PNNL-13024

RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site

D. G. Horton
S. M. Narbutovskih

January 2001

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This document describes the groundwater monitoring plan for Waste Management Area C located in the 200 East Area of the DOE Hanford Site. This plan is required under Resource Conservation and Recovery Act of 1976 (RCRA). The regulatory requirements can be found in WAC 173-303, and by reference, requirements in 40 CFR 265.93 (d)(6). The plan objectives are to detect hazardous constituents in the groundwater downgradient from Waste Management Area C. During the past eight years, groundwater monitoring results have not indicated that leaks from SSTs in WMA C have reached the uppermost aquifer.

The groundwater monitoring network currently contains four RCRA-compliant wells used to monitor the uppermost 20 ft (6 m) of the unconfined aquifer. In addition one pre-RCRA well is included as an upgradient well. The gradient of the water table is nearly flat causing ambiguity in flow determinations. In situ measurements of the groundwater flow direction are planned for FY 2001. If results can adequately define the flow direction, the network may be modified to provide additional coverage.

Currently, nitrate and ^{99}Tc are elevated in a well located southeast of the 241-C Tank Farm boundary. Concentrations/activities do not exceed drinking water standards. Recent small increases in ^{99}Tc, nitrate, sulfate, and calcium have also been observed north and northeast of the farm. Although it will be necessary to defer source delineation until a better understanding of flow direction is acquired, this contamination appears to be part of a regional plume moving into the area from an easterly direction.

Recently, the waste management area was monitored either monthly or bimonthly prior to and during sluicing activities to remove residual waste from a single-shell tank. Waste transfer activities have ceased and beginning in FY 2001, sampling will revert to quarterly. Groundwater samples will be analyzed for indicator parameters (pH, conductivity, total organic carbon, total organic halides), anions, alkalinity, turbidity, ICP metals and site-specific contaminants such as ^{99}Tc, cyanide, ^{137}Cs, ^{60}Co, ^{90}Sr, ^{129}I and tritium. Depths to groundwater are measured quarterly.

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1.0 Introduction

This document describes the interim-status groundwater monitoring plan for Waste Management Area (WMA) C. The plan is in agreement with the Resource Conservation and Recovery Act of 1976 (RCRA), as described in 40 CFR 265, Subpart F, by reference of Washington Administrative Code (WAC) 173-303-400 (3). It is designed to meet interim status requirements for WMA C and replaces the previous plan that included seven single-shell tank (SST) WMAs in one document (Caggiano and Goodwin 1991; Jensen et al. 1989). In accordance with requests from DOE/Richland Operations Office (RL), separate monitoring plans have been developed for each of the seven WMAs.

Radioactive waste has been generated since 1944 at the U.S. Department of Energy (DOE) Hanford Site as part of the program to generate plutonium for national defense activities. Mixed waste, consisting of radioactive elements and dangerous chemicals from the processing of irradiated fuel rods has been stored in 149 underground SSTs since that time. Waste Management Area C consists of the 241-C Tank Farm. The WMA is defined to develop and operate the RCRA groundwater monitoring network. This WMA is located in the 200 East Area of the DOE Hanford Site (Figure 1.1). The facilities in this WMA are included in the interim status RCRA Dangerous Waste Permit Application, Part A submitted in accordance with 40 CFR 265.93 by reference from WAC 173-303. As defined, this WMA may differ from other waste management operable units delineated for remediation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The WMA C consists of 12 SSTs with capacities of 530,000 gal (1,892,500 L) each and four SSTs with capacities of 55,000 gal (208,000 L) each. Also included are ancillary equipment consisting of eight diversion boxes, associated piping, valve pits, pumps and the 244-CR waste transfer vault. Figure 1.2 is a map of the WMA showing the location of each facility except diversion box 241-C-154. This diversion box is located outside the WMA boundaries near the 261-C process building.

The initial groundwater monitoring network was designed for westward groundwater flow and did not include coverage for the 244-CR waste transfer vault. Recent analysis of the flow direction and inclusion of the 244-CR vault into the permit dictate that the network be redesigned for current conditions. Tasks required to bring the plan into alignment with current subsurface conditions and the RCRA permit application are identified in this plan.

Current Regulatory Status

Between 1970 and 1980, the SSTs in WMA C were removed from active service and replaced by double-shell tanks (DST) for the receipt of new waste and for transfer of waste from SSTs. Liquid is currently being pumped from various SSTs to the DSTs for long-term storage.

In May 1987, DOE issued a final rule (10 Code of Federal Regulations [CFR] 962) stating that the hazardous waste components of radioactive waste, defined as hazardous waste under RCRA, are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized

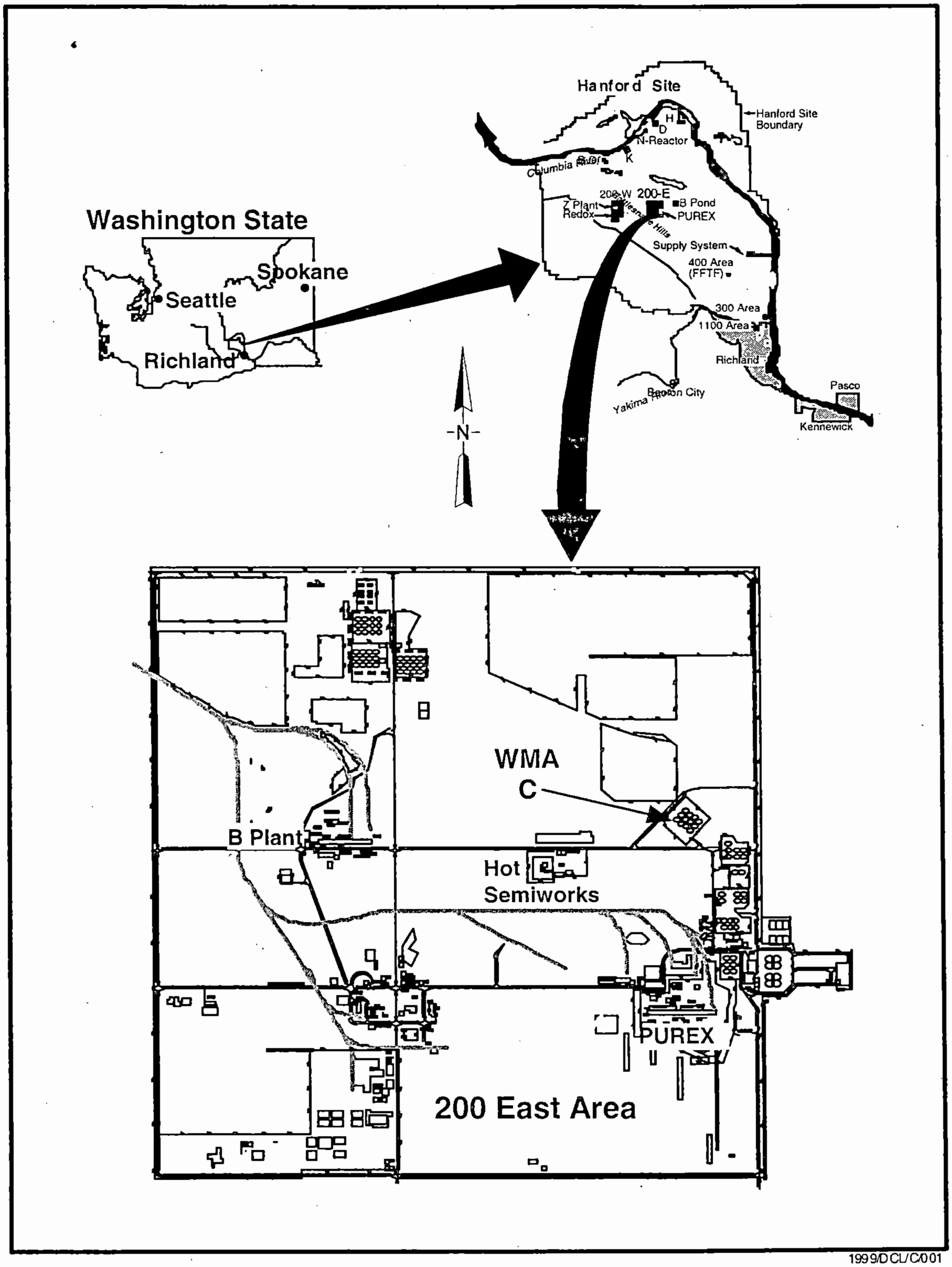


Figure 1.1. Location Map of the 200 East Area at the DOE Hanford Site in Eastern Washington (from Narbutovskih 1998)

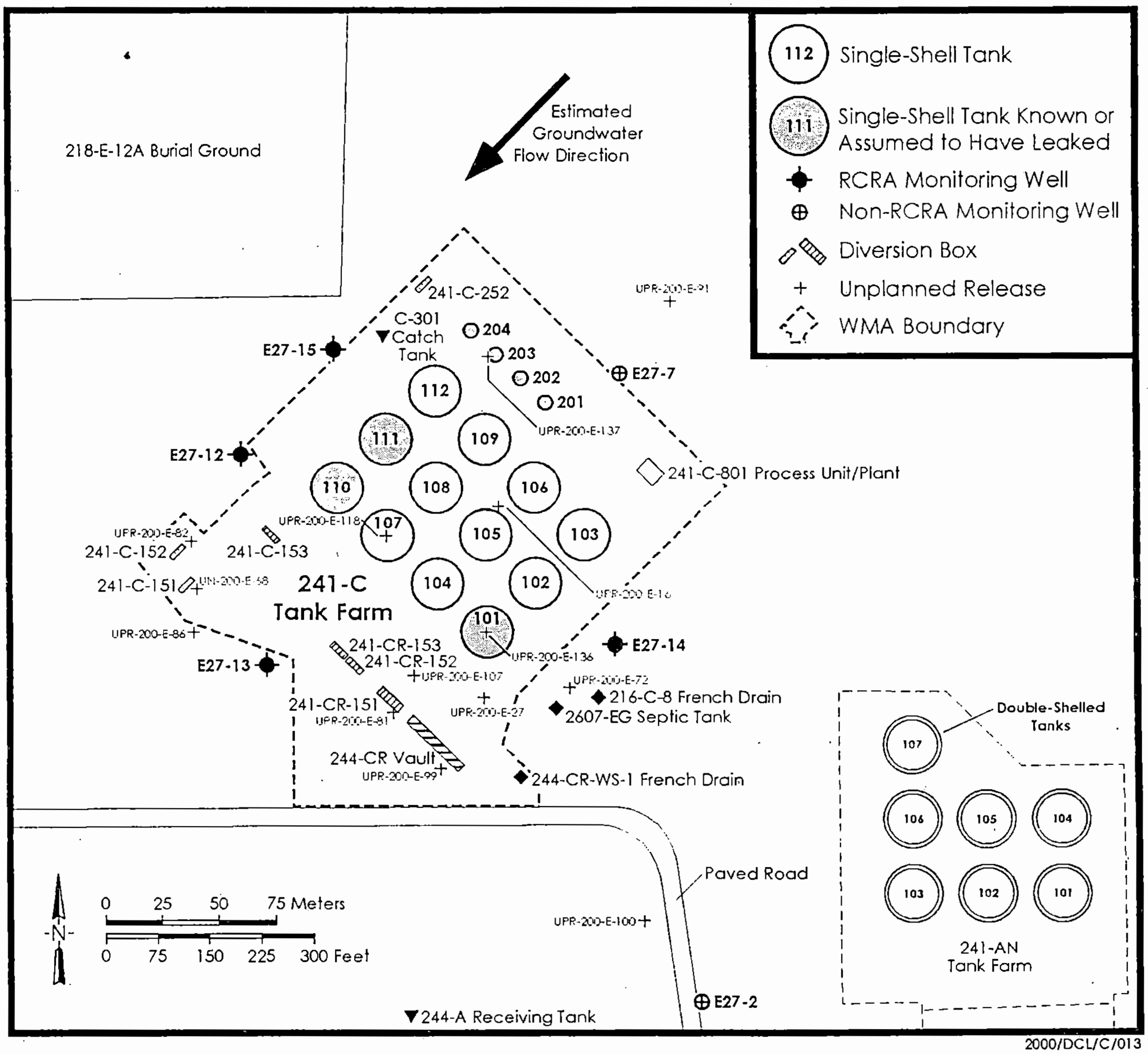


Figure 1.2. Location Map of WMA C and Surrounding Facilities

the Washington State Department of Ecology (Ecology) to regulate the hazardous component of radioactive mixed waste within the State of Washington (51 FR 24504). Consequently, DOE (radioactive constituents) and Ecology (hazardous chemical constituents) jointly regulate the waste stored in the SSTs.

In May 1989, DOE, EPA and Ecology signed the Tri-Party Agreement (Washington State Dept. of Ecology 1994). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes the SST RCRA Waste Management Areas. As part of the RCRA regulatory process, an interim status RCRA Part A permit application (DOE/RL-88-21 1996) and closure/work plan (DOE/RL-89-16 1996) have been submitted to

Ecology for the SSTs. In accordance with the most recent revision of the Part A permit application in November 1996, the 244-CR waste transfer vault, containing four underground tanks and eight diversion boxes were added to the WMA C.

Waste Retrieval and Closure Plans

As a result of negotiating efforts from March 1993 to September 1993, DOE, Ecology and EPA revised the tank waste disposal and closure strategy. Certain aspects of the closure plan affect current and future groundwater monitoring strategies. It is required that SST waste be retrieved from the tanks and separated into high-level and low-level fractions. The low-level waste will be vitrified and disposal will be onsite in a manner that does not preclude subsequent retrieval. The vitrified high-level waste will be sent offsite to a geologic repository. It is also stipulated that the SST farm operable units, including tanks, contaminated soil, and ancillary equipment, will be closed as treatment, storage, and disposal (TSD) units under a single set of regulatory standards pertaining to the hazardous waste constituents (i.e., WAC 173-303, "Dangerous Waste Regulations"). The radioactive constituents continue to be managed in accordance with the Atomic Energy Act of 1954 (AEA). Closure of the SST farms is to be concluded by 2024. In accordance with these long term goals, it is prudent and cost-effective that any major modification of the groundwater monitoring plan consider both the impacts of waste retrieval on the subsurface and the extended monitoring needs of these closure plans.

1.1 Plan Objectives

This revision of the original RCRA groundwater monitoring plan has several goals. First, it is desirable to have separate monitoring plans developed for each WMA instead of one encompassing plan. This document contains the RCRA monitoring plan tailored for WMA C. It includes the sampling and analysis plan (SAP) for continued interim detection. Second, according to the most recent revision to the Part A interim status permit application, the 244-CR waste transfer vault and eight diversion boxes have been added to the WMA C. Coverage of these facilities was not included in the original monitoring strategy (Caggiano and Goodwin 1991). This plan provides the groundwork to collect the data needed to redesign the monitoring network to include the vault and diversion boxes. Third, the 200 East Area has a flat water table that makes determination of the flow direction difficult. This plan contains a course of action to obtain data needed to make a more accurate estimate of the flow direction. Any modification to the current well network indicated by flow direction will be addressed by later changes to the plan.

1.2 Scope and Organization

This document describes the facilities and associated outlying equipment, operational history, and characteristics of the stored waste at WMA C. This is followed by discussions of the site geology and hydrogeology used to design and operate the monitoring well network and to interpret the groundwater data. The historic groundwater chemistry is also provided. Next is a discussion of the integrated conceptual model for WMA C that forms the basis for identification of potential sources and source type, migration pathways and driving forces.

The plan includes a description of network well locations, well construction, sample constituents, and sampling frequency. Also included is a discussion of the adequacy of the current monitoring network required for compliance with 40 CFR 265, Subpart F and WAC 173-303-400 (3). It is anticipated that new well installations will be needed to account for changes in the facilities included within the WMA and in response to a better understanding of the local groundwater flow direction. Finally, this plan provides the basis for rapid development of an assessment plan should a validated exceedance of an indicator parameter be found.

2.0 Background Information

Knowledge of the surface conditions, facility histories, nature of possible contamination and subsurface conditions is required to design and operate an adequate groundwater monitoring program. This section provides an overview of the facilities that comprise WMA C, including a brief account of the facilities' operational history and a description of wastes that are stored in the tanks. A discussion of the subsurface conditions found under the WMA also is included in this section. The stratigraphic framework is provided along with the nature of the unconfined aquifer and the current state of groundwater quality in the immediate area of the WMA. The bulk of the information in this section has been taken from Agnew (1997), Anderson (1990), Hanlon (1999), Hartman (2000), DOE/RL-88-21 (1996), Kupfer et al. (1997), and Stephens (1996).

2.1 Facility Description

WMA C encompasses the 241-C Tank Farm and is located in the east central portion of the 200 East Area. The 241-C Tank Farm contains twelve single-shell 100 series and four single-shell 200 series tanks constructed in 1943 and 1944 (Figure 1.2). The 100 series tanks are 75 ft (22.9 m) in diameter, have a 15 ft (4.6 m) operating depth, and have an operating capacity of 530,000 gal (1,892,500 L) each (Table 2.1). The 200 series tanks are 20 ft (6.1 m) in diameter with a 17 ft (5.2 m) operating depth and a capacity of 55,000 gal (208,000 L) each. Tank configuration and dimensions are shown in Figure 2.1. The tanks sit below grade with at least 7 ft (2.1 m) of soil cover to provide shielding from radiation exposure to operating personnel. The inlet and outlet lines are located near the top of the liners (Figure 2.2). The tanks in WMA C were removed from service between 1970 and 1980 (Hanlon 1999). The SSTs in the 241-C Tank Farm were used to store waste primarily from the bismuth phosphate, the PUREX, and the uranium extraction processes.

