	0.50	5,000	--	--	--	Yes
218-E-8	Burial Ground	0.70	0.80	NA	NA	NA	--	No
218-E-12A	Burial Ground	0.70	0.80	2,000[a/]	NA	NA	--	Yes
218-E-13	Burial Ground	0.00	0.00	NA	NA	NA	--	No
			Unplanned Releases					
UN-200-E-10	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-11	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-12	Unplanned Release	1.00	--	NA	NA	NA	--	No
UN-200-E-13	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-15	Unplanned Release	1.10	--	NA	NA	NA	--	No
UN-200-E-19	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-20	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-22	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-25	Unplanned Release	1.10	--	NA	NA	NA	--	No
UN-200-E-26	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-28	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-31	Unplanned Release	1.03	--	NC	NC	NC	--	No
UN-200-E-33	Unplanned Release	Low	--	NA	NA	NA	--	No

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	Radiation Surveys dis/min	Radiation Surveys mrem/h	Environmental Protection Score	Priority
UN-200-E-35	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-39	Unplanned Release	1.00	--	NA	NA	NA	--	No
UN-200-E-40	Unplanned Release	1.00	--	NA	NA	NA	--	No
UN-200-E-42	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-49	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-56	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-58	Unplanned Release	0.80	--	NA	NA	NA	--	No
UN-200-E-60	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-62	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-65	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-67	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-68	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-72	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-88	Unplanned Release	Low	--	6,000[a]	NA	NA	--	Yes
UN-200-E-94	Unplanned Release	1.00	--	NA	NA	NA	--	No
UN-200-E-96	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-97	Unplanned Release	Low	--	NA	NA	NA	--	No
UN-200-E-100	Unplanned Release	Low	--	--	--	5	--	Yes
UN-200-E-114	Unplanned Release	Low	--	NA	NA	NA	--	No

Table 5-1. Hazard Ranking Scores for PUREX Plant Aggregate Area.

Site Name	Site Type	HRS Rating	mHRS Rating	Radiation Surveys ct/min	dis/min	mrem/h	Environmental Protection Score	Priority
UN-200-E-117	Unplanned Release	1.00	--	NA	NA	NA	--	No
UN-200-E-142	Unplanned Release	Low	--	NA	NA	NA	--	No

NA = No data available.
NC = No contamination.
NU = Not used. Unit was never used.
[a/] = Values derived from converting reported beta/gamma results from dis/min to ct/min.

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6.0 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

6.1 INTRODUCTION

The Superfund Amendments and Reauthorization Act (SARA) of 1986 amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to require that all applicable or relevant and appropriate requirements (ARARs) be employed during implementation of a hazardous waste site cleanup. "Applicable" requirements are defined by the U.S. Environmental Protection Agency (EPA) in "CERCLA Compliance with Other Laws Manual" (OSWER Directive 9234.1-01, August 8, 1988) as:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

A separate set of "relevant and appropriate" requirements that must be evaluated include:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

"To-be-Considered Materials" (TBCs) are nonpromulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs will be considered along with potential ARARs and may be used in determining the necessary level of cleanup for protection of health or the environment.

The following sections identify potential ARARs to be used in developing and assessing various remedial action alternatives at the PUREX Plant Aggregate Area. Specific requirements pertaining to hazardous and radiological waste management, remediation of contaminated soils, surface water protection, and air quality will be discussed.

The potential ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of potential ARARs evaluated include the following:

- Contaminant-specific
- Location-specific
- Action-specific.

Potential contaminant-specific ARARs are usually health or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that are generally recognized by the regulatory agencies as allowable to protect human health and the environment. In the case of the PUREX Plant Aggregate Area, potential contaminant-specific ARARs address chemical constituents and/or radionuclides. The potential contaminant-specific ARARs that were evaluated for the PUREX Plant Aggregate Area are discussed in Section 6.2.

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances, or the conduct of activities, solely because they occur in specific locations. The potential location-specific ARARs that were evaluated for the PUREX Plant Aggregate Area are discussed in Section 6.3.

Potential action-specific ARARs apply to particular remediation methods and technologies, and are evaluated during the detailed screening and evaluation of remediation alternatives. The potential action-specific ARARs that were evaluated for the PUREX Plant Aggregate Area are discussed in Section 6.4.

The TBC requirements are other federal and state criteria, advisories, and regulatory guidance that are not promulgated regulations, but are to be considered in evaluating alternatives. Potential TBCs include U.S. Department of Energy (DOE) Orders that carry out authority granted under the Atomic Energy Act. All DOE Orders are potentially applicable to operations at the PUREX Plant Aggregate Area. Specific TBC requirements are discussed in Section 6.5.

Potential contaminant- and location-specific ARARs will be refined during the aggregate area management study (AAMS) process. Potential action-specific ARARs are briefly discussed in this section, and will be further evaluated upon final selection of remedial alternatives. The points at which these ARARs must be achieved and the timing of the ARARs evaluations are discussed in Sections 6.6 and 6.7, respectively.

6.2 CONTAMINANT-SPECIFIC REQUIREMENTS

A contaminant-specific requirement sets concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. Based on available information, some of the currently known or suspected contaminants that may be present in the PUREX Plant Aggregate Area are outlined in Table 4-32. The currently identified potential federal and state contaminant-specific ARARs are summarized below.

6.2.1 Federal Requirements

Federal contaminant-specific requirements are specified in several statutes, codified in the U.S. Code (USC), and promulgated in the Code of Federal Regulations (CFR), as follows:

- **Clean Water Act (33 USC 1251).** Federal Water Quality Criteria (FWQC) (40 CFR 131) are developed under the authority of the Clean Water Act (CWA) (33 USC 1251) to serve as guidelines to the states for determining receiving water quality standards. Different FWQC are derived for protection of human health and protection of aquatic life. The human health FWQC are further subdivided according to how people are expected to use the water (e.g., drinking the water versus consuming fish caught from the water). The SARA 121(d)(2) states that remedial actions shall attain FWQC where they are relevant and appropriate, taking into account the designated or potential use of the water, the media affected, the purpose of the criteria, and current information. Many more substances have FWQC than maximum contaminant levels (MCLs) issued under the Safe Drinking Water Act (SDWA, see discussion below); consequently, EPA and other state agencies rely on these criteria more than MCLs, even though these criteria can only be considered relevant and appropriate and not applicable.

  The FWQC would not be considered at the PUREX Plant Aggregate Area, as no natural surface water bodies exist. The only existing man-made surface water bodies at PUREX Plant Aggregate Area are waste management units.

- **Safe Drinking Water Act (42 USC 300(f)).** Under the authority of the Safe Drinking Water Act (42 USC 300(f)), MCLs (40 CFR 141) apply when the water may be used for drinking. Currently, EPA and the State of Washington apply MCLs as the standards for groundwater contaminants at CERCLA sites that could be used as drinking water sources. Groundwater contamination and application of MCLs as ARARs are addressed under a separate AAMS specific to groundwater.

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- **Resource Conservation and Recovery Act (42 USC 6901, 40 CFR 260 to 271).** The Resource Conservation and Recovery Act (RCRA) addresses the generation and transportation of hazardous waste, and waste management activities at facilities that treat, store, or dispose of hazardous wastes. Subtitle C (Hazardous Waste Management) mandates the creation of a cradle-to-grave management and permitting system for hazardous wastes. The RCRA defines hazardous wastes (40 CFR 261) as "solid wastes" (even though the waste is often liquid in physical form) that may cause or significantly contribute to an increase in mortality or serious illness, or that poses a substantial hazard to human health or the environment when improperly managed. In Washington State, RCRA is implemented by EPA and the authorized state agency, the Washington State Department of Ecology (Ecology).

  The CERCLA Sections 121(d) and 121(e) respectively require that CERCLA activities, including remedial actions, comply with substantive requirements and not administrative requirements such as permitting. Therefore, hazardous waste activities conducted onsite at the PUREX Plant Aggregate Area will comply with the substantive requirements of RCRA, and not permitting requirements of RCRA, which are deemed to be potential ARARs.

  Two key potential contaminant-specific potential ARARs have been adopted under the federal hazardous waste regulations: the Toxicity Characteristic Leaching Procedure (TCLP) designation limits promulgated under 40 CFR Part 261; and the hazardous waste land disposal restrictions (LDRs) for constituent concentrations promulgated under 40 CFR Part 268.

  The TCLP designation limits define when a waste is hazardous, and are used to determine when more stringent management standards apply than would be applied to typical solid wastes. Thus, the TCLP potential contaminant-specific potential ARARs can be used to determine when RCRA waste management standards may be required. The TCLP limits are presented in Table 6-1.

  The LDRs are numerical limits derived by EPA by reviewing available technologies for treating hazardous wastes. Until a prohibited waste can meet the numerical limits, it can be prohibited from land disposal. Two sets of limits have been promulgated: limits for constituent concentrations in waste extract, which uses the TCLP test to obtain a leached sample of the waste; and limits for constituent concentrations in waste, which addresses the total contaminant concentration in the waste. Applicability to CERCLA actions is based on determinations of waste "placement/disposal" during a remediation action. According to OWSER Directive 9347.3-OSFS, EPA concludes that Congress did

not intend in situ consolidation, remediations, or improvement of structural stability to constitute placement or disposal. The land disposal numerical limits can be used to determine if generated cleanup wastes can be redisposed of onsite without further treatment, or must be subject to certain treatment practices prior to land disposal. The LDR limits are presented in Table 6-1 (see Section 6.4.1 for further discussion on the applying limits.

- **Clean Air Act (42 USC 7401).** The Clean Air Act (42 USC 7401) establishes National Primary and Secondary Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), National Emission Standards for Hazardous Air Pollutants (NESHAP)(40 CFR Part 61), and New Source Performance Standards (NSPS)(40 CFR Part 60).

  In general, new and modified stationary sources of air emissions must undergo a preconstruction review to determine whether the construction or modification of any source, such as a CERCLA remedial program, will interfere with attainment or maintenance of NAAQS or fail to meet other new source review requirements including NESHAPs and NSPS. However, the process applies only to "major" sources of air emissions (defined as emissions of 250 tons per year). The PUREX Plant Aggregate Area would not constitute a major source.

  Section 112 of the Clean Air Act directs EPA to establish standards at the level that provides an ample margin of safety to protect the public health from hazardous air pollutants. The NESHAP standards for radionuclides are directly applicable to DOE facilities under Subpart H of Section 112 that establishes a 10 mrem/year facility-wide standard for exposure to an offsite receptor. Further, if the maximum individual dose during remediation exceeds 1% of the NESHAPs standard (0.1 mrem/yr), a report meeting the substantive requirements of an application for approval of construction must be prepared.

6.2.2 State of Washington Requirements

Potential state contaminant-specific requirements are specified in several statutes, codified in the Revised Code of Washington (RCW) and promulgated in the Washington Administrative Code (WAC).

- **Model Toxics Control Act (RCW 70.105D, Chapter 173-340 WAC).** The Model Toxics Control Act (MTCA) (RCW 70.105D) authorized Ecology to adopt cleanup standards for remedial actions at hazardous waste sites. These regulations are considered potential ARARs for soil, groundwater, and surface

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water cleanup actions. The processes for identifying, investigating, and cleaning up hazardous waste sites are defined and cleanup levels are set for groundwater, soil, surface water, and air in Chapter 173-340 WAC.

Under the MTCA regulations, cleanup standards may be established by one of three methods.

- Method A may be used if a routine cleanup action, as defined in WAC 173-340-200, is being conducted at the site or relatively few hazardous substances are involved for which cleanup standards have been specified by Tables 1, 2, or 3 of WAC 173-340-720 through -745.

- Under Method B, a risk level of 10^{-6} is established and a risk calculation based on contaminants present is determined.

- Method C cleanup standards represent concentrations that are protective of human health and the environment for specified site uses. Method C cleanup standards may be established where it can be demonstrated that such standards comply with applicable state and federal laws, that all practical methods of treatment are used, that institutional controls are implemented, and that one of the following conditions exist: (1) Method A or B standards are below background concentrations; (2) Method A or Method B results in a significantly greater threat to human health or the environment; (3) Method A or Method B standards are below technically possible concentrations, or (4) the site is defined as an industrial site for purposes of soil remediation.

Table 1 of Method A addresses groundwater, so it is not considered to be an ARAR for the PUREX Plant Aggregate Area (groundwater will be addressed in the 200 East Groundwater Aggregate Area Management Study Report, [AAMSR]). Table 2 of Method A is intended for non-industrial site soil cleanups, and Table 3 is intended for industrial site soil cleanups. Method A industrial soil cleanup standards for preliminary contaminants of concern are provided as potential ARARs in Table 6-1.

In addition to Method A, Method B and Method C cleanup standards may also be considered potential ARARs for the PUREX Plant Aggregate Area. Method B and Method C cleanup standards can be calculated on a case-by-case basis in concert with Ecology. Method B and Method C should be used where Method A

standards do not exist or cannot be met, or where routine cleanup actions cannot be implemented at a specific waste management unit.

- **State Hazardous Waste Management Act and Dangerous Waste Regulations (Chapter 173-303 WAC).** The State of Washington is a RCRA-authorized state for hazardous waste management, and has developed state-specific hazardous waste regulations under the authority of the State Hazardous Waste Management Act. Generally, state hazardous waste regulations (WAC 173-303) parallel the federal regulations. The state definition of a hazardous waste incorporates the EPA designation of hazardous waste that is based on the compound being specifically listed as hazardous, or on the waste exhibiting the properties of reactivity, ignitability, corrosivity, or toxicity as determined by the TCLP.

  In addition, Washington State identifies other waste as hazardous. Three unique criteria are established: toxic dangerous waste; persistent dangerous waste; and carcinogenic dangerous waste. These additional designation criteria may be imposed by Ecology as potential ARARs, for purposes of determining acceptable cleanup standards and appropriate waste management standards.

- **Ambient Air Quality Standards and Emission Limits for Radionuclides (Chapter 173-480 WAC).** These Ecology ambient air quality standards specify maximum accumulated dose limits to members of the public. Other Air Quality Standards potentially applicable include carbon monoxide, ozone, nitrogen dioxide (WAC 173-475), and volatile organic compounds (VOCs) (WAC 173-490). Although these standards may be potential ARARs, these standards are less restrictive than DOE public dose limits per DOE Order 5400.5, Radiation Protection of the Public and the Environment.

- **Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (Chapters 246-247 WAC).** These standards by the Washington State Department of Health (Health) adopt the Ecology standards for maximum accumulated dose limits to members of the public. These standards apply to DOE facilities as provided in WAC 246-247-010 (2).

- **Controls for New Sources of Toxic Air Pollutants (Chapter 173-460 WAC).** In accordance with regulations recently promulgated by Ecology in Chapter 173-460 WAC, any new emission source will be subject to Toxic Air Pollutant emission standards. The regulations establish allowable ambient source impact levels (ASILs) for hundreds of organic and inorganic compounds. Ecology's ASILs may constitute potential ARARs for cleanup activities that have a potential

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to affect air. The ASILs for preliminary contaminants of concern are provided in Table 6-1.

- **Water Quality Standards.** Washington State has promulgated various numerical standards related to surface water and groundwater contaminants. These are included principally in the following regulations:

  - **Public Water Supplies (Chapter 248-54 WAC).** This regulation establishes drinking water standards for public water supplies. The standards essentially parallel the federal drinking water standards (40 CFR Parts 141 and 143).

  - **Water Quality Standards for Groundwaters of the State of Washington (RCW 90.48, Chapter 173-200 WAC).** This regulation establishes contaminant standards for protecting existing and future beneficial uses of groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwater.

  - **Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201 WAC and Proposed Amendments to Chapters 173-203 and 173-201 WAC).** Ecology has adopted numerical ambient water quality criteria for six conventional pollutant parameters (defined at WAC 173-201-025): (1) fecal coliform bacteria; (2) dissolved oxygen; (3) total dissolved gas; (4) temperature; (5) pH; and (6) turbidity. In addition, toxic, radioactive, or deleterious material concentrations shall be below those of public health significance or which may cause acute or chronic toxic conditions to the aquatic environment or which may adversely affect any water use. Numerical criteria currently exist for a limited number of toxic substances (WAC 173-201-047). Ecology has initiated rulemaking to modify and incorporate additional numerical criteria for toxic chemicals,and to reclassify certain waters of the state to Class A or better.

    Under the state Water Quality Standards, the criteria and classifications do not apply inside an authorized dilution zone surrounding a wastewater discharge. In defining dilution zones, Ecology generally follows guidelines contained in "Criteria for Sewage Works Design." Although water quality standards can be exceeded inside the dilution zone, state regulations will not permit

discharges that cause mortalities of fish or shellfish within the zone or that diminish aesthetic values.

Groundwater will be addressed in the 200 East Groundwater AAMSR in which pertinent groundwater-related potential ARARs will be covered. No surface water bodies exist within the PUREX Plant Aggregate Area, so there will be no need to achieve ambient water quality standards during remediation activities.

The numerical water quality standards cited above may become potential ARARs if selected remedial actions could result in discharges to groundwater or surface water (e.g., if treated wastewaters are discharged to the soil column or the Columbia River). Determining appropriate standards for such discharges will depend on the type of remediation performed and will have to be established on a case-by-case basis as remedial actions are defined.

- **National Pollutant Discharge Elimination System and Water Quality Standards (RCW 90.48, WAC 173-220 and 40 CFR 122).** National Pollutant Discharge Elimination System (NPDES) regulations govern point source discharges into navigable waters. Limits on the concentrations of contaminants and volumetric flowrates that may be discharged are determined on a case-by-case basis and permitted under this program. No point source discharges have been identified. The EPA implements this program in Washington State for federal facilities; however, assumption of the NPDES program by the state is likely within five years.

6.3 LOCATION-SPECIFIC REQUIREMENTS

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Table 6-2 lists various location-specific standards and indicates which of these may be potential ARARs. Potential ARARs have been identified as follows:

- **Floodplains.** Requirements for protecting floodplains are not ARARs for activities conducted within the PUREX Plant Aggregate Area as the aggregate area is not located in flood plain boundaries (see Section 3.1). However, remedial actions selected for cleanup may require projects in or near floodplains

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(e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific floodplain requirements may be potential ARARs.

- **Wetlands, Shorelines, and Rivers and Streams.** Requirements related to wetlands, shorelines, and rivers and streams are not ARARs for activities conducted within the PUREX Plant Aggregate Area. However, remedial actions selected for cleanup may require projects on a shoreline or wetland, or discharges to wetlands (e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific shoreline and wetlands requirements may be potential ARARs.

- **Threatened and Endangered Species Habitats.** As discussed in Section 3.6, various threatened and endangered species inhabit portions of the Hanford Site and may occur in the PUREX Plant Aggregate Area (American peregrine falcon, bald eagle, white pelican, and sandhill crane). Therefore, critical habitat protection for these species would constitute a potential ARAR.

- **Wild and Scenic Rivers.** The Columbia River Hanford Reach is currently undergoing study pursuant to the federal Wild and Scenic Rivers Act. Pending results of this study, actions that may impact the Hanford Reach may be restricted. This requirement would not be an ARAR for remedial activities within the PUREX Plant Aggregate Area. However, Wild and Scenic Rivers Act requirements may be potential ARARs for actions taken as a result of PUREX Plant Aggregate Area cleanup efforts that could affect the Hanford Reach.

6.4 ACTION-SPECIFIC REQUIREMENTS

Potential action-specific ARARs are requirements that are triggered by specific remedial actions at the site. These remedial actions will not be fully defined until a remedial approach has been selected. However, the universe of potential action-specific ARARs defined by a preliminary screening of potential remedial action alternatives will help focus the selection process. Potential action-specific ARARs are outlined below. (Note that potential contaminant- and potential location-specific ARARs discussed above will also include provisions for potential action-specific ARARs to be applied once the remedial action is selected.)

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6.4.1 Federal Requirements

- **Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601).** The CERCLA and regulations adopted pursuant to CERCLA contained in the National Contingency Plan (40 CFR Part 300) include selection criteria for remedial actions. Under the criteria, excavation and offsite land disposal options are least favored when onsite treatment options are available. Emphasis is placed on alternatives that permanently treat or immobilize contamination. Selected alternatives must be protective of human health and the environment, which implies that federal and state ARARs be met. However, a remedy may be selected that does not meet all ARARs if the requirement is technically impractical, if its implementation would produce a greater risk to human health or the environment, if an equivalent level of protection can otherwise be provided, if state standards are inconsistently applied, or if the remedy is only part of a complete remedial action which attains ARARs.

  The CERCLA gives state cleanup standards essentially equal importance as federal standards in guiding cleanup measures in cases where state standards are more stringent. State standards pertain only if they are generally applicable, were passed through formal means, were adopted on the basis of hydrologic, geologic, or other pertinent considerations, and do not preclude the option of land disposal by a state-wide ban. Most importantly, CERCLA provides that cleanup of a site must ensure that public health and the environment are protected. Selected remedies should meet all ARARs, but issues such as cost-effectiveness must be weighed in the selection process.

- **Resource Conservation and Recovery Act (42 USC 6901, 40 CFR 260 to 271).** The RCRA (42 USC 6901), and regulations adopted pursuant to RCRA, describe numerous action-specific requirements that may be potential ARARs for cleanup activities. The primary regulations are promulgated under 40 CFR Parts 262 (standards for generators), 264, and 265 (standards for owners and operators of hazardous waste treatment, storage, or disposal facilities), and include such action-specific requirements as follows:

  - Packaging, labeling, placarding, and manifesting of offsite waste shipments

  - Inspecting waste management areas to ensure proper performance and safe conditions

  - Preparation of plans and procedures to train personnel and respond to emergencies

- Management standards for containers, tanks, incinerators, and treatment units

- Design and performance standards for land disposal facilities

- Groundwater monitoring system design and performance.

Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

One key area of potential action-specific RCRA ARARs is the 40 CFR Part 268 LDRs. In addition to the contaminant-specific constituent concentration limits established in the LDRs (as previously discussed in Section 6.2), EPA has identified best demonstrated available treatment technologies (BDATs) for various waste streams. The EPA could require the use of BDATs prior to allowing land disposal of wastes generated during remediation. The EPA's imposition of the LDRs and BDAT requirements will depend on various factors.

Applicability to CERCLA actions is based on determinations of waste "placement/disposal" during a remediation action. According to OSWER Directive 9347.3-05FS, EPA concludes that Congress did not intend in situ consolidation, remediation, or improvement of structural stability to constitute placement or disposal. Placement or disposal would be considered to occur if:

- Wastes from different units are consolidated into one unit (other than a land disposal unit within an area of contamination)

- Waste is removed and treated outside a unit and redeposited into the same or another unit (other than a land disposal unit within an area of contamination)

- Waste is picked up from a unit and treated within the area of contamination in an incinerator, surface impoundment, or tank and then redeposited into the unit (except for in situ treatment).

Consequently, the requirement to use BDAT would not apply under the LDR standards unless placement or disposal had occurred. However, remediation actions involving excavation and treatment could trigger the requirements to use BDAT for wastes subject to the LDR standards. In addition, the agencies could consider BDAT technologies to be relevant and appropriate when developing and evaluating potential remediation technologies.

Two additional components of the LDR program should be considered with regard to an excavate and treat remedial action. First, a national capacity variance was issued by EPA for contaminated soil and debris for a two-year period ending May 8, 1992 (54 FR 26640). Second, a series of variances and exemptions may be applied under an excavate and treat scenario. These include the following:

- A no-migration petition
- A case-by-case extension to an effective date
- A treatability variance
- Mixed waste provisions of a Federal Facilities Compliance Act.

The applicability and relevance of each of these options will vary based on the specific details of a PUREX Plant Aggregate Area excavate and treat option. An analysis of these variances can be developed once engineering data on the option becomes available.

The effect of the LDR program on mixed waste management is significant. Currently, limited technologies are available for effective treatment of these waste streams and no commercially available treatment facilities exist except for liquid scintillation counting fluids used for laboratory analysis and testing. The EPA recognized that inadequate capacity exists and issued a national capacity variance until May 8, 1992, to allow for the development of such treatment capacity.

Lack of treatment and disposal capacity also presents implications for storage of these materials. Under 40 CFR 268.50, mixed wastes subject to LDR may be stored for up to one year. Beyond one year, the owner/operator has the burden of proving such storage is for accumulating sufficient quantities for treatment. On August 29, 1991, EPA issued a mixed waste storage enforcement policy providing some relief from this provision for generators of small volumes of mixed wastes. However, the policy was limited to facilities generating less than 28 m^3 (1,000 ft^3) of land disposal-prohibited waste per year. Congress is considering amendments to RCRA postponing the storage prohibition for another five years; however, final action on these amendments has not occurred.

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- **Clean Water Act (33 USC 1251).** Regulations adopted pursuant to the CWA (33 USC 1251) under the NPDES mandate use of best available treatmenttechnologies (BAT) prior to discharging contaminants to surface waters. The NPDES requirements would not be ARARs for actions conducted only within the PUREX Plant Aggregate Area. However, NPDES requirements could constitute potential ARARs for cleanup actions which would result in discharge of treated wastewaters to the Columbia River, and associated treatment systems could be required to utilize BAT.

- **Department of Transportation Standards (49 CFR 171 to 177).** The Department of Transportation standards contained in 49 CFR 171 to 177 specify the requirements for packaging, labeling, and placarding for offsite transport of hazardous materials. These standards ensure that hazardous substances and wastes are safely transported using adequate means of transport and proper documentation.

6.4.2 State of Washington Requirements

- **Hazardous Waste Management (WAC 173-303).** As discussed in Section 6.2.2, there are various requirements addressing the management of hazardous wastes that may be potential action-specific ARARs. Pertinent Washington regulations appear in Chapter 173-303 WAC (under the authority of RCW 70.105) and generally parallel federal management standards. Determination of potential ARARs will be on a case-by-case basis as cleanup actions proceed.

- **Solid Waste Management (WAC 173-304).** Washington State regulations describe management standards for solid waste in Chapter 173-304 WAC (under the authority of RCW 70.95). Some of these management standards may be potential ARARs for disposal of cleanup wastes within the PUREX Plant Aggregate Area. Solid waste standards include such requirements as follows:

  - Inspecting waste management areas to ensure proper performance and safe conditions
  - Management standards for incinerators and treatment units
  - Design and performance standards for landfills
  - Groundwater monitoring system design and performance.

Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

- **Water Quality Management.** Chapter 90.48 RCW, the Washington State Water Pollution Control Act (WPCA), requires use of all known, available, and reasonable treatment technologies (AKART) for treating contaminants prior to discharge to waters of the state. Implementing regulations appear principally at Chapters 173-216, 173-220, and 173-240 WAC.

  The WPCA requirements for groundwater could be potential ARARs for actions conducted within the PUREX Plant Aggregate Area if such actions would result in discharge of liquid contaminants to the soil column. In this event, Ecology would require use of AKART to treat the liquid discharges prior to soil disposal.

  The WPCA requirements for surface water would not be ARARs for actions conducted only within the PUREX Plant Aggregate Area. However, these requirements could potentially constitute ARARs for cleanup actions that would result in discharge of treated wastewaters to the Columbia River and associated treatment systems could be required to demonstrate they meet AKART.

- **Air Quality Management (RCW 70.94).** Under the authority of the Washington Clean Air Act (RCW 70.94) the Toxic Air Pollution regulations for new air emission sources, promulgated in Chapter 173-460 WAC, require use of best available control technology for air toxics (T-BACT). The Toxic Air Pollution regulations may be potential ARARs for cleanup actions at the PUREX Plant Aggregate Area that could result in emissions of toxic contaminants to the air. Ecology may require the use of T-BACT to treat such air emissions.

- **Water Well Construction (RCW 18.104).** This regulation establishes authority for Ecology to require the licensing of water well contractors and operators, and for the regulation of water well construction.

- **Nuclear Energy and Radiation (RCW 70.98).** Chapter 70.98 RCW establishes a program to establish procedures for assumption and performance of certain regulatory responsibilities with respect to byproduct, source, and special nuclear materials.

- **Pollution Disclosure Act (RCW 90.52).** Chapter 90.52 RCW describes the authority of the state to regulate reports for any commercial or industrial discharge, other than sanitary sewage, into waters of the state.

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- **Water Resources Act (RCW 90.54).** Chapter 90.54 RCW gives the state authority to implement water related resources programs.

- **Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC).** Well construction regulations establish minimum standards for water well construction and require the preparation of construction reports.

- **Rules and Regulations Governing the Licensing of Well Contractors and Operators (Chapter 173-162 WAC).** Chapter 173-162 WAC establishes requirements for licensing well drillers.

- **State Waste Discharge Permit Program (Chapter 173-216 WAC).** Chapter 173-216 WAC establishes a permit system for discharges of wastewater to groundwater and surface water via municipal sewage system.

- **Underground Injection Control Program (Chapter 173-218 WAC).** Chapter 173-218 WAC pertains to the injection of wastes into aquifers that are used for drinking water.

- **Incinerators (Chapter 173-303-170 WAC).** If incinerators are used for a remedial technology this regulation would be applicable.

6.5 OTHER CRITERIA AND GUIDANCE TO BE CONSIDERED

In addition to the potential ARARs presented, other federal and state criteria, advisories, guidance, and similar materials are TBC in determining the appropriate degree of remediation for the PUREX Plant Aggregate Area. A myriad of resources may be potentially evaluated. The following represents an initial assessment of pertinent TBC provisions.

6.5.1 Health Advisories

The EPA Office of Drinking Water publishes advisories identifying contaminants for which health advisories have been issued.

6.5.2 International Commission of Radiation Protection/National Council on Radiation Protection

The International Commission of Radiation Protection and the National Council on Radiation Protection have a guidance standard of 100 mrem/yr whole body dose of gamma radiation. These organizations also issue recommendations on other areas of interest regarding radiation protection.

6.5.3 Environmental Protection Agency Proposed Corrective Actions for Solid Waste Management Units

In the July 27, 1990, federal register (55 FR 30798), EPA published proposed regulations for performing corrective actions (cleanup activities) at solid waste management units associated with RCRA facilities. The proposed 40 CFR Part 264 Subpart S include requirements that would be TBCs for determining an appropriate level of cleanup at the PUREX Plant Aggregate Area. In particular, EPA included an appendix, "Appendix A - Examples of Concentrations Meeting Criteria for Action Levels," which presented recommended contaminant concentrations warranting corrective action. These contaminant-specific TBCs are included in Table 6-1 for the preliminary contaminants of concern.

6.5.4 Department of Energy Standards for Radiation Protection

A number of DOE Orders exist which could be TBCs. The DOE Orders that establish potential contaminant-specific or action-specific standards for the remediation of radioactive wastes and materials are discussed below.

- **DOE Order 5400.5 - DOE Standards for Radiation Protection of the Public and Environment.** The DOE Order 5400.5 establishes the requirements for DOE facilities to protect the environment and human health from radiation including soil and air contamination. The purpose of the Order is to establish standards and requirements for operations of the DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.

  The Order mandates that the exposure to members of the public from a radiation source as a consequence of routine activities shall not exceed 100 mrem/yr from all exposure sources due to routine DOE activities. In accordance with the Clean Air Act, exposures resulting from airborne emissions shall not exceed 10 mrem/yr to the maximally exposed individual at the facility boundary. The DOE

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Order 5400.5 provides Derived Concentration Guide (DCG) values for releases of radionuclides into the air or water. The DCG values are calculated so that, under conditions of continuous exposure, an individual would receive an effective dose equivalent of 100 mrem/yr. Because dispersion in air or water is not accounted for in the DCG, actual exposures of maximally exposed individuals in unrestricted areas are considerably below the 100 mrem/yr level.

The DOE Order 5400.5 also provides for establishment of soil cleanup levels through a site-specific pathway analysis such as the allowable residual contamination level method. The calculation of allowable residual contamination level values for radionuclides is dependent on the physical characteristics of the site, the radiation dose limit determined to be acceptable, and the scenarios of human exposure judged to be possible and to result in the upper-bound exposure.

- **DOE Order 5820.2A - Radioactive Waste Management.** The DOE Order 5820.2A applies to all DOE contractors and subcontractors performing work that involves management of waste containing radioactivity. This Order requires that wastes be managed in a manner that assures protection of the health and safety of the public, operating personnel, and the environment. The DOE Order 5820.2A establishes requirements for management of high-level, transuranic, and low-level wastes as well as wastes containing naturally occurring or accelerator produced radioactive material, and for decommissioning of facilities. The requirements applicable to the PUREX Plant Aggregate Area remediation activities include those related to transuranic waste and low-level radioactive waste. These are summarized below.

  - **Management of Transuranic Waste.** Transuranic (TRU) waste resulting from the PUREX Plant Aggregate Area remedial action must be managed to protect the public and worker health and safety, and the environment, and performed in compliance with applicable radiation protection standards and environmental regulations. Practical and cost-effective methods must be used to reduce the volume and toxicity of TRU waste.

    The TRU waste must be certified in compliance with the Waste Isolation Pilot Plant (WIPP) Acceptance Criteria, placed in interim storage, if required, and sent to the WIPP. Any TRU waste that the DOE has determined, with the concurrence of the EPA Administrator, does not need the degree of isolation provided by a geologic repository or TRU waste that cannot be certified or otherwise approved for acceptance at the WIPP must be disposed of by

alternative methods. Alternative disposal methods must be approved by DOE Headquarters and comply with NEPA requirements and EPA/state regulations.

- **Management of Low-Level Radioactive Waste.** The requirements for management of low-level radioactive waste presented in DOE Order 5820.2A are relevant to the remedial alternative of removal and disposal of PUREX Plant Aggregate Area wastes. Performance objectives for this option shall ensure that external exposure to the radioactive material released into surface water, groundwater, soil, plants, and animals does not result in an effective dose greater than 25 mrem/yr to the public. Releases to the environment shall be at levels as low as reasonably achievable. An inadvertent intruder after the institutional control period of 100 years is not to exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure. A performance assessment is to be prepared to demonstrate compliance with the above performance objectives.

Other requirements under DOE Order 5820.2A which may affect remediation of the PUREX Plant Aggregate Area include waste volume minimization, waste characterization, waste acceptance criteria, waste treatment, and shipment. The low-level radioactive waste may be stored by appropriate methods prior to disposal to achieve the performance objectives discussed above. Disposal site selection, closure/post-closure, and monitoring requirements are also discussed in this Order.

6.6 POINT OF APPLICABILITY

A significant factor in the evaluation of remedial alternatives for the PUREX Plant Aggregate Area will be the determination of the point at which compliance with identified ARARs must be achieved (i.e., the point of a specific ARAR's applicability). These points of applicability are the boundaries at which the effectiveness of a particular remedial alternative will be assessed.

For most individual radioactive species transported by either water or air, Ecology and Health standards generally require compliance at the boundaries of the Hanford Site (e.g., Clean Air Act, Section 6.2.1). The assumed point of compliance for radioactive species is the point where a member of the public would have unrestricted access to live and conduct business, and, consequently, to be maximally exposed. Although Health is responsible for monitoring and enforcing the air standards promulgated by Ecology, and generally recognizes

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the site boundary as the point of applicability, Ecology has recently indicated that compliance may be required at the point of emission.

The point at which compliance with identified ARARs must be achieved will be a significant factor in evaluating appropriate remedial alternatives in the PUREX Plant Aggregate Area. Applicability of ARARs at the point of discharge, at the boundary of the disposal unit, at the boundary of the AAMS, at the boundary of the Hanford Site, and/or at the point of maximum exposure will need to be determined.

6.7 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS EVALUATION

Evaluation of ARARs is an iterative process that will be conducted at multiple points throughout the remedial process:

- When the public health evaluation is conducted to assess risks at the PUREX Plant Aggregate Area, the contaminant-specific ARARs and advisories and location-specific ARARs will be identified more comprehensively and used to help determine the cleanup goals

- During detailed analysis of alternatives, all the ARARs and advisories for each alternative will be examined to determine what is needed to comply with other laws and to be protective of public health and the environment.

Following completion of the investigation, the remedial alternative selected must be able to attain all ARARs unless one of the six statutory waivers provided in Section 121 (d)(4)(A) through (f) of CERCLA is invoked. Finally, during remedial design, the technical specifications of construction must ensure attainment of ARARs. The six reasons ARARs can be waived are as follows:

- The remedial action is an interim measure, where the final remedy will attain ARARs upon completion

- Compliance will result in greater risk to human health and the environment than will other options

- Compliance is technically impracticable

- An alternative remedial action will attain the equivalent performance of the ARAR

- For state ARARs, the state has not consistently applied (or demonstrated the intention to consistently apply) the requirements in similar circumstances

- For CERCLA-financed actions under Section 104, compliance with the ARAR will not provide a balance between the need for protecting public health, welfare, and the environment at the facility, and the need for fund money to respond to other sites (this waiver is not applicable at the Hanford Site)

Once investigations have been completed and final remedies have been selected, the ARARs that must be met will be formally identified in the Record of Decision (ROD). Compliance with those ARARs specified in the ROD will be achieved through the remedial action. The ARARs may need to be reevaluated if unanticipated circumstances are encountered during remediation which prevent the ability to satisfy the identified ARARs.

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Table 6-1. Potential Contaminant-Specific ARARs and TBCs for Preliminary Inorganic and Organic Contaminants of Concern.

	RCRA TCLP Designation Limits	RCRA Land Ban Limits Nonwastewater		MTCA Method A Cleanup Levels Industrial Soil	WCAA Toxic Air Pollutants ASIL	RCRA Corrective Action Levels (Proposed) (1)	
	in mg/L	CCWE in mg/L	CCW in mg/kg	in mg/kg	in $\mu g/m^3$	Air in $\mu g/m^3$	Soil in mg/kg
INORGANIC CHEMICALS							
Arsenic	5.0	5.0	—	200	.00023[b/]	0.00007	80
Barium	100	100	—	—	1.7*	0.4	4,000
Beryllium	-	-	-	-	.00042**	.0004	.02
Boron	—	—	—	—	***	—	—
Cadmium	1.0	1.0	—	10	.00056[a/b/]	0.0006	40
Chromium	5.0	5.0	—	500	.000083[b/]	0.00009	40
Copper	—	—	—	—	3.3[a/]	—	—
Cyanide (total)	—	—	590	—	16.7	—	2,000
Fluoride	—	—	—	—	8.3[a/]	—	—
Iron	-	-	-	-	2.7	-	-
Lead	5.0	5.0	—	1,000	0.2	—	—
Manganese	—	—	—	—	16.7	—	—
Mercury	0.2	0.20 (low-level)	—	1.0	0.3[a/]	—	20
Nickel	—	-	—	—	3.3[a/]	—	2,000
Nitrite	—	—	—	—	—	—	—
Silver	5.0	5.0	-	-	0.03	-	200
Vanadium	—	—	—	—	0.2[b/]	—	—
Zinc	—	—	—	—	0.03	—	—
ORGANIC CHEMICALS							
Acetone	—	0.5g	160	—	5,927.4[a/]	—	8,000
Chloroform	6.0	-	5.6	—	0.043[b/]	0.04	100
Hydrazine	-	-	-	-	-	0.0002	0.2
Methylene chloride	—	0.96	0.33	0.5	2.0	0.3	90
Toluene	—	0.33	28	40.6	1,248.8	7,000	20,000

ASIL = Acceptable Source Impact Level
CCWE = Constituent Concentration in Waste Extract
CCW = Constituent Concentration in Waste
MTCA = Washington State Model Toxics Control Act
RCRA = Federal Resource Conservation and Recovery Act
TCLP = Toxic Characteristic Leaching Procedure
WCAA = Washington State Clean Air Act

a/ Cadmium and compounds
b/ as V205

mg/L = milligrams per liter
mg/kg = milligrams per kilogram
$\mu g/m^3$ = micrograms per cubic meter

(1) RCRA Corrective Action Levels are only proposed at this time (40 CFR Part 264 Subpart S), so are not ARARs yet; they are "To Be Considered."

* Soluble compounds Ba
** Beryllium and compounds
*** Borontrifluoride - 10.0

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Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
GEOLOGICAL:			
Within 154 m (500 ft) of a fault displaced in Holocene time.	New treatment, storage or disposal of hazardous waste prohibited.	Hazardous waste management near Holocene fault.	40 CFR 264.18; WAC 173-303-282
Holocene faults and subsidence areas.	New solid waste disposal facilities prohibited over faults with displacement in Holocene time, and in subsidence areas.	New solid waste management activities near Holocene fault.	WAC 173-304-130
Unstable slopes.	New solid waste disposal areas prohibited from hills with unstable slopes.	New solid waste disposal on an unstable slope.	WAC 173-304-130
100-year floodplains.	Solid and hazardous waste disposal facilities must be designed, built, operated, and maintained to prevent washout.	Solid or hazardous waste disposal in a 100-year floodplain.	40 CFR 264.18; WAC 173-303-282; WAC 173-304-460
	Avoid adverse effects, minimize potential harm, restore/preserve natural and beneficial values in floodplains.	Actions occurring in a floodplain.	40 CFR Part 6 Subpart A; 16 USC 661 et seq; 40 CFR 6.302
Salt dome and salt bed formations, underground mines, and caves.	Placement of non-containerized or bulk liquid hazardous wastes is prohibited.	Hazardous waste placement in salt dome, salt bed, mine, or cave.	40 CFR 264.18
SURFACE WATER:			
Wetlands.	New hazardous waste disposal facilities prohibited in wetlands.	Hazardous waste management within 154 m (500 ft) of wetland (one-quarter mile for land-based facilities).	WAC 173-303-282
	New solid waste disposal facilities prohibited within 61 m (200 ft) of surface water (stream, lake, pond, river, salt water body).	Solid waste disposal within 61 m (200 ft) of surface water.	WAC 173-304-130
	New solid waste disposal facilities prohibited in wetlands (swamps, marshes, bogs, estuaries, and similar areas).	Solid waste disposal in a wetland (swamp, marsh, bog, estuary, etc.).	WAC 173-304-130

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
	Discharge of dredged or fill materials into wetlands prohibited without a permit.	Discharges to wetlands and navigable waters.	40 CFR Part 230; 33 CFR Parts 303, and 320 to 330
	Minimize potential harm, avoid adverse effects, preserve and enhance wetlands.	Construction or management of property in wetlands.	40 CFR Part 6 Appendix A
Shorelines.	Actions prohibited within 61 m (200 ft) of shorelines of statewide significance unless permitted.	Actions near shorelines.	Chapter 90.58 RCW; Chapter 173-14 WAC.
Rivers and streams.	Avoid diversion, channeling or other actions that modify streams or rivers, or adversely affect fish or wildlife habitats and water resources.	Actions modifying a stream or river and affecting fish or wildlife.	40 CFR 6.302
Water code and water rights.	Specifies conditions for extracting surface water for non-domestic uses. In essence, the laws provide that water extraction must be consistent with beneficial uses of the resource and must not be wasteful.	Extracting surface water.	Chapter 90.03 RCW
GROUNDWATER:			
Water code and water rights.	Specifies conditions for extracting groundwater for non-domestic uses. In essence, the laws provide that water extraction must be consistent with beneficial uses of the resource and must not be wasteful.	Extracting groundwater.	Chapter 90.14 RCW
Sole source aquifer.	New solid and hazardous waste land disposal facilities prohibited over a sole source aquifer.	Disposal over a sole source aquifer.	WAC 173-303-282; WAC 173-304-130

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
Uppermost aquifer.	Bottom of lowest liner of new solid waste disposal facility must be at least 3 m (10 ft) above seasonal high water in uppermost aquifer (5 ft) if hydraulic gradient controls installed).	New solid waste disposal.	WAC 173-304-130
	Protects the upper aquifers and upper aquifer zones to avoid depletions, excessive water level declines, or reductions in water quality. State regulations for upper aquifer zones are applicable to remedial alternatives that involve treating groundwater or presenting risks of groundwater contamination.	Activities within an aquifer.	Chapter 173-154 WAC
	Requires that Ecology review and approve plans for waste water treatment facilities that discharge to groundwater.	New treatment facilities discharging to the groundwater.	Chapter 173-240 WAC
Aquifer Protection Areas.	Activities restricted within designated Aquifer Protection Areas.	Activities within an Aquifer Protection Area.	Chapter 36.36 RCW.
Groundwater Management Areas.	Activities restricted within Ground Water Management Areas.	Activities within a Groundwater Management Area.	Chapter 90.44 RCW; Chapter 173-100 WAC
DRINKING WATER SUPPLY:			
Drinking water supply well.	New solid waste disposal areas prohibited within 305 m (1,000) feet upgradient, or 90 days travel time, of drinking water supply well.	New solid waste disposal within 305 m (1,000 feet) of drinking water supply well.	WAC 173-304-130
Watershed.	New solid waste disposal areas prohibited within a watershed used by a public water supply system for municipal drinking water.	New solid waste disposal in a public watershed.	WAC 173-304-130

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
AIR:			
Attainment areas.	Defines emissions standards and design and operation of solid waste incinerator facilities.	Activities in an attainment area.	Chapter 173-434 WAC
	Defines when certification of operators is necessary at incinerators and landfills.	Activities in an attainment area.	Chapter 173-300 WAC
Non-attainment areas.	Restrictions on air emissions in areas designated as non-attainment areas under state and federal air quality programs.	Activities in a designated non-attainment area.	Chapter 70.94 RCW; Chapters 173-400 and 173-403 WAC.
SENSITIVE ENVIRONMENTS:			
Endangered/threatened species habitats.	New solid waste disposal prohibited from areas designated by US Fish and Wildlife Service as critical habitats for endangered/ threatened species.	New solid waste disposal in critical habitats.	WAC 173-304-130 16 U.S.C. 742 16 U.S.C. 2901 50 C.F.R. 17
	Actions within critical habitats must conserve endangered/threatened species.	Activities where endangered or threatened species exist.	50 CFR Parts 200 and 402.
Parks.	No new solid waste disposal areas within 305 m (1,000 feet) of state or national park.	New solid waste disposal near state/national park.	WAC 173-304-130
	Restrictions on activities in areas that are designated state parks, or recreation/ conservation areas.	Activities in state parks or recreation/conservation areas.	Chapter 43.51 RCW; Chapter 352.32 WAC
Wilderness areas.	Actions within designated wilderness areas must ensure area is preserved and not impaired.	Activities within designated wilderness areas.	16 USC 1131 et seq; 50 CFR 35.1 et seq
Wildlife refuge.	Restrictions on actions in areas that are part of the National Wildlife Refuge System.	Activities within designated wildlife refuges.	16 USC 668dd et seq; 50 CFR Part 27

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
Natural areas preserves.	Activities restricted in areas designated as having special habitat value (Natural Heritage Resources).	Activities within identified Natural Area Preserves.	Chapter 79.70 RCW; Chapter 332-650 WAC
Wild, scenic, or recreational rivers.	Avoid actions that would have adverse effects on designated wild, scenic, or recreational rivers.	Activities near wild, scenic, and recreational rivers.	16 USC 1271 et seq; 40 CFR 6.302; Chapter 79.72 RCW
Columbia River Gorge	Restrictions on activities that could affect resources in the Columbia River Gorge.	Activities within the Columbia River Gorge.	Chapter 43.97 RCW
UNIQUE LANDS AND PROPERTIES:			
Natural resource conservation areas.	Restrictions on activities within designated Conservation Areas.	Activities within designated Conservation Areas.	Chapter 79.71 RCW
Forest lands.	Activities restricted within state forest lands to minimize fire hazards and other adverse impacts.	Activities within state forest lands.	Chapter 76.04 RCW; Chapter 332-24 WAC
	Restrictions on activities in state and federal forest lands.	Activities within state and federal forest lands.	16 USC 1601; Chapter 76.09 RCW
Public lands.	Activities on public lands are restricted, regulated, or proscribed.	Activities on state-owned lands	Chapter 79.01 RCW
Scenic vistas.	Restrictions on activities that can occur in designated scenic areas.	Activities in designated scenic vista areas.	Chapter 47.42 RCW 16 U.S.C. 461
Historic areas.	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeologic properties and resources, and minimize harm to national landmarks.	Activities that could affect historic or archaeologic sites or artifacts.	16 UST 469, 470 et seq; 36 CFR Parts 65 and 800; Chapters 27.34, 27.53, and 27.58 RCW.

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation
LAND USE:			
Neighboring properties.	No new solid waste disposal areas within 30.5 m (100 feet) of the facility's property line.	New solid waste disposal within 30.5 m (100 feet) of facility property line.	WAC 173-304-130
	No new solid waste disposal areas within 76 m (250 feet) of property line of residential zone properties.	New solid waste disposal within 76 m (250 feet) of property line of residential property.	WAC 173-304-130
Proximity to airports.	Disposal of garbage that could attract birds prohibited within 3,050 m (10,000 ft) (turbojet aircraft)/1,524 m (5,000 ft) (piston-type aircraft) of airport runways.	Garbage disposal near airport.	WAC 173-304-130

7.0 PRELIMINARY REMEDIAL ACTION TECHNOLOGIES

Previous sections identified contaminants of concern at the PUREX Plant Aggregate Area, potential routes of exposure, and potentially applicable or relevant and appropriate requirements (ARARs). Section 7.0 identifies preliminary remedial action objectives (RAOs) and develops preliminary remedial action alternatives consistent with reducing the potential hazards of this contamination and satisfying potential ARARs. The overall objective of this section is to identify viable and innovative remedial action alternatives for media of concern at the PUREX Plant Aggregate Area.

The process of identifying viable remedial action alternatives consists of several steps. In Section 7.1, RAOs are first identified. Next, in Section 7.2, general response actions are determined along with specific treatment, resource recovery, and containment technologies within the general response categories. Specific process options belonging to each technology type are identified, and these process options are subsequently screened based on their effectiveness, implementability, and cost (Section 7.3). The combining of process options into alternatives occurs in Section 7.4. Here the alternatives are described and diagrammed. Criteria are then identified in Section 7.5 for preliminary screening of alternatives that may be applicable to the waste management units and unplanned release sites identified in the PUREX Plant Aggregate Area. Figure 7-1 is a matrix summarizing the development of the remedial action alternatives starting with media-specific RAOs.

Because of uncertainty regarding the nature and extent of contamination at the PUREX Plant Aggregate Area waste management units, recommendations for remedial alternatives are general and cover a broad range of actions. Remedial action alternatives will be considered and more fully developed in future focused feasibility studies (FFS). The *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) is used to focus the range of remedial action alternatives that will be evaluated in focused studies. In general, the *Hanford Site Past-Practice Strategy* remedial investigation (RI)/Feasibility Study (FS) and the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Corrective Measures Studies (CMS) are defined as the combination of interim remedial measures (IRMs), limited field investigations (LFIs) for final remedy selection where interim actions are not clearly justified, and focused or aggregate area feasibility/treatability studies for further evaluation of treatment alternatives. After completion of an IRM, data will be evaluated including concurrent characterization and monitoring data to determine if a final remedy can be selected.

A secondary purpose of the evaluation of preliminary remedial action alternatives is the identification of additional information needed to complete the evaluation. This information

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may include field data needs and treatability tests of selected technologies. Additional data will be developed for most waste management units or waste groups during future data gathering activities (e.g., LFIs, characterization supporting IRMs, or treatability studies). These data may be used to refine and supplement the RAOs and proposed alternatives identified in this initial study. Data needs are defined in Section 8.0. Alternatives involving technologies that are not well-demonstrated under the conditions of interest are identified in Sections 7.3 and 7.5. These technologies may require bench-scale and pilot-scale treatability studies. The intent is to conduct treatability studies for promising technologies early in the RI/FS process. Conclusions regarding the feasibility of some individual technologies may change after new data become available.

The bias-for-action philosophy of addressing contamination at the Hanford Site requires an expedited process for implementing remedial actions. Implementation of general response actions may be accomplished using an observational approach in which the implementation is redirected as information is obtained. This observational approach is an iterative process of data acquisition and refinement of the conceptual model. Data needs are determined by the model, and data collected to fulfill these needs are used as additional input to the model. Use of the observational approach while conducting response actions in the 200 Areas will allow integrating these actions with longer range objectives of final remediation of similar areas and the entire 200 Areas. Site characterization and remediation data will be collected concurrently with the use of LFIs, IRMs, and treatability testing. The knowledge gained through these different activities will be applied to similar areas. The overall goal of this approach is convergence on an appropriate response action as early as possible while continuing to obtain valuable characterization information during remediation phases.

7.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The RAOs are remediation goals for protection of human health and the environment that specify the contaminants and media of concern, exposure pathways, and allowable contaminant levels. The RAOs discussed in this section are considered to be preliminary and may change or be refined as new data are acquired and evaluated.

The fundamental objective of the corrective action process at the PUREX Plant Aggregate Area is to protect environmental resources and/or human receptors from the potential threats that may exist because of known or suspected contamination. Specific interim and final RAOs will depend in part on current and reasonable potential future land use in the PUREX Plant Aggregate Area and the 200 East Area. The RAOs also take into account the preference under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for permanent isolation and permanent or significant reduction of volume, toxicity, or mobility of hazardous substances.

To focus remedial actions with a bias for action through implementing IRMs, preliminary RAOs are identified for the 200 East Area and PUREX Plant Aggregate Area. The overall objective for the 200 East Area is as follows:

> Reduce the risk of harmful effects to the environment and human users of the area by isolating and permanently reducing the toxicity, mobility, or volume of contaminants from the source areas to meet ARARs or risk-based levels that will allow industrial use of the area (this is a potential final RAO, and an interim action objective based on current use of the 200 Areas).

The RAOs are further developed in Table 7-1 for media of concern and applicable exposure pathways (see Sections 4.1 and 4.2) for the PUREX Plant Aggregate Area. The media of concern for the PUREX Plant Aggregate Area include the following:

- Radionuclide-contaminated and chemically contaminated soils that could result in direct exposure or inhalation of vapors or particles
- Contaminated soils that are or could contribute to groundwater contamination
- Vadose zone vapors that could cause ambient air impacts or contribute to the lateral and vertical migration of contaminants in the soil and to the groundwater
- Biota that could mobilize radionuclides or chemical contaminants directly or could degrade the integrity of other controls, such as caps thereby mobilizing contaminants.

Waste materials currently stored in single-shell tanks that contribute or may contribute contaminants to environmental media will not be addressed by this aggregate area management study (AAMS) program but rather by the Single-Shell Tank Closure Program. In addition, groundwater as an exposure medium is not addressed in this source Aggregate Area Management Study Report (AAMSR).

7.2 PRELIMINARY GENERAL RESPONSE ACTIONS

General response actions represent broad classes of remedial measures that may be appropriate to achieve both interim and final RAOs at the PUREX Plant Aggregate Area, and are presented in Table 7-2. The following are the general response actions for the PUREX Plant Aggregate Area followed by a brief description:

- No action (applicable to specific facilities)

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- Institutional controls
- Waste removal and treatment or disposal
- Waste containment
- In situ waste treatment
- Combinations of the above actions.

These general response actions are intended to cover the range of options from no action to complete remediation. Included are options that satisfy the CERCLA preference for isolation and permanent or significant reduction in volume, mobility, and toxicity of hazardous substances. No action is included for evaluations as required by the National Environmental Policy Act (NEPA) and National Contingency Plan (NCP) [40 CFR 300.68 (f)(l)(v)] to provide a baseline for comparison with other response actions. The no action alternative may be appropriate for some facilities and sources of contamination if risk assessments determine acceptable natural resource or human health risks posed by those sources or facilities and no exceedances of contaminant-specific ARARs occur.

Institutional controls involve the use of physical barriers or access restrictions to reduce or eliminate public exposure to contamination. Many access and land use restrictions are currently in place at the Hanford Site and will remain in place during implementation of IRMs. Because the 200 Areas are already committed to waste management for the long term, institutional controls will also be important for final remedial measures alternatives.

Waste removal and treatment or disposal involves excavation of contamination sources for eventual treatment and/or disposal either on a small- or large-scale basis. One approach being considered for large-scale waste removal is macro-engineering, which is based on high volume excavation using conventional surface mining technologies. Waste removal on a macro-engineering scale would be used over large areas such as groups of waste management units, operable units, or operational areas as a final remedial action. Waste removal on a small scale would be conducted for individual waste management units on a selective basis. Small-scale waste removal could be conducted as either an interim or final remedial action.

The alternatives for disposal of the excavated waste would depend on the volume of soil and the nature of the contaminants:

- Soil that contained low levels of radionuclides but no hazardous chemical waste could be disposed of into existing disposal sites at Hanford, or it could be shipped to licensed offsite disposal sites.

- Soil that contained chemical contaminants but no radionuclides could be disposed of at existing offsite RCRA-approved landfills, or disposed of onsite in a Hanford RCRA-approved landfill.

- Soil that was designated as "mixed waste" with both low-level radionuclides and hazardous chemical contaminants would have to be disposed of at Hanford.

- There are currently no facilities at the Hanford Site or offsite for permanent disposal of transuranic (TRU) waste. If such soil was excavated, it would have to be temporarily stored at Hanford until a geologic repository disposal site was licensed and constructed or another disposal option is identified.

One potential problem with off-site disposal is the lack of an alternate disposal location that will decrease the potential human exposure over the long time required for many of the contaminants. Waste removal actions may not be needed, or only be required on a small scale, to protect human health or the environment for industrial uses of the 200 Areas.

Waste treatment involves the use of biological, thermal, physical, or chemical technologies. Typical treatment options include biological land farming, thermal processing, soil washing, and fixation/solidification/stabilization. As described in Section 7.3, some of the technologies that have been used as industrial sites may not be feasible at the Hanford Site. Some treatment technologies must be pilot tested before they could be implemented. Waste treatment could be conducted either as an interim or final action and may be appropriate in meeting RAOs for all potential future land uses.

Waste containment includes the use of capping technologies (i.e., capping and grouting) to minimize the driving force for downward or lateral migration of contaminants. Vertical barriers can also be used to minimize lateral migration and to prevent biota from penetrating into contaminated areas. Containment also provides a radiation exposure barrier and a barrier to direct exposure. In addition, these barriers provide long-term stability with relatively low maintenance requirements. Containment actions may be appropriate for either interim or final remedial actions.

In situ waste treatment includes thermal, chemical, physical, and biological technology types, of which there are several specific process options including in situ vitrification, in situ grouting or stabilization, soil flushing, and in situ biotreatment. The distinguishing feature of in situ treatment technologies is the ability to attain RAOs without removing the wastes. The final waste form generally remains in place. This feature is advantageous when exposure during excavation would be significant or when excavation is technically impractical. In situ treatment can be difficult because the process conditions may not be easily controlled.

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In the next section, specific process options within these technology groups are evaluated.

7.3 TECHNOLOGY SCREENING

In this section, potentially applicable technology types and process options are identified. These process options are then screened using effectiveness, implementability, and relative cost as criteria to eliminate those process options that would not be feasible at the site. The remaining applicable processes are then grouped into remedial alternatives in Section 7.4.

The effectiveness criteria focuses on: (1) the potential effectiveness of process options in handling the areas or volumes of media and meeting the RAOs; (2) the potential impacts to human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site. This criteria also concentrates on the ability of a process option to treat a contaminant type (organics, inorganics, metals, radionuclides, etc.) rather than a specific contaminant (nitrate, cyanide, chromium, plutonium, etc.).

The implementability criteria places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services, and the availability of necessary equipment and skilled workers to implement the technology. It also focuses on the process option's developmental status, whether it is an experimental or established technology.

The relative cost criterion is an estimate of the overall cost of a process, including capital and operating costs. At this stage in the process, the cost analysis is made on the basis of engineering judgement, and each process is evaluated as to whether the costs are high, medium, or low relative to other process options.

A process option is rated effective if it can handle the amount of area or media required, if it does not impact human health or the environment during the construction and implementation phases, and if it is a proven or reliable process with respect to the contaminants and conditions at the site. Also a process option is considered more effective if it treats a wide range of contaminants rather than a specific contaminant. An example of a very effective process option would be vitrification because it treats inorganics, metals, and radionuclides. On the other hand, chemical reduction may only treat chromium (VI), making it a less useful option.

An easily implemented process option is one that is an established technology, uses readily available equipment and skilled workers, uses treatment, storage, and disposal services that are readily available, and has few regulatory constraints. Preference is given to technologies that are easily implemented.

Preference is given to lower cost options, but cost is not an exclusionary criterion. A process option is not eliminated based on cost alone.

Results of the screening process are shown in Table 7-3. Brief descriptions are given of the process options, followed by comments regarding the evaluation criteria. The last column of the table indicates whether the process option is rejected or carried forward for possible alternative formation. The table first lists technologies that address soil RAOs. Next, technologies pertaining to biota RAOs are presented. All the biota-specific technologies happen to be technologies that were listed for soil RAOs. Air RAOs are dealt with as soil remediation issues because the air contamination is a result of the contaminants in the soil: addressing and remediating the air pathways would be unnecessary and ineffective as long as there is soil contamination. If the soil is remediated, the source of the air contamination would be removed.

The conclusions column of Table 7-3 indicates that no action, monitoring, 3 institutional process options, and 16 other process options are retained for further development of alternatives. These options are carried forward into the development of preliminary alternatives.

7.4 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

This section develops and describes several remedial alternatives considered applicable to disposal sites that contain hazardous chemicals, radionuclides, and volatile and semivolatile organic compounds (VOCs). These alternatives are not intended as recommended actions for any individual units, but are intended only to provide potential options applicable to most units where multiple contaminants are present. Selection of actual remedial alternatives that should be applied to the individual units would be partly based on future expedited or interim actions and LFIs, as recommended in Section 9.0 of this report. Selection of proper alternatives would be conducted within the framework of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) and the strategy outlined in Section 9.4. The selection process would also be based on a preference for isolation and permanent treatment.

The remedial alternatives are developed in Section 7.4.1. Then, in Section 7.4.2 through Section 7.4.7, the remedial action alternatives are described. Detailed evaluations

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and costs are not provided because site-specific conditions must be further investigated before meaningful evaluations could be conducted.

7.4.1 Development of Remedial Alternatives

Potentially feasible remedial technologies were described and evaluated in Section 7.3. Some of those technologies have been proven to be effective and constructible at industrial waste management units, while other technologies are in the developmental stages. The EPA guidance (EPA 1988b) on FSs for uncontrolled waste management units recommends that a limited number of candidate technologies be grouped into "Remedial Alternatives." For this study, technologies were combined to develop remedial alternatives and provide at least one alternative for each of the following general strategies:

- No action
- Institutional controls
- Removal, above-ground treatment, and disposal
- Containment
- In situ treatment.

The alternatives are intended to treat all or a major component of the PUREX Plant Aggregate Area contaminated waste management units or unplanned releases. Consistent with the development of RAOs and technologies, alternatives were developed based on treating classes of compounds (radionuclides, heavy metals, inorganics, and organics) rather than specific contaminants. At a minimum, the alternative must be a complete package. For example, disposal of radionuclide-contaminated soil must be combined with excavation and backfilling of the excavated unit.

One important factor in the development of the preliminary remedial action alternatives is the fact that radionuclides, heavy metals, and some inorganic compounds cannot be destroyed. Rather, these compounds must be physically immobilized, contained, isolated, or chemically converted to less mobile forms to satisfy RAOs. Organic compounds can be destroyed, but may represent a smaller portion of the overall contamination at the PUREX Plant Aggregate Area. Both no action and institutional control options are required to be considered as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI/FS guidance. The purpose of including both of these

alternatives is to provide decision makers with information on the entire range of available remedial actions.

For the containment alternative, an engineered multimedia cover, with or without vertical barriers (depending on the specifics of the remediation) was selected. Two alternatives were selected to represent the excavation and treatment strategy. One of these deals with disposal of TRU contaminated soils. Finally, three in situ alternatives were identified. One deals with vapor extraction for VOCs, one with stabilization of soils and the other with vitrification of soils.

It is recognized that this does not represent an exhaustive list of all applicable alternatives. However, these do provide a reasonable range of remedial actions that are likely to be evaluated in future FSs. The remedial action alternatives are summarized as follows:

- No action
- Institutional controls
- Engineered multimedia cover with or without vertical barriers (containment); Feasible vertical barriers include slurry walls and grout curtains
- In situ grouting or stabilization of soil (in situ treatment)
- Excavation, above-ground treatment, and disposal of soil (removal, treatment and disposal); Feasible technologies for organic compounds include thermal processing and stabilization; Feasible technologies for radionuclides include soil washing, vitrification, and stabilization
- In situ vitrification of soil (in situ treatment)
- Excavation, treatment, and geologic disposal of soil with TRU radionuclides (removal, treatment, and disposal)
- In situ soil vapor extraction of VOCs (in situ treatment).

These alternatives, with the exception of no action and institutional controls, were developed because they satisfy a number of RAOs simultaneously and use technologies that are appropriate for a wide range of contaminant types. For example, constructing an engineered multimedia cover may effectively contain radionuclides, heavy metals, inorganic compounds, and organic compounds simultaneously. It satisfies the RAO of protecting

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human health and the environment from direct exposures from contaminated soil, bio-mobilization, and airborne contaminants. In situ soil vapor extraction is more specific than the other alternatives, but it addresses a contaminant class (VOCs) that is not readily treated using the other options, such as in situ stabilization. It is possible that some waste management units may require a combination of the identified alternatives to completely address all contaminants.

The use of contaminant-specific remedial technologies was avoided because there appear to be few, if any, waste management units where a single contaminant has been identified. It is possible to construct alternatives that include several contaminant-specific technologies, but the number of combinations of technologies would result in an unmanageable number of alternatives. Moreover, the possible presence of unidentified contaminants may render specific alternatives unusable. Alternatives may be refined as more contamination data are acquired. For now, the alternatives will be directed at remediating the major classes of compounds (radionuclides, heavy metals, inorganics, and organics).

In all alternatives except the no-action alternative, it is assumed that monitoring and institutional controls are required, although they may be temporary. These features are not explicitly mentioned, and details are purposely omitted until a more detailed evaluation may be performed in subsequent studies. Also, treatability studies may accompany many of the alternative during implementation.

In the next sections, the preliminary remedial action alternatives are described in more detail, with the exception of the no-action and institutional control options.

7.4.2 Alternative 1--Engineered Multimedia Cover with or without Vertical Barriers

Alternative 1 consists of an engineered multimedia cover. Vertical barriers such as grout curtains or slurry walls may be used in conjunction with the cover. Figure 7-2 shows a schematic diagram of an engineered multimedia cover with the vertical barriers. If the affected area includes either a naturally occurring or engineered depression, then imported backfill would be placed to control runoff and run-on water. The engineered cover itself may consist of fine-grained soil, gravel, sand, asphalt, top soil, and/or geo-synthetic liners. A liquid collection layer could also be included. The specific design of the cover and vertical barriers would be the subject of a focused feasibility study (FFS) which may be supported by treatability studies and performance testing. The barrier would be designed to minimize infiltration of surface water and to minimize biological intrusion (e.g., deep-rooting plants and burrowing animals). The covered area may be fenced, and warning signs may be posted.

Alternative 1 would provide a permanent cover over the affected area. The cover would accomplish the following: minimize the migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contamination and reduce the volatilization of VOCs and tritium to the atmosphere. If vertical barriers are included, they would limit the amount of lateral migration of contaminants.

This alternative would not reduce the volume or toxicity of the contaminants, and periodic inspections, maintenance, and monitoring would be required for an indefinite period.

7.4.3 Alternative 2--In Situ Grouting or Stabilization of Soil

Radioactive and hazardous soil would be grouted in this alternative using in situ injection methods to significantly reduce the leachability of hazardous contaminants, radionuclides and/or VOCs from the affected soil. This technology has not been proven to be effective for VOCs, so it is not recommended as the sole remedial action for VOC affected areas. Grouting may also be used to fill voids, such as in cribs, thereby reducing subsidence. Another variation of this alternative would be to stabilize the soil using in situ mixing of soil with stabilizing compounds such as pozzolanics or fly ash.

There are two common methods of in situ grout injection that have been used at industrial sites. In the first method (shown on Figure 7-3), grout injection wells are installed at prescribed lateral spacing (based on pilot tests) and screened through the affected vertical zones. Specially formulated grout is then injected at high pressure, to provide overlapping zones of influence, and allowed to cure. This first method can theoretically be used to stabilize soil deep below the ground surface. In the second method, a patented large diameter auger/mixer is used to mechanically agitate and blend grout mixtures that are injected into the soil through ports in the auger. This method has commonly been used to grout large areas of soil down to a depth of about 4.6 m (15 ft).

Alternative 2 would provide a combination of immobilization and containment of heavy metal, radionuclide, and inorganic, and semivolatile organic contamination. Thus, this alternative would reduce migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contaminated soils; and reduce the volatilization of VOCs.

In situ grouting has been demonstrated to be effective for stabilization of metals and semivolatile organic compounds at several CERCLA sites. However, this is considered to be a developing technology and has not yet been fully proven. Therefore, it is expected that

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treatability tests would be required. Because this alternative would not remove the contaminants from the soil, it is likely that institutional controls might also be required.