The SSTs were constructed in place with carbon steel (ASTM A283 Grade C) lining the bottom and sides of a reinforced concrete shell. The tanks have slightly concave bottoms and a curving intersection of the sides and bottom. This curvature decreased the buildup of stress in the bottom corners of the tanks, reducing corrosive effects and thus reducing the chance of developing a leak in the tank bottom.

WMA C also includes the 244-CR vault and eight diversion boxes. The 244-CR vault is located in the 241-C Tank Farm, south of the tanks (Figure 1.2). The vault is a two level, multi-cell, reinforced concrete structure constructed below grade (DOE 1993a). The 244-CR vault contains four permitted underground tanks along with overhead piping and equipment. Two tanks (244-CR-001 and 244-CR-011) have diameters of 19.7 ft (6 m), are 19 ft (6 m) tall, and have a capacity of 45,000 gal (170,343 L) each. The other two tanks (244-CR-002 and 244-CR-003) are 14 ft (4 m) in diameter, 12 ft (3.7 m) tall, and have capacities of 14,700 gal (55,494 L) each. This vault was constructed in 1946 and ceased operating in 1988. It was used to transfer waste solutions from processing and decontamination operations (DOE 1993). A schematic of the 244-CR vault is shown in Figure 2.3. Only tanks 244-CR-003 and 244-CR-011 are listed in the Dangerous Waste Permit Application (DOE 1996) as part of the WMA.

Table 2.1. Operating Period and Capacities for WMA C Facilities[a]

Facility	Constructed	Removed From Service	Operating Capacity (gal)
Single-Shell Tanks			
241-C-101	1943 - 1944	1970	530,000
241-C-102	1943 - 1944	1976	530,000
241-C-103	1943 - 1944	1979	530,000
241-C-104	1943 - 1944	1980	530,000
241-C-105	1943 - 1944	1979	530,000
241-C-106	1943 - 1944	1979	530,000
241-C-107	1943 - 1944	1978	530,000
241-C-108	1943 - 1944	1976	530,000
241-C-109	1943 - 1944	1976	530,000
241-C-110	1943 - 1944	1976	530,000
241-C-111	1943 - 1944	1978	530,000
241-C-112	1943 - 1944	1976	530,000
241-C-201	1943 - 1944	1977	55,000
241-C-202	1943 - 1944	1977	55,000
241-C-203	1943 - 1944	1977	55,000
241-C-204	1943 - 1944	1977	55,000
Diversion Boxes			Function
241-C-151	1946	1985	Interconnected 241-C-152, -153, and CR-151 diversion boxes
241-C-152	1946	1985	Interconnected 241-B-154 and -153 and 241-C Tank Farm, associated with the 241-C-301 Catch Tank
241-C-153	1946	1985	Interconnected 241-C-151 and -152 diversion boxes
241-C-154	1965	1985	Interconnected B-Plant to Hot Semi-Works locations. Box located at Hot Semi-Works
241-C-252	1946	1985	Interconnected 241-C-151 diversion box and 241-C Tank Farm
241-CR-151	1952	1985	Interconnected 241-C-151 and 241-C Tank Farms
241-CR-152	1946	1985	Interconnected 241-C-151 diversion box and 241-C Tank Farm
241-CR-153	1946	1985	Interconnected 241-CR-152 diversion box and 241-C Tank Farm
244-CR-Vault			
244-CR-011	1946	1988	Transfer of waste solutions from processes and decontamination operations.
244-CR-003	1946	1988	

(a) Data on SSTs is from Caggiano and Goodwin (1991) and Hanlon (1999). Data on diversion boxes and the 244-CR vault is from DOE (1993a) except for 241-C-154, which is from DOE (1993b).

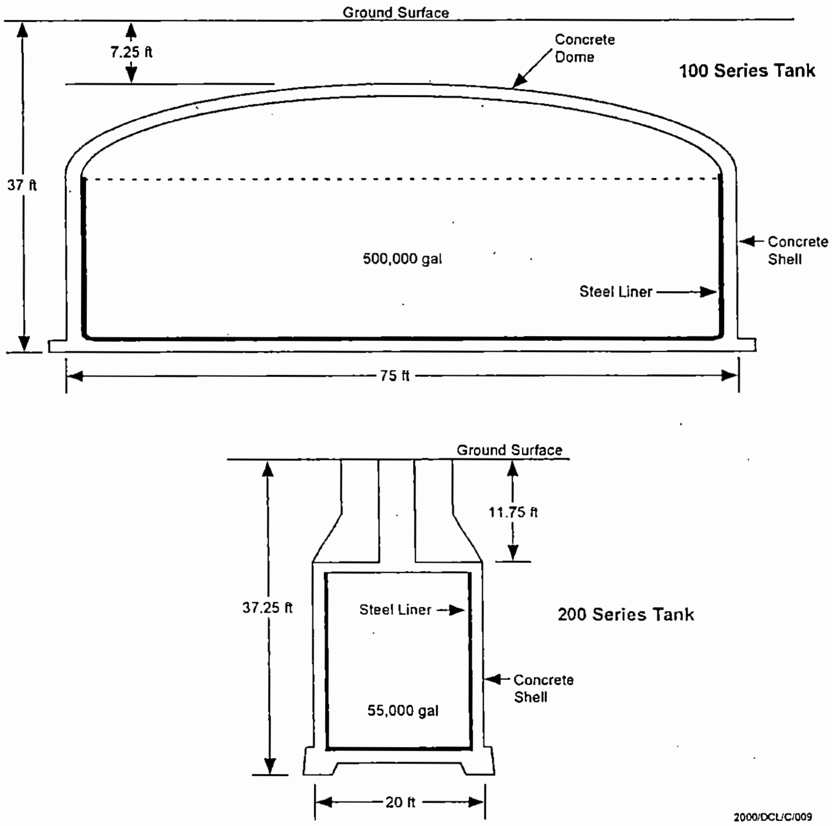


Figure 2.1. Typical Configuration and Dimensions of Single-Shell Tanks (modified from Hanlon 1999)

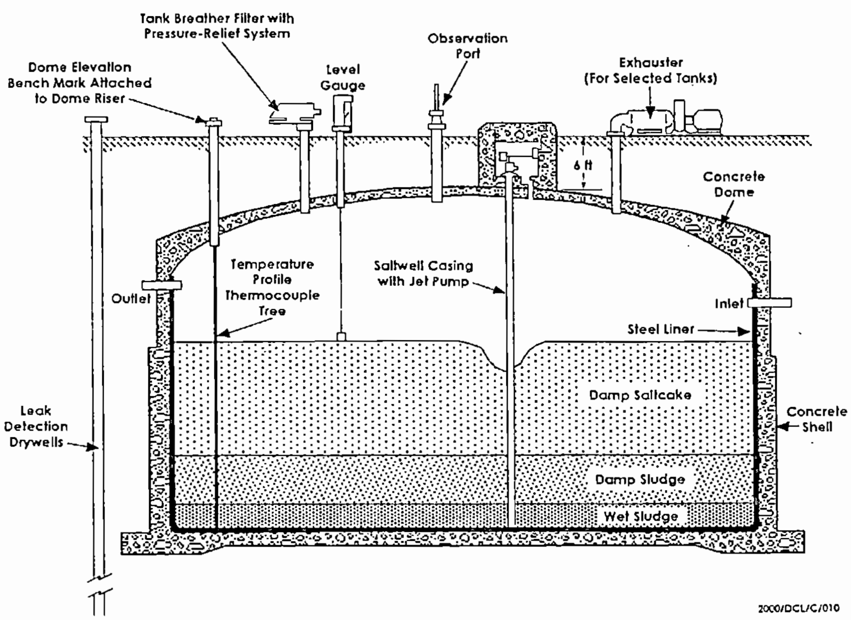


Figure 2.2. Typical Single-Shell Tank Instrumentation Configuration (from DOE 1993)

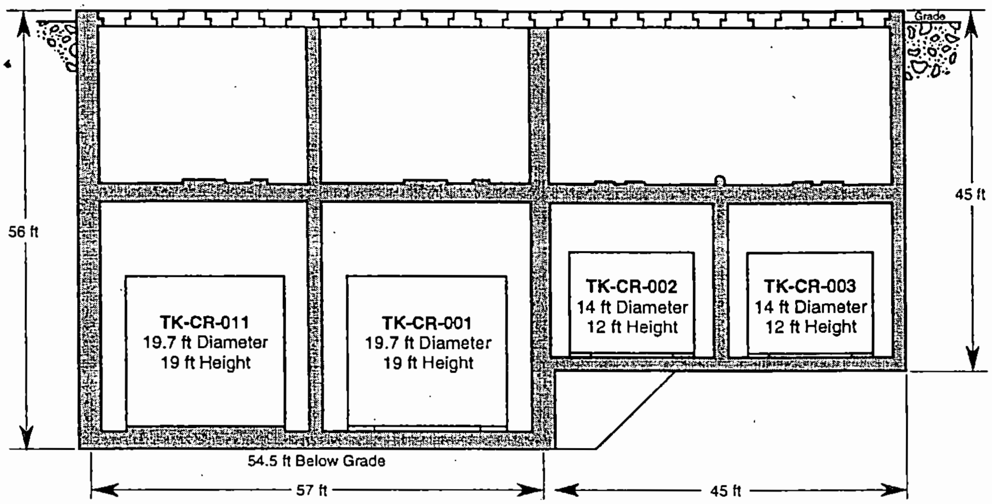


Figure 2.3. Schematic of the 244-CR Vault in WMA C (from DOE/RL-88-21). Only tanks TK-CR-011 and TKD-CR-003 are listed in the Dangerous Waste Permit Application (DOE/RL-88-21) as part of the WMA.

The routing of liquid waste from the operations buildings to the tank farms was done with underground lines and diversion boxes. The diversion boxes housed the switching facilities where waste could be routed from one process line to another. The diversion boxes are concrete boxes that were designed to contain any waste that leaked from the high-level waste transfer line connections. Diversion boxes generally drained by gravity to nearby catch tanks where any spilled waste was stored and then pumped to SSTs (DOE 1993a).

In 1996, the transfer lines and eight diversion boxes associated with 241-C Tank Farm were added as part of the WMA in the Part A permit application (DOE 1996). All diversion boxes used within the 241-C Tank Farm are inactive and presently isolated or covered from the weather. As used here, "isolated" means exterior water intrusion has been restricted. The diversion boxes are included in the RCRA permit application because they were an integral part of the waste transfer system. The boxes were the sites of contaminant releases to the subsurface and, thus, provide areas where tank waste can be remobilized through the vadose zone to the groundwater. It is estimated that each box contains 50 pounds (23 kg) of lead and they are listed as waste piles (Hanlon 1999). Figure 2.4 shows a schematic of a typical diversion box.

Pertinent information on the SSTs, the waste transfer vault, and the diversion boxes that are part of WMA C is provided in three tables. Table 2.1 lists the tank, vault and diversion box numbers, year of construction, year removed from service, and operating capacity or function. Tanks from which leaks have been confirmed or assumed are listed in Table 2.2 along with the estimated volume of leaked waste and the date that the tank was interim stabilized. Interim stabilized means that the tank now contains less than 50,000 gal (189,250 L) of drainable interstitial liquid and less than 5,000 gal (18,925 L) supernatant liquid (Hanlon 1999).

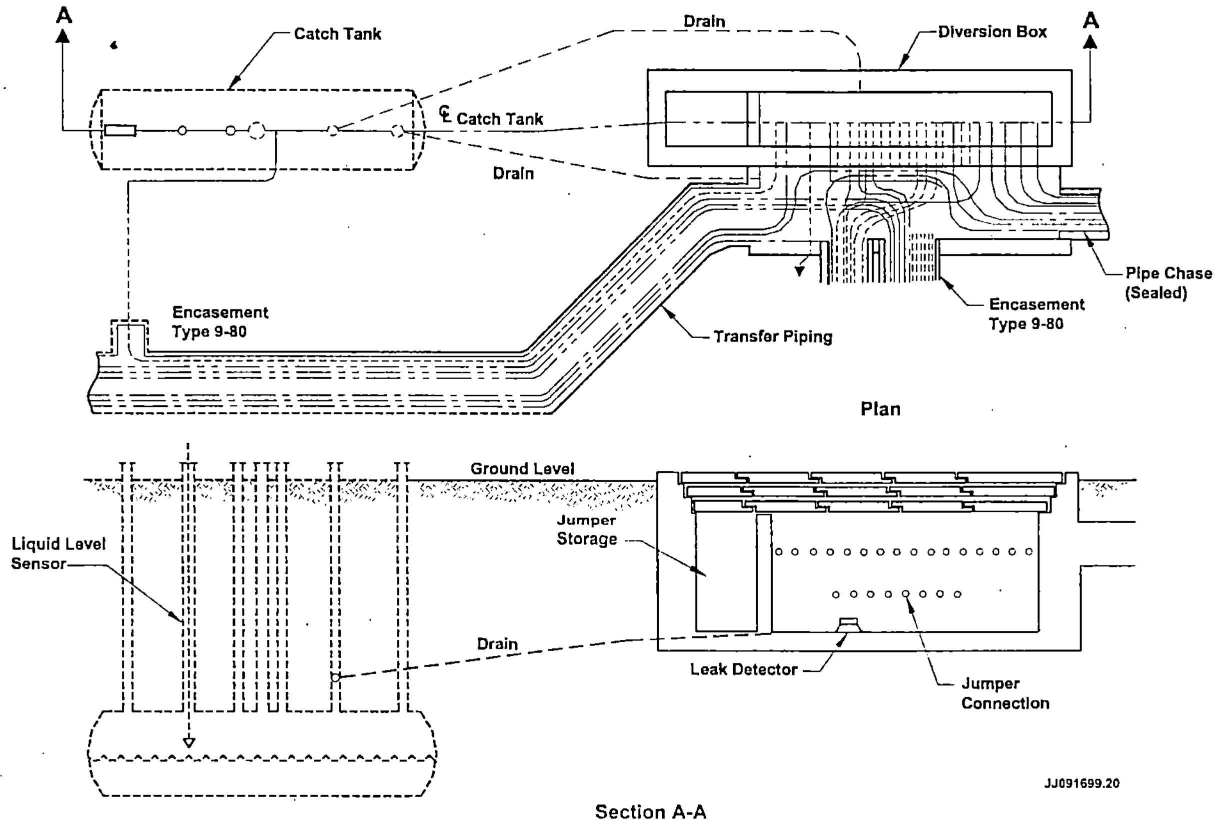


Figure 2.4. Schematic of a Typical Diversion Box Transfer System. There are eight diversion boxes that are part of the WMA C

Table 2.2. Tank Leak Volume Estimates (from Hanlon 2000)

Tank Number	Date Declared Confirmed or Assumed Leaker	Volume Leaked (gal)	Interim Stabilized Date	Leak Estimate Updated
241-C-101	1980	20,000	11/83	1986
241-C-110	1984	2,000	5/95	1989
241-C-111	1968	5,500	03/84	1989
241-C-201	1988	550	03/82	1987
241-C-202	1988	450	08/81	1987
241-C-203	1984	400	03/82	1986
241-C-204	1988	350	09/82	1987

Table 2.3 provides the current inventory and status of the SSTs in WMA C. Because of the advanced age of the SSTs, most of the pumpable liquid has been removed and transferred to DSTs as part of the interim stabilization project. However, two tanks (241-C-103 and 241-C-106) are not yet interim stabilized, although tank 241-C-106 has been sluiced. As used in Table 2.3, intrusion prevention (IP) is the administrative designation for the completion of the physical activities required to minimize the addition of liquids into an inactive storage tank. Electrical and other instrumentation devices are not disconnected during intrusion prevention. Partially interim isolation (PI) is the administrative designation for the completion of physical activities required for interim isolation except for isolation of risers and piping required for jet pumping or other stabilization methods (Hanlon 1999).

Table 2.3. Inventory and Status by Tank (from Hanlon 2000)

Tank	Tank Integrity	Stabilization/ Isolation Status[(a)]	Total Waste (gal x 1000)	Total Pumped (gal x 1000)	Drainable Liquid Remaining (gal x 1000)	Pumpable Liquid Remaining (gal x 1000)	Sludge (gal x 1000)	Salt Cake (gal x 1000)
241-C-101	Assumed leaker	IS/IP	88	0.0	4	0	88	0
241-C-102	Sound	IS/IP	316	46.7	62	55	316	0
241-C-103	Sound	/PI	198	0.0	83	83	119	0
241-C-104	Sound	IS/IP	295	0.0	34	30	295	0
241-C-105	Sound	IS/PI	134	0.0	12	8	132	0
241-C-106	Sound	/PI	74	0.0	68	62	6	0
241-C-107	Sound	IS/IP	257	40.8	30	25	257	0
241-C-108	Sound	IS/IP	66	0.0	4	0	66	0
241-C-109	Sound	IS/IP	66	0.0	6	4	62	0
241-C-110	Assumed leaker	IS/IP	178	15.5	38	30	177	0
241-C-111	Assumed leaker	IS/IP	57	0.0	4	0	57	0
241-C-112	Sound	IS/IP	104	0.0	6	1	104	0
241-C-201	Assumed leaker	IS/IP	2	0.0	0	0	2	0
241-C-202	Assumed leaker	IS/IP	1	0.0	0	0	1	0
241-C-203	Assumed leaker	IS/IP	5	0.0	0	0	5	0
241-C-204	Assumed leaker	IS/IP	3	0.0	0	0	3	0

(a) IP = Intrusion Prevention; IS = Interim stabilized or isolated; and PI = Partially interim isolation.

Unlike some tank farms at the Hanford Site, WMA C is not near many liquid waste disposal sites. There are few facilities in the area that present potential complications for discerning tank-associated contaminant sources. For example, the 218-E-12B burial ground lies 75 ft (23 m) northwest of WMA C. The burial ground has been in operation since 1967 and has 48,000 cubic yards of solid waste containing 160,000 Ci of radionuclides and an unknown volume of hazardous materials (Last and Bjornstad 1989). Another facility is the 216-C-8 french drain, located about 75 ft (23 m) southeast of the 241-C Tank Farm. The drain is a 6-foot (1.8 m) diameter, 8-foot (2.4-m) long, gravel-filled concrete pipe placed vertically in the ground. It was used between June 1962 and June 1965 and received an unknown amount of ion-exchange regenerant waste from the 271-CR control house (DOE 1993a). The 241-C-301 catch tank is located in the north corner of the 241-C Tank Farm adjacent to the 241-C-112 tank. This catch tank is connected to the 241-C-151, 241-C-152, 241-C-153 and 241-C-252 diversion boxes and was used for waste transfers. The catch tank was constructed in 1946 and isolated at the surface in 1985. In 1993, the tank held 10,470 gal (39,600 L) of 207-A retention basin condensate (DOE 1993a). The 241-C-801 cesium loadout facility is located in the eastern corner of the tank farm. Operated between 1962 and 1976, it was used to pump supernate into trucks for transport to Oak Ridge, Tennessee for cesium recovery. Although all these facilities had the potential to impact groundwater during operations, it is unlikely that leaks from any of them would compromise the groundwater monitoring network at WMA C.

2.2 Facility Operational History

The Hanford Site, established in 1943, was originally operated to produce weapons-grade plutonium using production nuclear reactors and chemical processing plants. In March 1943, construction began on three reactor facilities (B, D, and F Reactors) and three chemical process facilities (B, T, and U plants). After 1945, six more reactors were built, the last being N Reactor (DOE/RL-92-04 1993). Most of the information in this section is from Agnew (1997), Anderson (1990), DOE/RL (1993a, 1993b, 1993c) and Kupfer et al. (1997).

Operations in the 200 Areas were centered on the separation of special nuclear materials from irradiated nuclear fuel. There were two main separation processing facilities located in the 200 East Area. The first is B Plant (221-B Building), which began operations in 1945, where plutonium and later certain fission products were separated from uranium. The other is the PUREX Plant (202-A Building), constructed between 1953 and 1955, where plutonium and uranium were extracted from N Reactor fuels (Kupfer et al. 1997; DOE/RL-92-04 1993). A third smaller facility known as Hot Semi-Works, or Strontium Semi-Works, was used as a pilot plant to test separations processes and new equipment designs. The plant was retired in 1967. Waste from all three processing plants was sent to the 241-C Tank Farm.

Between 1945 and 1952, the bismuth phosphate process (BPP) was used at B Plant to recover plutonium. The valence state of plutonium was adjusted to allow precipitation as plutonium phosphate, separating it from the bulk uranium and the other radioactive fission products. Thus, the resulting waste is termed "metals waste." This process was discontinued in 1952.

From 1952 to 1957, uranium was recovered from the metal waste at the U Plant in the 200 West Area using the solvent extraction method, tri-butyl phosphate (TBP). The U Plant process columns were the first production use of this technology for radionuclide separation. The waste from this process, termed uranium recovery (UR) waste, was routed back to the underground storage tanks.

To provide more storage space while minimizing the need for additional storage tanks, three scavenging processes were used to precipitate long-lived fission products from UR waste from U Plant, first cycle decontamination (1C) waste from the bismuth phosphate process and UR waste already stored in the tanks. Beginning in May 1955, UR waste in the 200 Area tanks was sent to the 244-CR Vault for in-farm scavenging of ^{137}Cs and ^{90}Sr. Once treated, the scavenged waste was routed primarily to tanks in the 241-C Tank Farm.

In 1968, B Plant was used for a second mission, recovering cesium and strontium fission products from the liquid wastes stored in the SSTs and from wastes produced by the PUREX process. This process was termed B Plant Waste Fractionization. Stored PUREX and reduction oxidation (REDOX) process waste supernatants were processed for ^{137}Cs and ^{90}Sr removal. In addition, the waste produced at PUREX during this time was processed for ^{90}Sr removal. Settled sludge solids in the 241-C SSTs were also sluiced and transferred to B Plant for ^{90}Sr removal. In 1974, work began on precipitating and encapsulating the recovered cesium and strontium. Cesium recovery operations in B Plant were completed in September 1983, while strontium recovery operations were completed in February 1985. Other than the capsule storage at the Waste Encapsulation and Storage Facility, the B Plant facility is inactive (DOE/RL-92-05 1993; WHC-MR-0132 1990; Kupfer et al. 1997).

Between waste fractionization campaigns, a solvent extraction process was used in B Plant to recover, concentrate and purify ^{90}Sr and rare earths from the acid waste being generated at PUREX. Various organics including tributyl phosphate (TBP) were used as extractants and as chelating agents. These organics were part of the solvent extraction system wastes and were the main source of the organics currently found in the Hanford waste tanks (Kupfer et al. 1997). The waste streams from this process were sent to the 241-C, 241-A, and 241-AX Tank Farms.

Used between 1956 and 1972, the PUREX process was an advanced solvent extraction technique adapting TBP in normal paraffin hydrocarbon for recovery of plutonium, uranium, and neptunium from nitric acid solutions of irradiated uranium. This process was utilized at the PUREX plant between 1956 and 1972, processing aluminum-clad fuels and after 1966, some Zircaloy-clad fuels (Kupfer et al. 1997). After 11 years in standby, the plant resumed operations in November 1983. Only Zircaloy-clad fuels were processed from 1983 to 1989. In 1966 and 1970, two thorium campaigns were run in the 202-A Building. The waste generated from these events was sent to the 241-C Tank Farm. Operations ceased at PUREX Plant in 1990, and a decision to shut down the facility was announced in December 1992.

Finally, in 1949, the Hot Semi-Works, also called C Plant, was constructed as a pilot plant for reprocessing reactor fuel. The plant first tested the REDOX process and then the PUREX process. In 1961, the plant was converted for strontium recovery from stored and processed waste. That process operated until 1967 when the facility was put into safe storage mode until it was decommissioned in 1983 (DOE 1993a, Deford 1992). All the waste from Hot Semi-Works was sent to the 241-C Tank Farm.

2.2.1 Past Tank Operations

Constructed in the mid 1940s, 241-C Tank Farm was one of two original tank farms to receive bismuth phosphate process waste from B Plant. Tanks 241-C-101 through 241-C-106 and the 200 series tanks at the farm received metal waste from about 1946 to 1955. First cycle decontamination waste was sent to tanks 241-C-107 through 241-C-112 (Anderson 1990). By the end of 1948, all 100 series tanks in the farm were filled with waste from the bismuth phosphate process.

In 1952 and 1953, metal wastes were sluiced from the SSTs in the 241-C Tank Farm and sent to U Plant for uranium extraction. All the 100 series tanks in the 241-C Tank Farm received the uranium recovery waste from the tributyl phosphate processing. Thus, each of the 100 series had some organic content by this time.

Beginning in May 1955 until December 1957, the 244-CR vault was used to mix ferrocyanide scavenging chemicals with uranium recovery waste to precipitate ^{137}Cs and ^{90}Sr. Uranium recovery waste already stored in other 200 East Area Tank Farms, was pumped to the vault for processing. Although scavenged waste from U Plant and T Plant was sent to tanks in 241-BY Tank Farm, only in-farm scavenged waste from the 200 East Area was sent to tanks in the 241-C Tank Farm. The primary settling tanks for in-farm scavenged waste were tanks 241-C-108, 241-C-109, 241-C-111, and 241-C-112. Used later as a receiving station, operations ceased at the vault in 1988.

The PUREX process, along with B Plant waste fractionization processes, produced the most complicated combination of wastes at the Hanford Site. Waste types included both "boiling" or high-level solvent extraction wastes and "non-boiling," or cladding wastes, organic wash wastes and cell drainage. Most of the organic wash waste along with the cladding wastes and cell drainage was routed to the non-boiling tanks in the 241-C farm for subsequent in-farm concentration. Although Kupfer et al. (1997) states that the PUREX high-level waste was routed to the 241-A and the 241-AX Tank Farms, Anderson (1990) lists that PUREX high-level wastes was also routed to the 241-C tanks. Processing at PUREX included aluminum clad uranium fuel, aluminum clad thoria fuel and Zircaloy®-clad N Reactor fuels. Although sodium carbonate organic wash wastes were initially sent with high-level waste to the 241-A and 241-AX Tank Farms, most were sent to non-boiling tanks at 241-C farm. Wastes generated from the 1966 and 1970 thorium campaigns run at PUREX to produce ^{233}U, were sent in total to tanks 241-C-102 and 241-C-104 (Agnew 1977). The first campaign produced 443,000 gal (1,676,700 L) while the second campaign produced 912,000 gal (3,452,000 L).

All the waste generated by processes run at the Hot Semi-Works were routed to the 241-C Tank Farm. These wastes were added to tanks 241-C-107, 241-C-108, 241-C-109, 241-C-111, and 241-C-112 between 1961 and 1969. Between 1955 and 1977, Hot Semi-Works waste was also sent to all four 200 series tanks.

Several other waste streams were routed to tanks in the 241-C Tank Farm. These include S Plant ion-exchange wastes, N reactor complexed waste, Battelle laboratory wastes, evaporator bottom concentrate from 241-B and 241-BX Tank Farms, S Plant supernate, low level and metal waste from 241-B Tank Farm, and Hanford laboratory operations waste (DOE 1993a). Anderson (1990) gives a detailed description of waste streams routed to each SSTs at the Hanford Site up to 1979. After 1979, information concerning SSTs operations can be found in the "living document," Hanlon (1999), which is published monthly to report tank status and the current month's tank farm operations. Appendix A of this document contains the current total waste inventory of hazardous and radioactive waste on a tank-by-tank basis. Inventories in Appendix A were estimated with the Hanford defined waste model (Agnew 1997). These data are used to form a complete list of site-specific contaminants for groundwater monitoring and for comparison with observed groundwater chemistry.

2.2.2 Tank Leaks and Unplanned Releases

It is difficult to determine the exact causes of tank failure. While there are several mechanisms suggested for failure, including stress, corrosion, cracking and mechanical tearing of the liner, the lack of direct inspection makes it impossible to accurately characterize specific failures. The 241-C Tank Farm contains seven tanks that are declared confirmed or assumed leakers. Table 2.2 lists those tanks and gives the volumes associated with each leak. The volume estimates do not include 1) cooling water and raw water leaks, 2) intrusions such as rain water and subsequent leaks, 3) leaks inside the tank farm that were not through a tank liner, and 4) leaks from catch tanks, diversion boxes, and encasements (Hanlon 1999). The leak volume estimates for tanks 241-C-101 (20,000 gal [75,700 L]), 241-C-111 (5,500 gal [20,800 L]), and 241-C-203 (400 gal [1,500 L]) are based on observed liquid level decreases in those tanks. Hanlon (1999) states this method is the most accurate for leak volume estimation. All of the tanks in WMA C that are confirmed or assumed leakers are interim stabilized. The total amount of liquid leaked from 241-C Tank Farm tanks is estimated at 29,250 gal (110,700 L).

In fiscal year 1998 spectral gamma-ray logging was performed at the drywells in the 241-C Tank Farm (GJO-98-39-TAR, GJO-HAN-18). Figure 2.5 is a map of drywell locations at the farm. The gamma-ray data results were mapped to delineate the distribution of contamination in the vadose zone. These distributions were then associated with leaks from tanks and pipelines. Leakage of radionuclides from tanks 241-C-101 and 241-C-110 into the surrounding sediments as corroborated, though the amount of contamination around tank 241-C-110 is not great. There is no indication in the spectral gamma data, or in historical gross gamma data, to indicate that tank 241-C-111 leaked (GJO-98-39-TAR, GJO-HAN-18). Figure 2.6 shows selected spectral gamma-ray logs from 241-C Tank Farm drywells.

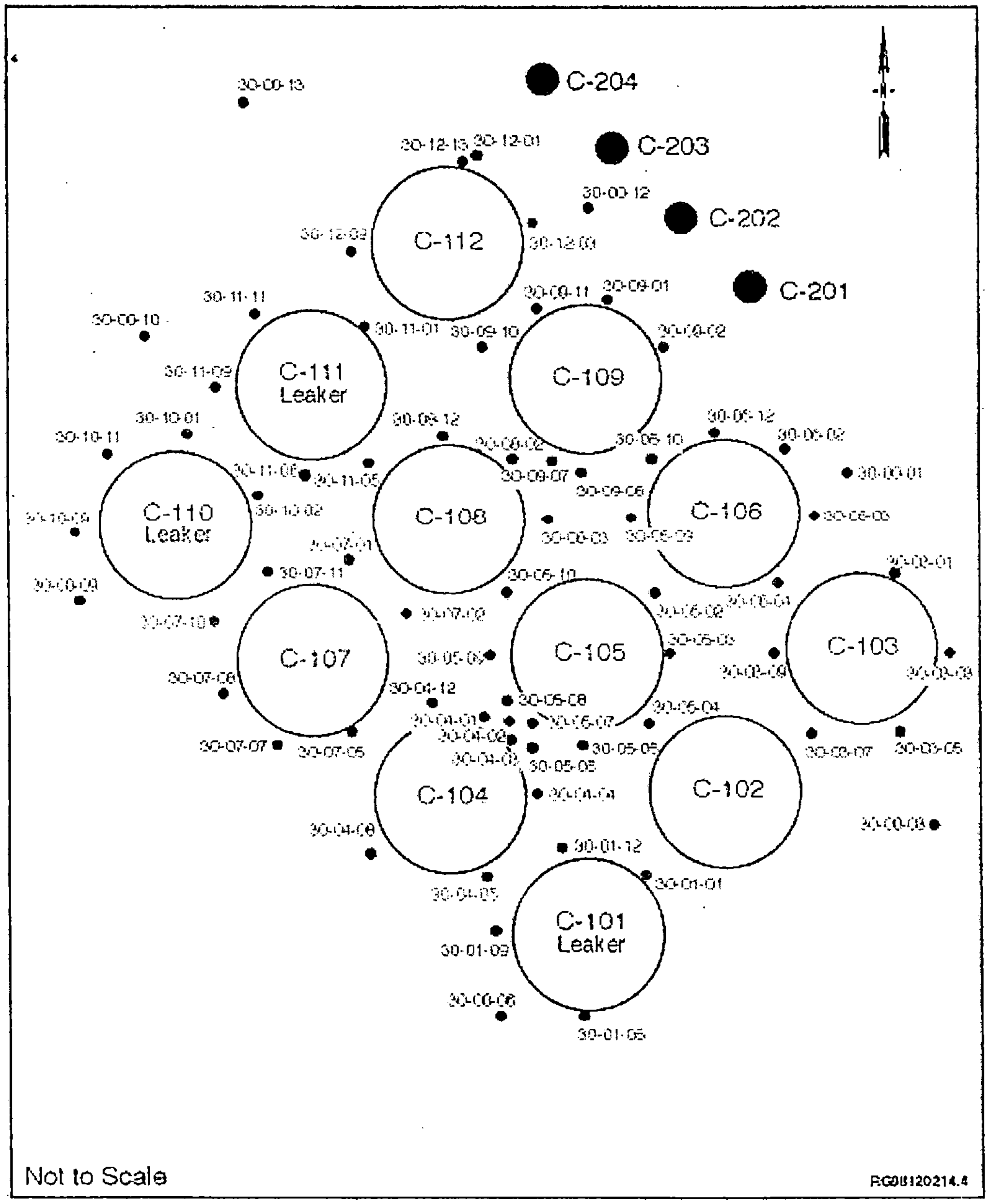


Figure 2.5. Map of the 241-C Tank Farm Showing Locations of the Drywells Used for Leak Detection

The best indication that tank 241-C-101 leaked is found in boreholes 30-10-06 and -09 where significant ^{137}Cs, close to 600 pCi/g, is found at or slightly above the base of the tank. The borehole logs show that contamination associated with tanks 241-C-110 and 241-C-111 is much less significant than contamination found elsewhere in the tank farm. The greatest activity in the area is in borehole 30-10-02, located between the two tanks. Contamination in borehole 30-08-12 is associated with either tank 241-C-108 or tank 241-C-110 (GJO-98-39-TAR, GJO-HAN-18).