7.4.4 Alternative 3--Excavation, Soil Treatment, and Disposal

Under Alternative 3, radioactive and hazardous soil would be excavated using conventional techniques, with special precautions to minimize fugitive dust generation. Depending on the configuration of the area to be excavated, shoring might be required to comply with safety requirements and to reduce the quantity of excavated soil. The excavated soil would be treated above ground. Several treatment options could be selected from the physical, chemical, and thermal treatment process options screened in Section 7.3. For example, thermal desorption with off-gas treatment could be used if organic compounds are present; soil washing could be used to remove contaminated silts and sands or specific compounds; and stabilization could be used to immobilize radionuclides and heavy metals. The specific treatment method would depend on site-specific conditions. Treatability tests wold be performed to determine the specific soil treatment protocols methodology. The treated soil would be backfilled into the original excavation or landfilled. Soil treatment by-products may require additional processing or treatment. Figure 7-4 shows a schematic diagram of this alternative.

Alternative 3 would be effective in treating a full range of contamination, depending on the type of treatment processes selected. Attainment of soil RAOs would depend on the depth to which the soil was excavated. If near surface soil was treated, airborne contamination, direct exposure to contaminated soil, and bio-mobilization of contamination would be minimized. Because of practical limits on deep excavation, deep contamination may not be removed and would be subject to migration into groundwater. Alternative 3 could be used in conjunction with Alternative 1 (multimedia cap) to reduce this possibility.

A combination of laboratory treatability tests and pilot-scale field tests might be required to develop the optimum methods for above-ground treatment of the excavated soil. The specification of the required treatability test would depend on the nature of the contaminants at each of the remediation sites.

7.4.5 Alternative 4--In Situ Vitrification of Soil

In this alternative, the contaminated soil in a subject site would be immobilized by in situ vitrification. Treatability tests would be performed initially to determine the unit-specific operating conditions. Figure 7-5 shows a schematic diagram of the alternative. Import fill would initially be placed over the affected area to reduce exposures to the remediation

workers from surface contamination. High power electrodes would be used to vitrify the contaminated soil under the site to a depth below where contamination is present. A large fume hood would be constructed over the site before the start of the vitrification process to collect and treat emissions. After completion of the vitrification, the site would be built back to original grade with imported backfill. Fences and warning signs may be placed around the vitrified monolith to minimize disturbance and potential exposure.

In situ vitrification would be effective in treating radionuclides, heavy metals, and inorganic contamination and may also destroy organic contaminants. This would reduce the potential for exposures by leaching to groundwater, windblown dust and direct dermal contact. However, this alternative would not reduce the mass or toxicity of the radionuclides present onsite. Also, in situ vitrification may be limited to depths of less than about 30 m (100 ft), which may not be adequate to immobilize deep contamination.

If organic compounds are present in the affected area, they could migrate laterally and vertically during the vitrification process, as a result of the soil heating process. Therefore, this technology must include provisions for collecting and treating organic vapors. This could be done using a combination of soil venting wells and an above-ground capture hood.

It should be noted that the in situ vitrification is a relatively new technology which is experiencing some "growing pains," and has not yet been used for a large-scale cleanup at an industrial site. Therefore, using this technology at the Hanford Site will likely require extensive pilot testing.

7.4.6 Alternative 5--Excavation, Above-Ground Treatment, and Geologic Disposal of Soil with TRU Radionuclides

Some of the waste management units in the PUREX Plant Aggregate Area may contain isolated zones where the concentrations of TRU radionuclides exceed 100nCi/g. For Alternative 5, the soil from those isolated zones would be excavated, stabilized or treated, and shipped to an offsite geologic disposal site. Such a disposal facility has not yet been licensed, so interim storage of the stabilized soil may be required until the facility is constructed.

Figure 7-6 shows a schematic diagram of Alternative 5. Depending on the configuration of the affected area, shoring may be required during excavation to comply with worker safety regulations and to minimize the amount of excavated soil. Special excavation procedures would have to be used to minimize fugitive dust. The excavated soil would be sorted according to its TRU concentration. Soil with TRU radionuclides exceeding 100

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nCi/g would be either vitrified or stabilized using and above-ground treatment plant, then stored until a geologic disposal facility was available.

Some of the excavated soil could contain TRU radionuclides at concentrations less than 100 nCi/g. This would be treated using a combination of the technologies described in Section 7.3. After the non-TRU soil was treated to achieve appropriate cleanup standards, it could be backfilled into the original excavation. Alternatively, the non-TRU soil could be disposed of at an appropriate landfill. Imported fill material would be used to restore the unit to its original grade. If the residual unexcavated soil or the treated soil used for backfill contained contaminants at concentrations exceeding the RAOs, then a combination of an engineered cover and vertical barriers (Alternative 1) might have to be installed at the unit to prevent direct exposure or groundwater impacts.

This alternative would utilize many excavation and treatment technologies that have been only partly demonstrated at industrial sites. Extensive treatability testing would be required for the TRU-containing soil to develop optimum methods for treating or stabilizing the TRU radionuclides. Additional treatability studies might be required to support the above-ground treatment of the non-TRU soil.

For Alternative 5, soil containing TRU radionuclides at concentrations exceeding 100 nCi/g would be excavated, treated, and disposed. Thus, potential exposure to and migration of TRU-wastes would be minimized. Potential exposure to other contaminants would be determined by other remedial alternatives implemented. At sites containing TRU and non-TRU wastes, the use of Alternative 5 alone may not satisfy all RAOs.

7.4.7 Alternative 6--In Situ Soil Vapor Extraction for Volatile Organic Compounds

Figure 7-7 shows a schematic diagram of a representative soil vapor extraction system. Soil vapor is vented from wells that are screened in permeable soil zones that contain high organic vapor concentrations. The vented air would be treated to remove water vapor, the organic vapor of concern, particulate radionuclides that might be entrained in the air stream, and volatile radionuclides. Figure 7-7 shows one common combination of offgas treatment technologies; other technologies can also be used depending on the nature of the vapors that are extracted. Water vapor must be removed (usually by condensation) to protect the vacuum pumps. If the condensed water contains organic contamination or radionuclides, then it would have to be treated and/or disposed of in an appropriate manner. Particulate radionuclides that were entrained in the air stream can be effectively removed using banks of conventional High Efficiency Particulate Air (HEPA) filters. The organic vapors would have to be treated to satisfy best available control technology (BACT) in accordance with air toxics regulations. If the disposal site is considered a RCRA facility, then the offgas

treatment system must also satisfy RCRA emission control standards. Destruction efficiencies exceeding 98% have often been achieved using soil vapor extraction systems at industrial sites. The required destruction efficiency will be determined based on applicable ARARs.

A pilot-scale test would probably have to be performed to determine the required venting well spacing and the required vacuum pump design. Analysis of the vented gas during the pilot test would be done to assess what types of offgas emission controls would be required.

Some of the waste management units at the PUREX Plant Aggregate Area contain VOCs along with other non-volatile contaminants. Alternative 6 utilizes proven technologies to remove the volatilized vapors from the vadose zone soil. In situ soil vapor extraction is a proven technology for removal of VOC from the vadose zone soils although some pilot-scale testing may be needed at specific units. Soil vapor extraction would reduce downward migration of the VOC vapors through the vadose zone, and thereby minimize potential cross-media migration into the groundwater. Soil vapor extraction would reduce upward migration of VOC through the soil column into the atmosphere, and thereby minimize inhalation exposures to the contaminants. In some cases the radionuclides were discharged to the waste management units with VOCs (e.g., MIBK). Removal of the VOC by implementing soil vapor extraction could reduce the mobility of the radionuclides, and thereby reduce the potential for downward migration of the radionuclides. Finally, soil vapor extraction would enhance partitioning of the VOC off of the soil and into the vented air stream, resulting in the permanent removal and destruction of the VOC. Alternative 6 may be used in conjunction with other alternatives if contaminants other than VOCs are present. However, because of the limited number of PUREX Plant Aggregate Area units that contain VOCs, the use of soil vapor extraction will not be extensive.

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7.5 PRELIMINARY REMEDIAL ACTION ALTERNATIVES APPLICABLE TO WASTE MANAGEMENT UNITS AND UNPLANNED RELEASE SITES

The purpose of this section is to discuss which preliminary remedial action alternatives could be used to remediate each PUREX Plant Aggregate Area waste management unit or unplanned release site. The criteria used for deciding this are as follows:

- Installing an engineered multimedia cover with or without vertical barriers (Alternative 1) could be used on any site where contaminants may be leached or mobilized by surface water infiltration or if surface/near-surface contamination exists.

- In situ grouting or stabilization (Alternative 2) could be used on any waste management unit or unplanned release site that contain heavy metals, radionuclides, and/or other inorganic compounds. In situ grouting could also be effective in filling voids for subsidence control.

- Excavation and soil treatment (Alternative 3) could be used at most waste management units or unplanned release sites that contain radionuclides, heavy metals, other inorganics compounds, ~~and/or~~ semi-volatile organic compounds, and VOCs.

- In situ vitrification (Alternative 4) could be used at most waste management units or unplanned release sites, although vapor extraction may be needed when VOCs are present. Waste management units or unplanned release sites where in situ vitrification may not be effective include reverse wells and other sites where the contamination is present in a very narrow geometry. In situ vitrification is also not considered for surface spills.

- Excavation, treatment, and geologic disposal of TRU-containing soils (Alternative 5) could only be used ~~only~~ on those waste management units and unplanned release sites that contain TRU radionuclides. Since a geologic repository is likely to accept only TRU radioactive soils, the non-TRU radioactive soils will not be remediated using this alternative.

- In situ soil vapor extraction (Alternative 6) could be used on any waste management unit or unplanned release sites that contains volatile organic compounds. Such sites are not common in the PUREX Plant Aggregate Area. Nonetheless, the 216-A-8 Crib, where butyl phosphate and/or paraffin hydrocarbons were disposed, is one site at which soil vapor extraction would be an effective remedy.

~~Using these criteria, Table 7-4 was created showing possible preliminary remedial action alternatives that could be used to remediate each of the waste management units and unplanned release sites. Table 7-4 excludes sites that will be addressed by other programs. For example, single-shell tanks are excluded because they will be addressed by the single-shell tank program. Note that a single alternative may not be sufficient to remediate all contamination at a single site. For example, soil vapor extraction to remove organic contaminants could precede in-situ vitrification. Also, different combinations of technologies are possible besides those presented in these preliminary alternatives.~~ Using these criteria, Table 7-4 was created showing possible preliminary remedial action alternatives that could be used to remediate each of the waste management units and unplanned release sites. Each waste management unit or unplanned release may require just one alternative or a

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combination of many alternatives. Furthermore, similar units may be remediated simultaneously. Also, more specific waste treatment alternatives could be identified and evaluated as more information is obtained. Note that a single alternative may not be sufficient to remediate all contamination at a single waste management unit or unplanned release site. For example, soil vapor extraction could precede in situ vitrification to remove organic contaminants. Also, different combinations of technologies are possible besides those presented in these preliminary alternatives. Table 7-4 excludes units that are covered by other programs. For example, single-shell tanks are excluded because they are addressed by the Single-Shell Tank Closure Program.

Each waste management unit or unplanned release site may require just one alternative or a combination of many alternatives. Furthermore, similar sites may be remediated simultaneously. Also, more specific waste treatment alternatives could be identified and evaluated as more information is obtained.

Technology development studies will be needed for the in situ vitrification process, and treatability studies will be needed for the in situ grouting or stabilization process, and for soil treatment processes to make sure that they will effectively remediate the contaminants. Specifically, organic waste mobility may be a problem for in situ vitrification; grouting agents and the resulting reduction of contaminant leachability will need to be determined before in situ grouting can be performed; and appropriate treatment protocols and systems will need to be identified before soil washing can be used. Capping, soil vapor extraction, and disposal options are all proven processes but may require site-specific performance assessment (treatability) studies.

~~A~~The FFSs will be required to evaluate alternative designs for all of the alternatives evaluated, as they relate to the specific waste management unit being remediated. A site-by-site economic evaluation is also required before making a decision. This evaluation will require site-specific information obtained in LFIs and FFSs.

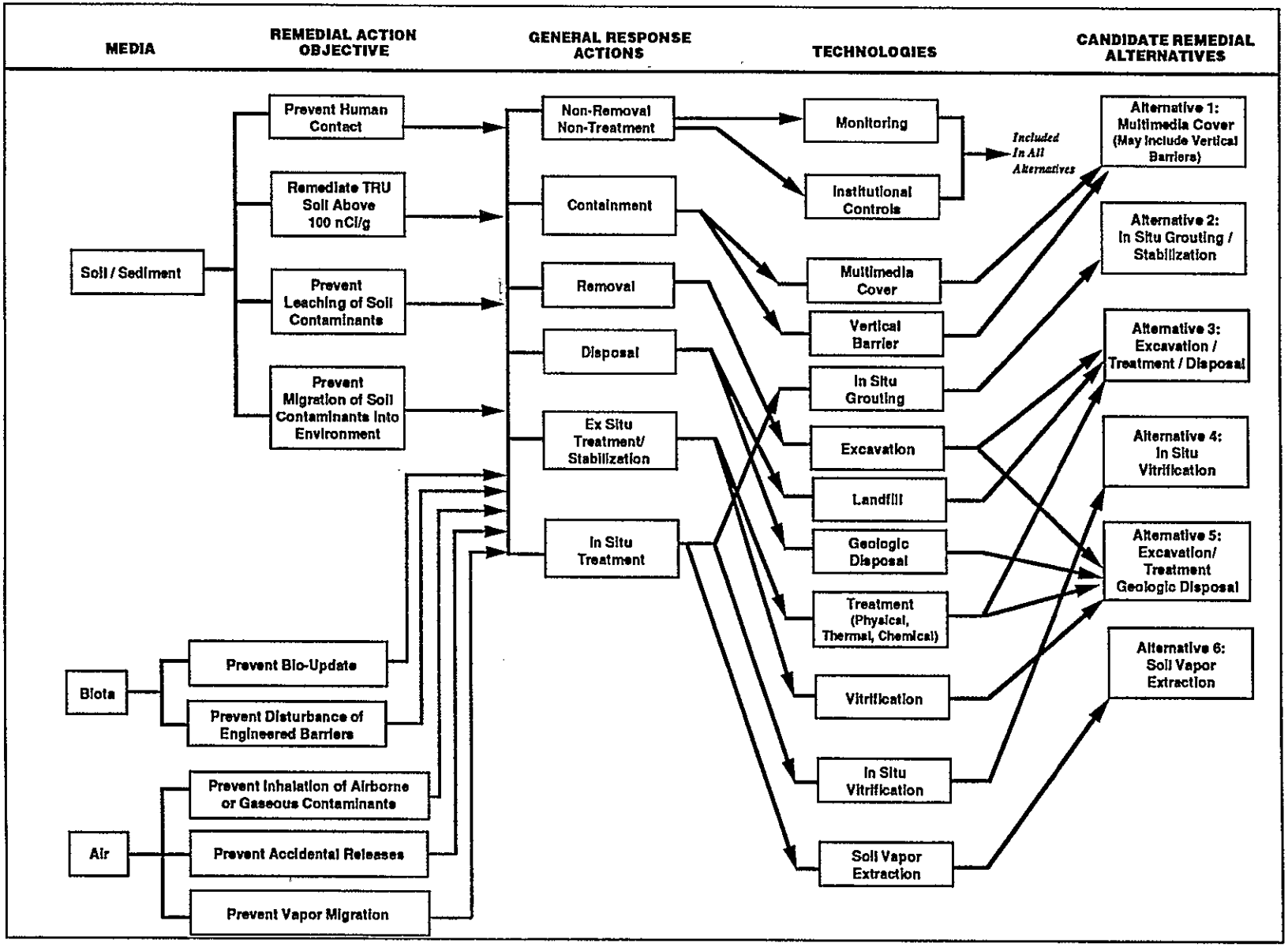

Figure 7-1. Development of Candidate Remedial Alternatives for the PUREX Plant Aggregate Area.

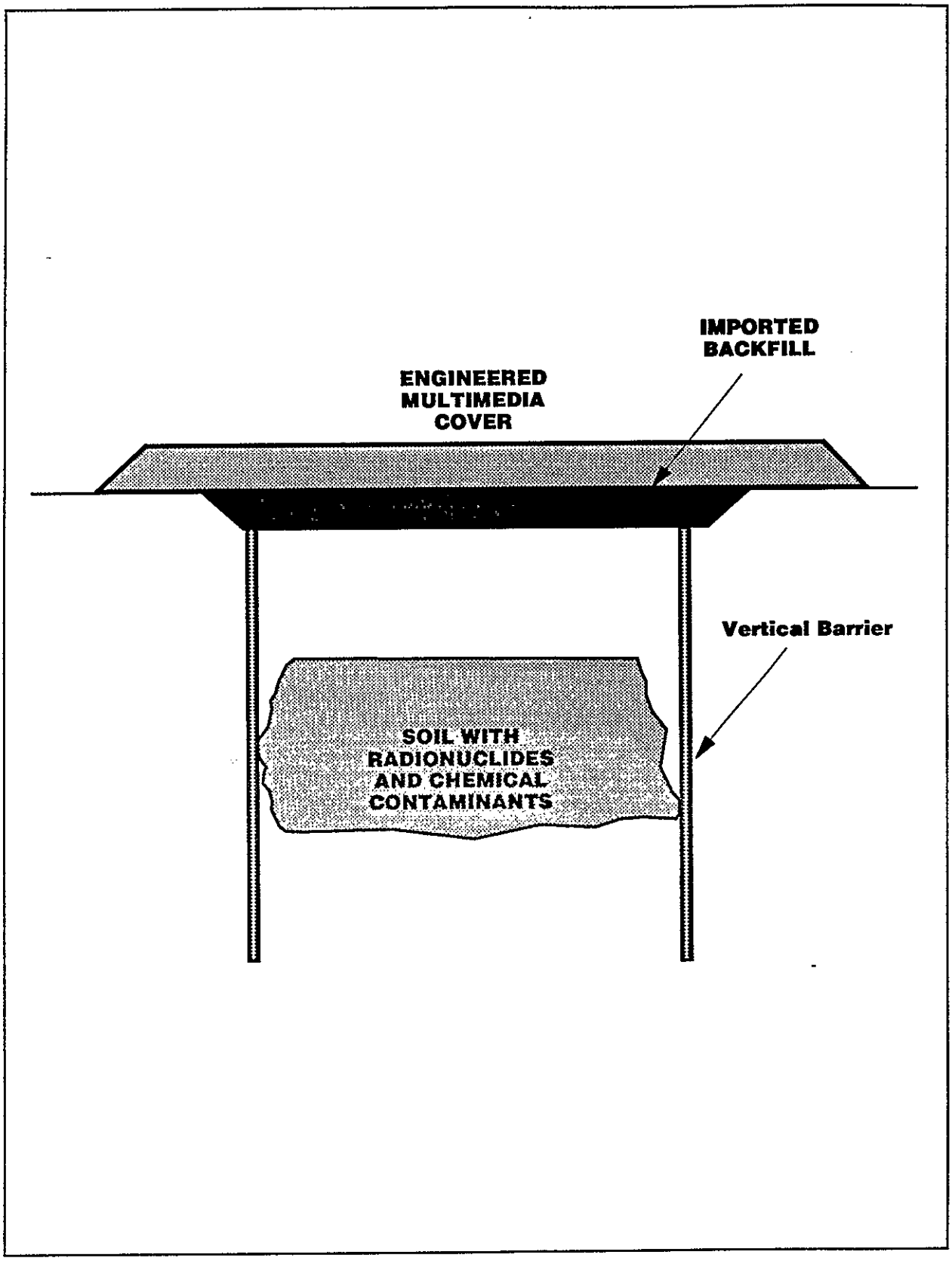

Figure 7-2. Alternative 1: Multimedia Cover With Vertical Barrier.

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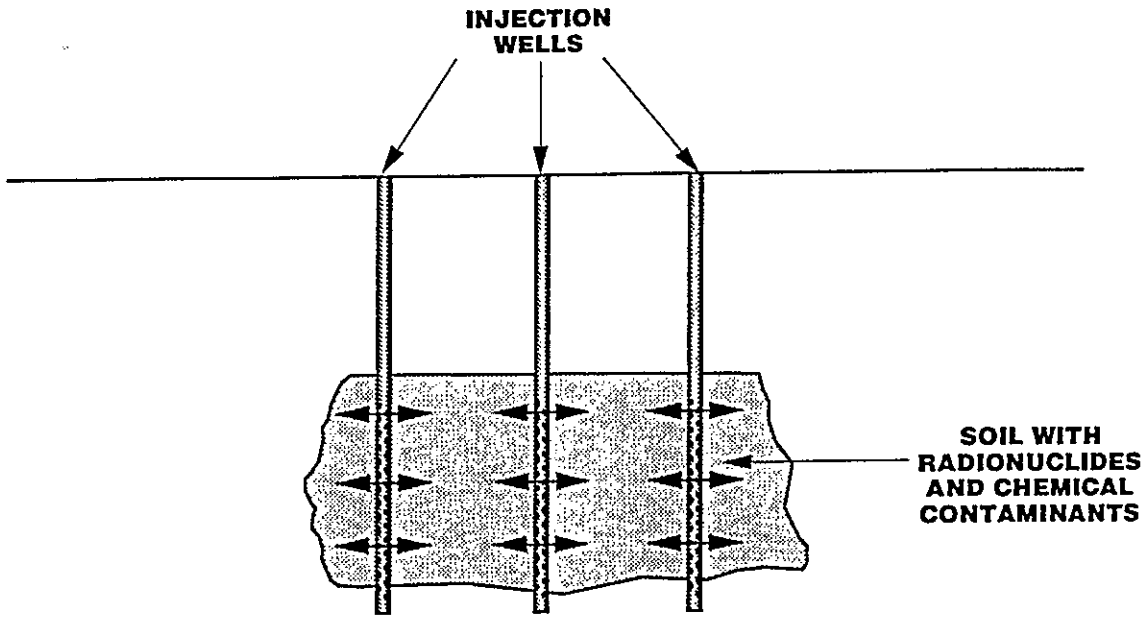

Figure 7-3. Alternative 2: In Situ Grouting of Soil.

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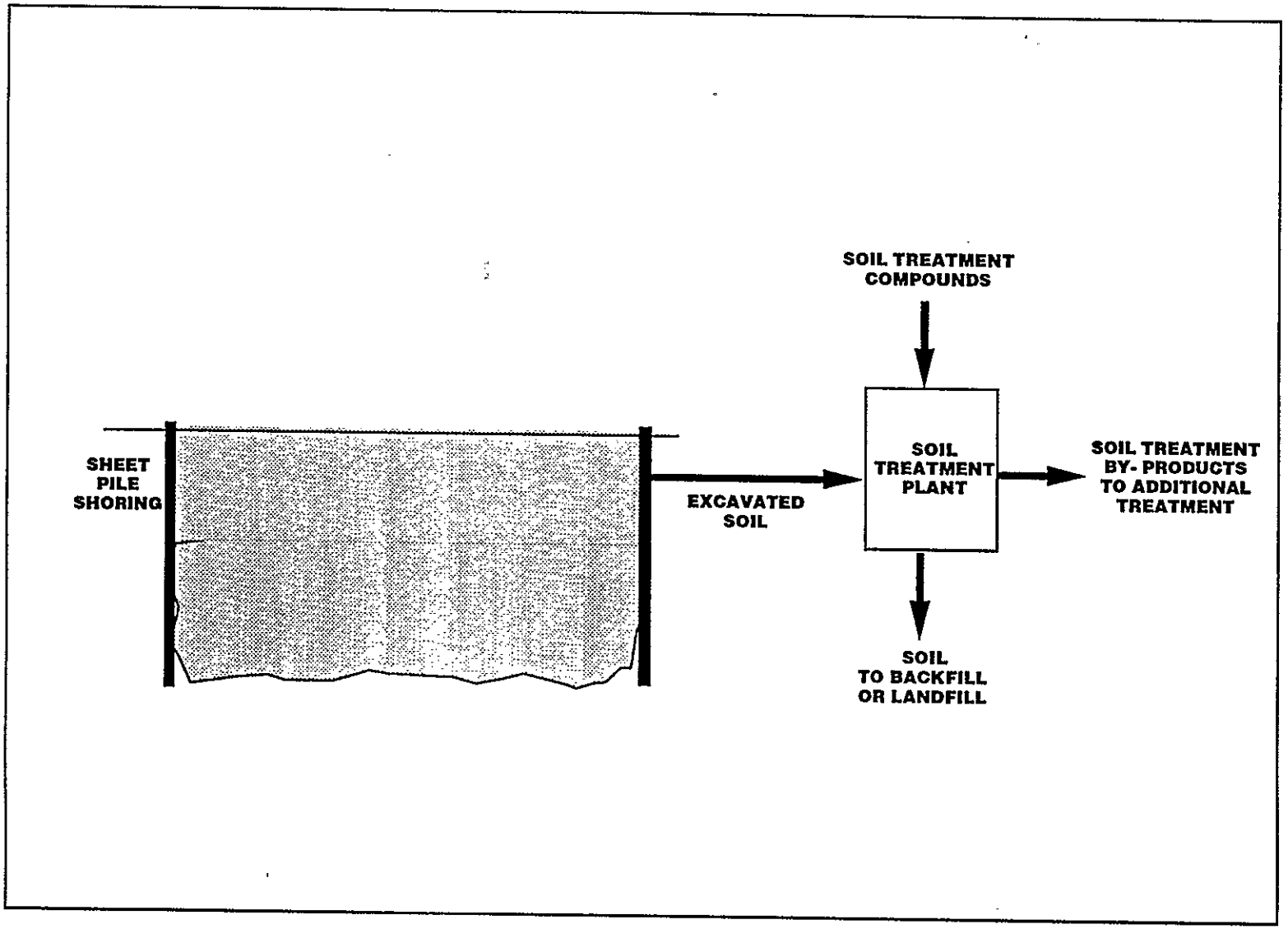

Figure 7-4. Alternative 3: Excavation, Treatment, and Disposal.

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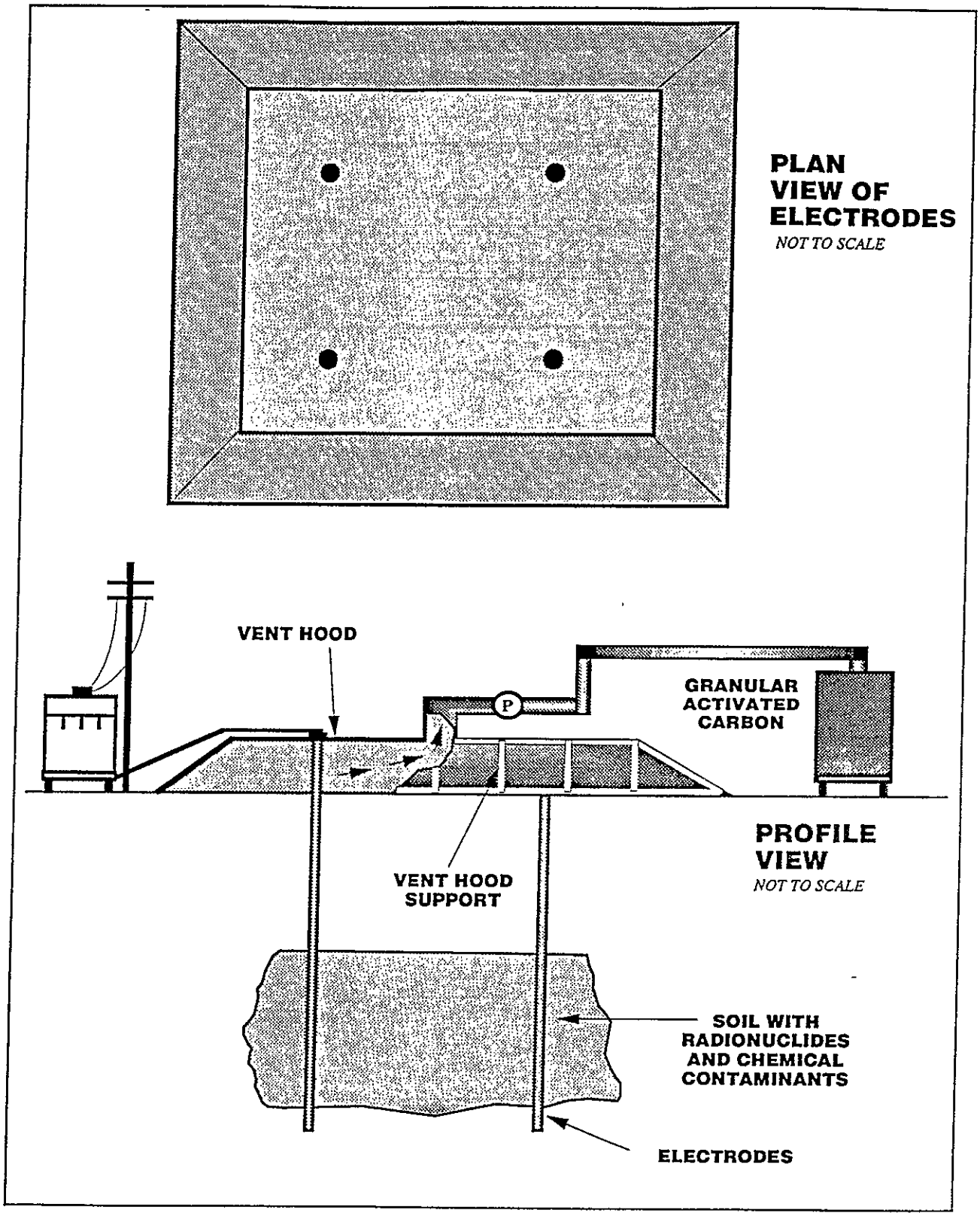

Figure 7-5. Alternative 4: In Situ Vitrification of Soil.

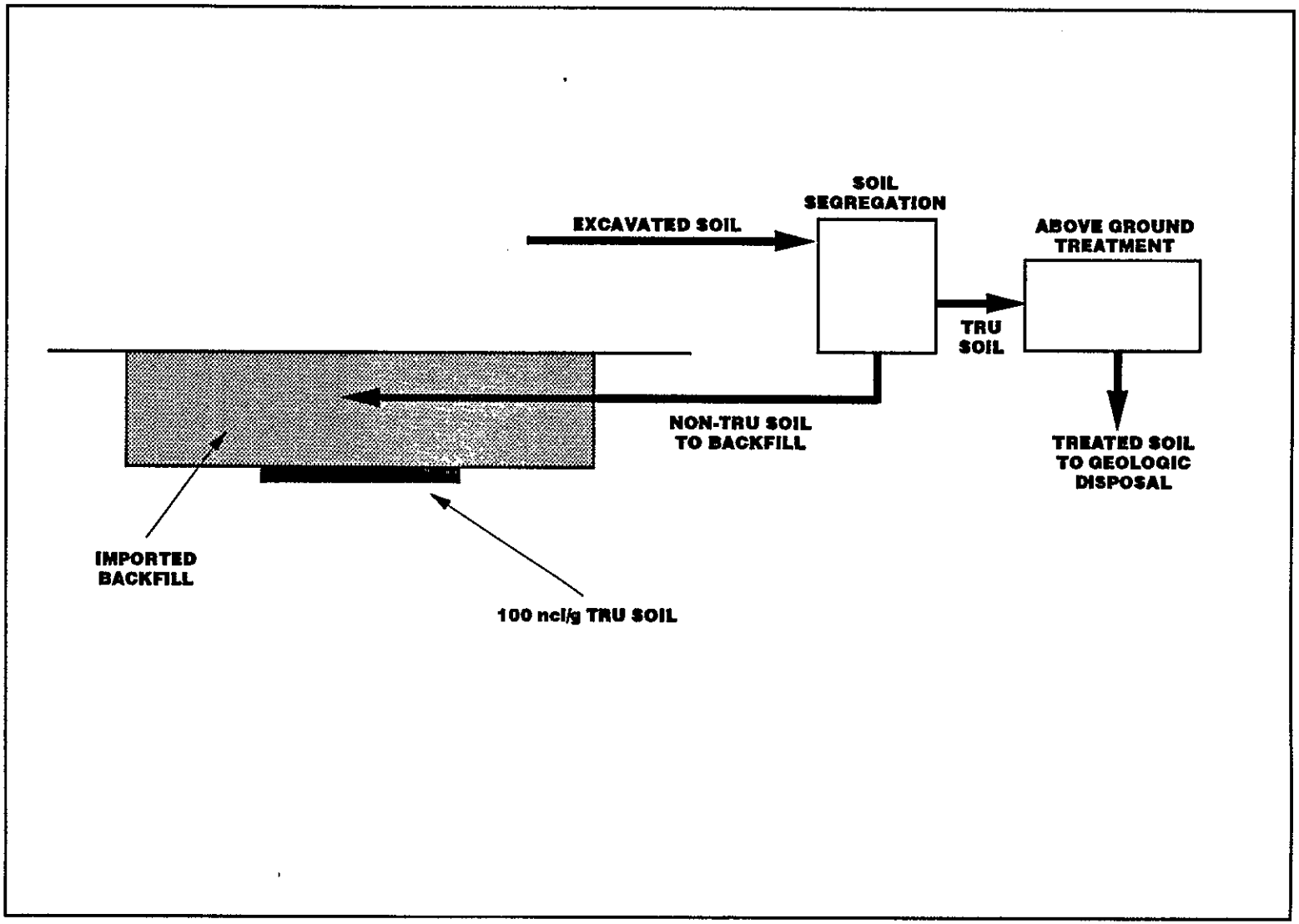

Figure 7-6. Alternative 5: Excavation, Vitrification, and Geologic Disposal of Soil with TRU Radionuclides.