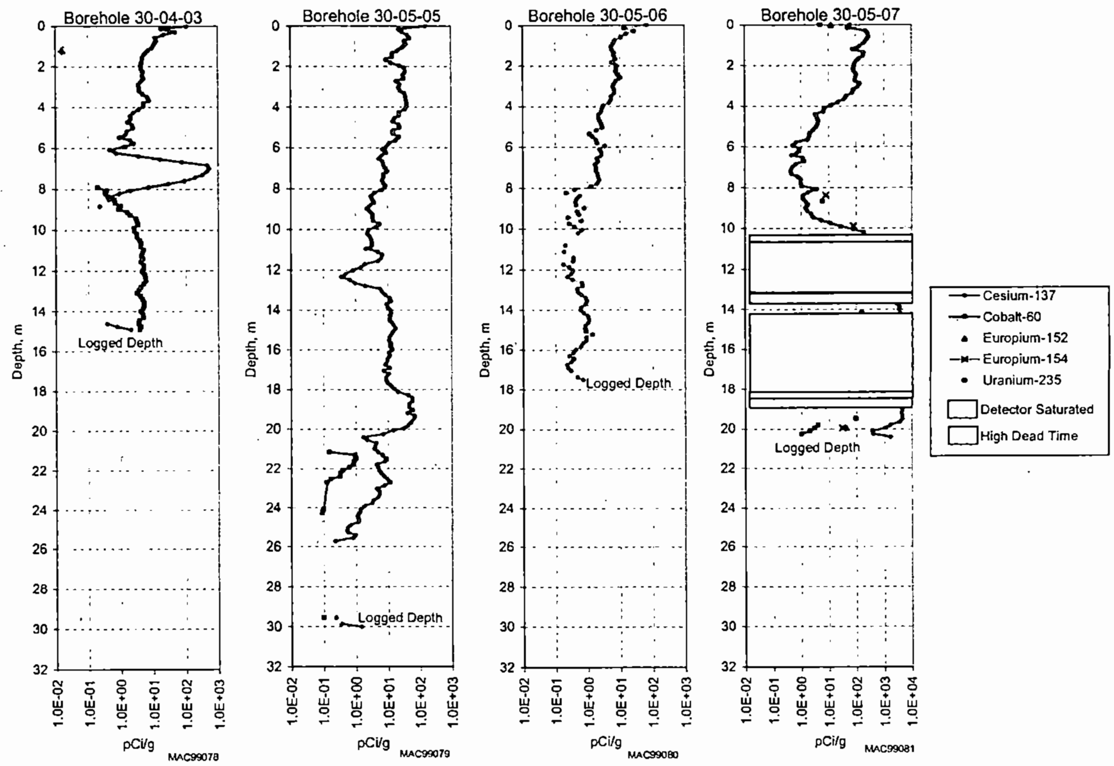


Figure 2.6. Representative Spectral Gamma-Ray Logs from 241-C Tank Farm

Two areas in the 241-C Tank Farm show greater contamination than that associated with the assumed leakers. Several boreholes between tanks 241-C-104 and 241-C -105 exhibit over 10 pCi/g ^{137}Cs between 40 and 60 ft (~12 and 18 m) below the surface. The highest activity of 500 pCi/g is found in borehole 30-04-03 at a shallower depth near 24 ft (7.3 m). Borehole 30-05-07 has the greatest ^{137}Cs activity, but detector saturation, or excessive dead time obscured the results. Low levels of ^{60}Co are associated with ^{137}Cs in six of the boreholes between tanks 241-C-104 and 241-C-105. This area of contamination has been linked to a series of cascade line leaks between the two tanks (GJO-98-39-TAR, GJO-HAN-18). Contamination in this area appears localized and does not show up in all boreholes.

A second area of contamination exists between tanks 241-C-108 and 241-C-109. Levels of contamination are less than the area around tanks 241-C-104 and 105. Data from borehole 30-08-02 has the greatest activity. Except for borehole 30-08-02, contamination that is not associated with surface sources is low with 1 pCi/g ^{60}Co and $\leq$10 pCi/g ^{137}Cs. The only ^{154}Eu contamination found in the 241-C Tank Farm occurs in this area at 2 to 3 pCi/g coincident with the ^{137}Cs maximum. The source for contamination in this area cannot be positively identified. The logging at 241-C Tank Farm showed evidence of surface and near-surface contamination from spills and pipeline leaks. Most of the surface contamination is ^{137}Cs but other radioisotopes observed include ^{60}Co and ^{154}Eu.

In addition to tank leaks, fourteen unplanned releases occurred within or adjacent to the 241-C Tank Farm (GJO-98-39-TAR, GJO-HAN-18, and DOE 1993a). The locations of the unplanned releases are shown on Figure 1.2. The following brief descriptions of the unplanned releases are summarized from GJO-98-39-TAR, GJO-HAN-18 and DOE (1993a).

- Unplanned release UN-200-E-16 is a surface spill that resulted from a leak in an overground transfer pipeline between tanks 241-C-105 and 241-C-108. The surface spill associated with this release is located approximately 60 ft (18 m) northeast of tank 241-C-105 and occurred in 1959. The spilled liquid was classified as coating waste from the PUREX process.

- Unplanned release UN-200-E-27 is located just east of the 244-CR vault and extends easterly beyond the tank farm fence line. DOE (1993a) indicates the surface contamination was deposited in 1960, but does not specify the source or potential sources of the contamination.

- Unplanned release UN-200-E-68 was wind-borne surface contamination spread from the 241-C-151 diversion box. The release occurred in 1985 and was subsequently decontaminated or covered with clean sediment.

- Unplanned release UN-200-E-72 is located south of the 241-C Tank Farm and occurred in 1985. The source of the contamination was buried contaminated waste. The waste posed little release potential because the contamination was fixed in place. The source of contamination was stabilized and the area posted as a radiologically controlled area. The volume of the contamination was not specified.

- Unplanned release UN-200-E-81 is located near the 244-CR vault. It occurred as a result of a leak in an underground transfer pipeline in October 1969. The waste leaked from the pipeline consisted of PUREX coating waste. The site was covered with gravel.

- Unplanned release UN-200-E-82 is located between 241-C-152 diversion box and tank 241-C-105 and was the result of a leak from an underground pipeline from the 202-A building to the 241-C-102 tank by way of the 241-CR-151 diversion box. The release occurred in December 1969. The leak spilled an unknown volume of waste. The contaminated site was covered with clean gravel.

- Unplanned release UN-200-E-86 was a spill that resulted from a leak in a pipeline used to transfer waste from the 244-AR vault to the 241-C Tank Farm. The release was approximately 8 ft (2.4 m) below the ground surface. It occurred in March 1971 and is located just outside the west corner of the tank farm. The spill consisted of 25,000 Ci of ^{137}Cs. The sediments surrounding the pipeline were sampled and it was determined the contamination had not penetrated below 20 ft. The contamination plume volume was estimated at 1,300 cubic feet.

- Unplanned release UN-200-E-91 is located approximately 100 ft from the northeast side of the tank farm. It resulted from surface contamination that migrated from the 241-C Tank Farm. The date of the occurrence, its areal extent, and the nature of the contamination are not specified. DOE (1993a) states that the contaminated sediment was removed and the area was released from radiological controls.

- Unplanned release UN-200-E-99 was surface contamination that resulted from numerous piping changes associated with the 244-CR vault. It is located west of the 244-CR vault and was established as a release site in 1980 although the actual occurrence date is unknown. The site was decontaminated in 1981.

- Unplanned release UN-200-E-100 was a surface spill of unknown proportions and constituents that occurred in 1986. It is located about 200 ft (60 m) south and east of the 241-C Tank Farm and surrounds the 244-A lift station.

- Unplanned release UN-200-E-107 was a surface spill located north of the 244-CR vault, inside the 241-C Tank Farm. DOE (1993a) states that a spill occurred on November 26, 1952 when a pump discharged liquid to the ground surface during a pump installation. The spilled waste was tributyl phosphate waste from 221-U building. The proportions of the spill and any cleanup actions were not documented.

- Unplanned release UN-200-E-118 was located in the northeast portion of the tank farm and extends north up to about 300 m beyond the fence line It was the result of an airborne release from tank 241-C-107 that occurred in April 1957. The highest exposure rate was estimated at 50 millirem/hour at the ground surface (DOE 1993a).

- Unplanned release UPR-200-E-136 was a release of 17,000 to 24,000 gal (64,345 to 90,840 L) of waste from tank 241-C-101. Two thousand curies were released between 1946 and 1970 (DOE 1993a).

- Unplanned release UPR-200-E-137 occurred when natural water entered tank 241-C-203, migrated through the salt cake, and either became entrained in the salt cake or leaked out of the tank. The leak was 400 gal (1,514 L) of PUREX high-level waste.

Although the volumes associated with most of the releases are small, they have produced pods of vadose zone contamination. These discrete zones of contamination in the soil horizon could be remobilized in the future if exposed to migrating fluids such as water from ruptured or leaking lines at the surface.

2.2.3 Recent Activity

Of the 16 SSTs at the 241-C Tank Farm, nine tanks are currently classified as sound and seven tanks are classified as assumed leakers. Intrusion prevention has been completed in all 16 tanks. Thirteen tanks are interim stabilized and three are partially interim isolated. Definitions of intrusion prevention, interim stabilized, and partially interim isolated can be found in Section 2.1.

Two tanks in the 241-C Tank Farm are currently on the Organics Watch List. Tanks on the Organic Watch List contain greater than 3 wt % organic carbon (GJO-98-39-TAR, GJO-HAN-18). Tanks 241-C-102 and 241-C-103 were put on the Organics Watch List in May 1994 and January 1991 respectively. Although, tanks 241-C-108, 241-C-109, 241-C-111, and 241-C-112 were on the Ferrocyanide Watch List, they were removed in June 1996.

The major activity currently performed at the SSTs is treatment of the mixed waste in the tanks. Treatment occurs when solids and interstitial liquids are separated and/or cooling liquids are added. These treatment processes generally employ mechanical retrieval, sluicing, and saltwell pumping of the mixed waste, each involving the transfer of waste. The entire SST system has a process design limit of 600,000 gal (2,271,000 L) per day based on the simultaneous pumping of two SSTs in a 24-hour period. Ancillary equipment used for the transfer of liquid mixed waste consists of: 1) centrifugal pumps capable of pumping liquid mixed waste at 400 gal (1,500 L) per minute, 2) induction pumps capable of pumping liquid waste from the salt wells at 5 gal (19 L) per minute, and 3) associated valves and piping to the DST system.

Because tank 241-C-106 was the highest heat-generating SST, it was chosen as the first SST for sluicing operations to remove waste for further storage in the DST system, pending final processing. Prior to the official start date in November 1998, a new underground pipeline was constructed to transport the sluiced waste to tank 241-AY-102, next to the 241-AX Tank Farm (Hanlon 1999). Several attempts to begin sluicing occurred earlier in the fall of 1998, but problems occurred with the pump. Shortly after waste removal finally began, sluicing was shut down for evaluation of stack gaseous emissions. By December 1998, a process test was conducted but aborted early due to a jumper leak in the tank 241-C-106 sluice pit. Sluicing operations continued to be shut down through the rest of December 1998 and January 1999. A high pressure test of the sluice line was conducted in February 1999, using about 3,000 gal (11,350 L) of flush water. The tank was actively sluiced after this time. By September 1999, sluicing of tank 241-C-106 was considered complete. Hanlon, however, reports in October 1999 that 0.14 inch of additional sludge was removed. The October 1998 inventory for tank 241-C-106 was listed as 229,000 gal (867,000 L) with 197,000 gal (746,000 L) of sludge. The goal of sluicing was sludge removal. In December 1999, the total waste was reported as 54,000 gal (204,000 L) or a total reduction of 175,000 gal (662,000 L). The final sludge is listed as 6,000 gal (22,700 L) or a decrease of 191,000 gal (723,000 L) of sludge (Hanlon 1999). Tank 241-C-106 was taken off the High Heat Load Watch List in December 1999.

Leak detection is an on-going activity in all tank farms. Monitoring the liquid levels within the tanks, taking into account liquid evaporation and known liquid increases is the primary method of ascertaining the integrity of WMA C SSTs. This method is capable of detecting a leak of 8,000 gal (30,300 L) or more. Liquid level monitoring is accomplished by manually lowering a tape, or by detecting variations in the weight of a device suspended in the tank waste. Only tanks 241-C-103, 241-C-106, 241-C-107, and 241-C-110 are monitored. Monitoring the surface levels of other tanks in the 241-C Tank Farm is not required because they contain less than 2 ft (0.6 m) of liquid and are interim stabilized (Hanlon 1999).

Prior to 1994, a secondary method of leak detection around the SSTs was the use of gross gamma logs from adjacent dry wells located around each 100 series tank. These drywells extend to depths of 100 to 150 ft (30 m to 46 m). Newly acquired data were compared to previous logs to determine if leaks occurred and to ascertain whether subsurface contamination had moved. Unfortunately, this method is limited to detection of only the gamma emitting waste in proximity of the boreholes and excludes detection of the mobile beta emitting radionuclides like ^{99}Tc. The region between boreholes, under the tanks and from the bottom of the drywells to the aquifer is not covered by this method. The most recent monitoring at WMA C was initial spectral gamma-ray monitoring of each dry well to produce a baseline for future spectral gamma-ray logging (GJO-98-39-TAR, GJO-HAN-18). Also, the drywells associated with tank 241-C-106 were monitored monthly during the recent sluicing activities. That monitoring did not detect an impact on the vadose zone from sluicing operations.

Because of the advanced age of the SSTs, the pumpable liquid is currently being removed from the tanks and stored in the DSTs as part of the interim stabilization project. For a summary of stabilization pumping at WMA C, see Table 2.3. Most of the pumpable liquid has been removed from these tanks with the exception of 241-C-103 (83,000 gal [314,000 L]) and 241-C-106 (42,000 gal [137,800 L]). A decision will be made by December 30, 2000 to remove the organic layer and pumpable liquids from tank 241-C-103 together or separately. A deadline for initiating pumping will be established at that time (Hanlon 2000).

2.3 Waste Characteristics

To assure that the groundwater monitoring approach at WMA C provides a complete constituent list for sample analysis, especially in the event the site is placed in assessment, it is necessary to study pertinent waste types and identify key elements in the wastes. The following discussion provides information on the chemical and radioactive species derived from the processes run at B Plant, U Plant, PUREX, and Hot Semi-Works and cataloged for each tank in Appendix A.

Information on the chemical species in the waste streams sent to tanks in WMA C is taken from Agnew (1997), Anderson (1990), and Kupfer (1997). Although Hanlon (1999) reports the general chemistry of the last waste received by the SSTs, it is necessary to consider all the waste types stored in the tanks since residual vadose zone plumes from past tank associated leaks can act as sources for groundwater contamination (Johnson and Chou 1998; Hodges 1998; Narbutovskih 1998). The most current tank-by-tank waste inventory can be found in the best-basis inventory developed as part of the Standard Inventory task and maintained by the River Protection Project (Kupfer et al. 1997). This inventory includes not only estimates based on models of the chemical processes used for plutonium/ uranium extraction but also the analytical data of waste samples taken directly from specific tanks. Direct tank sampling and analysis is an ongoing project, and the database is currently being compiled. This waste characterization information is used in Section 4.0 to determine the main constituent list for chemical analyses of groundwater monitoring at WMA C.

The chemistry of waste routed to tanks in the 241-C Tank Farm is discussed with respect to the primary related processes. The pertinent processes are:

- bismuth phosphate process
- uranium recovery process
- in-farm $^{137}Cs/^{90}Sr$ ferrocyanide scavenging

- PUREX primary process
- PUREX organic wash waste
- B Plant fractionization process.

The combination of the various chemical processes used to concentrate nuclear material has produced a complicated combination of wastes at the 241-C Tank Farm (Agnew 1997). From the PUREX campaign, Agnew identified twenty-one distinct waste types. These wastes take one of three general forms: sludge, salt cake, or liquid. Different salts precipitated over time as water evaporated from the waste producing the salt cake found in the tanks today. The sludge consists of partial solids such as hydrous metal oxides that precipitated from the neutralized high-level acid wastes. Liquids exist as supernatants or as interstitial liquid leaving a stratified structure of salt, sludge, and liquid within the tanks.

The 241-C Tank Farm received waste initially from B Plant in 1946, which was running the $BiPO_4$ process. After neutralizing the waste to an alkaline pH to reduce corrosion of the carbon steel tank liners, the buffered waste streams were sent to underground storage tanks. This farm had a system of cascading tanks where the dissolved metal salts in the alkaline waste precipitated. The solids were allowed to settle primarily as hydroxides or hydrated oxides thus removing chemicals and radionuclides from the supernatant as it progressed through the cascade system. Thus, the final liquid in the last tank in the cascade was lower in activity than the original waste. This liquid was sent to cribs for disposal to the ground. The original waste sent to C-Farm tanks consisted of coating waste containing dissolved aluminum cladding, metal waste containing uranium and about 90% of the fission products, and first decontamination cycle waste with about 90% of the remaining fission products.

These liquids were later used as feed for the uranium recovery process. Process vaults with stainless steel tanks were constructed near each tank farm while sluice pump pits were added to each tank containing metal waste. The sluiced solids containing the uranium were dissolved in nitric acid, and the resulting slurry was routed to U Plant. The solvent extraction method used an organic phase of tri-butyl phosphate (TBP) as the extractant. The solvent was cleaned and recycled while the recovered uranium nitrate was concentrated then dinitrated to UO_3. The plutonium valence in the solvent extraction feed stream was adjusted to keep the plutonium in the waste. The uranium recovery waste was sent back to the storage tanks. It consisted of the solvent extraction waste (concentrated in U Plant under certain conditions), and the solvent wash waste. The waste was neutralized before transfer to the tank farms. This uranium recovery waste contained all the components of the metal waste without the carbonate and with only 1 to 2 percent of the uranium. Additions to the waste consisted primarily of nitrate (added as nitric acid to dissolve the original solids), iron (added as a plutonium reductant), sulfate (from the iron and as sodium sulfate in the solvent cleanup wash), and sodium (from sodium carbonate and sodium sulfate solvent washes plus sodium hydroxide used to neutralize the waste).

The next process important to understanding the tank chemistry at WMA C is ferrocyanide waste scavenging developed during the 1950s to provide additional waste storage space and to reduce the need to construct additional waste tanks. For the 241-C Farm, this process is called in-farm ferrocyanide scavenging. Long-lived fission products, ^{137}Cs and ^{90}Sr, were precipitated so that the resulting supernatants could be disposed to the ground thereby reducing the volume of stored waste. Aqueous waste was pumped to the 244-CR vault where the pH was adjusted and potassium ferrocyanide and nickel sulfate were added as precipitating agents. Later sodium ferrocyanide was used in place of potassium ferrocyanide. If liquids contained significant ^{90}Sr, calcium nitrate was added to precipitate calcium phosphate. At times, nonradioactive strontium nitrate was used in place of calcium. After stirring to mix, the treated waste was sent to receiving tanks to wait for the precipitate containing the scavenged ^{137}Cs and ^{90}Sr to settle. The supernatant was then discharged to cribs. These scavenging processes left the waste high in ferrocyanide, ^{137}Cs, and ^{90}Sr, potassium, nickel, and calcium in addition to components left from the previous processes.

Although it is not completely clear, Anderson (1990) records that some tanks at WMA C began receiving both coating waste and acid waste from the PUREX Plant in 1963. The principal constituents in the waste are sodium, nitrate, nitrite, sulfate, phosphate, aluminum, and iron. The TBP used in the PUREX process was broken down to CO_2, and H_2 gas. The principal radioactive nuclides in order of decreasing concentrations are ^{90}Sr, ^{137}Cs, ^{99}Tc, and ^{60}Co. Although $^{239,240}Pu$, ^{241}Am, and ^{137}Np are detectable, it is unlikely that either is sufficiently soluble to be found in the groundwater. There is very little ^{129}I in the tank wastes. Iodine tends to be volatile during generation in the reactor and, like tritium, migrates to the outer regions of the fuel rod. Any ^{129}I left in the reactor fuel would have been removed along with the tritium, which was disposed to cribs.

The organic solvent used in PUREX was treated with potassium permanganate and sodium carbonate followed by dilute nitric acid. The resulting organic wash waste (OWW) was eventually combined and sent to the self-boiling tanks until 1969. The main constituents in OWW were sodium, lead, nitrate, potassium, and manganese. All the waste from the two thorium campaigns were routed to tank 241-C-104. This included the equipment flush waste. The only new compound added to the waste stream was potassium fluoride.

Kupfer (1997) states that waste from the pilot plant known as Hot Semi-Works, was routed exclusively to the 241-C Tank Farm. The waste streams that originated from this facility were relatively high in ^{90}Sr activity. As a result, for many tanks at the WMA, the activity of ^{90}Sr is significantly greater than any other radionuclides. Based on analyses of waste samples, other important constituents are the metals Na, Ca, Al, Ba, K, U, Fe, Si, Pb, Ni, and Mn.

The waste streams added last to the tanks during the ^{137}Cs and ^{90}Sr fractionization processes caused the total tank waste to be extremely complicated chemically. The Phosphotungstic Acid Process (PTA), one method used for the recovery of ^{137}Cs, left minor amounts of tungsten and phosphate in the wastes. Zeolites were used as resins in another ^{137}Cs recovery process. For the final ^{90}Sr extraction process, several water-soluble organics were used as chelating agents to remove divalent metals such as iron from solution. These organics were ethylenediamine tetra acetic acid (EDTA) and N (2-hydroxyethyl) ethylenediamine tetra acetate (HEDTA) or citrate. Di (2-ethylhexyl) phosphoric acid (D2EHPA) and TBP was used as extractants. Approximately 20% of the ^{90}Sr was left in the waste and returned to the tanks. These organics are the complexents added to the tanks in 1978 and 1979. Although this leaves

241-C tank wastes high in organics, it appears the waste organics are primarily in solid form. The site-specific parameters found in Section 4.4 are based on the chemical species identified in the above discussion.

2.4 Geology

This section describes the geology beneath the SST WMA C. It contains a revision of the description given in Caggiano and Goodwin (1991). The geologic interpretation provides an understanding of the local subsurface. This information will assist decisions concerning well location and construction if new wells are added to the network. This interpretation is also used to evaluate flow properties, interpret the groundwater chemistry, and evaluate the network over time. In addition, the results of this revision are used to construct the conceptual model for WMA C presented in the next section.

This geologic description is based on the most recent interpretations of the stratigraphy beneath the 200 East Area near the WMA C, interpretations of gross gamma-ray and neutron moisture logs not included by Caggiano and Goodwin (1991), and on the results of past investigations. Archived soil samples were re-evaluated to confirm the interpretations of areas left ambiguous after inspecting the geology or drillers logs. Results were compared to regional studies to assure coherence within the larger framework of stratigraphic interpretations of the Hanford Site.

Aquifer properties were determined from the stratigraphic interpretations, previous aquifer tests, local water level measurements and the regional groundwater table provided in the annual groundwater monitoring report (Hartman 1999).

2.4.1 General Stratigraphy

The regional geologic setting of the Pasco Basin and the Hanford Site has been described previously by Delaney et al. (1991) and DOE (1988). Tallman et al. (1979) and more recently Lindsey et al. (1992) described the geology of the 200 East Area. The geology specific to WMA C was first described by Price and Fecht (1976) and then by Caggiano and Goodwin (1991). Most recently the WMA C geology was summarized by Lindsey (in Narbutovskih et al. 1996) and by Lindsey and Reynolds (in Jones et al. 1998). This update is based on previous work amended with gross gamma-ray and neutron moisture logs, re-evaluated drill cuttings, and laboratory moisture and particle size distribution data.

In summary, the geology of the 200 East Area consists of the Elephant Mountain Member of the Saddle Mountains Basalt Formation, Columbia River Basalt Group overlain by the Ringold Formation and the Hanford formation. The Elephant Mountain Member of the Saddle Mountains Basalt Formation is a medium to fine-grained tholeiitic basalt with abundant microphenocrysts of plagioclase (DOE 1988). The Elephant Mountain Member has been dated by K/Ar methods to be about 10.5 Ma (McKee et al. 1977) and consists of two flows beneath the 200 East Area.

The Ringold Formation consists of fluvial and lacustrine sediments deposited by the ancestral Columbia and Clearwater-Salmon river systems between about 3.4 and 8.5 Ma. Lindsey (1996) described the Ringold Formation in terms of three informal members: 1) Wooded Island, 2) Taylor Flat, and 3) Savage Island. Of these, only the member of Wooded Island is present beneath the 200 East Area. This member consists of five separate units dominated by fluvial gravels. The gravels are designated from bottom to top as units A, B/D, C, and E and are separated by fine-grained deposits typical of overbank and lacustrine environments. The lowermost of the fine-grained sequences is designated the lower mud unit. Only gravel units A and E are present beneath the 200 East Area and the Ringold Formation is absent beneath the north and northeast parts of the 200 East Area (Lindsey et al. 1992).

The Ringold Formation gravels are clast- and matrix-supported, pebble to cobble conglomerates with a fine to coarse sand matrix (Lindsey 1996). The most common lithologies are basalt, quartzite and intermediate to felsic volcanics. Interbedded lenses of silt and sand are common. Cemented zones within the conglomerates are discontinuous and of variable thickness. In outcrop, the conglomerates are massive, planer bedded, or cross-bedded. In several places, reworked Ringold sediments occur above the Ringold Formation. If these sediments were laid down by fluvial and eolian processes prior to ice-age flooding, they are a Plio-Pleistocene unit. Elsewhere, these deposits may be called pre-Missoula gravels (PSPL 1982). If these reworked sediments are attributed to Pleistocene floods, then the reworked Ringold sediments are part of the lower Hanford formation gravels.

The Hanford formation overlies the Ringold Formation and/or the Plio-Pleistocene unit. This formation consists of glaciofluvial sediments deposited by cataclysmic floods from glacial Lake Missoula, pluvial Lake Bonneville, and other ice-margin lakes. The sediments in this formation resulted from at least four major glacial events and were deposited between 1 Ma and 13 Ka. The Hanford formation consists of pebble to boulder gravel, fine- to coarse-grained sand and silt. These deposits are divided into three facies: 1) gravel-dominated facies, 2) sand-dominated facies, and 3) silt-dominated facies. These same facies are referred to as coarse-grained deposits, plane-laminated sand facies, and rhythmite facies, respectively in Baker et al. (1991). The Hanford formation is present throughout the Hanford Site and is up to 213 ft (65 m) thick (Delaney et al. 1991).

1) GRAVEL-DOMINATED FACIES. This facies generally consists of very poorly sorted coarse-grained basaltic sand and granule to boulder gravel. These deposits display an open framework texture, massive bedding, plane to low-angle bedding, and large-scale planar cross bedding in outcrop. Comparatively thin, fining-upward sand and silt beds occur between some gravel beds. Gravel clasts are dominantly basalt with lesser amounts of Ringold Formation clasts, granite, quartzite, and gneiss (Lindsey et al. 1992). The gravel-dominated facies was deposited by high-energy floodwaters in or immediately adjacent to the main cataclysmic flood channelways.

2) SAND-DOMINATED FACIES. This facies consists of fine- to coarse-grained sand and granule gravel. The sands typically have a high basalt content and are commonly referred to as black, gray, or salt-and-pepper sands (Lindsey et al. 1992). Individual beds, ranging from about one meter to several meters in thickness, typically contain pebble to granule gravel at their base and plane-laminated sand through the main portion of the bed. The plane-laminated sand may grade upward into a thinner sequence of fine sand or silt at the top. The silt content of the sands is variable, but

where it is low a well-sorted and open framework texture is common. In outcrop, this facies commonly displays plane lamination and bedding and less commonly channel-fill sequences (Lindsey et al. 1992). The sand-dominated facies was deposited adjacent to main flood channelways during the waning stages of flooding. The facies is transitional between the gravel-dominated facies and the silt-dominated facies.

3) SILT-DOMINATED FACIES. This facies consists of rhymically bedded, plane laminated and ripple cross-laminated silt and fine- to coarse-grained sand. Beds are typically a few centimeters to several tens of centimeters thick and commonly display normally graded-bedding (Lindsey et al. 1992). Sediments of this facies were deposited under slackwater conditions along the margins of flooded valleys and in back-flooded areas (DOE 1988).

2.4.2 Site-Specific Stratigraphy

The locations of all groundwater wells used in this study is shown in Figure 2.7. A generalized stratigraphic column for WMA C is provided in Figure 2.8. The quality of data obtained from the wells

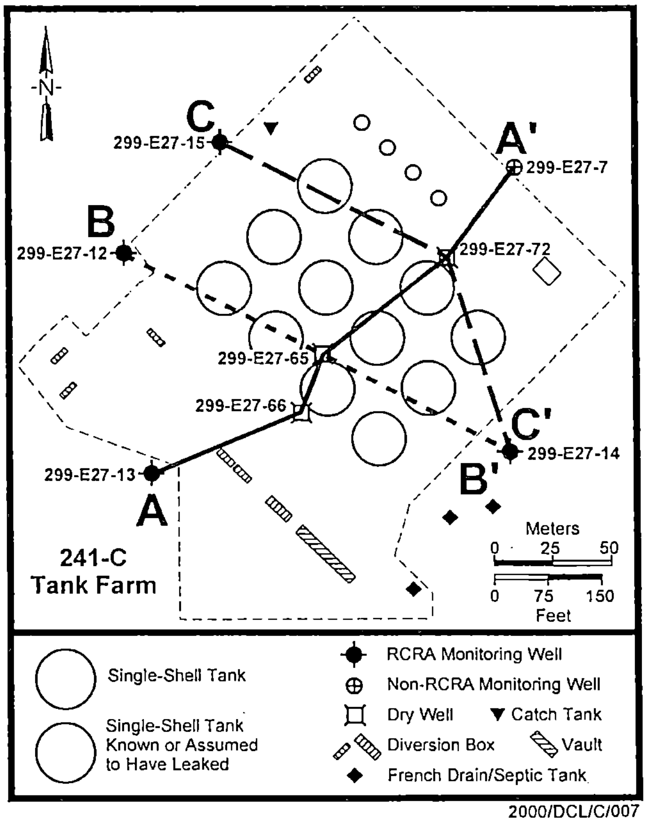


Figure 2.7. Location Map of Wells and Cross Sections Used to Delineate the Subsurface Geology Beneath WMA C

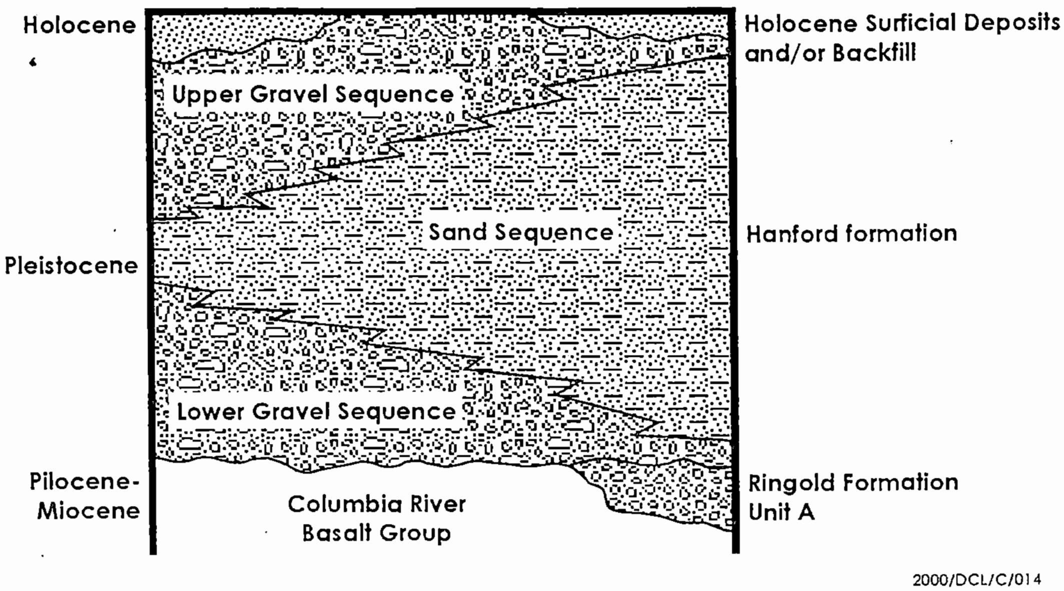


Figure 2.8. Generalized Stratigraphic Column for the WMA C Area

varies and is a function of when the well was drilled, the drilling methods, and the well's purpose. Table 2.4 summarizes pertinent stratigraphic information from the boreholes. Data from RCRA boreholes 299-E27-12, 299-E27-13, 299-E27-14, and 299-E27-15 are more useful than data from the other boreholes listed in Table 2.4 because standardized logging techniques were applied by a trained geologist. All of the boreholes used by Caggiano and Goodwin (1991) are included in Table 2.4 and used in this interpretation.

Table 2.4. Stratigraphic Data for WMA C

Borehole	Surface Elevation (ft)	Total Depth (ft)	Thickness of the Hanford Formation Upper Gravel Sequence	Elevation of the Top of the Hanford Formation Sand Sequence	Thickness of the Hanford Formation Sand Sequence	Elevation of the Top of the Hanford Formation Lower Gravel Sequence
299-E27-7	633.32	281		593	170	423
299-E27-12	657.64	270	35	623	190	433
299-E27-13	666.02	279.9	40	626	198	428
299-E27-14	655.34	266.8	45	610	185	425
299-E27-15	649.83	262.5	20	630	210	420
299-E27-65	~646	135				
299-E27-66	~646	145				
299-E27-67	~646	135				
299-E27-72	~646	125				

Geologic interpretations were made from the well-site geologist's (or driller's) logs and, if necessary, comparing the logs to selected, archived samples at the Hanford Geotechnical Sample Library. The logs were then modified and refined based on the archived samples. This was particularly necessary where only older driller's logs were available. Geophysical logs and laboratory moisture data were then compared with the lithologic logs. In some cases, geophysical logs (e.g., gross gamma-ray) allowed refinement of the data by permitting better placement of geologic contacts.

Plates 1 through 3 show cross-sections adjacent to and through WMA C. The locations of cross-sections were chosen to illustrate the geology beneath WMA C in both northeast-southwest and northwest-southeast directions. The geology beneath WMA C consists of basalt basement overlain by four sedimentary sequences distinguished by texture or particle size and stratigraphic position. These sequences are:

- Hanford formation lower gravel sequence and/or Plio-Pleistocene gravels (reworked Ringold Formation Unit A)
- Hanford formation sand sequence
- Hanford formation upper gravel sequence
- Holocene eolian sediments and/or backfill material.

The Elephant Mountain Member of the Saddle Mountains Basalt Formation is the base of the unconfined aquifer in the area. The Elephant Mountain Member was not encountered in any boreholes in the WMA C Area. Based on driller's logs from nearby deep wells 299-E26-8 and 299-E27-3, the elevation of the top of the Elephant Mountain Member is at about 355 ft (108 m) at WMA C (Caggiano and Goodwin 1991). The Elephant Mountain Member dips gently to the south into the Cold Creek syncline.

The Hanford formation lower gravel sequence overlies the Elephant Mountain Member beneath WMA C. This sequence is described on borehole logs of cuttings and samples from the WMA C Area as cobble to pebble gravels, sandy gravels and gravelly sands with lesser amounts of silty sandy gravel and sand. The gravels are subangular to well rounded and generally uncemented, although some local calcium carbonate consolidation is present. The composition of the gravels varies from borehole to borehole and ranges from 85% basaltic and 15% felsic to about 20% basaltic and 80% felsic.

Based on observations of outcrop and intact core, the lower gravel sequence sediments are interpreted to be the high-energy, gravel-dominated facies of the Hanford formation. This facies is typically open framework or matrix supported, granule to boulder gravel with massive bedding, plane to low-angle bedding, and cross-bedding in outcrop. Lenticular and discontinuous units of sand-dominated facies are interbedded in the gravel-dominated facies. The Hanford formation lower gravel sequence was deposited by high-energy, cataclysmic, Pleistocene floods.