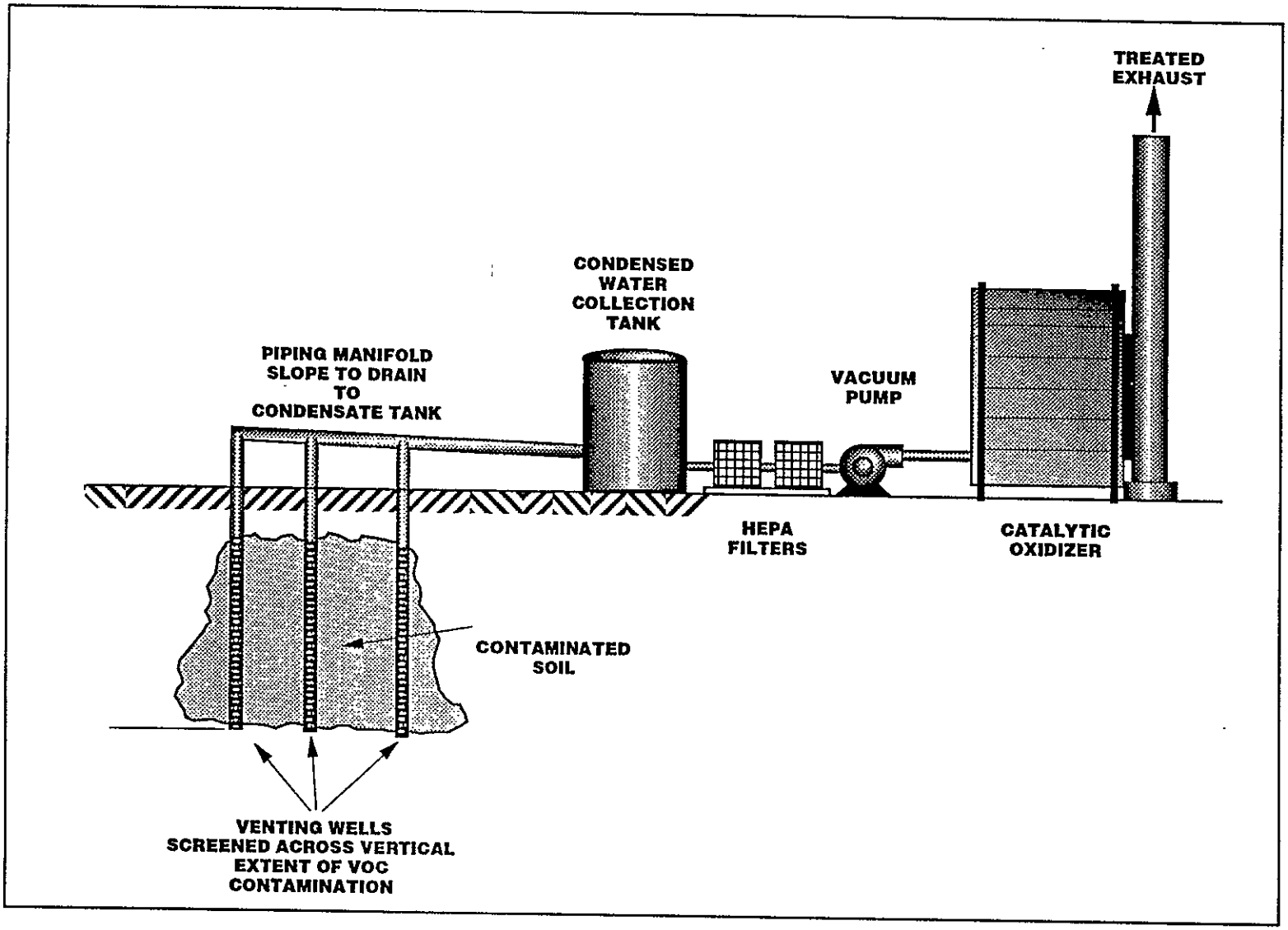

Figure 7-7. Alternative 6: Soil Vapor Extraction for VOCs.

Table 7-1. Preliminary Remedial Action Objectives and General Response Actions. Page 1 of 2

Environmental Media	Remedial Action Objectives: Human Health	Remedial Action Objectives: Environmental Protection	General Response Actions
Soils/ Sediments	• Prevent ingestion, inhalation, or direct contact with solids containing radioactive and/or hazardous constituents present at concentrations above MTCA and DOE standards for industrial sites (or subsequent risk-based standards). • Remediate soils containing TRU contamination above 100 nCi/g in accordance with 40 CFR 191 requirements. • Prevent leaching of contaminants from the soil into the groundwater that would cause groundwater concentrations to exceed MTCA and DOE standards at the compliance point location.	• Prevent migration of radionuclides and hazardous constituents that would result in groundwater, surface water, air, or biota contamination with constituents at concentrations exceeding ARARs.	• No Action • Institutional Controls/ Monitoring • Containment • Excavation • Treatment • Disposal • In Situ Treatment
Biota	• Prevent bio uptake by plants. • Prevent disturbance of engineered barriers by biota.	• Prevent bio-uptake of radioactive contaminants.	• No Action • Institutional Controls/ Monitoring • Excavation • Disposal • Containment
Air[a/]	• Prevent inhalation of contaminated airborne particulates and/or volatile emissions exceeding MTCA and DOE limits from soils/sediments. • Prevent accidental release from collapse of containment structures.	• Prevent adverse environmental impacts on local biota.	

Table 7-1. Preliminary Remedial Action Objectives and General Response Actions. Page 2 of 2

Environmental Media	Remedial Action Objectives: Human Health	Remedial Action Objectives: Environmental Protection	General Response Actions
Buried Containers	• Prevent leakage of liquids from buried containers that would cause groundwater concentrations to exceed MTCA standards at the compliance point location, or which could result in volatilization emissions of leaking chemicals to the atmosphere.	• Prevent wind erosion or soil cover material that would expose buried wastes. • Prevent wind erosion of contaminated soil that would lead to exposure exceeding MTCA or DCGs.	• No Action/Institutional Controls/Monitoring • Wind Barriers Installed • Capping • Drum Removal • Subsurface Barriers

Note: [a/] No General Response Actions are required for the air because soil remediation will eliminate the air contamination source.

Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
Soil	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA
	Containment	Capping	Multimedia	I,M,R,O
		Vertical Barriers	Slurry Walls	I,M,R,O
			Grout Curtains	I,M,R,O
			Cryogenic Walls	I,M,R,O
		Dust & Vapor Suppression	Membranes/Sealants/Wind Breaks/Wetting Agents	I,M,R,O
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O
	Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Incineration	O
			Thermal Desorption	O
			Calcination	I,M,R,O
		Chemical Treatment	Chemical Reduction	M
			Hydrolysis	I,O
			Chemical Dechlorination	O
		Physical Treatment	Soil Washing	I,M,R,O
			Solvent Extraction	O
			Physical Separation	I,M,R,O
			Fixation/Solidification/ Stabilization	I,M,R,O
			Containerization	I,M,R,O

Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
		Biological Treatment	Aerobic (Landfarming)	O
			Anaerobic	O
	Disposal	Landfill Disposal	On-site Landfill	I,M,R,O
			Off-site Landfill	I,M,O
			Offsite RCRA Landfill	I,M,O
		Geologic Repository	Geologic Repository	T (I,M,O non-transuranic radionuclides if mixed with T)
	In Situ Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Thermal Desorption	O
		Chemical Treatment	Reduction	M,O
		Physical Treatment	Soil Flushing	I,M,R,O
			Vapor Extraction	O
			Grouting	I,M,R
			Fixation/Solidification/ Stabilization	I,M,R,O
		Biological Treatment	Aerobic	O
			Anaerobic	O
Biota	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O

Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
	Disposal	Landfill Disposal	Landfill Disposal	I,M,R,O
	Containment	Capping	Multimedia	I,M,R,O

I = Other Inorganics contaminants applicability
M = Heavy Metals contaminants applicability
R = Radionuclide contaminants applicability
O = Organic contaminants applicability
NA = Not Applicable
T = TRU Radionuclides Applicability

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
SOIL TECHNOLOGIES:						
No Action	No Action	Do nothing to cleanup the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline" case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as farming.	Depends on continued implementation. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.
Access Controls	Signs/Fences	Install a fence and signs around areas of soil contamination.	Effective if the fence and signs are maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to prevent people from becoming exposed.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Analyze soil and soil gas samples for contaminants and scan with radiation detectors.	Does not reduce the contamination, but is very effective in tracking the contaminant levels.	Easily implemented. Standard technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective on all types of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will be necessary.	Medium	Retained because of potential effectiveness and implementability.
Vertical Barriers	Slurry Walls	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry.	Effective in blocking lateral movement of all types of soil contamination. May not be effective for deep contamination.	Commonly used practice and easily implemented with standard earth moving equipment. May not be possible for deep contamination.	Medium	Retained for shallow contamination.
	Grout Curtains	Pressure injection of grout in a regular pattern of drilled holes.	Effective in blocking lateral movement of all types of soil contamination.	Commonly used practice and easily implementable, but depends on soil type. May be difficult to ensure continuous wall.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Cryogenic Walls	Circulate refrigerant in pipes surrounding the contaminated site to create a frozen curtain with the pore water.	Effective in blocking lateral movement of all types of soil contamination.	Specialized engineering design required. Requires ongoing freezing.	Medium	Rejected because it is difficult to implement.
Dust and Vapor Suppression	Membranes/ Sealants/ Wind Breaks/ Wetting Agents	Using membranes, sealants, wind breaks, or wetting agents on top of the contaminated soil to keep the contaminants from becoming airborne.	Effective in blocking the airborne pathways of all the soil contaminants, but may require regular upkeep.	Commonly used practice and very easy to implement, but land restrictions will be necessary.	Low	Rejected because of limited duration of integrity and protection.
Excavation	Standard Excavating Equipment	Moving soil around the site and loading soil onto process system equipment.	Effective in moving and transporting soil to vehicles for transportation, and for grading the surface.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.
Thermal Treatment	Above-ground Vitrification	Convert soil to glassy materials by application of electric current.	Effective in destroying organics and immobilizing the inorganics and radionuclides. Off-gas treatment for volatiles may be required.	Commercial units are available. Laboratory testing required to determine additives, operating conditions, and off gas treatment. Must pre-treat soil to reduce size of large materials.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.
	Incineration	Destroy organics by combustion in a fluidized bed, kiln, etc.	Effectively destroys the organic soil contaminants. Some heavy metals will volatilize. Radionuclides will not be treated.	Technology is well developed. Mobile units are currently available for relatively small soil quantities. Off-site treatment is available. Air emissions and wastewater generation should be addressed.	High	Rejected because of potential air emissions and wastewater generation.
	Thermal Desorption	Organic volatilization at 150 to 400°C (300 to 800°F) by heating contaminated soil followed by off gas treatment.	Effectively destroys the organic soil contaminants. Heavy metals less likely to volatilize than in high temperature treatments. Radionuclides will not be treated.	Successfully demonstrated on a pilot-scale level. Full-scale remediation yet to be demonstrated. Pilot testing essential.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Calcination	High temperature decomposition of solids into separate solid and gaseous components without air contact.	Effective in the decomposition of inorganics such as hydroxides, carbonates, nitrates, sulfates, and sulfites. Removes organic components but does not combust them because of the absence of air. Radionuclides will not be treated.	Commercially available. Most often used for concentration and volume reduction of liquid or aqueous waste. Off-gas treatment is required.	High	Rejected because of limited effectiveness on non-liquid or aqueous wastes.
Chemical Treatment	Chemical Reduction	Treat soils with a reducing agent to convert contaminants to a more stable or less toxic form.	May be effective in treating heavy metal soil contaminants. Radioactivity will not be reduced.	Virtually untested on treating soils. Competing reactions may reduce efficiency.	Medium	Rejected because of limited applicability and implementation problems.
	Hydrolysis	Acid- or base-catalyst reaction in water to break down contaminants to less toxic components.	Very effective on compounds generally classified as reactive. Limited effectiveness on stable compounds. Radioactivity will not be reduced.	Common industrial process. Use for treatment of soils not well demonstrated.	Medium	Rejected because of limited effectiveness and unproven on soils.
	Chemical Dechlorination	Detoxify chlorinated organic chemicals by reaction with organic reagents.	Not commonly used on the chlorinated compounds that have been identified at T Plant.	Difficult to implement. Requires soil washing or solvent extraction before use.	High	Rejected because of limited effectiveness and difficult implementation.
	Chemical Dechlorination	Detoxify chlorinated organic chemicals byreaction with organic reagents.	Not commonly used on the chlorinated compounds that have been identified at Z Plant.	Difficult to implement. Requires soil washing or solvent extraction before use.	High	Rejected because of limited effectiveness and difficult implementation.
Physical Treatment	Soil Washing	Leaching of waste constituents from contaminated soil using a washing solution.	Effectiveness is contaminant specific. Generally more effective on contaminants that partition to the fine soil fraction. Radioactivity will not be reduced.	Treatability tests are necessary. Well developed technology and commercially available.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Solvent Extraction	Contacting a solvent with contaminated soils to preferentially dissolve the contaminants into the solvent.	The selected solvent is often just as hazardous as the contaminants presented in the waste. May lead to further contamination. Radioactivity will not be reduced.	Laboratory testing necessary to determine appropriate solvent and operating conditions. Not fully demonstrated for hazardous waste applications.	Medium	Rejected because the solvent may lead to further contamination.
	Physical Separation	Separating soil into size fractions.	Effective as a concentration process for all contaminants that partition to a specific soil size fraction.	Most often used as a pretreatment to be combined with another technology. Equipment is readily available.	Low	Retained because of potential effectiveness and implementability.
	Fixation/ Solidification/ Stabilization	Form low permeability solid matrix by mixing soil with cement, asphalt, or polymeric materials.	Effective in reducing inorganic and radionuclide soil contaminant mobility. Effectiveness for organic stabilization is highly dependent on the binding agent.	Stabilization has been implemented for site remediations. Treatability studies are needed. Volume of waste is increased.	Medium	Retained because of potential effectiveness and implementability.
	Containerization	Enclosing a volume of waste within an inert jacket or container.	Effective for difficult to stabilize, extremely hazardous, or reactive waste. Reduces the mobility of radionculides.	May be implemented for low concentration waste. Disposal or safe storage of containers required. Regulatory constraints may prevent disposal of containers of certain waste types.	Low	Retained because of potential effectiveness and implementability.
Biological Treatment	Aerobic (Landfarming)	Microbial degradation in an oxygen-rich environment.	Effectiveness is very contaminant- and concentration-specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Anaerobic	Microbial degradation in an oxygen deficient environment.	Effectiveness is very contaminant and concentration specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.
Disposal	Landfill Disposal	Place contaminated soil in an existing onsite landfill.	Does not reduce the soil contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an on-site landfill area.	Medium	Retained because of potential effectiveness and implementability.
	Geologic Repository	Put the contaminated soil in a safe geologic repository.	Does not reduce the soil contamination, but is a very effective and long-term way of storing radionuclides. Probably unnecessary for nonradioactive waste.	Not easy to implement because of limited site availability, and permits for transporting radioactive wastes are hard to get.	High	Retained because of effectiveness on TRU wastes.
In Situ Thermal Treatment	Vitrification	Electrodes are inserted into the soil and a carbon/glass frit is placed between the electrodes to act as a starter path for initial melt to take place.	Effective in immobilizing radionuclides and most inorganics. Effectively destroys some organics through pyrolysis. Some volatilization of organics and inorganics may occur.	Potentially implementable. Implementability depends on site configuration, e.g., lateral and vertical extent of contamination. Treatability studies required.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.
	Thermal Desorption	Soil is heated in situ by radio-frequency electrodes or other means of heating to temperatures in the 80 to 400°C (200 to 750°F) range thereby causing desorption of volatile and semi-volatile organics from the soil.	Effective for removal of volatile and semi-volatile organics from soil. Ineffective for most inorganics and radionuclides. Contaminants are transferred from soil to air.	Implementable for shallow organics contamination. Not implementable for radionuclides and inorganics. Emission treatment and treatability studies required.	Medium	Rejected because of limited applicability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
In Situ Chemical Treatment	Chemical Reduction	Reducing agent is added to the soil to change oxidation state of target contaminant.	Effective for certain inorganics, e.g., chromium. Ineffective for organics. Limited applicability.	Difficult to implement in situ because of distribution requirements for reducing agent.	Low	Rejected because of limited applicability and implementation problems.
In Situ Physical Treatment	Soil Flushing	Solutions are injected through injection system to flush and extract contaminants.	Potentially effective for all contaminants. Effectiveness depends on chemical additives and hydrology. Flushing solutions posing environmental threat likely to be needed. Difficult recovery of flushing solution.	Difficult to implement. Not implementable for complex solvents of contaminants. Flushing solution difficult to recover. Chemical additives likely to pose environmental threat.	Medium	Rejected because of implementation problem.
	Vapor Extraction	Vacuum is applied by use of wells inducing a pressure gradient that causes volatiles to flow through air spaces between soil particles to the extraction wells.	Effective for volatile organics. Ineffective for inorganics and radionuclides. Emission treatment required.	Easily implementable for proper site conditions. Requires emission treatment for organics and capture system for radionculides and volatilized metals.	Medium	Retained for potential application to volatile organics.
	Grouting	Involves drilling and injection of grout to form barrier or injection to fill voids.	Effective in limiting migration of leachate, but difficult to maintain barrier integrity. Potentially effective in filling voids.	Implementable as barrier and for filling voids. Implementability depends on site conditions.	Medium	Retained because of ability to limit contaminant migration and potential use for filling void spaces.
	Fixation/ Solidification/ Stabilization	Solidification agent is applied to soil by mixing in place.	Effective for inorganics and radionuclides. Potentially effective for organics. Effectiveness depends on site conditions and additives used.	Implementable. Treatability studies required to select proper additives. Thorough characterization of subsurface conditions and continuous monitoring required.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
In Situ Biological Treatment	Aerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by injection of or spraying with oxygen source and nutrients.	Effective for most organics at proper conditions. Ineffective for inorganics and radionuclides.	Difficult to implement. Treatability studies and thorough subsurface characterization required.	Low	Rejected because of limited applicability and difficult implementation.
	Anaerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by addition of nutrients.	Effective for volatile and complex organics. Not effective for inorganics and radionuclides.	Difficult to implement. Anoxic ground conditions required. Treatability studies and thorough subsurface characterization necessary.	Low	Rejected because of limited applicability and difficult implementation.
BIOTA TECHNOLOGIES:						
No Action	No Action	Do nothing to clean-up the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline"case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as agriculture.	Effective if implementation is continued. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.
Access Controls	Signs/Fences	Install a fence and signs around areas of contamination to keep people out and the biota in.	Effective if fencing is maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to eliminate people from coming in contact with the contamination.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel are easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Take biota samples and test them for contaminants.	Does not reduce the contamination, but is very effective tracking the contaminant levels.	Easily implemented. Standard Technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective in reducing the uptake of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will also be necessary.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Excavation	Standard Excavating Equipment	Remove affected biota and load it onto process system equipment.	Effective in moving and transporting biota to vehicles for transportation.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.
Disposal	Landfill Disposal	Place contaminated biota in an existing landfill.	Does not reduce the biota contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an offsite landfill area.	Medium	Retained because of potential effectiveness and implementability.

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting or Stabilization	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
Cribs and Drains						
216-A-1 Crib	X	X	X	X	X	
216-A-2 Crib	X	X	X	X	X	X
216-A-3 Crib	X	X	X	X	X	
216-A-4 Crib	X	X	X	X	X	
216-A-5 Crib	X	X	X	X	X	
216-A-6 Crib	X	X	X	X	X	
216-A-7 Crib	X	X	X	X	X	
216-A-8 Crib	X	X	X	X	X	X
216-A-9 Crib	X	X	X	X	X	
216-A-10 Crib	X	X	X	X	X	
216-A-21 Crib	X	X	X	X	X	
216-A-24 Crib	X	X	X	X	X	X
216-A-27 Crib	X	X	X	X	X	
216-A-30 Crib	X	X	X	X	X	
216-A-31 Crib	X	X	X	X	X	
216-A-32 Crib	X	X	X	X	X	
216-A-36A Crib	X	X	X	X	X	
216-A-36B Crib	X	X	X	X	X	
216-A-37-1 Crib	X	X	X	X	X	
216-A-37-2 Crib	X	X	X	X	X	
216-A-38-1 Crib	X	X	X	X	X	
216-A-41 Crib	X	X	X	X	X	
216-A-45 Crib	X	X	X	X	X	
216-A-11 French Drain	X	X	X	X	X	
216-A-12 French Drain	X	X	X	X	X	

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting or Stabilization	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
216-A-13 French Drain	X	X	X	X	X	
216-A-14 French Drain	X	X	X	X	X	
216-A-15 French Drain	X	X	X	X	X	
216-A-22 French Drain	X	X	X	X	X	
216-A-26 French Drain	X	X	X	X	X	
216-A-26A French Drain	X	X	X	X	X	
216-A-28 French Drain	X	X	X	X	X	
216-A-33 French Drain	X	X	X	X	X	
216-A-35 French Drain	X	X	X	X	X	
Reverse Wells						
299-E24-111 Injection Well	X	X				
Ponds, Ditches and Trenches						
216-A-29 Ditch	X	X	X	X	X	
216-A-34 Ditch	X	X	X	X	X	
216-A-18 Trench	X	X	X	X	X	
216-A-19 Trench	X	X	X	X	X	
216-A-20 Trench	X	X	X	X	X	
216-A-40 Trench	X	X	X	X	X	
Septic Tanks and Associated Drain Fields						
2607-EA Septic Tank/Drain Field	X	X	X			
2607-EC Septic Tank/Drain Field	X	X	X			
2607-ED Septic Tank/Drain Field	X	X	X			
2607-EG Septic Tank/Drain Field	X	X	X			
2607-EJ Septic Tank/Drain Field	X	X	X			
2607-EL Septic Tank/Drain Field	X	X	X			
2607-E6 Septic Tank/Drain Field	X	X	X			

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting or Stabilization	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
Transfer Facilities, Diversion Boxes, and Pipelines						
216-A-524 Control Structure	X	X	X	X	X	X
Basins						
207-A Retention Basin	X	X	X		X	
216-A-42 Retention Basin	X	X	X		X	
Burial Sites						
218-E-1 Burial Ground	X	X	X			
218-E-8 Burial Ground	X	X	X			
218-E-12A Burial Ground	X	X	X			
218-E-13 Burial Ground	X	X	X			
Unplanned Releases						
UN-200-E-10 Unplanned Release	X	X	X			
UN-200-E-11 Unplanned Release	X	X	X			
UN-200-E-12 Unplanned Release	X	X	X			
UN-200-E-13 Unplanned Release	X	X	X			
UN-200-E-15 Unplanned Release	X	X	X			
UN-200-E-19 Unplanned Release	X	X	X			
UN-200-E-20 Unplanned Release	X	X	X			
UN-200-E-22 Unplanned Release	X	X	X			
UN-200-E-25 Unplanned Release	X	X	X			
UN-200-E-26 Unplanned Release	X	X	X			
UN-200-E-28 Unplanned Release	X	X	X			
UN-200-E-31 Unplanned Release	X	X	X			
UN-200-E-33 Unplanned Release	X	X	X			
UN-200-E-35 Unplanned Release	X	X	X			
UN-200-E-39 Unplanned Release	X	X	X			

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt 1. Multimedia Cover With or Without Vertical Barriers	Alt 2. In Situ Grouting or Stabilization	Alt 3. Excavation and Treatment	Alt 4. In Situ Vitrification	Alt 5. Excavation, Treatment, and Geologic Disp. of TRU Soil	Alt 6. In Situ Soil Vapor Extraction for VOCs
UN-200-E-40 Unplanned Release		X	X			
UN-200-E-42 Unplanned Release	X	X	X			
UN-200-E-49 Unplanned Release	X	X	X			
UN-200-E-56 Unplanned Release	X	X	X			
UN-200-E-58 Unplanned Release			X			
UN-200-E-60 Unplanned Release			X			
UN-200-E-62 Unplanned Release	X	X	X			
UN-200-E-65 Unplanned Release	X	X	X			
UN-200-E-67 Unplanned Release		X	X			
UN-200-E-68 Unplanned Release	X	X	X			
UN-200-E-72 Unplanned Release	X	X	X			
UN-200-E-88 Unplanned Release		X	X			
UN-200-E-94 Unplanned Release	X	X	X			
UN-200-E-96 Unplanned Release	X	X	X			
UN-200-E-97 Unplanned Release	X	X	X			
UN-200-E-100 Unplanned Release	X	X	X			
UN-200-E-114 Unplanned Release	X	X	X			
UN-200-E-117 Unplanned Release	X	X	X	X		
UN-200-E-142 Unplanned Release	X		X			

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8.0 DATA QUALITY OBJECTIVES

As described in Section 1.2.2, this aggregate area management study (AAMS) process, as part of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a), is designed to focus the remedial investigation (RI)/feasibility study (FS) process toward comprehensive cleanup or closure of all contaminated areas at the earliest possible date and in the most effective manner. The fundamental principle of the *Hanford Site Past-Practice Strategy* is a "bias for action" that emphasizes the maximum use of existing data to expedite the RI/FS process as well as allow decisions about work that can be done at the site early in the process, such as expedited response actions (ERAs), interim remedial measures (IRMs), limited field investigations (LFIs), and focused feasibility studies (FFSs). The data have already been described in previous sections (2.0, 3.0, and 4.0). Remediation alternatives are described in Section 7.0. However, data, whether existing or newly acquired, can only be used for these purposes if it meets the requirements of data quality as defined by the data quality objective (DQO) process developed by the U.S. Environmental Protection Agency (EPA) for use at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (EPA 1987). This section implements the DQO process for this, the scoping phase in the PUREX Plant Aggregate Area.

In the guidance document for DQO development (EPA 1987), the process is described as involving three stages which have been used in the organization of the following sections:

- Stage 1--Identify decision types (Section 8.1)
- Stage 2--Identify data uses and needs (Section 8.2)
- Stage 3--Design a data collection program (Section 8.3).

8.1 DECISION TYPES (STAGE 1 OF THE DQO PROCESS)

Stage 1 of the DQO process is undertaken to identify:

- The decision makers (thus, data users) relying on the data to be developed (Section 8.1.1)
- The data available to make these decisions (Section 8.1.2)
- The quality of these available data (Section 8.1.3)

- The conceptual model into which these data must be incorporated (Section 8.1.4)

- The objectives and decisions that must evolve from the data (Section 8.1.5).

These issues serve to define, from various sides, the types of decisions that will be made on the basis of the PUREX Plant AAMS.

8.1.1 Data Users

The data users for the PUREX Plant AAMS and subsequent investigations such as LFIs, RI/FSs, and Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI)/Corrective Measures Studies (CMSs) are the following:

- The decision makers for policies and strategies on remedial action at the Hanford Site. These are the signatories of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) including the Washington State Department of Ecology (Ecology), EPA, and the Department of Energy (DOE).

  Nominally these responsibilities are assigned to the managers of these agencies (the Director of Ecology, the Administrator of EPA, and the Secretary of Energy for DOE), although the political process requires that more local policy-makers (such as the Regional Administrator of EPA and the head of the U.S. Department of Energy, Richland Operations Office (DOE RL) and, to a great extent, technical and policy-assessment staff of these agencies will have a major say in the decisions to be evolved through this process.

- Unit managers of Westinghouse Hanford and potentially other Hanford Site contractors who will be tasked with implementing remedial activities at the PUREX Plant Aggregate Area. Staff of these contractors will have to make the lower level (tactical) decisions about appropriate scheduling of activities and allocation of resources (funding, personnel, and equipment) to accomplish the recommendations of the AAMS.

- Concerned members of the wide community involved with the Hanford Site. These may include:

  - Other state (Washington, Oregon, and other states) and federal agencies

  - Affected Indian tribes

- Special interest groups

- The general public.

These groups will be involved in the decision process through the implementation of the Community Relations Plan (Ecology et al. 1989), and will apply their concerns through the "primary" data users, the signatories of the Tri-Party Agreement.

The needs of these users will have a pivotal role in issues of data quality. Some of this influence is already imposed by the guidance of the Tri-Party Agreement.

8.1.2 Available Information

The *Hanford Site Past-Practice Strategy* specifies a "bias for action" which intends to make the maximal use of existing data on an initial basis for decisions about remediation. This emphasis can only be implemented if the existing data are adequate for the purpose.

Available data for the PUREX Plant Aggregate Area are presented in Sections 2.0, 3.0, and 4.0 and in topical reports prepared for this study. As described in Section 1.2.2, these data should address several issues:

- Issue 1: Facility and process descriptions and operational histories for waste sources (Sections 2.2, 2.3, and 2.4)

- Issue 2: Waste disposal records defining dates of disposal, waste types, and waste quantities (Section 2.3)

- Issue 3: Sampling events of waste effluents and affected media (Section 4.1)

- Issue 4: Site conditions including the site physiography, topography, geology, hydrology, meteorology, ecology, demography, and archaeology (Section 3.0)

- Issue 5: Environmental monitoring data for affected media including air, surface water, sediment, soil, groundwater and biota (Section 4.1, except that groundwater data is presented in the separate 200 East Groundwater Aggregate Area Management Study Report, AAMSR).

A major requirement for adequate characterization of many of these issues is identification of chemical and radiological constituents associated with the sites, with a view

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to determine the contaminants of concern there and the extent of their distribution in the soils beneath each of the waste management units in the PUREX Plant Aggregate Area. There was found to be a limited amount of data in this regard. The data reported for the various waste management units in the PUREX Plant Aggregate Area (see Section 4.1 and Tables 4-1, 4-2, and 4-3) have been found to describe:

- Inventory: generally estimated from chemical process data and emphasizing radionuclides (Issues 1 and 2). These data are especially limited regarding reconstruction of early operations activities, and even the most recent data are based on very few sampling events, possibly non-representative of the long-term activity of the waste management units. In some cases (e.g., for the 2607-EL Septic Tank) even the location of the facility is not adequately understood.

- Surface radiological surveys: undifferentiated radiation levels, without identification of radionuclides present, presented in terms of extent of radiation and maximal levels (Issue 5). These historical data are extremely difficult to relate to the present-day distribution and nature of the radioactive contamination they purport to measure because of the lack of radionuclide identification and the likelihood that changes have occurred (at least to surface soils) since the time of these surveys.

- External radiation monitoring: similar to the surface radiological surveys but provide even less information because with a fixed-point thermoluminescent dosimeter (TLD) no spatial distribution is provided. In addition, data are also available for some TLDs placed at points not associated with specific waste management units. The TLD data ~~again~~also do not differentiate radionuclide species.

- Waste, soil, or sediment sampling: these include waste sampling in single-shell tanks (in the 241-A, 241-AX and 241-C Tank Farms), and sediment sampling in the 216-A-29 Ditch (Issue 5). The quality of these data ~~is apparently good, but changes~~will be addressed based on the criteria presented in Section 8.3. Changes at the release sites ~~(e.g., cleanup activities)~~ since the time of the sampling ~~makes~~may make the data ~~again generally~~ inapplicable to determination of the present-day distribution of contamination. Such changes might include cleanup activities which could alter the location of waste or cause soil particle fractionation, chemical leaching of contaminants, or contaminant reactions in the environment which could alter the nature of the contamination.

  There are also ~~some~~ sets of data of soil sampling and analysis that were conducted for several years on a grid pattern that cannot be assigned to a

particular waste management unit. These data would indicate impacts of historical operations at the Hanford Site, and in the vicinity of the grid points, but the impacts cannot be ascribed to a particular unit and so do not assist in decision making on a unit-by-unit basis but may be used to estimate background contamination levels.

- Biota sampling: only in the 216-A-24 Crib, and the 216-A-29 Ditch. These data could assist assessment of bio-uptake and transfer pathways from this unit (Issue 5).

There are also analytical data for grid-point samples of vegetation which ~~again~~ cannot be assigned to a specific waste management unit but may be useful to indicate background contamination levels in vegetation.

- ~~Biota sampling: only in the 216-A-24 Crib. These data could assist assessment of bio-uptake and bio-transfer pathways from this unit (Issue 5).~~

- Borehole geophysics: these data, for a number of units which discharged to the soil column (cribs, ~~french drains, and the 216-U-14 Ditch~~trenches, and ditches) and the single-shell tanks, were designed to detect the presence of radionuclides (by their gamma-ray radiation) in the subsurface and to indicate whether these materials are migrating vertically (Issue 5). A list of these surveys that have been conducted in the PUREX Plant Aggregate Area is included in the *PUREX Plant Geologic and Geophysics Data Package for the 200 Aggregate Area Management Study* prepared for this study (Chamness et al. 1992). ~~These~~Most of the earlier data are limited by the method's inability to identify specific radionuclides and, thus, to differentiate naturally occurring radioactive materials from possible releases. Variations in quality control further limit their comparability and possible use for estimation of concentrations.

Besides these historic data, additional borehole geophysical data will be available through the Radionuclide Logging System (RLS), being carried out at the time of this report and in support of the AAMS process. Like the previous (gross gamma) logging conducted at waste management units in the PUREX Plant Aggregate Area, the RLS depends on gamma rays and ~~so~~ cannot detect some species of radionuclides. However, unlike the gross gamma surveys, the RLS is designed to identify individual radionuclide species through their characteristic gamma ray photon energy levels. It should thus be able to differentiate naturally-occurring radionuclides from those resulting from releases. It will also (like gross gamma logging) determine the vertical extent of the presence of the radionuclides. It will be conducted in about ten wells located in the PUREX

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Plant Aggregate Area and will be available with completion of the AAMS process.

Based on the above summary, the data are considered to be of varying quality. These data have not been validated, a process generally required for risk assessment or final Record of Decision (ROD) purposes. Most of the data are based on field methods, which are generally applicable only for screening purposes and can be used to focus future activities (e.g., sampling and analysis plans).

They are considered to be deficient in one or more of the following ways:

- ~~The methods~~Methods which have been used in the past are unable to differentiate the various radionuclides that may have been present at the time of the survey.

- The release locations have been changed (especially by remediation activities) since the time of the survey or sampling, and it is likely that contaminant distributions have changed.

- The survey or sampling has been done at a location different from the waste management unit or release, and so would not be representative of the concentrations in the zone of release. This deficiency applies to horizontal and vertical differences in location: the borehole geophysics data may be at the correct depths, but the distance of the borehole from the waste management unit can severely attenuate the gamma-radiation that is used to indicate contamination; surface sampling and surveys similarly cannot establish subsurface contaminant concentrations or even disprove the possible presence of some radioactive constituents (particularly alpha-emitting transuranic~~,~~ (TRU~~,~~) elements).

- There has been virtually no measurement of non-radioactive hazardous constituents in the sampling and analysis of media in the PUREX Plant Aggregate Area.

As a result of these deficiencies, the data are not considered to be usable for input to a quantitative risk assessment or for comparison to ~~applicable or relevant and appropriate requirements~~ (ARARs). Further discussion of the data quality is provided in Section 8.1.3.

In addition to these data, there are also data regarding site conditions (Issue 4) ~~which~~that do not directly relate to the presence of environmental releases, but which will assist in the assessment of its potential migration if present. These data are generally summarized in the ~~T~~topical ~~R~~reports prepared for this AAMS. Those include the following:

- *PUREX Plant Geologic and Geophysics Data Package for the 200 Aggregate Area Management Study* (Chamness et al. 1992), contains tables of wells in which borehole geophysics have been conducted, the types and dates of the tests, and a reference to indicate the physical location of the logs. The package also includes a list of the data available from the drilling of each well located in the PUREX Plant Aggregate Area, such as the logs available (driller's or geologist's; indication of their physical location; grain size, carbonate, moisture, and chemical/radiological analyses; lists of depths, dates, elevation, and coordinates for all wells; and copies of the boring logs and well completion (as-built) summaries for a selection of wells in the PUREX Plant Aggregate Area.

- *Geologic Setting of the 200 East Area: An Update* (Lindsey et al. 1992) includes descriptions of regional stratigraphy, structural geology, and local (200 East Area) stratigraphy, with revised structure and isopach maps of the various unconsolidated strata found beneath the 200 East Area.

The data in these topical reports was obtained for the AAMS based on a review of driller's and geologist's logs for wells drilled in the PUREX Plant Aggregate Area. A selection of 15 of those logs was made which best represented the geologic structures below the aggregate area and is presented in Chamness et al. (1992). Lindsey et al. (1992) then used these wells (and others from other Aggregate Areas in the 200 East Area) to develop cross-sections, structure maps, and isopach maps, which were in turn adapted to the specific needs of this report and presented in Section 3.0. Only existing logs were used; no new wells were drilled as part of this study. The quality of the data varies among the logs according to the time they were drilled and the scope of the study they were supporting, but generally these data are sufficient for the general geological characterization of the site. Issues involving the potential of contaminant migration at specific sites, based on stratigraphic concerns, may not be fully addressed through any existing borings or wells because appropriate borings may not be located in close proximity; these issues should be addressed during subsequent field investigations at locations where contaminant migration is considered likely.

Another class of data that was gathered in the general area of the 200 West Area, and is potentially appropriate to the PUREX Plant Aggregate Area, is the result of a set of studies which were performed for the Basalt Waste Isolation Project (BWIP) (DOE 1988b), in the attempt to site a high-level radioactive waste geologic repository in the basalt beneath and in the vicinity of the Hanford Site. The proposed Reference Repository Site included the 200 West Area and some distance beyond it, mainly to the west. For this siting project, a number of geologic techniques were used, and some of the data generated by the drilling program has been used for the stratigraphic interpretation presented in Section 3.4 (all the wells denoted with an alias "BH-.." were drilled for the BWIP) and a number of the figures

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used in this and other sections of Section 3.0. The program also included a number of geophysical studies, using the following techniques:

- Gravity
- Magnetics
- Seismic reflection
- Seismic refraction
- Magnetotellurics.

These data, as presented in Section 1.3.2.2.3 of DOE (1988b), were reviewed for their relevance to the present PUREX Plant (source area) AAMS. The limitations of these studies include the following aspects:

- Most of the studies covered a regional scale with lines or coverages that may have crossed the PUREX Plant Aggregate Area (or even the 200 East Area) only in passing. Some of the surveys (e.g., the grid of gravity stations) specifically avoided the 200 East Area ("due to restricted access").

- Many of the techniques are more sensitive to the basalt than to the suprabasalt sediments of specific interest in the AAMS program, and even less sensitive to the features which are closer to the surface, as is applicable to the source area AAMS. Basalt is by nature much denser than the unconsolidated sediments (and thus also has a characteristic seismic signature) and has more consistent magnetic properties. In addition, the analysis of the data emphasized the basalt features that were apparent in the data. All this is appropriate to a study of the basalt, but does not make the studies applicable to the current study.

- Even when features potentially caused by shallow sediments are identified, they are interpreted either very generally (e.g., "erosional features in the Hanford and (or) Ringold Formations") or as complications (e.g., "shallow sediment velocity variations causing stacking velocity correction errors"). There are ~~only a~~ very few features (and none in the PUREX Plant Aggregate Area) which are interpreted as descriptive of the structure of the suprabasalt sediments.

- Lastly, some of the anomalies which are interpreted in terms of a sedimentary stratigraphic cause (e.g., "erosion of Middle Ringold") do not bear up under the

more detailed stratigraphic interpretation carried out under the topical reports for the AAMS (Lindsey et al. 1992; Chamness et al. 1992).

However, these data will be reviewed in more detail for the purposes of the 200 East Groundwater AAMSR, since deeper features (including in the basalt) are of more concern for that study.

Other data, presented in Sections 2.0, 3.0, and 4.0, are broader-scale rather than site-specific such as contaminant concentrations. These include topography, meteorology, surface hydrology, environmental resources, human resources, and contaminant characteristics. These data are generally of acceptable quality for the purposes of planning remedial actions in the PUREX Plant Aggregate Area.

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8.1.3 Evaluation of Available Data

The EPA (1987) has specified indicators of data quality, the five "PARCC" parameters (precision, accuracy, representativeness, completeness, and comparability), which can be used to evaluate the existing data and to specify requirements for future data collection.

- Precision—the reproducibility of the data
- Accuracy—the lack of a bias in the data

Much of the existing data are of limited precision and accuracy due to the analytical methods which have been used historically. The gross gamma borehole geophysical logging in particular is limited by methodological problems although reproducibility has been generally observed in the data. Conditions that have contributed to lack of precision and/or accuracy include: improvements in analytical instrumentation and methodology making older data incompatible; effects of background levels (particularly regarding radioactivity and inorganics); and lack of quality control on data acquisition.

The limitations in precision and accuracy in existing data are mainly due to the progress of analytical methodologies and quality assurance (QA) procedures since the time they were collected. The *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) recommends that existing data be used to the maximum extent possible, at two levels: first to formulate the conceptual model, conduct a qualitative risk assessment, and prepare work plans, but also as an initial data set that can be the basis for a fully qualified data set through a process of review, evaluation, and confirmation.

- Representativeness—the degree to which the appropriate environmental parameters or media have been sampled.

This parameter highlights a shortcoming of most of the historical data. Some discussion of representativeness limitations is presented in Section 8.1.2. Limitations include the observation only of gross gamma radiation rather than differentiating it by radionuclide (e.g., through spectral surveying methods as are being used by the RLS program), the analysis of samples only for radionuclides rather than for chemicals and radionuclides, and the failure to sample (especially in the subsurface) for the full potential extent of contaminant migration.

The data are incomplete primarily because of the lack of subsurface sampling for extent of contamination. This is because no subsurface investigation has been initiated on the waste management units in the PUREX Plant Aggregate Area yet. The lack of these data is also caused by concerns to limit the potential exposure to radioactivity of workers who would have to drill in contaminated areas and the possible release or spread of contamination through these intrusive procedures. The result of this data gap is that none of the sites can be demonstrated to have contamination either above or below levels of regulatory concern, and a full quantitative risk assessment cannot be conducted.

In addition, in many cases it has been necessary to use general data (i.e., from elsewhere in the 200 East Area or even from the vicinity of the 200 Areas) rather than data specific to a particular waste management unit. For most purposes of characterization for transport mechanisms, this procedure is acceptable given the screening level of the present study. For example, while it is appropriate to use a limited number of boring logs to characterize the stratigraphy in the ~~A~~aggregate ~~A~~area (Chamness et al. 1992, Lindsey et al. ~~1991~~1992), the later, waste management unit specific, field sampling plans will require detailed consideration of more of the logs of wells drilled in the immediate vicinity, whatever their quality, as a starting point to conceptually model the geology specifically beneath that unit.

- Completeness—the fraction of samples which are considered "valid."

None of the data that have been previously gathered in the PUREX Plant Aggregate Area has been "validated" in the EPA Contract Laboratory Program (CLP) sense, although varying levels of quality control have been applied to the sampling and analysis procedures. The data are generally adequate for characterization purposes but may not be suitable for use in a formal risk assessment. The best indication of the validity of the data is the reproducibility

of the results, at least as far as precision is concerned (accuracy requires proof of a lack of bias). This indicates that validity (completeness) is one of the less significant problems with the data.

- Comparability—the confidence that can be placed in the comparison to two data sets (e.g., separate samplings)

  With varying levels of quality control and varying procedures for sample acquisition and analysis, this parameter is also generally poorly met. Much of this is due to the more recent development of QA procedures.

While these limitations cannot in most cases be quantified (and some such as representativeness are specifically only qualitative), most of the data gathered in the PUREX Plant Aggregate Area can be cited as failing one or more of the PARCC parameters. As discussed in Section 8.1.2, the data are considered to be deficient in completeness, (the appropriate media, constituents, or locations were generally not sampled or analyzed). These data should, however, be used to the maximum extent in the development of work plans for site field investigations, prioritization of the various units, and to determine, to the extent possible, where contamination is or is not present.

In addition to these site-specific data, there are also a limited number of non site-specific sampling events that are being developed to determine background levels of naturally occurring constituents (Hoover and LeGore 1991). These data can be used to differentiate the effect of the environmental releases from naturally occurring background levels.

8.1.4 Conceptual Model

The initial conceptual model of the waste management units in the PUREX Plant Aggregate Area is presented and described in Section 4.2 (Figure 4-3). The model is based on best estimates of where contaminants were discharged and their potential for migration from release points. The conceptual model is designed to be conservatively inclusive in the face of a lack of data. This means that a migration pathway was included if there is any possibility of contamination travelling on it, historically or at present. In most cases there may not be a significant flux of such contamination migration for many of the pathways shown on the figure.

The pathway from the cribs leading to adsorption of transuranic elements on vadose-zone soils is possibly the most significant. These and other pathways can be traced on the conceptual model. All are possible; only a few are likely because of the conservatism inherent in including all conceivable pathways. More importantly, even if a pathway carries

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significant levels of a contaminant, it still may not have carried contamination to the ultimate receptors, human or ecological. This can only be assessed by sampling at the exposure point on this pathway, or sampling at some other point and ~~extrapolation~~extrapolating to the exposure point, to indicate the dosage to the receptors.

There are significant uncertainties in the contaminant levels in the contaminant migration pathways shown on the conceptual model, yet almost none of these pathways has been sampled to determine whether any contamination still exists in any of the locations implicated from the conceptual model, and if so which constituents, how much, and to what extent.

8.1.5 Aggregate Area Management Study Objectives and Decisions

The specific objectives of the PUREX Plant AAMS are listed in Section 1.3. They include the following:

- Assemble site data (as described in Section 8.1.2)
- Describe site conditions (see Section 3.0)
- Conduct limited new site characterization work (see separate topical reports)
- Develop a preliminary site conceptual model (see Section 8.1.4)
- Identify contaminants of concern and their distribution (Section 4.0)
- Identify potential ARARs (Section 6.0)
- Define preliminary remedial action objectives and screen potential remedial technologies to prepare preliminary remedial action alternatives (Section 7.0) and provide recommendations for FFS (Section 9.4.1) and treatability studies (Section 9.5)
- Define data needs, establish general DQOs, and set priorities
- Recommend ERA, IRM, LFI, or other actions (Section 9.0)
- Redefine and prioritize, as data allow, operable units, their boundaries, and work plan activities with emphasis on supporting early cleanup actions and records of decision (Sections 8.3 and 9.0)

- Integrate RCRA TSD closure activities with past-practice activities (Section 9.3.4).

The decisions that will have to be made on the basis of this AAMS can best be described according to the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart (Figure 1-2 in Section 1.0) that must be conducted on a site-by-site basis. Decisions are shown on the flow chart as diamond-shaped boxes, and include the following:

- Is an ERA justified?
- Is less than six months' response needed (is the ERA time critical)?
- Are data sufficient to formulate the conceptual model and perform a qualitative risk assessment?
- Is an IRM justified?
- Can the remedy be selected?
- Can additional required data be obtained by LFI?
- Are data (from field investigations) sufficient to perform risk assessment?
- Can an Operable Unit/Aggregate Area ROD be issued?

(The last two questions will only be asked after additional data are obtained through field investigations, and so are DQO issues only in assessing scoping for those investigations.)

Most of these decisions are actually a complicated mixture of many smaller questions, and will be addressed in Section 9.0 in a more detailed flowchart for assessing the need for remediation or investigation.

Similarly, the tasks that will need to be performed after the AAMS that drive the data needs for the study are found in the rectangular boxes on the flow chart. These include the following:

- ERA (if justified)

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- Definition of the threshold contamination levels, and formulation of conceptual model, performance of qualitative risk assessment, and FS screening (IRM preliminaries)

- FFS for IRM selection

- Determination of minimum data requirements for IRM path

- Negotiation of Scope of Work, relative priority, and incorporation into integrated schedule, performance of LFI

- Determination of minimum data needs for risk assessment and final remedy selection (preparation of RI/FS path).

These stages of the investigation must be considered in assessing data needs (Section 8.2.1).

8.2 DATA USES AND NEEDS (STAGE 2 OF THE DQO PROCESS)

Stage 2 of the DQO development process (EPA 1987) defines data uses and specifies the types of data needed to meet the project objectives. These data uses and needs are based on the Stage 1 results, but must be more specific. The elements of this stage of the DQO process include:

- Identifying data uses (Section 8.2.1)

- Identifying data types (Section 8.2.2.1)

- Identifying data quality needs (Section 8.2.2.2)

- Identifying data quantity needs (Section 8.2.2.3)

- Evaluating sampling/analysis options (Section 8.2.2.4)

- Reviewing data quality parameters (Section 8.2.2.5)

- Summarizing data gaps (Section 8.2.3).

Stage 2 is developed on the basis of the conceptual model and the project objectives. These following sections discuss these issues in greater detail.

8.2.1 Data Uses

For the purposes of the remediation in the PUREX Plant Aggregate Area, most data uses fall into one or more of four general categories:

- Site characterization
- Public health evaluation and human health and ecological risk assessments
- Evaluation of remedial action alternatives
- Worker health and safety.

Site characterization refers to a process that includes determination and evaluation of the physical and chemical properties of any wastes and contaminated media present at a site, and an evaluation of the nature and extent of contamination. This process normally involves the collection of basic geologic, hydrologic, and meteorologic data but more importantly for the PUREX Plant Aggregate Area waste management units, data on specific contaminants and sources that can be incorporated into the conceptual model to indicate the relative significance of the various pathways. Site characterization is not an end in itself, as stressed in the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a), but rather the data must work toward the ultimate objectives of assessing the need for remediation (according to risk assessment methods, either qualitative or quantitative or compliance with ARARs) and providing appropriate means of remediation (through an FFS, FS, or CMS). The understanding of the site characterization, based on existing data, is presented in Sections 2.0, 3.0, and 4.0, and summarized in the conceptual model (Section 4.2).

Data required to conduct a public health evaluation, and human health and ecological risk assessments at the sites in the PUREX Plant Aggregate Area include the following: input parameters for various performance assessment models (e.g., the Multimedia Environmental Pollutant Assessment System); site characteristics; and contaminant data required to evaluate the threat to public and environmental health and welfare through exposure to the various media. These needs usually overlap with site characterization needs. An extensive discussion of risk assessment data uses and needs for both human health and ecological evaluations is presented in the *Risk Assessment Guidance for Superfund* Volumes 1 and 2 (EPA 1989a,c). The EPA Region 10 has also developed its preferred methodology for these risk assessment activities (EPA 1989a, 1991a). The ecological and human health risk assessments will follow the guidance outlined in the approved M-29-03 milestone document, *Hanford Site Baseline Risk Assessment Methodology*. The data requirements for an ecological risk assessment include (1) identification of critical species, (2) identification of habitat within and surrounding the Hanford Site, (3) feeding relationships among species of

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concern, and (4) contaminant concentrations in environmental media and species of interest. The main deficiency in the data available for waste management units in the PUREX Plant Aggregate Area is that a quantitative assessment of contaminant concentrations for purposes of risk assessment cannot be performed. The present understanding of site risks is presented in the selection of constituents of concern (Section 4.0). The data needs for quantitative risk assessments will be considered in developing site-specific sampling and analysis plans according to the *Hanford Site Past-Practice Strategy*.

Data collected to support evaluation of remedial action alternatives for ERAs, IRMs, FFSs, or the full RI/FS, include site screening of alternatives, feasibility-level design, and preliminary cost estimates. Once an alternative is selected for implementation, much of the data collected during site investigations (LFI or RI) can also be used for the final engineering design. Generally, collection of information during the investigations specifically for use in the final design is not cost effective because many issues must be decided about appropriate technologies before effective data gathering can be undertaken. It is preferable to gather such specific information during a separate predesign investigation or at the time of remediation (i.e., the "observational approach" of the *Hanford Site Past-Practice Strategy* [DOE/RL 1992a]). Based on the existing data, broad remedial action technologies and objectives have been identified in Section 7.0.

The worker health and safety category includes data collected to establish the required level of protection for workers during various investigation activities. These data are used to determine if there is concern for the personnel working in the vicinity of the aggregate area. The results of these assessments are also used in the development of the various safety documents required for field work (see Health and Safety Plan, Appendix B).

It should be noted that each of these data use categories (site characterization, risk assessment needs, remedial actions, and health and safety) will be required at each decision point on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart, as discussed at the end of Section 8.1.5. To the extent possible, however, not all sites will be investigated to the same degree but only those with the highest priority. These results will then be extended to the other, analogous sites which have similar geology and disposal histories (see Section 9.2.3).

The existing data can presently be used for two main purposes:

- Development of site-specific sampling plans (site characterization use)
- Screening for health and safety (worker health and safety use).

Table 8-1 presents a summary of the availability of existing data for these two uses.

For the purposes of developing sampling plans, existing information is available for:

- The location of waste management units and unplanned releases—: many of the units or releases have surface expressions, markers, or have been surveyed in the past. The unplanned releases in particular are lacking in this information, as well as for the 2607-EL Septic Tank and Drain Field. Many of the unplanned releases are located by coordinates only and can be found on various site maps by a number of different names.

- Possible contamination found at the waste management units—: these data are derivable from the inventories for the units (mainly for the cribs and other disposal facilities) as well as from the limited sampling that has been done at specific sites, such as the 216-A-29 Ditch.

- The likely depth of contaminants—this information is mainly obtained from the gross gamma borehole logging for many of the units.

Two types of information are available for the purposes of worker health and safety, and will be used for the development of health and safety documents:

- Levels of surface radiation—derived from the on-going periodic radiological surveys done under the Environmental Surveillance program (Schmidt et al. ~~1991~~1992). Table 8-1 shows where surveys have indicated no detectable levels of surface radiation and so no additional survey is required before surface activities can be conducted.

- Expected maximum contaminant levels—these data can be used mainly on the results of subsurface soil sampling. Extensive sampling of this type has generally not been conducted at the PUREX Plant Aggregate Area waste management units.

Table 8-1 also presents a first expression of the data needs for the individual waste management units in the PUREX Plant Aggregate Area, which must be addressed for remediation approaches to be developed.

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8.2.2 Data Needs

The data needs for the PUREX Plant Aggregate Area are discussed in the following sections according to the categories of types of data (Section 8.2.2.1), quality (8.2.2.2), quantity (8.2.2.3), options for acquiring the data (8.2.2.4), and appropriate DQO (PARCC) parameters (8.2.2.5). These considerations are summarized for each category of waste management unit site in the PUREX Plant Aggregate Area (Section 8.2.3).

8.2.2.1 Data Types. Data use categories described in Section 8.2.1 define the general purpose of collecting additional data. Based on the intended uses, a concise statement regarding the data types needed can be developed. Data types specified at this stage should not be limited to chemical parameters, but should also include necessary physical parameters such as bulk density, moisture, and hydraulic conductivity. Precipitation recharge, chemical distribution coefficients, and organic complexation data appear adequate, but may require additional study based on the results of future evaluations. Since environmental media and source materials are interrelated, data types used to evaluate one media may also be useful to characterize another media.

Identifying data types by media indicates that there are overlapping data needs. Data objectives proposed for collection in the site investigations at sites in the PUREX Plant Aggregate Area are discussed in Section 8.3 to provide focus to investigatory methods that may be employed. The data type requirements for the preliminary remedial action alternatives developed in Section 7.4 are summarized in Table 8-2.

8.2.2.2 Data Quality Needs. The various tasks and phases of a CERCLA investigation may require different levels of data quality. Important factors in defining data quality include selecting appropriate analytical levels and validation and identifying contaminant levels of concern as described below. The Westinghouse Hanford document, *A Proposed Data Quality Strategy for Hanford Site Characterization,* will be used to help define these levels (McCain and Johnson 1990). The DQOs will also be devloped and defined on an operable unit basis in the work plans and, specifically, in the Quality Assurance Project Plans (QAPjPs) which will guide investigation activities.

Chemical and radionuclide laboratory analysis will be one of the most important data types, and is required at virtually all the waste management units in the PUREX Plant Aggregate Area. In general, increasing accuracy, precision, and lower detection limits are obtained with increasing cost and time. Therefore, the analytical level used to obtain data should be commensurate with the intended use. Table 8-3 defines five analytical levels associated with different types of characterization efforts. While the bulk of the analysis during LFIs/RIs will be screening level (DQO Level I or II), these data will require confirmation sampling and analysis to allow final remedial decisions through quantitative risk

assessment methods. Individual DQO analytical PARCC parameters for Level III or IV analytical data associated with each contaminant anticipated in the PUREX Plant Aggregate Area (as developed in Section 5) are given in Table 8-4. These parameters will be used for the development of site-specific sampling and analysis plans and quality assurance plans for investigations and remediations in the aggregate area.

Before laboratory or even field data can be used in the selection of the final remedial action, they must first be validated. Exceptions are made for initial evaluations of the sites using existing data, which may not be appropriate for validation but will be used on a screening basis based on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a). Other screening data (e.g., estimates of contaminant concentration inferred from field analyses) may also be excepted. Validation involves determining the usability and quality of the data. Once data are validated, they can be used to successfully complete the remedial action selection process. Activities involved in the data validation process include the following:

- Verification of chain-of-custody and sample holding times
- Confirmation that laboratory data meet Quality Assurance/Quality Control (QA/QC) criteria
- Confirmation of the usability and quality of field data, which includes geological logs, hydrologic data, and geophysical surveys
- Proper documentation and management of data so that they are usable.

Validation may be performed by qualified Westinghouse Hanford personnel from the Office of Sample Management (OSM), other Westinghouse Hanford organizations, or a qualified independent participant subcontractor. Data validation of laboratory analyses will be performed in accordance with *A Proposed Data Quality Strategy for Hanford Site Characterization* (McCain and Johnson 1990) and standards set forth by Westinghouse Hanford.

To accomplish the second point, all laboratory data must meet the requirements of the specific QA/QC parameters as set up in the QAPjP for the project before it can be considered usable. The QA/QC parameters address laboratory precision and accuracy, method blanks, instrument calibration, and holding times.

The usability of field data must be assessed by a trained and qualified person. The project geohydrologist/geophysicists will review the geologic logs, hydrologic data, geophysical surveys, and results of physical testing, on a daily basis, and senior technical reviews will be conducted periodically throughout the project.

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Data management procedures are also necessary for the validation. Data management includes proper documentation of field activities, sample management and tracking, and document and inventory control. Specific consistent procedures are discussed in the Information Management Overview (Appendix D).

8.2.2.3 Data Quantity Needs. The number of samples that need to be collected during an investigation can be determined by using several approaches. In instances where data are lacking or are limited (such as for contamination in the vadose zone soils), a phased sampling approach will be appropriate. In the absence of any available data, an approach or rationale will need to be developed to justify the sampling locations and the numbers of samples selected. This will be accomplished and documented in the production of work plans and field sampling plans for each aggregate area, under the guidance and review of the Tri-Party Agreement participants. Specific locations and numbers of samples will be determined based on data collected during screening activities. For example, the number and location of beta/gamma spectrometer probe locations can be based on results of surface geophysical and radiation surveys. These may help locate some subsurface features, which may not be adequately documented. Details of any higher DQO level subsurface soil sampling scheme will depend on results of screening investigations such as geophysics surveys, surface radiation surveys, field chemical screening, and beta/gamma spectrometer probe surveys. In situations where and when available data are more complete, statistical techniques may be useful in determining the additional data required.

8.2.2.4 Sampling and Analysis Options. Data collection activities are structured to obtain the needed data in a cost-effective manner. Developing a sampling and analysis approach that ensures that appropriate data quality and quantity are obtained with the resources available may be accomplished by using field screening techniques and focusing the higher DQO level analyses on a limited set of samples at each site. The investigations on waste management units in the PUREX Plant Aggregate Area should take advantage of this approach for a comprehensive characterization of the site in a cost-effective manner.

A combination of lower level (Levels I and II), higher level analytical data (Levels III and IV), and special analytical data (Level V) should be collected. This approach would provide the certainty necessary to determine contaminants present near the sources. Samples collected from the other media (i.e., subsurface soils, sediments) will be analyzed by *Test Methods for Evaluating Solid Wastes*, (EPA 1986), CLP (EPA 1988b, EPA 1989a), *Methods for Chemical Analysis of Water and Wastes* (EPA 1983), or *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980a).

8.2.2.5 Data Quality Parameters. The PARCC parameters are indicators of data quality. Ideally, the end use of the data collected should define the necessary PARCC parameters. Once the PARCC requirements have been identified, then appropriate analytical methods can

be chosen to meet established goals and requirements. Definitions of the PARCC parameters are presented in Section 8.1.3.

In general the precision and accuracy objectives are governed by the capabilities of the available methodologies and in most cases these are more than adequate for the needs of the investigations. Chemical analyses can usually attain parts per billion detection range in soils and water, and this level is adequate to the needs of the risk assessment for most analytes. Radiological analyses reach similar levels. Table 8-4 shows detection levels, generally obtained from the method description such as the document *Test Methods for Evaluating Solid Wastes* (EPA 1986) or from experience with laboratory analysis. Some constituents (e.g., arsenic) would require analysis to much lower levels, but this is impossible because of the limitations of analytical methods and the effects of natural background levels. For example, EPA Method 200.62-C-CLP can analyze to detection levels of 500 mg/kg in soils, while the Model Toxics Control Act (MTCA) Method C industrial soils cleanup level is 50 μg/kg. In some cases, special analytical methods can be developed to obtain lower detection levels. In addition, risk assessment is conventionally computed only to a single digit of precision and uses conservative assumptions, which reduce the impact of measurements with lower accuracy.

For other measurements, such as physical parameters, the precision and accuracy capabilities of existing measurement technologies are sufficient for the evaluation methods used to produce characterization data, so the objectives are based on the limitations of the analysis methodologies.

Representativeness is maintained by fitting the sampling program to the governing aspects of the sources and transport processes of the site, as demonstrated in the site conceptual model (Section 4.2). Initial sampling should concentrate on sources, which are fairly well-understood, and on representative locations of anticipated transport mechanisms. If necessary, following activities can focus on aspects or locations that were not anticipated but were demonstrated by the more general results.

Completeness is generally attained by specifying redundancy on critical samples and maintaining quality control on their acquisition and analysis. As with representativeness, the initial sampling program may lead to modifications of which samples should be considered critical during subsequent sampling activities.

Comparability will be met through the use of Westinghouse Hanford standard procedures generally incorporated into the *Environmental Investigation and Site Characterization Manual* (WHC 1988b).

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8.2.3 Data Gaps

Considering the data needs developed in Section 8.2.2, and the data available to meet these needs as presented in Section 8.1.2, it is apparent that a number of data gaps can be identified. These are summarized, on a waste management unit category basis, in Table 8-5, and should be the focus of LFIs on a waste management unit category basis, using the analogue sites approach. These contaminant concentration data are the highest priority because of the need to assess the need for remediation (through quantitative risk assesssment and evaluation of compliance with ARARs) and appropriate remedial actions for each site.

In addition to these data needs specifically addressing contamination problems at sites included for consideration in this aggregate area, there are general data needs which will be required for characterization of the possible transport pathways, as presented in the conceptual model, at locations away from the individual units. These general, nonsite-specific needs include characterization of the following:

- Geologic stratigraphy, particularly for possible perched water zones
- Transport through the vadose zone (mobilization through natural or artificial recharge or drainage)
- Air transport of contamination
- Ecological impacts and transport mechanisms (bio-uptake, bio-concentration, secondary receptors through predation)
- Potential releases from process effluent lines between facilities and to waste disposal sites.

All of these needs will have to be addressed in the data collection program (Section 8.3). In addition, data gaps that impact groundwater are also addressed in the 200 East Groundwater AAMSR.

8.3 DATA COLLECTION PROGRAM (STAGE 3 OF THE DQO PROCESS)

The data collection program is Stage 3 of the process to develop DQOs. Conducting an investigation with a mixture of screening and higher-level data is a common method for optimizing the quantity and quality of the data collected. It would be very inefficient and

overly expensive to specify beforehand all the types of samples and analyses that will yield the most complete and accurate understanding of the contamination and physical behavior of the site. Data adequate to achieve all the goals and objectives for remedial action decisions are obtained at a lower cost by using the information obtained in the field to focus the ongoing investigation and remediation process.

Initial sampling should collect new data believed most necessary to confirm and refine the conceptual model particularly at priority sites. Sampling may then be extended to further reduce uncertainty, to fill in remaining data gaps, to collect more detailed information for certain points where such information is required, or to conduct any needed treatability studies or otherwise support the data needs of the remedial action selection process. An alternative of extrapolating the data from a limited number of sites to other analogous ones will also be used. The need for subsequent investigation phases will be assessed throughout the investigation and remediation activities as data become available. Assessing completeness of the investigation data through a formal statistical procedure is not possible, given the complexity and uncertainty of the parameters required to describe the site and the time to make decisions. Rather, the use of engineering judgement is considered sufficient to the decision process.

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8.3.1 General Rationale

The general rationale for the investigation of sites in the PUREX Plant Aggregate Area is to collect needed data that are not available. Because of the size of the aggregate area, the complexity of past operations, and the number of unplanned releases and waste management units, a large amount of new information will be required such as the specific radionuclides and chemicals present, their spatial distribution and form, and the presence of special migration pathways.

The following work plan approach will be used for LFIs and RI/FS in the PUREX Plant Aggregate Area. The results are described in Sections 8.3.2 and 8.3.3 in general form.

- Existing data as described in Sections 2.0, 3.0, and 4.0 should be used to the maximum extent possible. Although existing data are not fully validated, the data are still useful in developing a preliminary conceptual model (Section 4.2) and in helping to focus and guide the planning of investigations, expedited actions, and interim measures.

- Additional data at validated and screening levels should be collected to obtain the maximum amount of useful information for the amount of time and resources invested in the investigation.

- Data should be collected to support the intended data uses identified in Section 8.2.1.

- Nonintrusive sampling (e.g., geophysical surveys, surface radiation surveys, soil gas, and spectral gamma probe surveys), and surficial and source sampling should be conducted early in any investigation effort to identify necessary interim response actions (i.e., additional ERAs or IRMs).

- Data collected from initial investigation activities should be used to confirm and refine the conceptual model (Section 4.2), refine the analyte constituents of concern, and provide information to conduct interim response actions or risk assessment activities.

- Additional investigation activities are proposed to support (if needed) quantitative baseline risk assessments for final cleanup actions and further refine the conceptual model.

- Field investigation techniques should be used to minimize the amount of hazardous or mixed waste generated. Any waste generated will be in accordance with EII 4.3, "Control of CERCLA and Other Past-Practice Investigation Derived Waste" (WHC 1988b).

8.3.2 General Strategy

The overall objective of any field investigation (LFI, IRM, or RI) of the sites in the PUREX Plant Aggregate Area will be to gather additional information to support risk assessment and remedial action selection according to the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart discussed in Section 8.1.5. The general approach or strategy for obtaining this additional information is presented below.

- Analytical parameter selection should be based on verifying overall conditions and then narrowed to specific constituents of concern, in consideration with regulatory requirements and site conditions. Periodic analyses of the long list of parameters should be conducted to verify that the list of constituents of concern has not changed, either because new constituents are identified or some of those considered as a potential concern do not appear to be significant.

- Similarly, investigations should work from a screening level (DQO Levels I or II, e.g., surface radiation surveys) to successively more specific sampling and analysis methodologies (e.g., beta/gamma spectral probes, then DQO Level III or IV soil sampling and analysis), without time consuming remobilizations.

- Dangerous and radioactive wastes may be generated during the field investigation. While efforts should be made to minimize these wastes, any waste generated will be handled in accordance with EII 4.3, "Control of CERCLA and Other Past-Practice Investigation Derived Waste" (WHC 1988b). The analyses of samples for constituents of concern analytes will allow wastes generated to be adequately designated.

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8.3.3 Investigation Methodology

Initial field investigations (mainly LFIs, but also associated with IRMs at appropriate sites and possibly some RIs) may include some or all of the following integrated methodologies:

- Source Investigation (Section 8.3.3.1)
- Geological Investigation (Section 8.3.3.2)
- Surface Water Sediment Investigation (Section 8.3.3.3)
- Soil Investigation (Section 8.3.3.4)
- Air Investigation (Section 8.3.3.5)
- Ecological Investigation (Section 8.3.3.6)
- Geophysical Stratigraphic Survey (Section 8.3.3.7)
- Process Effluent Pipeline Integrity Assessment (Section 8.3.3.8)
- Geodetic Survey (Section 8.3.3.9)
- Cultural Resource Investigation (Section 8.3.3.10).

Each investigation methodology is briefly outlined in the following sections. Specific survey methods (such as electromagnetics or ground-penetrating radar) have not been recommended to allow flexibility in the development of field sampling plans which can be sensitive to very local conditions. A summary of the applicable methods for each waste management unit is presented in Table 8-6. In addition, some of the data needs must be addressed on an area-wide basis (e.g., stratigraphy interpretation). More detailed descriptions and specific methods and instrumentation will be included in site-specific work plans, sampling and analysis plans, and field sampling plans for LFIs/IRMs at waste management units that require these investigations.

These investigations are presented in the approximate priority of their need, with the source investigation first because of its importance to the decisions about remedial action on a site-by-site basis. The other investigations are of lower priority, and will be conducted according to the need to determine whether contamination has been transported beyond the immediate vicinity of the waste management units. To some extent, this need will depend on the results of the source investigation.

8.3.3.1 Source Investigation. The purpose of source investigation activities in the PUREX Plant Aggregate Area is to characterize the known waste management units and unplanned releases that exist in the area and that may contribute to contamination of surface soil, vadose zone, surface water, sediment, air, and biota. The completeness of the characterization effort will be assessed according to the needs of risk assessment, ARARs compliance, and remedial action selection, which will also determine what levels of the various constituents of concern comprise "contamination."