The upper 2 to 5 ft (0.6 to 1.5 m) of the Hanford lower gravel sequence is described on borehole logs as muddy to slightly muddy sandy gravel in the south and west portions of WMA C. This lithology is absent in the east and north part of the WMA (see Plates 1 through 3). The top of the Hanford formation lower gravel sequence was picked at the top of this muddy sandy gravel where it is present. Elsewhere, the top of the Hanford formation lower gravel sequence was picked at the base of a 30 ft (>9 m) thick sand sequence overlying the lower gravel sequence.

Caggiano and Goodwin (1991) interpret a 20 ft (6 m) gravelly muddy sand directly overlying basalt as part of the middle Ringold Formation from data extrapolated from outside the area. This depth was penetrated in only one borehole in the area (299-E27-7) and the sediments at that depth may represent Ringold Formation Unit A gravels or post-Ringold fluvial reworking of Ringold Unit A gravels.

The age of this lower gravel sequence is currently under dispute. Lindsey and Reynolds (1998) consider this sequence to represent the Ringold Formation Unit A gravels and part of the overlying lower mud unit. Williams et al. (2000) considers these same sediments as Hanford formation gravel-dominated facies. In the eastern half of WMA C in boreholes 299-E27-14 and 299-E27-7, the gravels have characteristics of Ringold Formation gravels; that is, they are dominantly felsic in composition, subangular to well rounded, and locally consolidated. However, in the northeast, the archive samples for borehole 299-E27-7suggest interbedded Ringold Formation and Hanford formation lithologies. This could only occur if the Ringold Formation sediments were reworked during Pleistocene time. In the west and southwest in boreholes 299-E27-12 and 299-E27-13, the gravels are unconsolidated and between 50% and 85% basaltic, characteristics typical of the Hanford formation.

Regionally, the Ringold Formation Unit A or reworked Ringold Formation Unit A of a later age is found beneath the 241-A and the 241-AX tank farms to the southeast of WMA C. The Ringold Formation is entirely absent beneath the 241-B, 241-BX, and 241-BY tank farms to the northwest of WMA C. For this stratigraphic revision, all of the sediments below the Hanford formation sand sequence in the boreholes listed in Table 2.4 are considered part of the Hanford formation lower gravel sequence. However, an earlier reworking of Ringold Formation sediments remains a possibility.

The Hanford formation sand sequence overlies the Hanford formation lower gravel sequence beneath WMA C. This sequence is the thickest in the area and is equivalent to the sandy sequence of Lindsey et al. (1992), the Hanford formation H2 sequence of Lindsey et al. (1994), and to Qfs of Reidel and Fecht (1994). It is described on borehole logs of cuttings in the WMA C Area as variably bedded silty sand, sand, and slightly gravelly to gravelly sand. The sediments contain a higher proportion of gravel in the west and southwest part of the WMA. Based on observations of outcrop and intact core, the sand sequence is interpreted to be the transitional sand-dominated facies of the Hanford formation deposited during the waning stages of glacial flooding. Ranging in thickness from about 170 to 210 ft (52 to 64 m), the Hanford formation sand sequence averages 190 ft (58 m). The sandy beds exhibit a "salt and pepper" texture ranging from about 30% basaltic and 70% felsic sand to 70% basaltic and 30% felsic sand. The sequence is not cemented but does contain zones with calcium carbonate as small concretions and as coatings on grains.

Thin silt lenses overlie some individual beds within the Hanford formation sand sequence. These lenses are generally 6 in (0.15 m) or less in thickness. The silt lenses can not be correlated among boreholes. However, samples are usually collected every 5 ft (1.5 m) during drilling such that most thin silt lenses are unrecognized. The base of the Hanford formation sand sequence is picked at the top of a thin muddy gravelly sand, where present, or at the top of a thick (<30 ft [9 m]) sequence of sandy gravel. The top of the sequence is the base of a thick sequence of gravelly sand or sandy gravel.

The Hanford formation upper gravel sequence overlies the sand sequence. The Hanford formation upper gravel sequence is described on borehole logs of cuttings as consisting of interbedded sandy gravels, gravelly sands, and sands. This sequence is equivalent to the Hanford formation upper gravel sequence of Lindsey et al. (1992), the Hanford formation H1 sequence of Lindsey et al. (1994), and Qfg of Reidel and Fecht (1994). Caggiano and Goodwin (1991) did not differentiate this sequence and the underlying Hanford formation sand sequence. The upper gravel sequence consists of the gravel-dominated facies and was deposited by high-energy, glacial flood waters.

The Hanford formation upper gravel sequence varies from 20 to 40 ft (6 to 12 m) thick in the WMA C Area and averages about 32 ft (10 m) thick. This unit was removed from most, if not all, of the tank farm during construction and replaced as backfill after construction was complete. The base of the sequence was picked at either the top of the first sand or muddy sand sequence that was at least 10 ft (3 m) thick or at a subtle shift in the gross gamma-ray log at about 30 to 40 ft (9 to 12 m) depth. This contact may be arbitrary, particularly in the south and southwest part of the tank farm where the underlying Hanford formation sand sequence contains numerous gravelly beds.

Within the 241-C Tank Farm, the upper 40 ft (12 m) of material is backfill consisting of mixed gravel, sand and silt excavated from the Hanford formation during construction of the tank farm (Narbutovskih et al. 1996). Areas outside the tank farm have a variable thickness from 0 to 15 ft (0 to 4.5 m) of Holocene eolian sediment where the surface has not been disturbed by construction. Price and Fecht (1976) state that clastic dikes were detected in the 241-C Tank Farm during construction although they could not be mapped. Clastic dikes were not detected during drilling of the RCRA wells in 1989. However they are extremely difficult to recognize from drill cuttings.

2.4.3 Aquifer Properties

This section provides information on the current nature of the unconfined, uppermost aquifer in the immediate region of WMA C. Aquifer properties were determined from stratigraphic interpretations, current water elevations, and previous aquifer test results. Currently, the water table beneath WMA C lies 400 ft (122 m) above sea level with about 255 ft (77 m) of vadose zone above. The aquifer thickness, based on the top of basalt at 355 ft (108 m), is approximately 44 ft (13.4 m). The aquifer materials consist dominantly of sandy gravel or silty sandy gravel. Although there is some consolidation of the sediment within the unconfined aquifer, there is little evidence of compaction or cementing. Consequently, permeability is high and relatively homogeneous within the aquifer.

Figure 2.9 shows hydrographs for four of the five RCRA network wells that are currently used to monitor the water table at WMA C. The water level data from well 299-E27-15 is historically inconsistent with data from the other wells in the WMA C network and with the regional water table data (Hartman 1999). Well 299-E27-15 may be deviated from vertical. Therefore, data from well 299-E27-15 is not used to determine flow direction in this monitoring plan. A borehole deviation survey is proposed for FY 2001 to alleviate the ambiguities in the flow direction.

The data in Figure 2.9 show that groundwater well 299-E27-7 is an upgradient well and 299-E27-13 is a downgradient well. Wells 299-E27-12 and 299-E27-14 have similar and intermediate water table elevations. Furthermore, these data show that the flow direction at WMA C appears to be toward the southwest, which is consistent with the regional water table map (Hartman 1999). The original groundwater monitoring network, which is currently used, was designed for a flow direction from east to west with wells 299-E27-7 and 299-E27-14 as upgradient wells (Caggiano and Goodwin 1991). Current information will be supplemented with a direct flow measurement investigation in FY 2001. If the results of this investigation are useful, the direction of flow will be reevaluated.

The rate of groundwater flow is calculated for a homogeneous, isotropic aquifer using the Darcy equation (Hartman 1999), which incorporates values for the estimated hydraulic conductivity, the gradient across the site, and the porosity of the sediments in the aquifer. There are various published values for hydraulic conductivities in the 200 East Area (Newcomer et al. 1990, Connelly et al. 1992). Values used

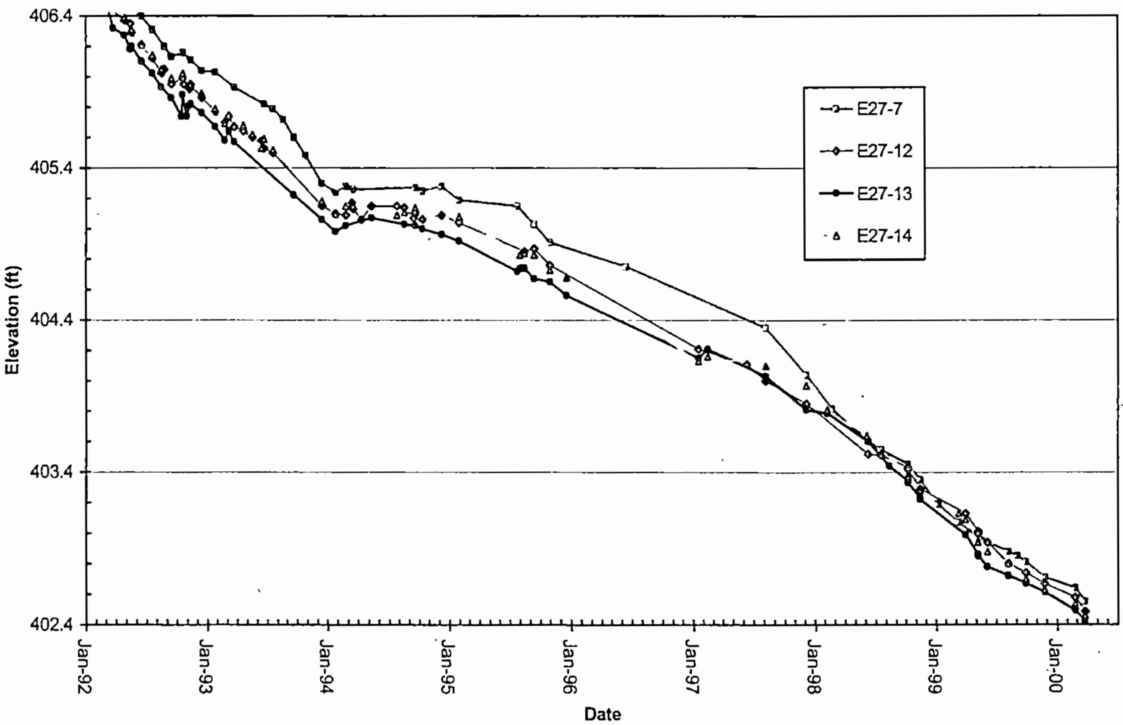


Figure 2.9. Hydrographs for Wells in the WMA C Monitoring Network. All data referenced to the NAVD88 datum. Spurious data have been removed.

in this monitoring plan were derived from pumping tests, which are considered more reliable than values derived from slug tests. Also, the pumping test values are more comparable with tracer test plume tracking results than are slug test values. Hydraulic conductivity values used for WMA C calculations are between 3,500 and 6,800 ft/d (1067 and 2073 m/d) as reported by Connelly et al. (1992). Porosity is generally estimated to be about 30% for unconsolidated, coarse grained sediments at the DOE Hanford Site (Hartman 1999). Since it has not been possible to collect intact core from the aquifer, direct methods of determining porosity have not been used.

Water table elevations across WMA C vary from 402.3 to 402.8 ft (122.62 to 122.77 m). The local gradient between well 299-E27-7 and 299-E27-13 is 0.00021 based on June 2000 water levels. Depending on which hydraulic conductivity value is used, the flow rate at WMA C is estimated to be between 2.4 and 4.8 ft (0.7 and 1.4 m) per day. This equates to 876 to 1,752 ft (267 to 534 m) of groundwater movement per year. Tracer tests at the solid waste landfill about 3.5 miles (5.6 km) to the southeast, produced flows greater than 98 ft/d (30 m/d) (Hartman 1999). Consequently, the estimated flow rate is not unreasonably high.

The RCRA standard wells at WMA C have open intervals within the aquifer ranging from 7.9 to 10.6 ft (2.4 to 3.2 m) in length. Well 299-E27-7, which is a pre-RCRA well, has a 46.9 ft (14.3 m) open interval in the aquifer. The rate of water table decline beneath WMA C has increased from 0.3 ft (9.1 cm) per year in June 1997 to approximately 1 ft (30.5 cm) per year in March 1999. If this current rate continues, downgradient well 299-E27-13, with less than 10 ft (3 m) of water, may become unusable in six or seven years.

2.5 Groundwater Chemistry

This section provides historic information on the results of RCRA groundwater monitoring at WMA C since the initiation of routine detection monitoring at that site in 1992. Information on recent and past contaminant issues is provided. There have been recent (1994-1999) small increases in contaminant levels across the WMA. However, the concentrations are generally low. Without a better understanding of local flow direction, it is too early to suggest sources for these small increases in contamination. The critical mean values for the indicator parameters (pH, electrical conductivity, total organic carbon, and total organic halides) have not been exceeded during this time.

Technetium-99 activity has been rising gradually in all the network wells. In well 299-E27-14, it has been increasing since 1994 or earlier (Figure 2.10). The maximum value of 709 pCi/L for this well was reached in December 1999. This concentration is below the drinking water standard (DWS) of 900 pCi/L. Increases in various anion and cation concentrations correspond to the rising ^{99}Tc trend (Figure 2.11). Until June 1999, nitrate and sodium trends correlated with the ^{99}Tc activity (Figure 2.12). After September 1999, the nitrate and sodium values ceased to track the ^{99}Tc upward trend actually decreasing in concentration. The nitrate concentration in this well is currently about 16,000 µg/L (May 2000), which is well below the DWS of 45,000 µg/L. The calcium chloride and sulfate concentrations continue to track the rising ^{99}Tc activity (Figure 2.11 c, d, e). Maximum sulfate values are about 82,000 µg/L while the calcium value is about 40,000 µg/L. This change in co-contaminant chemistry may be due to chemical heterogeneities within a larger, regional plume.

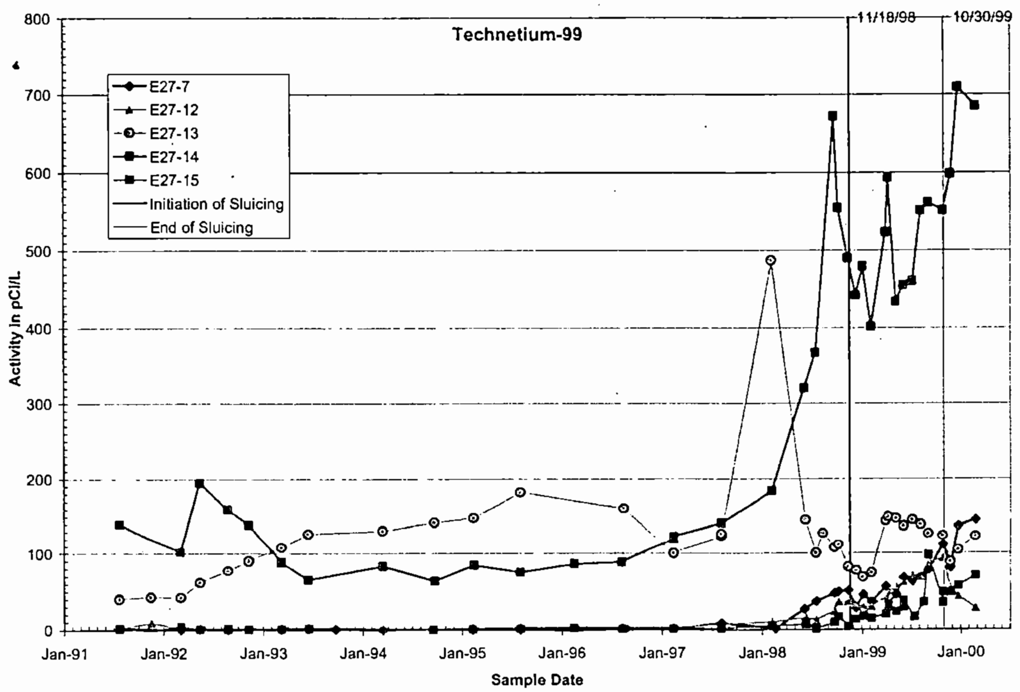
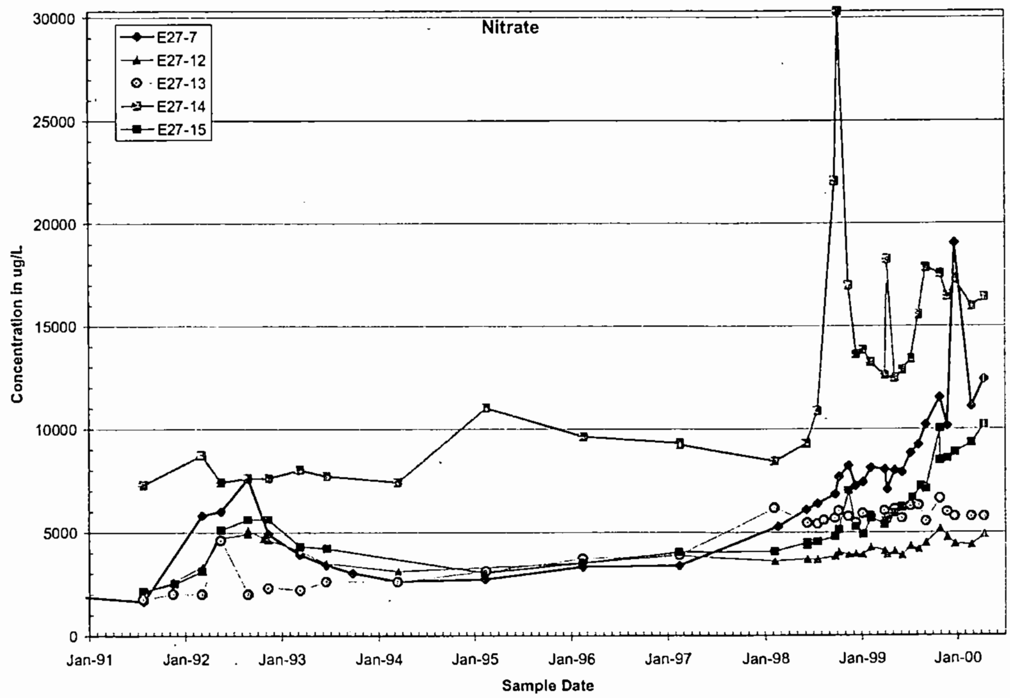
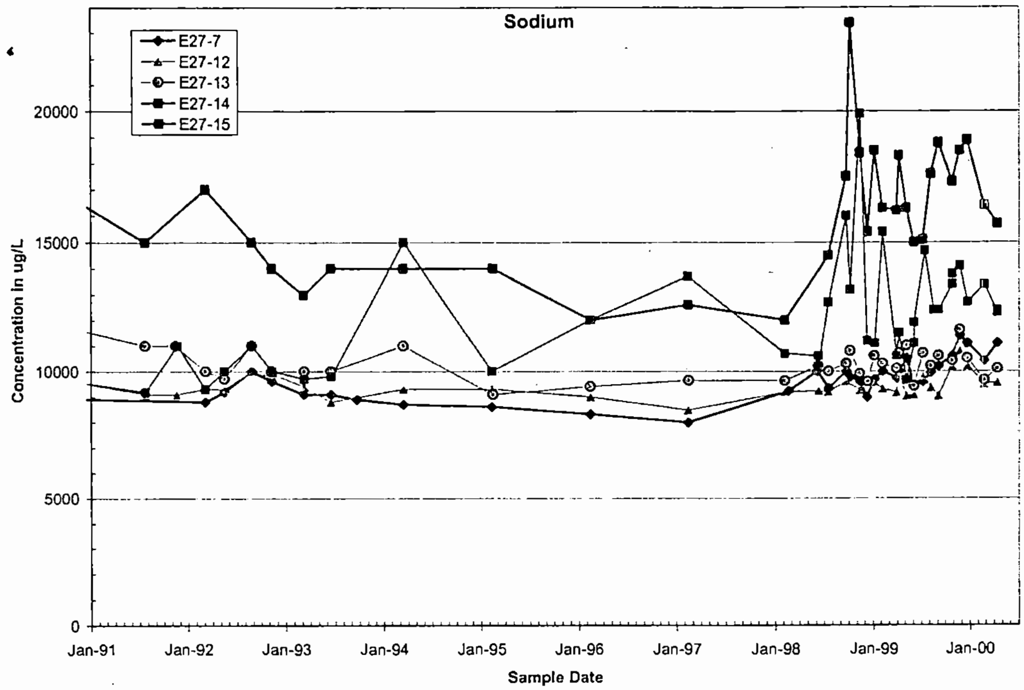