Source sampling should be conducted at waste management units or unplanned release locations where the available data indicate that dangerous, mixed, or radioactive wastes may be present. Activities which are proposed to be performed during the source investigations include the following:

- Compile and evaluate additional existing data for the purpose of: verifying locations, specifications of engineered facilities, and pipelines, and waste stream characteristics; assessment of the construction and condition of boreholes/wells that exist in the operable unit and their suitability for use for investigation activities, QA/QC information, and raw data regarding radiological and hazardous substances monitoring; and integrating any additional environmental modeling data into the conceptual model. This has been done (on an aggregate area basis) in this report; the process will be extended to site-specific planning and on-going assessments of the investigation/remediation as it is carried out.

- Conduct surface radiological surveys of suspected or known source areas to verify locations and nature of surface and subsurface radiological contamination. Conditions at specific sources within a waste management unit should also be noted in order to plan sampling/remediation activities and worker health and safety.

- Conduct nonintrusive surface geophysical surveys at specific waste management units such as the 2607-EL Septic Tank and Drain Field (Section 2.3.6.2), and unplanned release locations to verify locations and physical characteristics of source locations. Data generated from these activities can be used in planning intrusive source sampling activities.

- Conduct beta/gamma spectrometer probe survey to screen for near-surface contamination and to confirm the absence or presence of some specific radionuclides, which may be of particular concern. Existing boreholes will be used to the maximum extent, but new boreholes may be needed at many locations (to be decided based on screening results). Logging will be done both by NaI detectors or μR meters for rapid screening as well as the RLS high purity germanium logging system. Westinghouse Hanford will develop an EII Procedure for the beta/gamma spectrometer probe survey. The beta/gamma spectrometer probe survey serves two purposes depending on the source conditions: to confirm absence of contamination in the near-surface soils, and to serve as a screening tool to choose locations and quantities of vadose zone soil borings. The RLS procedure could demonstrate "assay quality" data for radionuclide concentrations, but will probably continue to require supporting Level III or IV soil analysis data to allow a risk assessment before final remedial decisions. The need to conduct this survey will be based (at least in part) on the screening results of the surface survey and on information about site burial.

- Soil gas surveys should be conducted at waste management units ~~(~~such as cribs~~)~~ where volatile organic ~~chemicals~~compounds (VOCs) are suspected, as a screening method to identify compounds such as solvents ~~and degreasers~~ that may have been used in ~~separate~~ processes ~~or during construction activities~~. The soil gas survey should not be considered conclusive that volatile organic compounds at lower concentrations may not be present. Data from the soil gas survey can be used to help locate surface and near-surface samples and vadose zone borings.

- Collect surface and near-surface samples of contaminated soils and/or waste materials at selected locations. Specific sampling sites will be chosen to assess particular facilities or releases. Additional sampling sites may be specified based on results from nonintrusive investigations.

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- ~~Wipe samples should be collected as part of the investigations of surface contamination or building (piping or pavement) surfaces. The wipe sample locations can be chosen based on visual observations and a surface radiation survey conducted during a site walkthrough. The methodology may be limited by the presence of soil, rough concrete, or paving and so may not be heavily used except as confirmation following removal of loose contamination.~~

8.3.3.2 Geologic Investigation. A geologic investigation should be performed to better characterize the vadose zone and the nature of unsaturated soils that make up this system. The geologic investigation will include the following tasks:

- Borings may be advanced into zones where an accurate interpolation of the subsurface stratigraphy is important to understanding migration pathways in the vadose zone.

- Geologic data collected during the ongoing vadose zone soil (Section 8.3.3.4) and other (deeper) investigations (e.g., geologic and geophysical logs from groundwater well installations for groundwater AAMS) will be compared, compiled, and evaluated.

8.3.3.3 Surface Water Sediment Investigation. A surface water sediment investigation should be conducted. The investigation will include:

- Radiation surveys along ditches and trenches for health and safety purposes and to locate areas of elevated radiation for selection of specific sediment sampling locations.

- Sampling of sediment in any ditches and trenches that still contain water. This will probably be limited to the 207-A Retention Basin. This sediment is ~~also~~ likely to be ~~just~~ windblown soil.

8.3.3.4 Soil Investigation. The purpose of soil investigations is to determine physical and chemical properties of the soil and to determine the nature, type, and extent of soil contamination associated with waste management units and unplanned releases to allow initiation of interim remedial actions and to assess the quantitative risk at other sites. Sampling will include:

- Samples of vadose zone soil will be collected and analyzed for constituents of concern when wells are drilled for other studies (i.e., groundwater investigations) in the vicinity of a waste management unit or unplanned release with reported liquid disposals or spills. Organic vapor (at sites with suspected volatiles) and

radiation sampling should also be performed with samples selected by onsite screening.

- Data collected during this investigation will be evaluated to further understand the contribution of contaminants to the vadose zone from specific waste management units and/or unplanned releases and to better define the hydrology and water quality in the vadose zone system through moisture content profiles ~~and~~, tracking of specific contaminants~~,~~ and soil hydraulic characteristics. However, the issue of contaminant transport through the vadose zone is more appropriate to studies conducted under the direction of the Groundwater AAMSRs.

8.3.3.5 Air Investigation. Air investigations (on an aggregate area scale) should consist of onsite particle sampling as part of the health and safety program. In addition, high-volume air samplers should be placed in appropriate locations on-site based on evaluation of existing meteorological data. The purpose of these samplers will be to determine if any migration of airborne contaminants occurs.

8.3.3.6 Ecological Investigation. Ecological investigation activities, on ~~an aggregate area~~ site-wide scale, should include a literature search and data review, and a site walkthrough. Data collected during the soils characterization activities are expected to be sufficient to evaluate biota remediation technologies. These activities are intended to identify potential biota concerns which need to be addressed in the site investigation. Particular emphasis should be given to identifying potential exposure pathways to biota that migrate offsite or that introduce contaminants into the food web. Data obtained in this survey will be used to both refine the conceptual model as well as to conduct the ecological risk assessment.

8.3.3.7 Geophysical Stratigraphic Survey. A geophysical survey of subsurface stratigraphy should be conducted across the aggregate area to help characterize the geology and hydrogeology of the vadose zone.

8.3.3.8 Process Effluent Pipeline Integrity Assessment. An assessment of process effluent pipeline integrity should be conducted early in site investigation activities to look for potential leaks and therefore possible areas of contamination. Initially, as part of this effort, drawings of the process lines and encasements within the aggregate area (Section 2.3.7) should be reviewed and their construction, installation, and operation evaluated. Specific lines will then be selected for integrity assessment with emphasis on lines serving the waste management units that have received large volumes of liquid (e.g., cribs). Investigation of operating high-level waste transfer lines will be deferred to their respective programs. Results of the integrity assessments will be evaluated and additional sampling activities may be recommended for subsequent studies.

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8.3.3.9 Geodetic Survey. Geodetic surveys will be conducted after the installation and completion of each investigation activity. The survey will be used to locate the horizontal locations of surface and near-surface soil samples; corners of geophysics, soil gas, and beta/gamma probe surveys; and surface water and sediment sample locations. Horizontal and vertical locations of all vadose zone soil borings and perched zone wells will be surveyed. The geodetic survey should be conducted by a professional surveyor licensed in the state of Washington and should be referenced to both historic (e.g., Hanford coordinates) and current coordinate datums (e.g., North American Datum of 1983 - NAD-83), both vertical and horizontal.

8.3.3.10 Cultural Resource Investigation. A cultural resource investigation should be conducted for investigating locations outside the 200 East Area to verify the locations of known archaeological sites by reviewing existing data. The focus of the investigation will be to confirm that no archaeological resources are present at proposed drilling sites.

8.3.4 Data Evaluation and Decision Making

Data will be evaluated as soon as results (e.g., soil gas, radiation screening, drilling results) become available for use in restructuring and focusing the investigation activities. Data reports will be developed that summarize and interpret new data. This includes groundwater sampling and RLS borehole logging as part of the AAMS. Data will be used to refine the conceptual model, further assess potential contaminant-specific ARARs, develop the quantitative risk assessment, and assess remedial action alternatives.

The objectives of data evaluation are the following:

- To reduce and integrate data to ensure that data gaps are identified and that the goals and objectives of the PUREX Plant AAMS are met
- To confirm that data are representative of the media sampled and that QA/QC criteria have been met.

Table 8-1. Uses of Existing Data for PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Development of Sampling Plans			Health and Safety	
	Location	Possible Contamination	Depth Contamination	Surface Radiation	Expected Maximum Level
Cribs and Drains					
216-A-1 Crib	*	*	--	*	*
216-A-2 Crib	*	*	--	*	--
216-A-3 Crib	*	*	--	*	--
216-A-4 Crib	*	*	--	*	--
216-A-5 Crib	*	*	--	*	--
216-A-6 Crib	*	*	--	*	*
216-A-7 Crib	*	*	--	*	*
216-A-8 Crib	*	*	--	*	--
216-A-9 Crib	*	*	--	*	*
216-A-10 Crib	*	*	--	*	--
216-A-21 Crib	*	*	--	*	*
216-A-24 Crib	*	*	--	*	--
216-A-27 Crib	*	*	--	*	--
216-A-30 Crib	*	*	--	*	--
216-A-31 Crib	*	*	--	*	--
216-A-32 Crib	*	--	--	*	--
216-A-36A Crib	*	*	--	*	--
216-A-36B Crib	*	*	--	*	--
216-A-37-1 Crib	*	*	--	*	--
216-A-37-2 Crib	*	--	--	*	--
216-A-38-1 Crib	*	*	--	*	--
216-A-41 Crib	*	--	--	--	--
216-A-45 Crib	*	*	--	*	--
216-A-11 French Drain	*	*	--	*	--
216-A-12 French Drain	*	*	--	*	--
216-A-13 French Drain	*	*	--	*	--
216-A-14 French Drain	*	*	--	*	--
216-A-15 French Drain	*	*	--	*	--
216-A-22 French Drain	*	*	--	*	--
216-A-23A French Drain	*	*	--	*	--
216-A-23B French Drain	*	*	--	*	--
216-A-26 French Drain	*	*	--	*	--
216-A-26A French Drain	*	*	--	*	--
216-A-28 French Drain	*	*	--	*	--
216-A-33 French Drain	*	--	--	*	--

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Table 8-1. Uses of Existing Data for PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Development of Sampling Plans			Health and Safety	
	Location	Possible Contamination	Depth Contamination	Surface Radiation	Expected Maximum Level
216-A-35 French Drain	*	*	--	*	--
Reverse Wells					
299-E24-111 Injection Well	*	*	--	*	--
Ponds, Ditches and Trenches					
216-A-29 Ditch	*	--	--	*	--
216-A-34 Ditch	*	--	--	*	--
216-A-18 Trench	*	--	--	*	--
216-A-19 Trench	*	--	--	*	--
216-A-20 Trench	*	--	--	*	--
216-A-40 Trench	*	--	--	*	--
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					
216-A-524 Control Structure	--	*	--	*	--
Basins					
207-A Retention Basin	*	--	--	*	*
216-A-42 Retention Basin	*	--	--	--	--
Burial Sites					
218-E-1 Burial Ground	*	*	--	*	--
218-E-8 Burial Ground	*	*	--	--	--
218-E-12A Burial Ground	*	*	--	*	--
218-E-13 Burial Ground	*	*	--	*	--
Unplanned Releases					
UN-200-E-10 Unplanned Release	*	--	--	--	--
UN-200-E-11 Unplanned Release	*	*	--	--	--
UN-200-E-12 Unplanned Release	*	*	--	--	--
UN-200-E-13 Unplanned Release	*	--	--	--	--
UN-200-E-15 Unplanned Release	*	--	--	--	--
UN-200-E-19 Unplanned Release	*	*	--	--	--

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Table 8-1. Uses of Existing Data for PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Development of Sampling Plans			Health and Safety	
	Location	Possible Contamination	Depth Contamination	Surface Radiation	Expected Maximum Level
UN-200-E-20 Unplanned Release	*	*	--	--	--
UN-200-E-22 Unplanned Release	*	*	--	--	--
UN-200-E-25 Unplanned Release	*	*	--	--	--
UN-200-E-26 Unplanned Release	*	*	--	--	--
UN-200-E-28 Unplanned Release	*	*	--	--	--
UN-200-E-31 Unplanned Release	*	*	--	--	--
UN-200-E-33 Unplanned Release	*	--	--	--	--
UN-200-E-35 Unplanned Release	*	--	--	--	--
UN-200-E-39 Unplanned Release	*	*	--	--	--
UN-200-E-40 Unplanned Release	*	*	--	--	--
UN-200-E-42 Unplanned Release	*	--	--	--	--
UN-200-E-49 Unplanned Release	*	--	--	--	--
UN-200-E-56 Unplanned Release	*	*	--	--	--
UN-200-E-58 Unplanned Release	*	--	--	--	--
UN-200-E-60 Unplanned Release	*	--	--	--	--
UN-200-E-62 Unplanned Release	*	--	--	--	--
UN-200-E-65 Unplanned Release	*	--	--	--	--
UN-200-E-67 Unplanned Release	*	--	--	--	--
UN-200-E-68 Unplanned Release	*	--	--	--	--
UN-200-E-72 Unplanned Release	*	--	--	--	--
UN-200-E-88 Unplanned Release	*	*	--	*	*
UN-200-E-94 Unplanned Release	*	--	--	--	--
UN-200-E-96 Unplanned Release	*	*	--	--	--
UN-200-E-97 Unplanned Release	*	--	--	--	--
UN-200-E-100 Unplanned Release	*	*	--	--	--
UN-200-E-114 Unplanned Release	*	*	--	--	--
UN-200-E-117 Unplanned Release	*	*	--	--	--
UN-200-E-142 Unplanned Release	*	--	--	--	--

An asterisk (*) indicates potential use for available data.
A dashed line (--) indicates no data available.

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Table 8-2. Data Needs for Preliminary Remedial Action Technologies PUREX Plant Aggregate Area.

Alternative	Physical Attribute	Chemical/Radiochemical Attribute
1. Multimedia Cover (plus possible vertical barriers)	• areal extent • depth of contamination • structural integrity (collapse potential) • run-off/run-on potential • cover properties (permeability)	• surface radiation • biologic transport potential
2. In Situ Grouting/ Stabilization	• areal extent • depth • particle size • hydraulic properties (permeability/porosity) • stratigraphy • borehole spacing • grout/additive mix parameters	• solubility • reactivity • leachability from grout medium
3. Excavation, Soil Treatment, and Disposal	• areal extent[a/] • depth[a/] • particle size • silt-size (dust) content • excavation stability	• toxicity/radioactivity • levels of contaminants • solubility/reactivity • soil chemistry (relative affinity) • concentrations in PM-10 fraction • spent solvent treatment/disposal options
4. In Situ vitrification	• areal extent • depth • soil/waste conductivity • thermal properties • moisture contact • voids	• volatility • reactivity • leachability/integrity • off-gas treatment waste disposal options
5. Excavation, Above Ground Treatment, and Geologic Disposal	• areal extent[a/] • depth[a/] • mineralogy of soil/waste • particle size • silt-size (dust) content • excavation stability • treatment parameters	• concentrations of TRU • toxicity/radioactivity • levels of contaminants • concentrations in PM-10 fraction • reactivity • leachability/integrity of final waste form

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Table 8-2. Data Needs for Preliminary Remedial Action Technologies PUREX Plant Aggregate Area.

Alternative	Physical Attribute	Chemical/Radiochemical Attribute
6. In Situ Soil Vapor Extraction	• areal extent • depth • locations/depth of highest concentrations (vapors, adsorbed) • stratigraphy • soil permeability/porosity • voids	• volatility of constituents (Henry's Law Constant) • non-volatile organics • levels • volatile radionuclides (Radon) • treatability (catalytic oxidization)

[a] May be obtained during remediation using the observational approach recommended by the *Hanford Past-Practice Strategy* (DOE/RL 1992a)

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Table 8-3. Analytical Levels for the PUREX Plant Aggregate Area.

Level	Description
LEVEL I	Field screening. This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.
LEVEL II	Field analysis. This level is characterized by the use of portable analytical instruments which can be used onsite, or in mobile laboratories stationed near a site (close-support laboratories). Depending on the types of contaminants, sample matrix, and personnel skill, qualitative and quantitative data can be obtained.
LEVEL III	Laboratory analysis using methods other than the Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is used primarily in support of engineering studies using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS without the CLP requirements for documentation.
LEVEL IV	Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data. Some regions have obtained similar support via their own regional laboratories, university laboratories, or other commercial laboratories.
LEVEL V	Nonstandard methods. Analyses which may require method modification and/or development are considered Level V by CLP Special Analytical Services (SAS).

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Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
RADIONUCLIDES								
Gross Alpha	900.0 M	TBD	±30	±25	900.0	10	±25	±25
Gross Beta	900.0 M	TBD	±30	±25	900.0	5	±25	±25
Gamma Scan	D3699 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Actinium-225	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Actinium-227	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-241	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Americium-242	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-242m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-243	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Antinomy-126	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Antimony-126m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Barium-137m	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Bismuth-210	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-213	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Carbon-14	C-01 M	TBD	±30	±25	TBD	TBD	±25	±25
Cesium-134	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Cesium-135	901.0 M	TBD	±30	±25	901.0	TBD	±25	±25
Cesium-137	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Cobalt-60	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Curium-242	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-244	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-245	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Europium-152	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Europium-154	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Europium-155	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Francium-221	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Iodine-129	902.0 M	TBD	±30	±25	902.0	TBD	±25	±25
Lead-209	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-210	Pb-01 M	TBD	±30	±25	Pb-01	TBD	±25	±25
Lead-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-212	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Neptunium-237	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Neptunium-239	D35649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Nickel-59	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Nickel-63	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Niobium-93m	TBD	TBD	±30	±25	TBD	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses. Page 3 of 6

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Plutonium	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-238	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-239/240	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-241	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-215	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-218	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Potassium-40	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Protactinium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Protactinium-234m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Radium-225	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium-226	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Ruthenium-106	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Samarium-151	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Selenium-79	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Sodium-22	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Strontium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Technetium-99	Tc-01 M	TBD	±30	±25	Tc-01	TBD	±25	±25
Thallium-207	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Thorium-227	00-06	TBD	±30	±25	00-07	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Thorium-229	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-230	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Tritium	906.0 M	TBD	±30	±25	906.0	300	±25	±25
Uranium	U-04	TBD	±30	±25	U-04	TBD	±25	±25
Uranium-233	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-234	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-235	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-238	U	TBD	±30	±25	908.0	TBD	±25	±25
Yttrium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Zirconium-93	TBD	TBD	±30	±25	TBD	TBD	±25	±25
INORGANICS								
Arsenic	7061	0.02	±25	±30	7061	10	±20	±25
Barium	6010	0.02	±25	±30	6010	20	±20	±25
Boron	6010	TBD	±25	±30	6010	TBD	±20	±25
Cadmium	6010	0.09	±25	±30	6010	1	±20	±25
Chromium	6010	0.07	±25	±30	6010	10	±20	±25
Copper	6010	0.06	±25	±30	220.2	10	±20	±25
Cyanide	9010	TBD	±25	±30	335.3	50	±20	±25
Fluoride	300 M	TBD	±25	±30	300	50	±20	±25
Iron	6010	20	±25	±30	6010	70	±20	±25

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Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
INORGANICS (cont.)								
Lead	6010	0.45	±25	±30	6010	450	±20	±25
Manganese	6010	0.02	±25	±30	6010	20	±20	±25
Mercury	7471	0.02	±25	±30	245.2	2	±20	±25
Nickel	6010	1.5	±25	±30	6010	50	±20	±25
Nitrate	352.1	TBD	±25	±30	352.1	130	±20	±25
Nitrite	354.1	TBD	±25	±30	354.1	40	±20	±25
Selenium	6010	0.75	±25	±30	270.2	20	±20	±25
Silver	6010	2	±25	±30	272.2	10	±20	±25
Titanium	6010	TBD	±25	±30	6010	TBD	±20	±25
Vanadium	6010	0.08	±25	±30	286.2	40	±20	±25
Zinc	6010	0.02	±25	±30	6010	20	±20	±25
ORGANICS								
Acetone	624	0.1	±25	±30	624	100	±20	±25
Carbon tetrachloride	624	0.005	±25	±30	624	1	±20	±25
Chloroform	624	0.005	±25	±30	624	5	±20	±25
Kerosene	8015-Mod	20	±35	±30	8015-Mod	500	±35	±25
Methylene chloride	8240	0.005	±25	±30	624	5	±20	±25
MIBK	8015	0.5	±25	±30	8015	5	±20	±25
1,1,1-Trichloroethane	8240	0.005	±25	±30	624	5	±20	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)[a/]	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/L)[a/]	Precision (RPD)	Accuracy (%)
ORGANICS (cont.)								
Toluene	8240	0.005	±25	±30	624	5	±20	±25
Tributyl phosphate	TBD	TBD	±25	±30	TBD	TBD	±30	±25

TBD = To Be Determined
M = method modified to include extraction from the solid medium, extraction method is matrix and laboratory-specific
RPD = Relative Percent Difference
Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA 1980a)
Test Methods for Evaluation Solid Waste (SW 846) *Third Edition* (EPA 1986)
Methods for Chemical Analysis of Water and Waste (EPA 1983)
Radionuclide Method for the Determination of Uranium in Soil and Air (EPA 1980b)
EML Procedures Manual (DOE/EML 1990)
Eastern Environmental Radiation Facility RadioChemistry Procedures Manual (EPA 1984)
High-Resolution Gamma-Ray Spectrometry of Water (ASTM 1985)
Precision and accuracy are goals. Since these parameters are highly matrix dependent they could vary greatly from the goals listed.
a/ Practical Quantitation Limits for organics and inorganics are reported in units of mg/kg for soil and mg/L for water.

Table 8-5. Data Gaps by Site Category.

Site Category	Identified Data Gaps
Tanks and Vaults	• Contaminant concentrations in waste management units other than single-shell tanks • Distribution of contaminants in subsurface soils released in leaks • Constituents concentrations in related surface contamination
Cribs and Drains	• Contaminant concentrations in cribs • Contaminant concentrations in soils beneath cribs • Specific constituents (especially organic chemicals) • Distribution and vertical/lateral extent of contamination
Ponds, Ditches, and Trenches	• Distribution/extent of subsurface contamination • Buried contaminant concentrations in stabilized portions/units
Septic Tanks and Associated Drain Fields	• Actual discharge levels • Possible discharge and presence/level of non-sanitary wastes (e.g., laboratory drains)
Transfer Facilities, Diversion Boxes, and Pipelines	• Contamination constituents and concentrations • Direct radiation levels in facilities • Constituents/concentrations in related surface contamination • Integrity of transfer lines
Unplanned Releases	• Surface soil constituents and concentrations • Buried contamination constituents and concentrations

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Table 8-6. Applicable Characterization Methods at PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Source Investigation Method							
	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
Cribs and Drains								
216-A-1 Crib	--	A	--	--	A	--	A	--
216-A-2 Crib	--	A	--	A	A	--	A	--
216-A-3 Crib	--	A	--	--	A	--	A	--
216-A-4 Crib	--	A	--	--	A	--	A	--
216-A-5 Crib	--	A	--	--	A	--	A	--
216-A-6 Crib	--	A	--	--	A	--	A	--
216-A-7 Crib	--	A	--	A	A	--	A	--
216-A-8 Crib	--	A	--	A	A	--	A	--
216-A-9 Crib	--	A	--	--	A	--	A	--
216-A-10 Crib	--	A	--	--	A	--	A	--
216-A-21 Crib	--	A	--	--	A	--	A	--
216-A-24 Crib	--	A	--	A	A	--	A	--
216-A-27 Crib	--	A	--	--	A	--	A	--
216-A-30 Crib	--	A	--	--	A	--	A	--
216-A-31 Crib	--	A	--	A	A	--	A	--
216-A-32 Crib	--	A	--	--	A	--	A	--
216-A-36A Crib	--	A	--	--	A	--	A	--
216-A-36B Crib	--	A	--	--	A	--	A	--
216-A-37-1 Crib	--	A	--	--	A	--	A	--
216-A-37-2 Crib	--	A	--	--	A	--	A	--
216-A-38-1 Crib	--	--	--	--	X	--	X	--

Table 8-6. Applicable Characterization Methods at PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Source Investigation Method							
	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
216-A-41 Crib	A	A	--	--	A	--	A	--
216-A-45 Crib	--	A	--	--	A	--	A	--
216-A-11 French Drain	--	--	--	--	X	--	X	--
216-A-12 French Drain	--	--	--	--	X	--	X	--
216-A-13 French Drain	--	--	--	--	X	--	X	--
216-A-14 French Drain	--	A	--	--	A	--	A	--
216-A-15 French Drain	--	--	--	--	X	--	X	--
216-A-22 French Drain	--	--	--	--	X	--	X	--
216-A-26 French Drain	--	--	--	--	X	--	X	--
216-A-26A French Drain	--	--	--	--	X	--	X	--
216-A-28 French Drain	--	A	--	--	A	--	A	--
216-A-33 French Drain	--	--	--	--	X	--	X	--
216-A-35 French Drain	--	--	--	--	X	--	X	--
Reverse Wells								
299-E24-11 Injection Well	--	X	--	--	X	--	X	--
Ponds, Ditches and Trenches								
216-A-29 Ditch	--	--	--	--	X	--	X	--
216-A-34 Ditch	--	--	--	--	X	--	X	--
216-A-18 Trench	--	--	--	--	X	--	X	--
216-A-19 Trench	--	--	--	--	X	--	X	--
216-A-20 Trench	--	--	--	--	X	--	X	--
216-A-40 Trench	--	--	--	--	X	--	X	--

Table 8-6. Applicable Characterization Methods at PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Source Investigation Method							
	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
Septic Tanks and Associated Drain Fields								
2607 EA Septic Tank/Drain Field	X	--	--	--	X	--	X	--
2607 EC Septic Tank/Drain Field	X	--	--	--	X	--	X	--
2607 ED Septic Tank/Drain Field	X	--	--	--	X	--	X	--
2607 EG Septic Tank/Drain Field	X	--	--	--	X	--	X	--
2607 EJ Septic Tank/Drain Field	X	--	--	--	X	--	X	--
2607 EL Septic Tank/Drain Field	X	--	X	--	X	--	X	--
2607 E6 Septic Tank/Drain Field	X	--	--	--	X	--	X	--
Transfer Facilities, Diversion Boxes, and Pipelines								
216-A-S24 Control Structure	--	--	--	--	--	--	--	--
Basins								
207-A Retention Basin	--	--	--	--	--	X	--	--
216-A-42 Retention Basin	X	--	--	--	X	X	X	--
Burial Sites								
218-E-1 Burial Ground	X	--	--	--	X	--	X	--
218-E-8 Burial Ground	X	--	--	--	X	--	X	--
218-E-12A Burial Ground	X	--	--	--	X	--	X	--
218-E-12B Burial Ground	X	--	--	--	X	--	X	--
218-E-13 Burial Ground	X	--	--	--	X	--	X	--

Table 8-6. Applicable Characterization Methods at PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Source Investigation Method							
	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
Unplanned Releases								
UN-200-E-10 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-11 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-12 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-13 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-15 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-19 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-20 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-22 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-25 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-26 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-28 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-31 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-33 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-35 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-39 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-40 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-42 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-49 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-56 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-58 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-60 Unplanned Release	X	--	--	--	X	--	X	--

Table 8-6. Applicable Characterization Methods at PUREX Plant Aggregate Area Waste Management Units.

Waste Management Unit	Source Investigation Method							
	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
UN-200-E-62 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-65 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-67 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-68 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-72 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-88 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-94 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-96 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-97 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-100 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-114 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-117 Unplanned Release	X	--	--	--	X	--	X	--
UN-200-E-142 Unplanned Release	X	--	--	--	X	--	X	--

X = Investigation at each individual site.
A = Investigation representative of several analogous sites.

9.0 RECOMMENDATIONS

The purpose of the aggregate area management study (AAMS) is to compile and evaluate the existing body of knowledge to support the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) decision making process. A primary task in achieving this purpose is to assess each waste management unit and unplanned release within the aggregate area to determine the most expeditious path for remediation within the statutory requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA). The existing body of pertinent knowledge regarding PUREX Plant Aggregate Area waste management units and unplanned releases has been summarized and evaluated in the previous sections of this study. A data evaluation process has been established that uses the existing data to develop preliminary recommendations on the appropriate remediation path for each waste management unit. This data evaluation process is a refinement of the *Hanford Site Past-Practice Strategy* (Figure 1-2) and establishes criteria for selecting an appropriate *Hanford Site Past-Practice Strategy* path (expedited response action, ERA; interim remedial measures, IRM; limited field investigation, LFI; and final remedy selection~~, FRS~~) for individual waste management units and unplanned releases within the 200 Areas. A discussion of the criteria for path selection and the results of the data evaluation process are provided in Sections 9.1. and 9.2, respectively. Figure 9-1 provides a flowchart of the data evaluation process that will be discussed. Table 9-1 provides a summary of the results of the data evaluation assessment of each unit. Table 9-2 provides the decisional matrix patterns each unit followed.

This section presents recommended assessment paths for the waste management units and unplanned releases at the PUREX Plant Aggregate Area. These recommendations are only proposed at this time and are subject to adjustment and change. Factors that may affect development of final recommendations include, but are not limited to, comments and advice from the Washington State Department of Ecology (Ecology), U.S. Environmental Protection Agency (EPA), or U.S. Department of Energy (DOE); identification and development of new information; and modification of the criteria used in the assessment path decision making process. The data evaluation process depicted in Figure 9-1 and discussed in Section 9.1 was developed to facilitate only the technical data evaluation step shown on the *Hanford Site Past-Practice Strategy* (Box A, Figure 1-2). Procedural and administrative requirements for implementation of the recommendations provided in this AAMS will be performed in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) and the *Hanford Site Past-Practice Strategy*. Changes in recommendations will be addressed, and more detail on recommended assessment paths for waste management units and unplanned releases will be included in workplans as they are developed for the actual investigation and remediation activities.

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A majority of waste management units and unplanned releases do not have information regarding the nature and extent of contamination necessary for quantitative or qualitative risk assessment, especially with regard to hazardous constituents, and were recommended for additional investigation (e.g., LFI). Several units and releases assessed within the ERA path were recommended for actions that fall within the scope of existing operational programs. Sites with elevated levels of surface radionuclide contamination are addressed by the Radiation Area Remedial Action (RARA) pProgram.

Waste management units and unplanned releases which are addressed entirely by other programs were not subjected to the data evaluation process. This includes units and unplanned releases that are within the scope of the Single-Shell Tank Closure Program, Decommissioning and RCRA Closure Program, and Waste Management Program. Table 9-3 provides a list of the units not included in the evaluation.

A majority of waste management units not addressed in the data evaluation fall within the scope of the Single-Shell Tank Closure Program. The activities associated with closure of the 200-PO-3 Operable Unit single-shell tanks have separate Tri-Party Agreement milestones and any recommendations for disposition of these units and associated unplanned releases will be developed as part of the ongoing program addressing the single-shell tanks. The units associated with the 200-PO-3 Operable Unit that were not evaluated include single-shell tanks and associated diversion boxes, vaults, catch tanks, and high-level waste transfer lines. The Waste Management Program will completely address the active double-shell tanks, and the active retention basins.

A discussion of the four decision-making paths shown on Figure 9-1: ERA, IRM, LFI, and final remedy selection, is provided in Section 9.1. Section 9.2 provides a discussion of the waste management units grouped under each of these paths. A discussion of regrouping and prioritization of the waste management units is provided in Section 9.3. Recommendations for redefining operable unit boundaries and prioritizing operable units for work plan development are also provided in Section 9.3. No additional aggregate area-based field characterization activities are recommended to be undertaken as a continuation of the AAMS. All recommendation for future characterization needs (see Section 8.0) will be more fully developed and implemented through work plans. Plan development and submittal will be accomplished in accordance with requirements of the *Hanford Site Past-Practice Strategy* and the Tri-Party Agreement and could include remedial investigation (RI)/feasibility study (RI/FS); RCRA facility investigation (RFI)/corrective measures study (CMS), or LFI work plans. Sections 9.4 and 9.5 provide recommendations for focused feasibility and treatability studies, respectively.

9.1 DECISION MAKING CRITERIA

The criteria used to assess the most expeditious remediation process path are based primarily on urgency for action and whether site data are adequate to proceed along a given path (Figure 9-1). All units and unplanned releases that are not completely addressed under other Hanford Site programs are assessed in the data evaluation process. All of the units and releases that are addressed in the data evaluation process are initially evaluated as candidates for an ERA. Sites where a release has occurred or is imminent are considered candidates for ERAs. Conditions that might trigger an ERA are the determination of an unacceptable health or environmental risk or a short time frame available to mitigate the problem (DOE/RL 1992a). As a result, candidate ERA units were evaluated against a set of criteria to determine whether potential for exposure to unacceptable health or environmental risks exists. Units and unplanned releases that are recommended for ERAs will undergo a formal evaluation following the selection process outlined in WHC (1991b).

Waste management units and unplanned releases that are not recommended for consideration as an ERA continue through the data evaluation process. Sites continuing through the process that potentially pose a high risk (refer to Section 5.0), become candidates for consideration as an IRM. The criteria used to determine a potential for high risk, thereby indicating a high priority site, were the Hazard Ranking System (HRS) score used for nominating waste management units for CERCLA cleanup (40 CFR 300), the modified Hazard Ranking System (mHRS) scores, surface radiation survey data, and rankings by the Environmental Protection Program (Huckfeldt 1991b). Units and unplanned releases with HRS or mHRS scores greater than 28.5 (the CERCLA cleanup criterion) were designated as candidate sites for IRM consideration. Units and unplanned releases that did not have an HRS score were compared to similar sites to establish an estimated HRS score. Sites with surface contamination greater than 2 mrem/h exposure rate, 100 ct/min beta/gamma above background or alpha greater than 20 dis/min were also designated as candidate IRM sites. The radiation and surface contamination criteria are based on the Westinghouse Hanford Radiation Protection Manual (WHC-CM-4-10) posting requirements. In addition, surface contamination sites that had an Environmental Protection Program ranking of greater than 7 were also designated as candidate IRM sites. A value of 7 was chosen because it represents the approximate midpoint of the scoring range. The candidate IRM sites are listed in Table 5-1, which summarizes the high priority sites. The four risk indicators are based on limited data (refer to Section 8.0) and therefore may not adequately represent the actual risk posed by the site. Technical judgement, including assessment of similarities in site operational histories, was used to include sites not ranked as high priority in the list of sites under consideration for an IRM. Candidate IRM sites were then further evaluated to determine if an IRM is appropriate for the site. Candidate IRM sites that did not meet the IRM criteria were placed into the final remedy selection path. As future data become available the list of units recommended for consideration as IRM sites may be altered.

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For certain units and unplanned releases, it was recognized that remedial actions could be undertaken under an existing operational or other Hanford Site program (e.g., Single-Shell Tank Closure, RARA, Waste Management, or Decommissioning and RCRA Closure Programs). As a result, recommendations were made that remedial actions be undertaken (partially or completely) outside the 200 AAMS past-practice program. Units or unplanned releases that could be addressed only in part by another program (e.g., surface contamination cleanup under the RARA Program) remained in the 200 AAMS data evaluation process for further consideration. If it cannot be demonstrated that these sites will be addressed under the operational program within a time frame compatible with the past practice program, they will be readdressed by the 200 AAMS process. Tracking of waste management units included in operational programs will be discussed in the work plans developed for each operable unit/aggregate area.

Units and unplanned releases recommended for complete disposition under another program (e.g., single-shell tanks and associated structures under the Single-Shell Tank Closure Program) were not considered in the 200 AAMS data evaluation process. In addition potentially new sites that were identified during the AAMS were also not considered. It is recommended that a formal determination be made regarding the regulatory status of all new sites following established procedures before they are considered further under the 200 AAMS data evaluation process. Potentially new sites identified in the PUREX Plant Aggregate Area are described in Section 2.3.10.

Specific criteria used to develop initial recommendations for ERAs, LFIs, and IRMs for units and unplanned releases within the PUREX Plant Aggregate Area are provided in Sections 9.1.1 and 9.1.2. Units and unplanned releases not initially addressed under an ERA, LFI, or IRM will be evaluated under the final remedy selection path discussed in Section 9.1.3.

9.1.1 Expedited Response Action Path

Candidate ERA sites are evaluated to determine if they pose an unacceptable health or environmental risk and a short time-frame available to mitigate the problem exists. All units and unplanned releases other than those recommended for complete disposition under another Hanford program are assessed against the ERA criteria. The *Hanford Site Past-Practice Strategy* describes conditions that might trigger abatement of a candidate waste management unit or unplanned release under an ERA. Generally, these conditions would rely on a determination of, or suspected, existing or near future unacceptable health or environmental risk, and a short time-frame available to mitigate the problem. Conditions include, but are not limited to:

- Actual or potential exposure to nearby human populations, biota, or the food chain from hazardous substances and radioactive or mixed waste contaminants

- Actual or potential contamination of drinking water supplies or sensitive ecosystems

- Threats of release of hazardous substances and radioactive or mixed waste contaminants

- High levels of hazardous substances and radioactive or mixed waste contaminants in soils that pose or may pose a threat to human health or the environment, or have the potential for migration

- Weather conditions that may increase potential for release or migration of hazardous substances and radioactive or mixed waste contaminants

- The availability of other appropriate federal or state response mechanisms to respond to the release

- Time required to develop and implement a final remedy

- Further degradation of the medium which may occur if a response action is not expeditiously initiated

- Risks of fire or explosion or potential for exposure as a result of an accident or failure of a container or handling system

- Other situations or factors that may pose threats to human health or welfare or the environment.

These conditions were used as the initial screening criteria to identify candidate waste management units and unplanned releases for ERAs. Candidate waste management units and releases that did not meet these conditions were not assessed through the ERA evaluation path. Additional criteria for further, detailed screening of ERA candidates were developed based on the conditions outlined in the *Hanford Site Past-Practice Strategy*. Quantification of these criteria for further screening were developed. These screening criteria are depicted in Figure 9-1 and are described below.

The next decision point on Figure 9-1 used to assess each ERA candidate is whether a driving force to an exposure pathway exists or is likely to exist. Units or unplanned releases with contamination that is migrating or is likely to significantly migrate to a medium that can

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result in exposure and harm to humans required additional assessment under the ERA process. Units or unplanned releases where contamination could migrate and, therefore, potentially require significantly more extensive remedial action if left unabated were also assessed in the ERA path.

Waste management units and unplanned releases with a driving force were assessed to determine if unacceptable health or environmental risk and a short time-frame available to mitigate the problem exists from the release. The criteria used to determine unacceptable risks are based on the quantity and concentration of the release. If the release or imminent release is greater than 100 times the CERCLA reportable quantity for any constituent, the unit or unplanned release remains in consideration for an ERA. If the release or imminent release contains hazardous constituents at concentrations that are 100 times the most applicable standard, the unit or unplanned release continues to be considered for an ERA. Application of the criterion of 100 times applicable standards is for quantification of the strategy criterion that addresses "high levels of hazardous substances and radioactive or mixed waste contaminants...". The factor of 100 is based on best engineering judgement of what constitutes a high level of contamination warranting expedited action. In some cases, engineering judgment was used to estimate the quantity and concentration of a postulated release. Standards applied include Model Toxics Control Act (MTCA) standards for industrial sites and DOE and Westinghouse Hanford radiation criteria (refer to Section 6.0). The application of these standards does not signify they are recognized as ARARs.

The ERA screening criteria, in addition to those presented in the *Hanford Site Past-Practice Strategy*, were applied to provide a consistent quantitative basis for making recommendations in the AAMS. The decision to implement the recommendations developed in the AAMS will be made collectively between DOE, EPA and Ecology based only on the criteria established in the *Hanford Site Past-Practice Strategy*.

If a release is unacceptable with respect to health or environmental risk, a technology must be readily available to control the release for a unit or unplanned release to be considered for an ERA. An example that would require substantial technology development before implementation of cleanup would be a tritium release since no established treatment technology is available to separate low concentrations of tritium from water.

The next step in the ERA evaluation path involves determining whether implementation of the available technology would have adverse consequences that would offset the benefits of an ERA. Examples of adverse consequences include: (1) use of technologies that result in risks to cleanup personnel that are much greater than the risks of the release; (2) the ERA would foreclose future remedial actions; and (3) the ERA would prevent or greatly hinder future data collection activities. If adverse consequences are not expected, the site remains in consideration for an ERA.

The final criterion is to determine if the candidate ERA is within the scope of an operational program. Maintenance and operation of active waste management facilities are within the scope of activities administered by the Waste Management Program. Active facilities include certain transfer lines, diversion boxes, catch tanks, and the 207-A and the 216-A-42 Retention Basins. Generally, active waste management units will not be included in past-practice investigations unless operation is discontinued prior to initiation of the investigation. The Decommissioning and RCRA Closure Program is responsible for safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities and RCRA closures at the Hanford Site. The Decommissioning and RCRA Closure Program is also responsible for RARA activities that include surveillance, maintenance, decontamination, and/or stabilization of inactive burial grounds, cribs, ponds, trenches, and unplanned release sites.

If the proposed ERA will not address all the contamination present, the unit or unplanned release continues through the process to be evaluated under a second path. For example, surface contamination cleanup under the RARA Program may not address subsurface contamination and, therefore, additional investigation may be needed.

Final decisions regarding the conduct of ERAs in the aggregate area will be made among Ecology, EPA, and DOE based, at least in part, on the recommendations provided in this section, and results of the final selection process outlined in WHC (1991b).

9.1.2 Limited Field Investigation and Interim Remedial Measure Paths

High priority waste management units and unplanned release sites were evaluated to determine if sufficient need and information exists such that an IRM could be pursued. An IRM is desired for high priority units and unplanned releases where extensive characterization is not necessary to reach defensible cleanup decisions. Implementation of IRMs at waste management units and unplanned releases with minimal characterization is expected to rely on observational data acquired during remedial activities. Successful execution of this strategy is expected to reduce both time and cost for cleanup of units and unplanned releases without impacting the effectiveness of the implemented action.

The initial step in the IRM evaluation path is to categorize the units. The exposure pathways of interest are similar for each waste management unit in a category; therefore, it is effective to evaluate candidate units as a group. The groupings used in Section 2.3 (e.g., cribs; tanks and vaults; etc.) will continue to be used to group the units for IRM assessment. This grouping approach is especially effective in reducing characterization requirements. As done in the 100 Areas using the observational approach, the LFIs can be used to characterize a representative unit or units in detail to develop a remedial alternative for the group of

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units. Observational data obtained during implementation of the remedial alternative could be used to meet unit specific needs. Similarities of waste management units may make it possible to remediate them using the observational approach after first characterizing only a few units. It is expected, therefore, that a LFI would provide sufficient information to proceed with an IRM for groups of similar high priority waste management units.

Data adequacy is assessed in the next step. The existing data are evaluated to determine if: 1) existing data are sufficient to develop a conceptual model and qualitative risk assessment; 2) the IRM will work for this pathway; 3) implementing the IRM will have adverse impacts on the environment, future remediation activities or data collection efforts; 4) the benefits of implementing the IRM are greater than the costs. If data are not adequate an assessment was made to determine if an LFI might provide enough data to perform an IRM. If an LFI would not collect sufficient data to perform an IRM, the unit was addressed in the final remedy selection path.

The final step in the IRM evaluation process is to assess if the IRM will work without significant adverse consequences. This includes: will the IRM be successful? will it create significant adverse environmental impacts (e.g., environmental releases)? will the costs outweigh the benefits? will it preclude future cleanup or data collection efforts? and will the risks of the cleanup be greater than the risks of no action? Units where remediation is considered to be possible without adverse consequences outweighing benefits of the remediation are recommended for IRMs. Low priority unplanned releases at candidate IRM units will be included in the IRM evaluations of the candidate units.

Final decisions will be made among DOE, EPA, and Ecology regarding the conduct of IRMs in the PUREX Plant Aggregate Area based, at least in part, on the recommendations provided in this AAMSR, and the results of a supporting LFI.

9.1.3 Final Remedy Selection Path

Sites recommended for initial consideration in the final remedy selection pathway are those not recommended for IRMs, LFIs, or ERAs and those considered to be low priority sites. It is recognized that all units and unplanned releases within the operable unit or aggregate area will eventually be addressed collectively under the final remedy path to support a final aggregate area or operable unit Record of Decision (ROD).

The initial step in the final remedy selection process path is to assess whether the combined data from the AAMS, and any completed ERAs, IRMs, and LFIs are adequate for performing a risk assessment (RA) and selecting a final remedy. Whereas the scope of an ERA, IRM, and LFI is limited to individual waste management units or groups of similar

waste management units, the final remedy selection path will likely address an entire operable unit or aggregate area.

If the data are collectively sufficient, an operable unit or aggregate area RA will be performed. If sufficient data are not available, additional needs will be identified and collected.

9.2 PATH RECOMMENDATIONS

Initial recommendations for ERA, IRM, and LFI are discussed in Section 9.2.1 through 9.2.3, respectively. Waste management units and unplanned releases proposed for initial consideration under the final remedy selection path are discussed in Section 9.2.4. Table 9-1 provides a summary of the data evaluation process path assessment. A summary of the responses to the decision points on the flowchart that led to the recommendations is provided in Table 9-2. Following approval by Ecology, EPA, and DOE, these recommendations will be further developed and implemented in work plans.

9.2.1 Proposed Sites for Expedited Response Actions

~~Fifteen~~Three waste management units ~~were evaluated along the ERA path.~~ meet all the criteria for an ERA prior to determining whether the proposed action was within the scope of an operational program. Each of these units is a surface contamination site and is recommended for disposition under the RARA program. The three units are:

- 216-A-14 French Drain
- 216-A-28 French Drain
- 216-A-42 Retention Basin (Active).

A discussion of the recommendations for these waste management units are included in this section. Since the anticipated response actions are not expected to fully remediate the ERA sites, all units will be included for further data evaluation.

9.2.1.1 Sites With Significant Surface Contamination. Each of the ~~15 sites~~three units has levels of surface contamination that are high enough to be of immediate concern. Surface contamination is immediately accessible to humans (i.e., workers) and biota. The potential for transport by the wind or biota is also significant and so surface migration is also a problem. It is expected that the releases of radionuclides and potential radiation exposure

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levels at these ~~sites~~units would be greater than 100 times reportable quantities and ~~quality~~concentration standards. The corrective actions for these surface contamination ~~sites~~ units are addressed within the scope of the RARA Program.

~~The following sites were evaluated along the ERA path because of surface contamination:~~

- ~~216-A-1 Crib~~
- ~~216-A-6 Crib~~
- ~~216-A-7 Crib~~
- ~~216-A-9 Crib~~
- ~~216-A-21 Crib~~
- ~~216-A-14 French Drain~~
- ~~216-A-28 French Drain~~
- ~~216-A-40 Trench~~
- ~~207-A Retention Basins~~
- ~~216-A-42 Retention Basin~~
- ~~218-E-1 Burial Ground~~
- ~~218-E-12A Burial Ground~~
- ~~UN-200-E-88 Unplanned Release~~
- ~~UN-200-E-100 Unplanned Release.~~

~~The surface contamination at each of these units is characterized below.~~

Surface contamination control activities are recommended for evaluation and implementation under the RARA Program. Investigation as a part of the aggregate area RI is recommended following the RARA action to confirm waste management unit cleanup.

- ~~The 216-A-1 Crib has an area of surface contamination of up to 3,000 dis/min.~~
- ~~The 216-A-6 Crib has an area of surface contamination of up to 5,000 dis/min.~~
- ~~The 216-A-7 Crib has been issued a Surveillance and Compliance Inspection Report (SCIR) and has been given a ranking of 7 out of 15 possible points. This means that the site has high surface radiation levels, that it is accessible, and that there is ongoing surface contaminant migration. This site contains areas of surface contamination of up to 30,000 dis/min.~~
- ~~The 216-A-9 Crib has surface contamination of up to 30,000 dis/min.~~
- ~~The 216-A-21 Crib has surface contamination of up to 15,000 dis/min.~~
- The 216-A-14 French Drain has surface contamination of up to 56,000 dis/min (alpha).
- The 216-A-28 French Drain has surface contamination of up to ~~10,000~~2,300 dis/min (alpha).
- ~~The 216-A-40 Trench has surface contamination of up to 4 mrem/h.~~
- ~~The 207-A Retention Basins have surface contamination of up to 1,500 ct/min.~~
- The 216-A-42 Retention Basin has surface contamination of up to 200,000 dis/min (beta/gamma).
- ~~The 218-E-1 Burial Ground has surface contamination of up to 5,000 ct/min.~~
- ~~The 218-E-12A Burial Ground has surface contamination of up to 20,000 dis/min.~~
- ~~The UN-200-E-88 Unplanned Release has surface contamination of up to 60,000 dis/min.~~

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- ~~The UN-200-E-100 Unplanned Release has surface contamination of up to 5 mrem/h.~~

9.2.1.32 Non-ERA Sites. The primary reason most waste management units and unplanned releases were not recommended for ERAs was because of the lack of driving force to an exposure pathway. Inactive cribs, ponds, ditches, and trenches are no longer receiving waste and, therefore, no longer have artificial recharge as a driving force to move subsurface contaminants. Natural recharge from local precipitation was not considered a significant short-term driving force. Specifics for each waste management unit or unplanned release are provided in Table 9-2.

A majority of the unplanned release sites either will be addressed by the RARA pProgram to eliminate the airborne release pathway or had insufficient quantity and concentration of contamination to qualify as an ERA.

9.2.2 Proposed Sites for Interim Remedial Measures

Twenty-~~six~~five of the ~~98~~89 waste management units and unplanned releases addressed in the PUREX Plant Aggregate Area data evaluation process were identified as high priority units (refer to section 5.0) and were assessed as candidates for IRMs. ~~Fourteen~~Sixteen of the ~~26~~24 units were designated as high priority units and unplanned releases because of high HRS and mHRS scores. The ~~other~~remaining 9 units and unplanned releases~~, 216-A-1 and 216-A-30 Cribs, 216-A-14 and 216-C-8 French Drains, 207-A Retention Basins, 218-E-1, 218-E-12A, and 218-E-12B Burial Grounds, 200-E Burning Pit and UN-200-E-88 and UN-200-E-100 Unplanned Releases,~~ were designated as high priority because of surface radiation measurements. The Environmental Protection rankings did not add to the high priority sites because they had been included on the list due to other criteria. In addition 8 low priority units were included as IRM candidates because of their similarities. Septic tanks and drain fields and the majority of the unplanned releases were two primary classes of units not considered in the IRM path.

All of the 33 candidate IRM waste management units or unplanned releases met the criteria for IRM designation with the exception of having adequate data. No direct sampling information exists for any of these 33 units. It was determined that an LFI could gather sufficient data for 25 of the 33 waste management units or unplanned releases; therefore, 24 units remain IRM candidates. The remaining 8 units and releases are recommended for direct inclusion in the final remedy selection path discussed in Section 9.2.4.1. A discussion of the LFIs is provided in 9.2.3.

~~All units remain as IRM candidates but require LFIs to obtain sufficient information to proceed with the IRM. A discussion of the LFIs is provided in Section 9.2.3. The reason units and unplanned releases are not immediately recommended for IRMs was because none were considered to have adequate data to perform a qualitative risk assessment and/or select a remedy.~~

9.2.3 Proposed Sites for Limited Field Investigation Activities

~~A LFI is the collection of limited additional site data which are sufficient to support a decision on conducting ERAs or IRMs (DOE/RL 1992a). In contract, a RI is a broader site-wide effort appropriate for lower priority sites. The goal for a RI is final remedy selection where as the goal of a LFI is focused on supporting ERAs and IRMs only.~~

Twenty-~~two~~five waste management units are recommended to undergo LFIs. The initial decision point in the IRM path is to assess whether data are adequate to conduct an IRM. For each of the twenty-five units, only screening level field data and inventory estimates are available. No data are available describing the nature and extent of contamination, so LFIs are required before IRMs may be implemented. The rationale for IRM and LFI will be more completely developed in work plans; however, the following addresses possible considerations during work plan development.

Possible LFI objectives would be to:

- Evaluate the potential for releases from the waste management unit to impact underlying groundwater quality.
- Determine if contamination exists in the soil beneath the waste management unit, and if so, assess the extent.
- Assess the nature and extent of contaminant migration from the waste management unit in support of focused feasibility studies.

Each waste management unit that is recommended for an LFI will be studied as part of an analogous group. The analogous site concept is presented in the *Hanford Site Past-Practice Strategy*.

This concept emphasizes that characterization activities can be reduced by identifying select sites (analogue sites) for characterization that are representative of group sites (analogous groups). This concept is particularly applicable to operable units which contain a number of waste management units that are similar in design, disposal history, and geology.

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Appropriate confirmatory characterization, as necessary to support remedial action, can then be performed at the sites within each analogous group during remediation. Collection of confirmatory data can again be reduced during remediation activities by emphasizing in work plans the use of the observational approach discussed in the *Hanford Site Past-Practice Strategy*.

To facilitate the implementation of these strategies in work plans, individual LFIs are assembled into analogous groups for study. One analogous group has been identified in the PUREX Plant Aggregate Area: cribs and french drains. Specific waste management units are then identified that are considered to be representative of the analogous groups. Considerations used to select an analogue site for an analogous group include, but are not limited to, the following:

- Disposal history (including type and quantity of waste received)
- Physical and chemical setting.

Generally, the selection process favored as analogue sites those units or releases that received the most waste and were considered as conservative samples in terms of release mechanism, media of concern, exposure routes, and receptors.

~~Candidate IRM units have been categorized into two groups that contain similar release waste, release mechanisms, and design. The two groups are cribs and french drains, and burial sites.~~

9.2.3.1 Cribs and French Drains. ~~The cribs and french drains have been grouped together because french drains are essentially small diameter cribs. The cribs and french drains recommended for a LFI also have been evaluated along the ERA path. All but three cribs were recommended for actions under the RARA program (Section 9.2.1). The actions implemented under the RARA program will precede the LFI activities. Cribs and french drains dispositioned under the RARA program include:~~ Twenty-four waste management units have been assigned to this analogous group based on their design and type of waste received. These units include:

- 216-A-1 Crib
- 216-A-2 Crib
- 216-A-3 Crib
- 216-A-4 Crib

- 216-A-5 Crib
- 216-A-6 Crib
- 216-A-7 Crib
- 216-A-8 Crib
- 216-A-9 Crib
- 216-A-10 Crib
- 216-A-21 Crib
- 216-A-24 Crib
- 216-A-27 Crib
- 216-A-30 Crib
- 216-A-31 Crib
- 216-A-32 Crib
- 216-A-36A Crib
- 216-A-36B Crib
- 216-A-37-1 Crib
- 216-A-37-2 Crib
- 216-A-41 Crib
- 216-A-45 Crib
- 216-A-14 French Drain
- 216-A-28 French Drain
- 216-A-524 Control Structure.

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~~• 216-C-8 French Drain~~

~~Cribs to be involved in LFI activities that do not require actions under the RARA program include the following:~~

~~• 216-A-8 Crib~~

~~• 216-A-30 Crib~~

~~• 216-A-36B Crib~~

~~• 216-A-37-2 Crib~~

The cribs and french drains have been grouped together because they have similar release points. The 216-A-524 Control Structure is included in this LFI grouping since it is ancillary equipment which will be remediated along with the 216-A-6 Crib. The 216-A-10 and the 216-A-36 B Cribs will be investigated under RCRA. Selection of these units as group analogs will allow for utilization of the data produced by the RCRA investigation in the CERCLA investigations. Any additional data requirements of the CERCLA investigation can be integrated into the RCRA investigation. This approach will maximize efficiencies and minimize costs, while securing data that is applicable to all the units in this analogous group.

The physical and chemical settings for the releases from these waste management units are generally similar:

- Relatively large-scale liquid releases, up to 7,110,000,000 L (1,880,952,381 gal) occurred at these waste management units and wastewater probably reached the unconfined aquifer beneath the units (Table 4-13).

- The waste management units were completed at about the same depths and in the same stratigraphic horizons. The depth to groundwater is also similar for all of the units (49 to 61 m [162 to 199 ft]).

- The vadose zone stratigraphy is generally uniform beneath the aggregate area and would tend to favor the downward movement of fluid with little lateral spreading.

Three cribs are proposed for analog study due to the distinct nature of their associated PUREX waste streams. These cribs include:

- 216-A-8 Crib (241-A-431 Building Ventilation Condensate)

- 216-A-10 Crib (PUREX Process Condensate).

- 216-A-36B (PUREX Ammonia Distillate Condensate).

The french drains with surface contamination were addressed in the IRM path after first being assessed in the ERA path. The actions recommended for the units will not address the subsurface contaminations in the facilities; therefore, they were included for assessment under the remaining criteria.

~~The initial decision point in the IRM path is to assess whether data are adequate to conduct an IRM. The data available for cribs are screening level data (Section 8.2.2.2) and estimated inventories (Tables 2-2 and 2-3) that do not provide information on the nature and extent of the contamination. Therefore, an IRM could not be implemented without further investigation.~~

~~Similarities of units may make it possible to remediate them using the observational approach after characterizing only a few of the units. Therefore, it was expected that a LFI would provide sufficient information to proceed with an IRM for waste management unit groups. Therefore, the basis for recommending a LFI is that sufficient information can be gained from a more detailed investigation of one or two of the cribs and a french drain that would allow a remedial decision to be made on the other cribs with little or no additional characterization.~~

~~Possible representative units for the PUREX Plant Aggregate Area would be the 216-A-9 Crib, the 216-A-24 Crib, and 216-A-28 French Drain. The 216-A-6 Crib was selected to represent cribs receiving waste during initial operations. The 216-A-6 Crib also received the greatest amount of waste for all of the cribs and has received a large amount contaminants. The 216-A30 Crib was selected to be representative of cribs receiving waste during more recent operations. The 216-A-28 French Drain was chosen because it received the most waste of the french drains and has the highest inventory of contaminants. The rationale for IRM and LFI will be more completely developed in work plans, however, the following addresses possible considerations during work plan development.~~

~~Possible LFI objectives would be to:~~

- ~~Evaluate the potential for releases from the waste management unit to impact underlying groundwater quality;~~

- ~~Determine if contamination exists in the soil beneath the cribs and, if so, assess the extent; and~~

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- Assess the extent of contaminant migration from the cribs in support of focused feasibility studies.

If transuranic radionuclides and/or other hazardous chemicals are not found in soil below the representative cribs, it is unlikely to be present below the other units in the group, therefore additional sampling for transuranic radionuclides and/or hazardous chemicals would likely not be necessary at the other units. The actual extent of transuranic contamination, if any, could be determined during implementation of an IRM (if justified) and would not need to be fully known prior to the decision to proceed. The extent of IRM actions for the other facilities would be based on measurements from the representative cribs, therefore, no other sampling for extent of contamination at the other units would be anticipated.

9.2.3.2 Burial Sites. This group includes six burial grounds. The six burial grounds are not covered under a RCRA closure or Part B permit action, and include the following:

- 200-E Burning Pit
- 218-E-1 Burial Ground
- 218-E-8 Burial Ground
- 218-E-12A Burial Ground
- 218-E-12B Burial Ground
- 218-E-13 Burial Ground.

The 218-E-1 and 218-E-12A Burial Grounds were identified as high priority waste management units and were designated as IRM candidates. Because the 200-E Burning Pit, the 218-E-8, 218-E-12B, and the 218-E-13 Burial Grounds received similar wastes and are generally constructed in a similar fashion, they were included in the group with the 218-E-1 and the 218-E-12A Burial Grounds. These waste management units have insufficient data to conduct an IRM; therefore, they were recommended for LFIs. It is expected that sufficient information could be obtained from a limited investigation of one or two burial grounds to continue with IRM assessments (if justified) with little or no additional characterization of the other burial grounds.

A possible representative burial ground for the LFI would be the 218-E-12A Burial Ground. The 218-E-12A Burial Ground is recommended as being representative because it is a high priority site due to surface contamination and received the greatest volume of waste

with the highest inventory of contaminants. It is expected to contain similar wastes and to be similar in design to the other burial sites.

Investigations of the active portion of the 218-E-12B Burial Ground will be included in the past practices investigation if the unit is deactivated prior to the investigation. Deactivation of the burial ground will remain with the ongoing program that is evaluating alternatives to replace the unit.

The rationale for IRM and LFI will be more completely developed in work plans; however, the following addresses possible considerations during work plan development.

Possible LFI objectives would be to:

- Conduct surface contamination surveys and assess likely source(s)
- Evaluate the potential for releases from the waste management unit to impact underlying groundwater quality
- Determine if contamination exists in the soil beneath the burial ground and, if so, assess the extent
- Assess the nature and extent of radionuclide and hazardous chemical contaminants in near surface and surface soils at the burial ground sufficient to support a focused feasibility study.

Additional field inspections and document reviews might be desirable to evaluate the relative integrity of existing burial ground caps and buried waste containers. Some geophysical survey work might be desirable to update information found regarding the location and construction of burial ground disposal units such as trenches and caissons, and to identify potential subsurface voids that have a potential for major settlement.

If transuranic radionuclides and/or other hazardous chemicals are not found in soil below the representative burial ground, it is unlikely to be present below the other burial grounds; therefore, additional sampling for transuranic radionuclides and/or hazardous chemicals would likely not be necessary at the other units. The actual extent of transuranic contamination, if any, could be determined during implementation of an IRM (if justified) at the burial ground and would not need to be fully known prior to the decision to proceed. The extent of IRM actions for the other facilities would be based on measurements from the representative burial ground; therefore, no other sampling for extent of contamination at the other burial grounds would be anticipated.

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9.2.4 Proposed Sites for Final Remedy Selection

A number of unplanned releases, along with several diverse waste management units which are unique because of design, contaminants received, or operational history, have been proposed for the final remedy selection path. Section 9.2.4.2 discusses the sites proposed for direct inclusion in the final remedy selection risk assessment. Direct inclusion in the final remedy ~~selector~~ selection RI is recommended for ~~the remainder of the~~ 63 of the remaining 64 waste management units and unplanned releases due to the lack of information to perform RAs and select final remedies. These waste management units and unplanned releases are discussed in Section 9.2.4.1.

9.2.4.1 Proposed Sites for Remedial Investigation. A RI has been recommended for the PUREX Plant Aggregate Area which includes several groups of waste management units and unplanned releases. The first group contains ~~cribs and~~ french drains. The second group contains ~~an injection~~ reverse wells. The third group contains the ditches and trenches. The fourth group contains the septic tanks and drain fields which require confirmatory sampling to show that the ~~sites~~ units do not contain hazardous or radioactive substances. The fifth group contains retention basins. The ~~fifth~~ sixth group contains burial sites which require confirmatory sampling to show no contamination exists. The ~~sixth~~ seventh group contains ~~low priority~~ unplanned releases which have unique contamination histories.

9.2.4.1.1 ~~Cribs and~~ French Drains. ~~Eighteen cribs and~~ Nine french drains have been grouped as a single class because of their similarity (see Tables 9-1 and 9-2). The ~~group consists of nine cribs and nine french drains. These units experienced similar disposal practices.~~ french drains include the following:

- 216-A-11 French Drain
- 216-A-12 French Drain
- 216-A-13 French Drain
- 216-A-15 French Drain
- 216-A-22 French Drain
- 216-A-26 French Drain
- 216-A-26A French Drain
- 216-A-33 French Drain

- 216-A-35 French Drain.

~~The units were first assessed along the ERA path. An ERA was warranted for each unit based on *Hanford Site Past Practice Strategy* criteria (DOE/RL-1992a) and releases occurred in every case. However, no driving force to an exposure pathway existed for any of the units.~~

~~All 18 units were assessed as low priority on the IRM evaluation path.~~ All french drains are low priority units which were assessed in the final remedy selection path. Insufficient data exists at ~~these sites~~ this unit to conduct a risk assessment. A RI is recommended that would include each of these ~~sites~~ units to provide nature and extent of contamination information to perform a risk assessment for final remedy selection.

~~Investigation of the two active cribs and one active french drain will be included in the past practices investigation if the units are deactivated prior to the investigation. Deactivation of the units will remain with the ongoing program that is currently operating them.~~

9.2.4.1.2 ~~Injection~~ Reverse Wells. Only one unit, the 299-E-34-11 Injection Well, appears in this group. ~~This unit was first assessed along the ERA path. An ERA was warranted for this unit based on *Hanford Site Past Practice Strategy* criteria (DOE/RL 1992a) and a release had occurred. The unit moved out of the ERA path as there was no driving force to an exposure pathway.~~

~~This unit was assessed as a low priority on the IRM evaluation path.~~ This unit is a low priority unit which was assessed in the final remedy selection path. Insufficient data exists at ~~these~~ this sites to conduct a risk assessment. A RI is recommended to provide nature and extent of contamination information to perform a risk assessment for final remedy selection.

9.2.4.1.3 Ditches and Trenches. Six units have been placed in this group due to their similarity. The group consists of two ditches and four trenches ~~(see Tables 9-1 and 9-2).~~

- 216-A-29 Ditch
- 216-A-34 Ditch
- 216-A-18 Trench
- 216-A-19 Trench

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- 216-A-20 Trench
- 216-A-40 Trench.

~~These units were first assessed along the ERA path. An ERA was warranted in each case due to *Hanford Site Past Practice Strategy* criteria (DOE/RL 1992a) and releases occurred at each site. For four of the sites, no driving force to an exposure pathway existed for any of the units. All four units were assessed as low priority on the IRM evaluation path.~~

Two of the ~~sites~~units, the 216-A-29 Ditch and 216-A-40 Trench, were rated as high priority ~~when~~ and evaluated along the IRM path. Data were not adequate ~~because~~ to perform an IRM and an LFI would not collect sufficient data, so these units were moved to the ~~FRS~~final remedy selection path. In each case insufficient data exists at these sites to provide nature and extent of contamination information to perform a risk assessment for ~~FRS~~final remedy selection.

~~Investigations of the active 216-A-29 Ditch will be included in the past practices investigation if the unit is deactivated prior to the investigation. Deactivation of the ditch will remain with the ongoing program that is planning closure.~~

The units were grouped and risk assessment possibilities were examined. No data exists to determine the nature and extent of contamination at these units. Therefore, inclusion in the aggregate area or operable unit RI was recommended to provide data adequate to perform a risk assessment and select a final remedy for the units.

9.2.4.1.4 Septic Tanks and Associated Drain Fields. Seven units have been placed in this group because of their similarity. ~~The group consists exclusively of septic tanks.~~

- 2607-EA Septic Tank and Drain Field
- 2607-EC Septic Tank and Drain Field
- 2607-ED Septic Tank and Drain Field
- 2607-EG Septic Tank and Drain Field
- 2607-EJ Septic Tank and Drain Field
- 2607-EL Septic Tank and Drain Field
- 2607-E6 Septic Tank and Drain Field.

~~This group was not assessed along the ERA path because an ERA was not warranted because of *Hanford Site Past-Practice Strategy* criteria (DOE/RL 1992a). The units were assessed as low priority on the IRM evaluation path. Insufficient data exists at these sites to conduct a risk assessment. A RI is recommended to provide nature and extent of contamination information to perform a risk assessment for FRS.~~

There are no sampling or inventory data for any of the units and so an RA cannot be performed. Therefore, these units are recommended for inclusion in the aggregate area RI to conduct confirmatory sampling. The purpose of a limited sampling program is to confirm that no contamination exists in the septic tanks and drain fields. If no contamination were to be found, then no further action would likely be recommended.

9.2.4.1.5 Retention Basins. Two units, 207-A and 216-A-42, have been placed in this group. ~~Both~~ One retention basins ~~were~~ (216-A-42) was ~~evaluated along the ERA path and~~ recommended for actions ~~under the RARA program (Section 9.2.1)~~. The actions implemented under the RARA pProgram will mitigate surface radiation of concern ~~and will move the units onto the IRM evaluation path. The units will no longer be high priority and will be moved onto the FRS path~~. The action implemented under the RARA Program will mitigate the conditions that caused the unit to be high priority; therefore, the unit was directly included in the final remedy selection path. The 207-A Retention Basin was low priority and directly included into the final remedy selection. In both cases insufficient data exists to provide nature and extent of contamination information to perform a risk assessment for ~~FRS~~final remedy selection.

Investigations of the active ~~portion of the~~ 207-A Retention Basins and 216-A-42 Retention Basin will be included in the past practices investigation if the units ~~is~~are deactivated prior to the investigation. Deactivation of the retention basins will remain with the ongoing program that is evaluating alternatives to replace the unit.

9.2.4.1.6 Burial Sites. Four burial sites have been placed in this group due to their similarity. This group includes:

- 218-E-1 Burial Ground
- 218-E-8 Burial Ground
- 218-E-12A Burial Ground
- 218-E-13 Burial Ground.

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Two of the sites, 218-E-1 and 218-E-13, were rated as high priority due to surface contamination and evaluated along the IRM path. Data were not adequate to perform an IRM and an LFI would not collect sufficient data so the units were directly included in the final remedy selection path. The 218-E-8 Burial Ground and 218-E-13 Burial Ground were low priority and were directly included in the final remedy selection path. In each case, insufficient data exist in these sites to provide the nature and extent of contamination information to perform a risk assessment for final remedy selection; therefore, the burial sites are recommended in the aggregate area RI.