Figure 2.10. Trend Plot of ^{99}Tc at WMA C

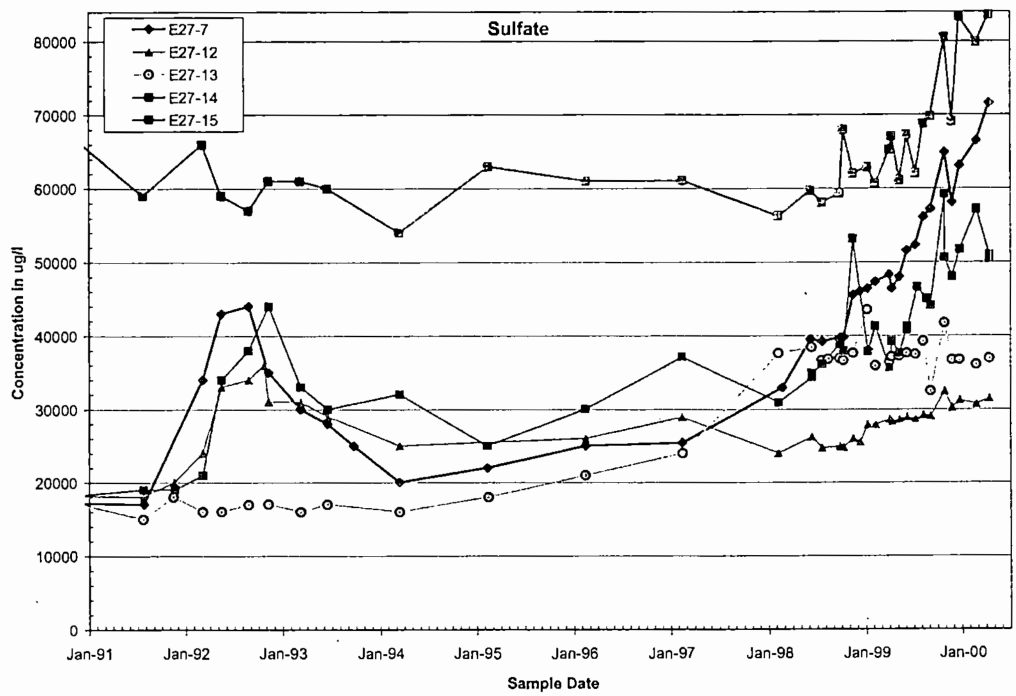


(a)

Figure 2.11. Trend Plots of Various Constituents at WMA C

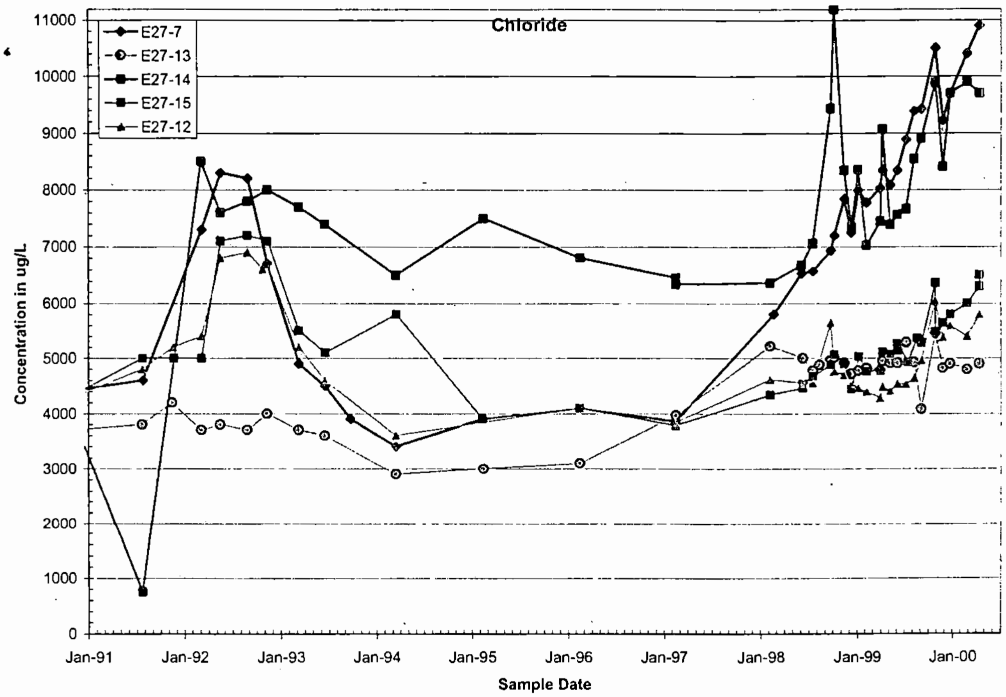


(b)

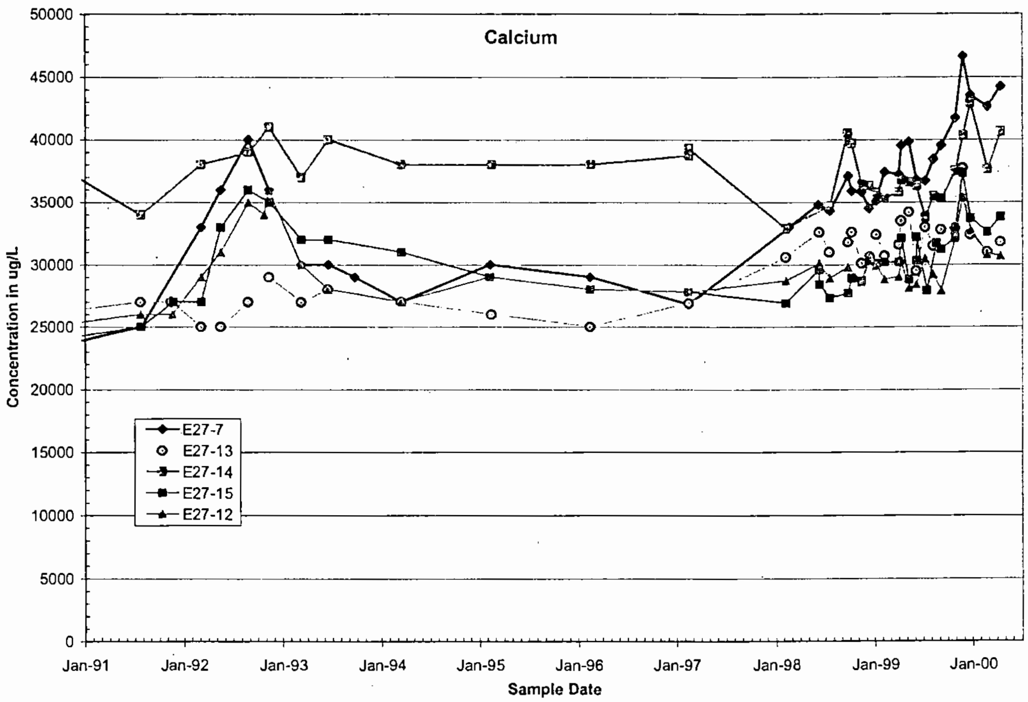


(c)

Figure 2.11. (contd)



(d)



(e)

Figure 2.11. (contd)

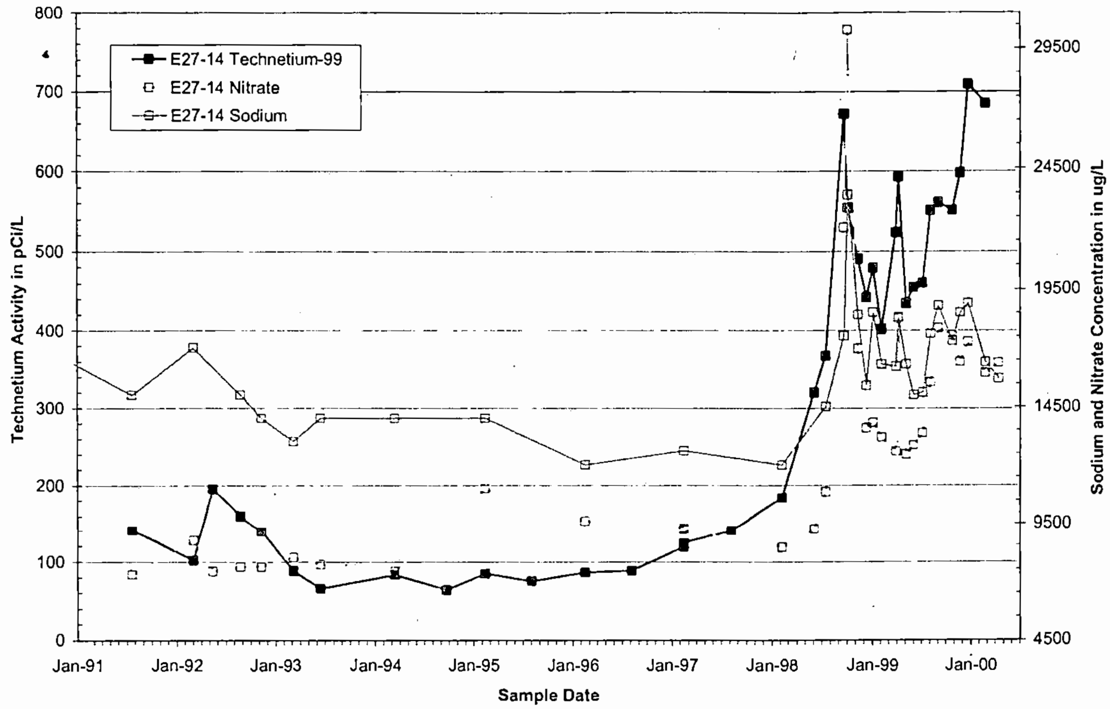


Figure 2.12. Trend Plots for Well 299-E27-14 Comparing ^{99}Tc to Various Ionic Species

From November 1998 to October 1999, sluicing operations were performed in tank 241-C-106. The WMA was temporarily monitored monthly and then bi-monthly to provide additional coverage before, during, and after the recent in-tank sluicing event to increase the ability to detect a leak related to sluicing operations. The period of sluicing is marked in Figure 2.10 by the two vertical lines. As can be seen, the groundwater plume currently impacting the groundwater under the 241-C Tank Farm entered the area several years before sluicing operations began. Thus, the rising contamination in well 299-E27-14 is unlikely to be associated with active sluicing of tank 241-C-106.

Just prior to the increases in contamination observed at well 299-E27-14, a single pulse (487 pCi/L) of ^{99}Tc was observed at well 299-E27-13 (Figure 2.10) in February, 1998. Small increases were also observed in nitrate, sulfate, chloride, and calcium at this well. In May 1998, ^{99}Tc activity returned to historical values of about 150 to 120 pCi/L. It is important to note there were no exceedances of indicator parameters, DWSs, or maximum contaminant levels (MCL) associated with this well. Currently, this well has the lowest levels of anions around the WMA except for well 299-E27-12. This elevated ^{99}Tc, seen in 1998, may be associated with the increased contamination currently observed in all the wells around WMA C.

For example, ^{99}Tc values are rising in 299-E27-7, 299-E27-15, and 299-E27-12; however, activities are below 200 pCi/L. Associated with this overall increase in ^{99}Tc, are sharp increases in sulfate, calcium, and chloride. Although there is some increase in nitrate (Figure 2.11), sulfate, calcium, and chloride are the dominant anions for this event. In fact, since early 1999, the chloride concentration at 10,900 µG/L and the calcium concentration at 46,600 μG/L have risen higher in well 299-E27-7 than in any other network well. Located north of the WMA, well 299-E27-15 has concentrations also rising sharply. Although sodium has shown increased levels in wells 299-E27-14 and 299-E27-15, it is not clear that sodium is rising with the ^{99}Tc, calcium, sulfate, and chloride seen in the groundwater at the other wells. Normally, sodium is the main cation observed in groundwater contamination associated with processing waste.

Well 299-E27-7 has also recently begun to show low levels of cyanide at 15 μG/L. Cyanide has not been seen in network wells prior to this recent occurrence nor has ^{60}Co been detected in any of the wells. Tanks at WMA C were used for in-tank scavenging with ferrocyanide. The general increase in ionic chemistry is elevating conductivity values up to 400 μS/cm in wells 299-E27-7 and 299-E27-14 (Figure 2.13). Well 299-E27-7 is still considered an upgradient well while it is unclear if well 299-E27-14 is upgradient or cross gradient. It may be necessary to recalculate the critical mean for this site, which is currently 553.5 μS/cm.

Rising sulfate, calcium, and chloride have recently been observed elsewhere in the northern part of the 200 East Area. Unfortunately, these wells to the north of WMA C are not sampled for ^{99}Tc. But the dominant sulfur and calcium character is similar. Thus, there may be some regional source moving into the area from a northwesterly direction.

There does not appear to be other tank-related wastes in the groundwater. Tritium levels are low, generally less than 1,500 pCi/L, except at well 299-E27-7 where values rose from about 600 pCi/L to 2,500 pCi/L during the late 1990's. Currently, the trend is not increasing remaining level at 2,480 pCi/L.

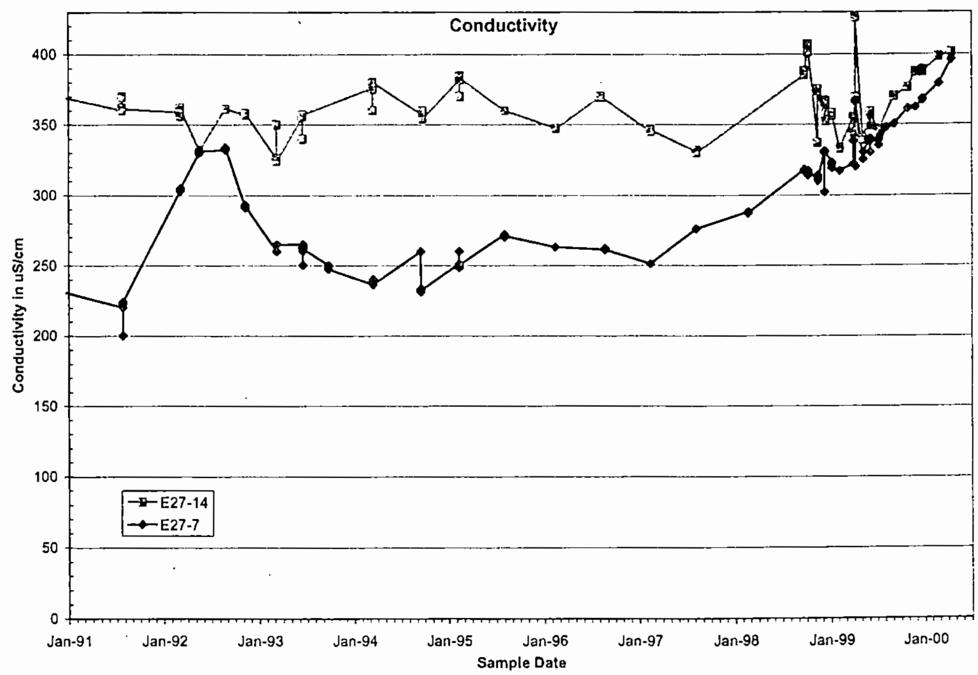


Figure 2.13. Trend Plots of Conductivity for Wells 299-E27-7 and 299-E27-14

3.0 Conceptual Model

The purpose of the conceptual model is to explore the complexity and spatial/temporal relationships of three important parameters: the contamination source, the driving force, and the migration pathway. Determinations of contaminant sources are facilitated by use of a conceptual model that integrates these three parameters. Such a qualitative model can also be used to guide monitoring network design. The model presented here includes the general waste chemistry, the tank farm settings, and the hydrogeology of the unconfined aquifer. In addition, the residual contaminant plumes along with the vadose zone migration pathways are qualitatively depicted. Pertinent aspects are discussed below.