9.2.4.1.67 Unplanned Releases. ~~Forty-six~~Thirty-four unplanned release sites have been placed in this group~~due to their similarity~~. The candidate sites are listed in Table 9-1. ~~Forty-four of these units were assessed along the ERA path and an ERA was initially warranted due to *Hanford Site Past-Practice Strategy* criteria (DOE/RL 1992a). Releases also occurred at each site, however, no driving force to an exposure pathway exists. All forty-four units were assessed as low priority on the IRM evaluation path.~~

Two of the ~~forty-six~~thirty-four unplanned releases, UN-200-E-88 and UN-200-E-100, were rated as high priority ~~when~~because of surface contamination and evaluated along the IRM path. Data were not adequate for an IRM and an LFI would not collect sufficient data, so these units were moved to the ~~FRS~~final remedy selection path. In all cases, insufficient data exists at these sites to provide nature and extent of contamination information to perform a risk assessment for ~~FRS~~final remedy selection; therefore, these sites are recommended for inclusion in the aggregate area RI.

9.2.4.2 Proposed Units for Risk Assessment. One candidate has sufficient information for inclusion in the RA under the final remedy selection path. The unit, 216-A-38-1 Crib, was reportedly never used. It is recommended that this unit be included in the final RA without additional investigation.

9.3 SOURCE OPERABLE UNIT REDEFINITION AND PRIORITIZATION

The investigation process can be made more efficient if units with similar histories and waste constituents are studied together. The data needs and remedial actions required for similar waste management units are generally the same. It is much easier to ensure a consistent level of effort and investigation methodology if like units are grouped together. Economies of scale also make the investigation process more cost effective if similar units are studied together.

9.3.1 Units Addressed By Other Aggregate Areas or Programs

The investigation of one unit should be transferred from the PUREX Plant Aggregate Area to the B Plant Aggregate Area for investigation. The 216-A-29 Ditch should be transferred to allow it to be investigated with the 216-B-3 Pond System along with units of similar regulatory and waste histories.

The investigation of several ~~sites~~ units should be transferred from the PUREX Plant Aggregate Area to other programs for investigation. The programs include ~~the Surplus Facilities Program,~~ the ~~Defense~~ Waste Management Program, the ~~RCRA TSD~~ Decommissioning and RCRA Closure Program, and the ~~Hanford Site~~ Single-Shell Tank Closure Program. Table 9-3 lists the waste management units and unplanned releases that are recommended for deferral to these programs. ~~No units within the PUREX plant aggregate area are recommended for deferral to another aggregate area.~~

The ~~Defense~~ Waste Management Program is recommended to include four catch tanks and eleven diversion boxes. These units are located in operable units 200-PO-1 and 200-PO-3. ~~If the units are closed prior to investigation the units would be included in the aggregate area evaluation. If the units are closed after investigation the units would be deferred to the Surplus Facilities Program.~~ The ~~Surplus Facilities~~ Decommissioning and RCRA Closure Program receives the ~~Defense W~~waste ~~M~~management ~~U~~units upon decommissioning.

The ~~RCRA program, including the TSD and the Hanford Site~~ Single-Shell Tank Closure Program~~, are~~ is recommended to include all single-shell tanks (241-A, 241-AX, and 241-C Tank Farms) and ancillary equipment and unplanned releases in the three single-shell tank farms. The UPR-200-E-59 ~~U~~unplanned ~~R~~release in the 200-PO-1 Operable Unit and the four french drains, 216-A-16, 216-A-17, 216-A-23A and 216-A-23B in ~~operable unit~~the 200-PO-5 Operable Unit are also recommended for deferral to these programs.

One potentially new site consisting of a fission products release to the environment has not been verified as an unplanned release. Action on this site is deferred until an actual release has been verified and the regulatory status of the site determined. The unplanned release occurred within the 241-C Tank Farm area; therefore, it should be addressed by the ~~Hanford Site~~ Single-Shell Tank Closure Program. This unplanned release is discussed in detail in Section 2.3.10.

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9.3.2 PUREX Plant Operable Unit Redefinition

Redefinition of the 200-PO-1 through 200-PO-6 Operable Units is suggested based on the data valuation in this report. General redefinition is recommended as follows:

- Investigation of groundwater should be removed from the scope and included in a 200 East Area Groundwater Operable Unit. Groundwater beneath the ~~PUREX Plant Operable Units~~ source operable units interacts with all surrounding operable units since it is not confined by the geographic boundaries. Contamination from nearby operable units can migrate beneath any PUREX Plant Operable Units. Similarly, the contamination originating from the operable units may migrate outside the boundaries of the operable units. These interactions with other operable units will necessitate the integration of groundwater response actions throughout the 200 East Area. This integration would likely be best handled in a ~~single 200 East Area wide~~ combined groundwater operable unit, rather than in individual source operable units.

- High-level waste transfer facilities and encased pipelines should remain within the scope of the ~~Defense~~ Waste Management Program and the ~~Surplus Facilities~~ Decommissioning and RCRA Closure Program. The facilities are also structures with no unplanned releases and can be dealt with more efficiently in these existing Hanford programs. The Tri-Party Agreement does not include these lines within the scope of the past-practices investigation. Effluent transfer lines associated with individual waste management units will be investigated with the respective units.

- Units included in other programs (e.g., RCRA, ~~Defense~~ Waste Management ~~Plan~~Program, etc.) are listed in Table 9-3. All operable units had sites included in other programs. Operable unit 200-PO-6 had the least number of sites recommended for inclusion in other programs; only one site, operable unit 200-PO-3, had the greatest number of sites recommended for inclusion into other programs; over 50 sites.

Specific redefinition of the operable units are as follows:

- 200-PO-1 will have UPR-200-E-59 reassigned to 200-PO-3. This unplanned release is associated with the 216-A-40 Trench, but spread into the tank farm area and is, therefore, recommended for inclusion in the 200-PO-3 Operable Unit and subsequent jurisdiction of the Single-Shell Tank Closure Program.

- 200-PO-3 will have UN-200-E-68, UN-200-E-94, and UN-200-E-100 reassigned to 200-PO-1. These unplanned releases are outside the perimeter of the tank farm and are more appropriately addressed under the past-practices investigation.

- 216-A-29 Ditch will be moved from PUREX Plant Aggregate Area jurisdiction to B Plant Aggregate Area jurisdiction. This ditch has been a contributor to the B Pond System and is more appropriately addressed with the B Plant Aggregate Area units.

- Four french drains currently residing in the 200-PO-5 Operable Unit should be reassigned to the 200-PO-3 Operable Unit. These french drains currently reside within the 241-A Tank Farm boundary and are more adequately addressed as part of this operable unit. It is, therefore, recommended that the geographic boundaries of the units be redrawn in the area of the 216-A-16, 216-A-17, 216-A-23A, and 216-A-23B French Drains. The units are located in close proximity to one another and very near to a common border of the two operable units. Movement of a section of the common border to the east would satisfy the recommendation.

9.3.3 Investigation Prioritization

Very little if any data exist to rank the waste management units and unplanned releases within the PUREX Plant Aggregate Area on a risk-related basis. The HRS and surface contamination data which were used to sort the waste management units and unplanned releases into either high or low priority are indicators of potential risk but are not suitable to develop a risk-related ranking. The most useful data for indicating potential risk are probably the waste inventories and facility construction or operation information.

In the Tri-Party Agreement, the operable units were prioritized in the following order: (1) 200-PO-2, (2) 200-PO-5, (3) 200-PO-1 and 200-PO-4, and (4) 200-PO-6. Operable unit 200-PO-3 was not prioritized because it contained single-shell tanks. Based on estimated waste inventories in Table 2-2, the cribs and french drains received the largest quantities of contamination and should be investigated first. This approach would change the prioritization order of the Tri-Party Agreement to the 200-PO-4 Operable Unit being recommended for highest priority of investigation. The new order of prioritization would be (1) 200-PO-4, (2) 200-PO-2, (3) 200-PO-5, (4) 200-PO-1, and (5) 200-PO-6~~, and 6) 200-PO-3~~.

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9.3.4 ~~RCRA~~ Resource Conservation and Recovery Act Facility Interface

~~Four~~ A number of RCRA waste management units exist in the PUREX Plant Aggregate Area ~~that will require integration into future investigations~~. They include:

- 216-A-29 Ditch
- 216-A-10 Crib
- 216-A-36B Crib
- 218-E-12B Burial Ground
- 241-A, 241-AX, and 241-C Single-Shell Tank Farm Systems
- 241-AN, 241-AP, 241-AW, 241-AY, and 241-AZ Double-Shell Tank Farm Systems
- 244-AR and 244-CR Vault
- 244-A Lift Station.
- Grout Treatment Facility

9.3.4.1 RCRA TSD Facilities. The following units are facilities under the control of the Waste Management Program:

- 241-AN, 241-AP, 241-AW, 241-AY, and 241-AZ Double-Shell Tank Farm Systems
- 244-AR and 244-CR Vault
- 244-A Lift Station
- 218-E-12B Burial Ground.
- Grout Treatment Facility

These units have current RCRA operating permits. Closure is not anticipated to occur for some time. Thus, there will be no need to interface with the past-practices program for these units at this time. In the event that any of these RCRA TSD facilities are closed while

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past-practices investigation or remediation activities are still occurring, it will be necessary at that time for the RCRA TSD closure activities to interface with the past-practices program.

9.3.4.2 216-A-10 and 216-A-36B Cribs. ~~The 216-A-29 Ditch has been deactivated and stabilized and the closure plan is currently being developed.~~ The 216-A-10 and 216-A-36B Cribs are inactive and also slated for closure. ~~The 218-E-12B Burial Ground is currently operating under a Landfill Permit. The RCRA facilities associated with all of the tank farms in the PUREX Plant Aggregate Area are not assessed under this study. These sites belong to a separate program with separate Tri-Party Agreement milestones.~~

The 216-A-10 and 216-A-36B Cribs have been recommended for consideration under the IRM path. To be successful, the LFIs/IRMs should be integrated with ongoing RCRA closure activities to ensure maximum efficiency, compatibility of remedial measures, and minimal duplication of efforts. Recommendations for such integration are discussed in detail below.

The 216-A-10 Pond and the 216-A-36B Cribs are scheduled to undergo closure, and are expected to be subject to post-closure care. A closure plan is scheduled for submission to Ecology and EPA by May 1996. It is recommended that TSD facility closure activities and the RFI/CMS investigation and remediation activities for past-practice units be integrated. To accomplish the integration, it is recommended that prior to submittal the closure plan will include the past-practice program requirements. The resulting document would be a combined closure plan and RFI/CMS work plan.

~~The 216-A-29 Ditch and the 216-A-10 and 216-A-36B Cribs are recommended for clean closure under RCRA and investigation and remediation under CERCLA. Data to support closure will be developed in RIs and an LFI. Investigation and remediation of these facilities will be included with the investigation and remediation of their associated groupings.~~

It is recommended that risk assessment and determination of clean closure be performed in a consistent manner for all the analogous group units. To accomplish this, the units would be evaluated in accordance with the risk assessment methodology being developed and agreed to between DOE, EPA, and Ecology under Tri-Party Agreement milestone M-29-03. The latest presentation of the risk assessment protocols appear in *The Hanford Site Baseline Risk Assessment Methodology*. It is expected that these risk assessment protocols will be at least as conservative as the guidelines established under the proposed 40 CFR Part 264 Subpart S EPA regulations published in the July 27, 1990 Federal Register. The Subpart S guidelines will provide the bases for closing RCRA units in a manner that will prevent future threats to human health and the environment. Use of the milestone M-29-03 methodology would both satisfy the past practices risk assessment

procedures and allow evaluation of whether or not clean closure of RCRA TSD units had been accomplished.

9.3.4.3 RCRA Single-Shell Tanks. The RCRA regulated 241-A, 241-AX, and 241-C Tank Farms and associated facilities will be addressed under the Single-Shell Tank Closure Program and are administered under a separate Tri-Party Agreement 30-year schedule. Therefore, although there will be RCRA interfaces on these tanks, these interfaces are not addressed under this AAMS.

Investigations have been recommended for several non-RCRA burial ground units under this AAMS. Since partial closures and corrective actions of the RCRA burial grounds have not been established, the recommended investigations may precede or overlap with RCRA activities. It will be necessary to ensure that investigations at non-RCRA units are integrated with schedules and proposed actions for the RCRA burial grounds as they are incorporated into the final status permit.

In addition, there are a number of unplanned releases associated with RCRA TSD facilities within the PUREX Plant Aggregate Area that are recommended to be addressed during RCRA closure and/or permitting activities. Investigation and remediation of affected soils associated with these unplanned releases, if any, would results in a need to interface with the planned RCRA facility activities.

9.4 FEASIBILITY STUDY

Two types of the FS will be conducted to support remediation in the 200 Areas including focused and the final FS. The FFSs are studies in which a limited number of units or remedial alternatives are considered. Final FS will be prepared to provide the data necessary to support the preparation of final record of decision. Insufficient data exists to prepare either a focused or final FS for any units or group of units within the PUREX Plant Aggregate Area. Sufficient data are considered available to prepare a FFS on selected remedial alternatives.

9.4.1 Focused Feasibility Study

Both LFIs and IRMs are planned for the PUREX Plant Aggregate Area for individual waste management units or waste management unit groups. The IRMs will be implemented as they are approved, and the FFSs will be prepared to support their implementation. The FFSs applied in this manner are intended to examine a limited number of alternatives for a specific unit or groups of units. The FFSs supporting IRMs will be based on the technology

screening process applied in Section 7.0, engineering judgement, and/or new characterization data such as that generated by an LFI.

Recommendations for the FFS in support of IRMs are not provided in this report because of limited data availability. In most cases, LFIs will be conducted at sites initially identified for IRMs. The information gathered is considered necessary prior to making a final determination whether an IRM is actually necessary or whether a remedy can be selected.

Rather than being driven by an IRM, the FFSs will also be prepared to evaluate select remedial alternatives. In this case, the FFSs focuses on technologies or alternatives that are considered to be viable based on their implementability, cost, and effectiveness and have broad application to a variety of units. The following recommendations are made for FFSs that focus on a particular technology or alternative:

- Capping
- Ex situ treatment of contaminated soils
- In situ stabilization.

These recommendations reflect select technologies developed in Section 7.0 of this report.

The FFS is intended to provide a detailed analysis of select remedial alternatives. The results of the detailed analysis provide the basis for identifying preferred alternatives. The detailed analysis for alternatives consists of the following components:

- Further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated environmental media to be addressed, the technologies to be used, and any performance requirements associated with those technologies. Remedial investigations and treatability studies, if conducted, will also be used to further define applicable alternatives.
- An assessment and summary of each alternative against evaluation criteria specified in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988b).
- A comparative analysis of the alternatives that will facilitate the selection of a remedial action.

9.4.2 Final Feasibility Study

To complete the remediation process for an aggregate area, a final or summary FS will be prepared. This study will address those sites not previously evaluated and will summarize the results of preceding evaluations. The overall study and evaluation process for an aggregate area will consist of a number of FFSs, field investigations, and interim RODs. All of this study information will be summarized in one final FS to provide the data necessary for the final ROD. The summary FS will likely be conducted on an aggregate area basis; however, future considerations may indicate that a larger scope is appropriate.

9.5 TREATABILITY STUDIES

A range of technologies which are likely to be considered for remediation of sites within the PUREX Plant Aggregate Area were discussed in Section 7.3. The range of technologies included:

- Engineered multimedia cover
- In situ grouting
- Excavation and soil treatment
- In situ vitrification
- Excavation, treatment, and disposal of transuranic (TRU) radionuclides
- In situ soil vapor extraction of volatile organic compounds (VOCs).

Treatability testing will be required to conduct a detailed analysis for most of the technologies. Relevant EPA guidance will be relied upon to conduct these future treatability studies. A summary of existing programs and treatability testing needs is as follows:

- Engineered multimedia cover--A number of cover design efforts have taken place in support of Hanford Site waste management, permitting, RARA and RCRA closure activities. Although performance testing is lacking, a number of conceptual cover designs have been developed for various types of waste management units. The feasibility/treatability process can be accelerated by utilizing existing cover design information. Long-term performance and maintenance objectives, and design criteria should be established for various categories of waste management units based on the degree of protection required.

The adequacy of existing conceptual designs should be evaluated against these design criteria and modified appropriately. Hydrologic performance and constructibility data needs can then be assessed by pilot-scale testing of preliminary cover designs.

- In situ grouting--Field pilot tests would be required to assess the required injection well spacing and the optimum grout injection methods; bench-scale and pilot-scale tests would be required to demonstrate the effectiveness for stabilizing the contaminants.

- Excavation and soil treatment--Testing will likely be required for several components of an excavation and treatment system. It is anticipated that the waste management units would be excavated with conventional mining and construction equipment. However, some equipment modifications may be required to ensure worker protection. If available, remote excavation equipment could be utilized to protect workers at waste management units containing high exposure potential. Testing of measures to control fugitive dust during retrieval activities will be required.

The testing required for the treatment process will depend on the type of treatment considered and the site-specific conditions. It is anticipated that most of the treatability information required could be obtained by a combination of literature research, laboratory screening, and bench-scale studies. However, pilot-scale testing may be required for certain treatment processes.

Physical separation (i.e., soil washing) pilot-scale treatability testing within the 300-FF-I Operable Unit is being planned which will be applicable for the 200 Areas. The soils of the Hanford Site are well suited for treatment with a physical separations process. The soils are predominantly coarse sand and gravel, with less than 10% silts and clay. It is expected that contaminants will be found largely adsorbed on the smaller soil particles and as coatings on larger particles. The physical soil washing process should provide removal of the precipitate coatings from the large particles and separation of large from small particles. This would result in a large volume reduction by separating and concentrating the contaminants.

The physical separations test in the 300-FF-1 Operable Unit will be conducted in three phases. In Phase I, soils will be characterized to assess physical, chemical, and radioactive properties. Phase II testing will establish baseline operations and capabilities of a system utilizing water as the washing solution. In Phase III, performance of the system will be optimized. Phase III may consist of two parts,

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processing with water only, and processing using selected nonhazardous and environmentally acceptable chemical extractants, if necessary to optimize the system. Laboratory bench tests may be performed to determine the primary and secondary chemical extractants to be considered for use in Phase III testing. However, it is anticipated that in the 300 Area, physical separation resulting in a large volume reduction of contaminated soil may be achieved with water only. Chemical extracts maybe required for soil washing to be successful in other areas of the Hanford Site (i.e., 200 and 100 Areas). This will depend to a large extent on the type of contaminant at the adsorption coefficient.

If the pilot-scale test is successful in the 300 Area, then the application of this process to the 200 Areas should be tested.

- In situ vitrification--In situ vitrification has been tested and field demonstrated on soil sites contaminated with radionuclides, heavy metals, and organic wastes. As a result of this testing and demonstration program, established capabilities and limitations of the in situ vitrification technology have been identified, along with technical issues that need to be resolved for successful implementation. The In Situ Vitrification Integrated Program was created by DOE's office of Technology Development to help resolve these issues and promote deployment of the technology in the field. The In Situ Vitrification Integrated Program is currently working to resolve the following key issues for implementation at contaminated soil sites:

  - Develop methods that accurately predict, measure, and achieve significantly greater melt depth and control of the melt shape. Presently, the in situ vitrification process has been demonstrated to a depth of 5 m (16 ft).

  - Improve the understanding of and verify VOC contaminant transport behavior.

  - Determine the potential for transient gas release events while vitrifying contaminated soils under varying conditions. Better define operating parameters and limits to ensure containment and treatment of offgases during processing.

  - Resolve secondary waste generation and handling concerns as they relate to the volatilization of ^{137}Cs from highly concentrated soils.

Other DOE in situ vitrification related activities include evaluating the cost of in situ vitrification against other technologies (report to be released before fiscal year end) and a field demonstration at the Idaho National Engineering Laboratory

(INEL) during fiscal year 1993. Additional field demonstrations will be required before all issues surrounding implementation of in situ vitrification to contaminated soil sites can be resolved.

There is a large uncertainty whether the In Situ Vitrification Integrated Program will obtain the funding required to resolve these issues. Without resolution of these issues in situ vitrification will have very limited application to remediation at the Hanford Site.

- Excavation, treatment and disposal of transuranic radionuclides--Development and testing of methods to characterize, retrieve, treat, and package waste from TRU contaminated waste management units will be required. The DOE Office of Technology Development has established the Buried Waste Integrated Demonstration (BWID) at INEL to resolve these issues. The BWID is focused on sites containing buried waste; however, it is expected that many of the original containers at INEL degraded significantly, resulting in contamination of the immediately surrounding soil. As a result, the BWID will also be resolving some of the issues surrounding retrieval and treatment of TRU contaminated soil.

  A major concern for retrieval of TRU contaminated materials will be control of fugitive dust. Testing of various types of foams and fixants, that will not interfere with treatment and disposal, will be required. In addition, development of foams and fixants for dust control will be important for non-TRU contaminated waste management units. The use of containment structures (e.g. buildings) to contain fugitive dust during remediation is very expensive and cumbersome (creating problems for both equipment and workers). A significant cost savings could be realized if foams and fixants are used in place of containment structures.

- In situ soil vapor extraction of volatile organic compounds--Development and testing of methods to characterize, retrieve, and treat waste from VOC contaminated soil will be required. The DOE has established the VOC-Arid Integration Demonstration to resolve these issues. The Z Plant Aggregate Area is currently the initial host site for the demonstration and is associated with an active ERA to remove carbon tetrachloride from the vadose zone using vapor extraction. These activities are expected to resolve numerous design and treatability issues associated with in situ soil vapor extraction. However, additional treatability testing may be required to resolve site specific data needs.

As treatability testing of the various alternatives progresses, other parameters are likely to be identified which require further development.

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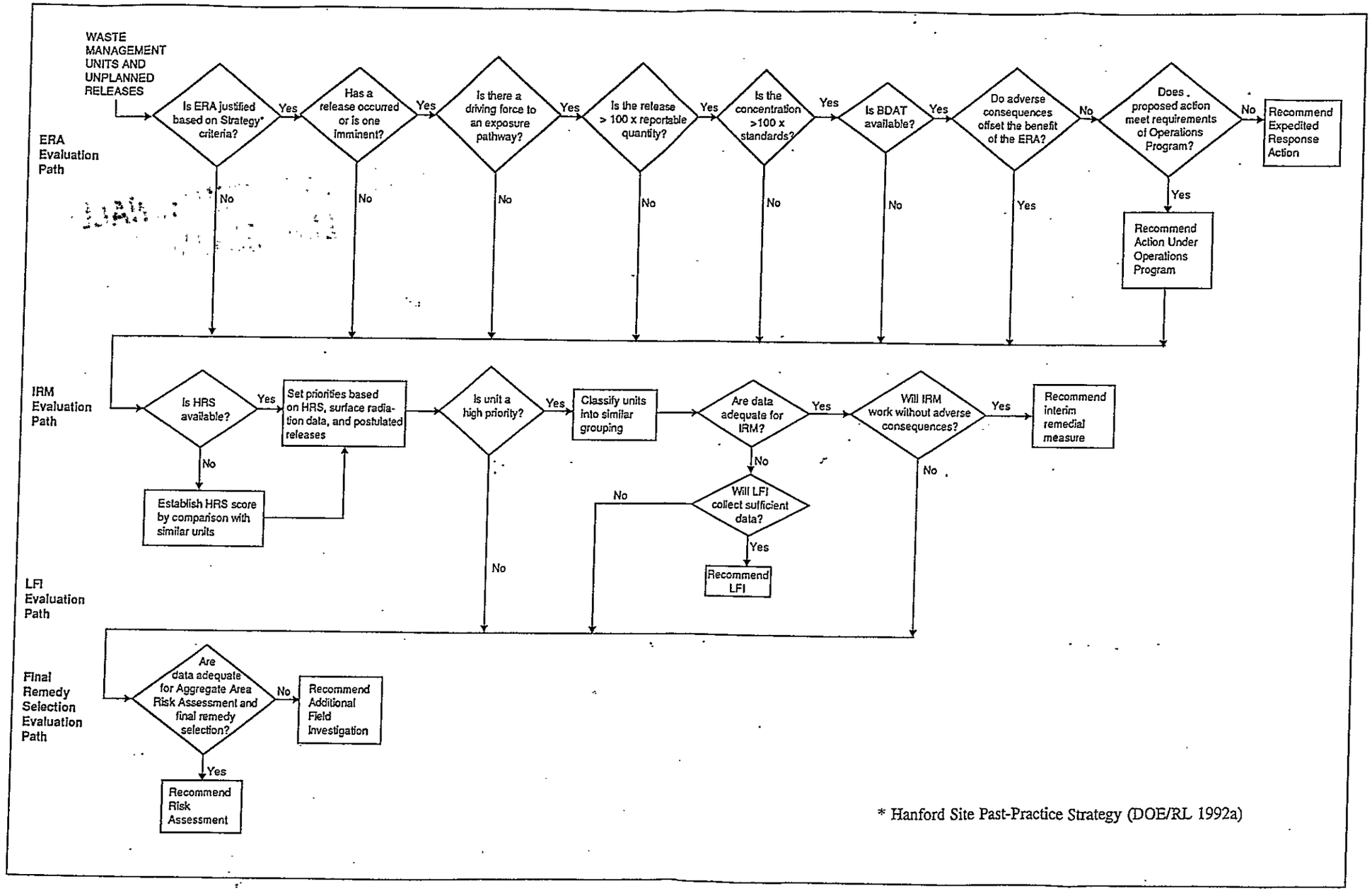

Figure 9-1. 200 Aggregate Area Management Study Data Evaluation Process.

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Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

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

Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

Waste Management Unit	Operable Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-A-37-2 Crib	200-PO-4	--	X	X	--	--	--	--
216-A-38-1 Crib	200-PO-2	--	--	--	X	--	--	--
216-A-41 Crib	200-PO-1	--	X	X	--	--	--	--
216-A-45 Crib	200-PO-2	--	X	X	--	--	--	--
216-A-11 French Drain	200-PO-1	--	--	--	--	X	--	--
216-A-12 French Drain	200-PO-1	--	--	--	--	X	--	--
216-A-13 French Drain	200-PO-1	--	--	--	--	X	--	--
216-A-14 French Drain	200-PO-1	--	X	X	--	--	X	RARA - Surface Contamination
216-A-15 French Drain	200-PO-2	--	--	--	--	X	--	--
216-A-22 French Drain	200-PO-5	--	--	--	--	X	--	--
216-A-26 French Drain	200-PO-5	--	--	--	--	X	--	--
216-A-26A French Drain	200-PO-1	--	--	--	--	X	--	--
216-A-28 French Drain	200-PO-1	--	X	X	--	--	X	RARA - Surface Contamination
216-A-33 French Drain	200-PO-1	--	--	--	--	X	--	--
216-A-35 French Drain	200-PO-1	--	--	--	--	X	--	--
Reverse Wells								
299-E24-111 Injection Well	200-PO-2	--	--	--	--	X	--	--

Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

Waste Management Unit	Operable Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Ponds, Ditches, and Trenches								
216-A-29 Ditch	200-PO-5	--	--	--	--	X	--	Deferred to B Plant Aggregate Area
216-A-34 Ditch	200-PO-5	--	--	--	--	X	--	--
216-A-18 Trench	200-PO-5	--	--	--	--	X	--	--
216-A-19 Trench	200-PO-5	--	--	--	--	X	--	--
216-A-20 Trench	200-PO-5	--	--	--	--	X	--	--
216-A-40 Trench	200-PO-1	--	--	--	--	X	--	--
Septic Tanks and Associated Drain Fields								
2607-EA Septic Tank/Drain Field	200-PO-1	--	--	--	--	X	--	--
2607-EC Septic Tank/Drain Field	200-PO-5	--	--	--	--	X	--	--
2607-ED Septic Tank/Drain Field	200-PO-3	--	--	--	--	X	--	--
2607-EG Septic Tank/Drain Field	200-PO-3	--	--	--	--	X	--	--
2607-EJ Septic Tank/Drain Field	200-PO-3	--	--	--	--	X	--	--
2607-EL Septic Tank/Drain Field	200-PO-4	--	--	--	--	X	--	--
2607-E6 Septic Tank/Drain Field	200-PO-1	--	--	--	--	X	--	--
Transfer Facilities, Diversion Boxes, and Pipelines								
216-A-524 Control Structure	200-PO-5	--	X	X	--	--	--	--

Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

Waste Management Unit	Operable Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Basins								
207-A Retention Basin	200-PO-5	--	--	--	--	X	--	--
216-A-42 Retention Basin	200-PO-4	--	--	--	--	X	X	RARA - Surface Contamination
Burial Sites								
218-E-1 Burial Ground	200-PO-1	--	--	--	--	X	--	--
218-E-8 Burial Ground	200-PO-6	--	--	--	--	X	--	--
218-E-12A Burial Ground	200-PO-6	--	--	--	--	X	--	--
218-E-13 Burial Ground	200-PO-1	--	--	--	--	X	--	--
Unplanned Releases								
UN-200-E-10 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-11 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-12 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-13 Unplanned Release	200-PO-2	--	--	--	--	X	--	--
UN-200-E-15 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-19 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-20 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-22 Unplanned Release	200-PO-2	--	--	--	--	X	--	--
UN-200-E-25 Unplanned Release	200-PO-2	--	--	--	--	X	--	--

Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

Waste Management Unit	Operable Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-E-26 Unplanned Release	200-PO-2	--	--	--	--	X	--	--
UN-200-E-28 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-31 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-33 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-35 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-39 Unplanned Release	200-PO-2	--	--	--	--	X	--	--
UN-200-E-40 Unplanned Release	200-PO-2	--	--	--	--	X	--	--
UN-200-E-42 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-49 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-56 Unplanned Release	200-PO-5	--	--	--	--	X	--	--
UN-200-E-58 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-60 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-62 Unplanned Release	200-PO-6	--	--	--	--	X	--	--
UN-200-E-65 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-67 Unplanned Release	200-PO-5	--	--	--	--	X	--	--
UN-200-E-68 Unplanned Release	200-PO-3	--	--	--	--	X	--	--
UN-200-E-72 Unplanned Release	200-PO-3	--	--	--	--	X	--	--
UN-200-E-88 Unplanned Release	200-PO-1	--	--	--	--	X	--	--
UN-200-E-94 Unplanned Release	200-PO-3	--	--	--	--	X	--	--

Table 9-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area.

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

Table 9-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	No Adverse Consequences?	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 9-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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 9-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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
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 9-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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 9-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit or Unplanned Release	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment 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.

Table 9-3. Waste Management Units and Unplanned Releases Deferred to Other Programs.

Site Name	Site Type	Program	Active/Inactive	Operable Units
Tanks and Vaults				
241-A-350	Catch Tank	WMP	Active	200-PO-3
241-A-417	Catch Tank	WMP	Active	200-PO-3
241-A-101	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-102	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-103	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-104	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-105	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-106	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-A-302A	Catch Tank	WMP	Active	200-PO-1
241-AX-101	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-AX-102	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-AX-103	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-AX-104	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-101	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-102	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-103	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-104	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-105	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-106	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-107	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-108	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-109	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-110	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-111	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-112	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-201	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-202	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-203	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-204	Single-Shell Tank	SSTCP	Inactive	200-PO-3
241-C-301C	Catch Tank	SSTCP	Inactive	200-PO-3
Cribs and Drains				
216-A-16	French Drain	SSTCP	Inactive	200-PO-5
216-A-17	French Drain	SSTCP	Inactive	200-PO-5

9 2 1 2 6 3 1 3 9

Table 9-3. Waste Management Units and Unplanned Releases Deferred to Other Programs.

Site Name	Site Type	Program	Active/Inactive	Operable Units
216-A-23A	French Drain	SSTCP	Inactive	200-PO-5
216-A-23B	French Drain	SSTCP	Inactive	200-PO-5
216-A-39	Crib	SSTCP	Inactive	200-PO-3
216-C-8	French Drain	SSTCP	Inactive	200-PO-3
Diversion Boxes				
241-A-151	Diversion Box	WMP	Active	200-PO-1
241-A-152	Diversion Box	SSTCP	Inactive	200-PO-3
241-A-153	Diversion Box	SSTCP	Inactive	200-PO-3
241-A-A	Diversion Box	WMP	Active	200-PO-3
241-A-B	Diversion Box	WMP	Active	200-PO-3
241-AR-151	Diversion Box	WMP	Active	200-PO-3
241-AX-151	Diversion Box	WMP	Active	200-PO-3
241-AX-152DS	Diversion Box	WMP	Active	200-PO-3
241-AX-155	Diversion Box	WMP	Active	200-PO-3
241-AX-501	Valve Pit	WMP	Active	200-PO-3
241-AX-A	Diversion Box	WMP	Active	200-PO-3
241-AX-B	Diversion Box	WMP	Active	200-PO-3
241-C-151	Diversion Box	SSTCP	Inactive	200-PO-3
241-C-152	Diversion Box	SSTCP	Inactive	200-PO-3
241-C-153	Diversion Box	SSTCP	Inactive	200-PO-3
241-C-252	Diversion Box	SSTCP	Inactive	200-PO-3
241-CR-151	Diversion Box	SSTCP	Inactive	200-PO-3
241-CR-152	Diversion Box	SSTCP	Inactive	200-PO-3
241-CR-153	Diversion Box	SSTCP	Inactive	200-PO-3
241-ER-153	Diversion Box	DWMP	Active	200-PO-3
Unplanned Releases				
UN-200-E-16	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-18	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-27	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-48	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-81	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-82	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-107	Unplanned Release	SSTCP	--	200-PO-3
UN-200-E-118	Unplanned Release	SSTCP	--	200-PO-3

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Table 9-3. Waste Management Units and Unplanned Releases Deferred to Other Programs.

Site Name	Site Type	Program	Active/Inactive	Operable Units
UPR-200-E-59	Unplanned Release	SSTCP	--	200-PO-1
UPR-200-E-119	Unplanned Release	SSTCP	--	200-PO-3
UPR-200-E-125	Unplanned Release	SSTCP	--	200-PO-3
UPR-200-E-126	Unplanned Release	SSTCP	--	200-PO-3
UPR-200-E-136	Unplanned Release	SSTCP	--	200-PO-3
UPR-200-E-137	Unplanned Release	SSTCP	--	200-PO-3

WMP = Waste Management Program
SSTCP = Single-Shell Tank Closure Program

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