3.1 Contaminant Sources

A graphical summary of the physical characteristics and mechanisms that could potentially lead to the generation and transport of contamination at WMA C to the groundwater is presented in Figure 3.1. Various possible contamination sources are shown. The red represents liquid waste at the time of an initial leak occurring from a tank, a waste transfer line, or a surface spill. The color shading, from red to orange to yellow, depicts contaminant migration since the initial leak to the present plume location in the vadose zone. The color change may represent either a chemical reaction of the waste with mineral phases in the soil or adsorption of relatively immobile waste constituents on to the soil grains leaving the mobile constituents dissolved in the pore water. In the latter case, the mobile constituents remain dissolved in the pore water. Also shown is the interaction of fresh water migrating from the surface, moving the residual waste in the vadose zone plumes to the groundwater. This is shown as blue water interacting with residual yellow waste in the pore water to form migrating green waste. In this case, the residual vadose zone plumes are distinct and different sources of contamination than the waste material in the tanks.

In the following text, the sources of contamination in and around WMA C are discussed as they relate to this general conceptual model. Viable migration pathways are shown that hazardous wastes could take from a source to a monitoring well. Driving forces are also illustrated as the most likely mechanism for carrying tank-associated waste constituents through the vadose zone to the groundwater.

Most tanks in WMA C have no appreciable liquid remaining, and consequently, there is little risk that new leaks will occur from the tanks. There are two tanks, however, that have not been interim stabilized. Tank 241-C-103 contains 83,000 gal (314,000 L) of drainable liquid and tank 241-C-106 contains 68,000 gal (257,000 L) of drainable liquid (Hanlon 2000). Both tanks currently are considered sound tanks. During sluicing of tank 241-C-106 from November 1998 to October 1999, monthly spectral gamma-ray logging of the drywells was performed. The logging did not indicate that waste was released to the vadose zone during the sluicing operation. A date to remove liquid from tank 241-C-103 will be established no later than December 2000 (Hanlon 2000).

The lack of significant liquid in the tanks suggests that any tank waste found in the groundwater associated with WMA C is related to either remobilization of residual vadose zone plumes or leaks associated with liquid waste transfers.

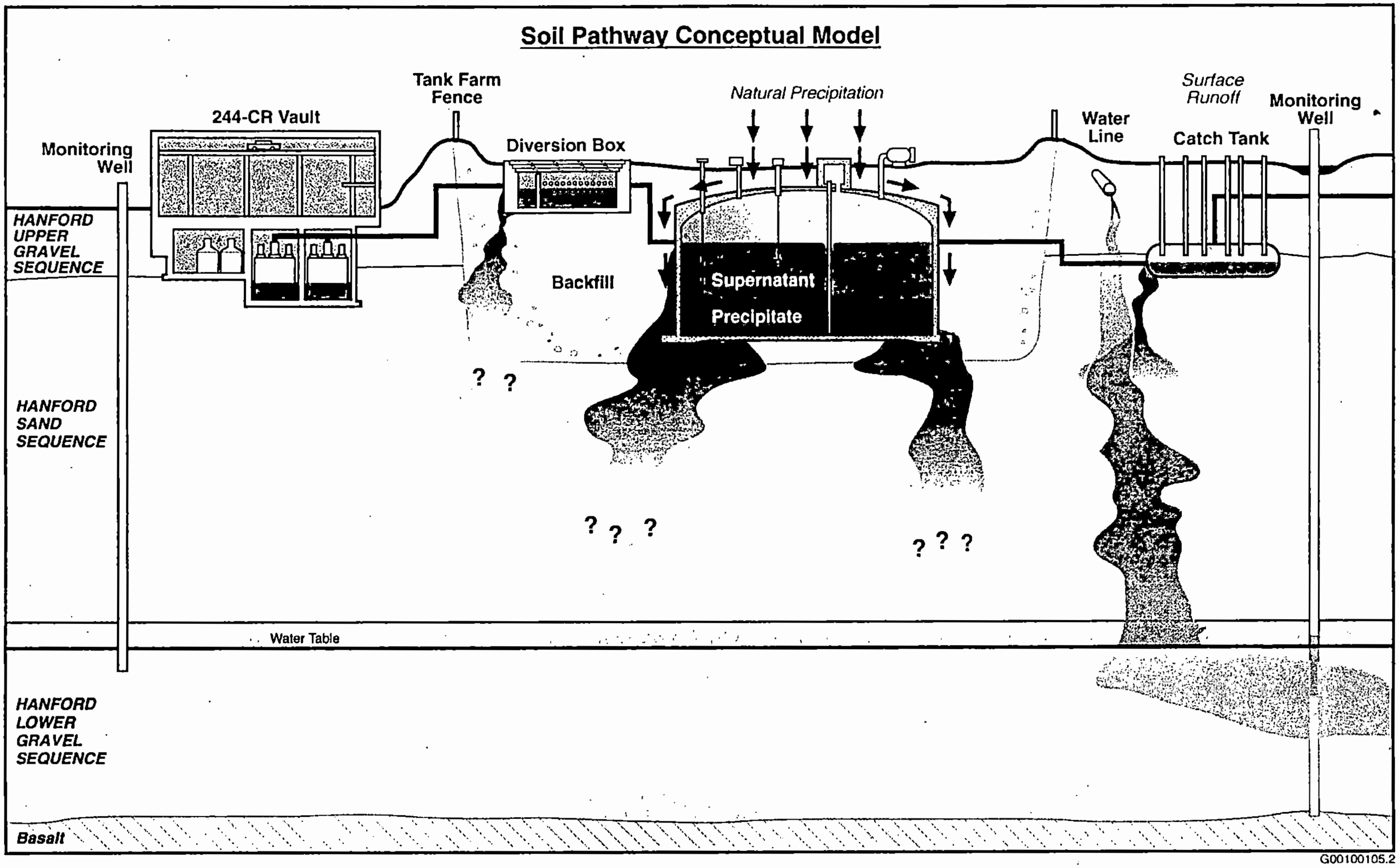


Figure 3.1. Conceptual Model for WMA C. This schematic depicts possible contaminant sources in the vicinity of WMA C. Viable, hypothetic migration pathways are shown that hazardous wastes could take from a source to a monitoring well. Driving forces are also illustrated as the most likely mechanism for carrying tank-associated waste constituents through the vadose zone to the groundwater.

3.1.1 Tank Leaks

Seven of the 16 SSTs in WMA C are confirmed or assumed leakers (Hanlon 1999). A maximum volume of 29,000 gal (110,700 L) of liquid is reported to have leaked from the tanks. Four of the leaks are from the 200 series tanks and are very small (< about 530 gal [2,000 L]). The largest leaks are from tanks 241-C-101 (20,000 gal [75,700 L]) and 241-C-111 (5,500 gal [20,820 L]). Groundwater monitoring during the past eight years has not indicated that leaks from SSTs in WMA C have reached the uppermost aquifer. Thus, any leaked liquid from the tanks probably remains in the vadose zone where it is subject to remobilization.

Recently, spectral gamma-ray logging of drywells in the 241-C Tank Farm has provided a better understanding of where gamma-emitting contamination occurs in the upper part of the vadose zone (GJO-98-39-TAR, GJO-HAN-18). The major gamma-ray contaminants are ^{137}Cs and ^{60}Co with lesser amounts of ^{154}Eu. These contaminants are located mostly in and around areas of known or suspected tank and pipeline leaks. Logging results indicated that the plumes are isolated occurrences and most probably resulted from surface spills and pipeline leaks. Although most of the boreholes are deeper than the surrounding contamination, some plumes extend deeper than nearby boreholes. Consequently, the maximum depth of vadose zone contamination is not known in some areas.

This contamination in the vadose zone provides potential sources for future groundwater contamination if it is remobilized and transported downward. Although most of the larger areas of gamma contamination are mapped in the vadose zone, there remains a possibility of narrow, vertical plumes directly beneath a tank. These narrow plumes would not have been identified by current subsurface characterization techniques.

Although the major gamma-emitting contaminants have been characterized in the vadose zone, other contaminants emanating from tanks that are not gamma-emitters have not been characterized. For example, nitrate and ^{99}Tc are quite mobile in aqueous environments. The distribution of gamma-emitting waste constituents may not reflect the distribution of nitrate and ^{99}Tc. These constituents may exist deeper in the vadose zone, and because they are mobile, present the greater risk for future impacts to groundwater.

Mobilization of contamination by infiltrating surface water, however, could transport some fraction of tank waste to groundwater, as illustrated by the transition from red/yellow to green under the catch tank in the conceptual model (Figure 3.1). Water from surface leaks, spills, or ponded precipitation that encounters residual vadose zone waste in the pore liquids may cause this waste to move down in near-vertical, high-permeability channels, spreading the contamination to new regions. Waste liquid with mobile constituents from this scenario would tend to have some lateral movement by capillary forces if fine-grained sedimentary layers such as silt-rich zones are encountered. However, details of the subsurface geology discussed in Section 2.4 indicate few discrete silt layers on which lateral spreading could occur. Therefore, it is not expected that lateral migration is as important at WMA C as it may be in the 200 West Area.

3.1.2 Non-Tank Sources

Surface spills have occurred in the SST farms at various times in the past. The existence of concentrated gamma-emitting radionuclides close to the surface in the 241-C Tank Farm confirms the presence of shallow vadose zone plumes associated with spills (GJO-98-39-TAR, GJO-HAN-18). The near surface contamination is associated with leaks from transfer lines, diversion boxes, catch tanks, and vaults. Given a sufficient driving force, any of these residual plumes could become a source for groundwater contamination.

The 241-AN Tank Farm, the 216-C-8 french drain, the 241-C-301C catch tank, and the 241-C cesium loadout facility are located in or adjacent to WMA C. These facilities were used to dispose of, store, or transfer liquid waste. Should these facilities leak, they could produce vadose zone sources for groundwater contamination similar to leaks associated with tank waste. The presence of these sources should not complicate the task of distinguishing leaks associated with WMA C from those due to adjacent storage and past-practice disposal facilities once the flow direction is known.

3.1.3 Source Constituents

Not all of the chemical species in tank waste are mobile. Depending on the solubility and concentration, some species are more able to leak from a tank and migrate through the subsurface to the groundwater. Thus, it is important to consider the chemistry and fate of the waste routed to the SSTs in WMA C.

Initially, wastes at the 241-C Tank Farm were primarily inorganic consisting of sodium hydroxide, sodium salts of nitrate, nitrite, carbonate, aluminate, phosphate, and hydroxides of iron and manganese. The in-farm ^{137}Cs and ^{90}Sr scavenging left some tank waste elevated in iron, nickel, and cyanide. Although much of the carbon and hydrogen from the early organic solvents used in the TBP and PUREX process decomposed as CO_2 and H_2, Agnew (1997) shows significant concentrations of organics in some of these tanks in both solid and liquid phases.

The radioactive components consist of first-order fission products and associated daughter species. The primary radioactive components left in the tanks are ^{90}Sr, ^{137}Cs, ^{60}Co, ^{99}Tc, ^{154}Eu, ^{239,240}Pu, ^{241}Am, and tritium (Agnew 1997; Anderson 1990; Jansen et al. 1965). Although ^{137}Cs and ^{60}Co are in the liquid phase in tank waste, these species may be sorbed onto grains in the upper part of the soil column close to the leak point (Serne et al. 1998). These species should be removed from the remaining mobile fraction of migrating tank waste. This is shown in the conceptual model (Figure 3.1) with the red transitioning to yellow as adsorption occurs.

Recent analyses of porewater taken from contaminated soils collected at the 241-SX Tank Farm were reported in HNF-2855 (1998). These data show that nitrate is present above background to depths of 155 ft. None of the radioactive constituents found at shallower depths (130 ft [39.2 m]) were detected at this depth. Desorption tests on the most contaminated sediments suggest that ^{137}Cs is irreversibly adsorbed unto the soil grains. Thus, once ^{137}Cs is removed from the migrating waste, it unlikely to be remobilized by later migrating fluids. The adsorbed phases may be permanently stored in the soil column.

Although considered relatively immobile, ^{60}Co is found in the groundwater at WMA B-BX-BY along with cyanide. Thus, there may be chemical environments that allow ^{60}Co to be mobile. A radionuclide with one of the highest activities in most of the tanks is ^{90}Sr. This component has been found in the groundwater elsewhere and thus, can be mobile (Huntman 2000). Consequently, ^{60}Co and ^{90}Sr are constituents of concern at WMA C.

In general, the mono and divalent metals formed insoluble compounds with the excess hydroxide to form the sludges. Thus, it is unlikely to see metals such as aluminum, lead, or manganese in the leaked waste. Insoluble species such as $^{239,240}Pu$ and ^{241}Am, although present at high relative activity levels, would also tend to stay in the tanks as solids. The salt cake in these tanks is formed primarily from the carbonates and phosphates. The liquid phase of the waste is enriched in the anionic complexes such as nitrate, sulfate, and pertechnetate along with cyanide and tritium. Sodium and calcium are the main cations associated with these anionic phases.

Once the tank liquor has escaped to the soil, only the gamma-emitting radioactive nuclides such as ^{137}Cs and ^{60}Co can be detected with non-invasive logging techniques in the vadose zone. The mobile hazardous components such as nitrates and sulfates along with beta-emitting radionuclides such as ^{99}Tc and tritium cannot be identified until concentrations or activities reach detectable limits in the groundwater at a monitoring well. Hazardous and radioactive constituents detectable in the groundwater are likely to be those that form anionic compounds and are not readily sorbed in passing through the soils of the unsaturated zone. These compounds will move with the moisture front through the soils and can later be remobilized by subsequent renewed moisture movement such as migrating fresh water. Nitrate, sulfate, chloride, ^{99}Tc, and tritium are the most likely constituents to be detected in the groundwater. The organic components, if not completely degraded, should be detected with analyses for total organic carbon (TOC). Since only mobile components left in pore water are capable of remobilization due to later driving forces such as infiltrating water, an understanding of potential sources of moisture is also important.

3.2 Driving Forces

In general, there are two ways to transport tank-associated waste to groundwater. The first way is with a very large leak. In this case, the amount of liquid waste is sufficient to reach groundwater through gravitational forces and capillary action. The second is associated with an external source of water available to remobilize residual waste in vadose zone plumes. Since most tanks in WMA C no longer contain large amounts of liquid waste, it is unlikely that a tank could leak sufficient liquid to reach groundwater unassisted. However, an external source, such as ruptured waste transfer or water lines, could result in substantial volumes of liquid released to the vadose zone. The second mechanism provides the most likely driving force at WMA C. There is a complex system of water and waste transfer lines within the tank farm. Broken water lines or leaking valves can produce large volumes of water. For example, a two-inch raw water line broke in February 1978 on the east side of 241-A Tank Farm

(Caggiano 1991). Before the line could be turned off, 60,000 gal (227,125 L) of water were released to the soil column. Such large volumes of rapidly released water induced soil collapse in the center of the farm between tanks 241-A-102 and 241-A-105 even though the ruptured line was on the east side of the farm.

Mobility of escaped waste may be increased as a result of natural recharge such as heavy rainfalls and sudden snowmelts. Johnson and Chou (1998) discuss the extent that rapid snowmelt from recent years has contributed to natural driving forces. The results of a rapid snow melt event in February 1979 are documented in Hodges (1998) with photographs showing extensive flooding in the 241-T Tank Farm. The effects of these water sources can be enhanced by gravel surfaces, lack of plant uptake and transpiration, and surface depressions that tend to collect and pond run-off and snow melt.

3.3 Migration Pathways

The water table at WMA C is approximately 250 ft (75 m) below the surface. Consequently, much of the migration pathway from a near-surface source to a groundwater monitoring well will be in the unsaturated zone. Liquid migration through the unsaturated zone is highly dependent on heterogeneities and anisotropy in the permeability of the soils. The Hanford formation sediments making up the vadose zone beneath WMA C consist of moderate to high-energy flood deposits with a large variability in grain size over vertical and horizontal scales on the order of tens of feet. Permeability values would change at the same scale or less. Consequently, delineating a migration pathway through the thick sequence of unconsolidated sediments beneath WMA C is a challenging task.

In the 200 West Area, there are several stratigraphic units that allow for lateral spreading of liquids, in some cases for long distances. This lateral migration can allow contamination to impact the groundwater at some distance from the source location. In the 200 East Area, however, unsaturated sediments are primarily gravelly coarse-grained sands and sandy gravels with a few thin intermittent silt-rich units. Also, there are no horizons, such as the caliche zones in the 200 West Area, that would cause appreciable lateral spreading under WMA C. The detailed stratigraphic description provided in Section 2.4.2 and in Plates 1, 2, and 3 show a vertical column of predominantly coarse sands in the vadose zone.

Intercalated, silt-rich units and paleosols exist in the vadose zone but are thin, not common and generally not laterally continuous. Thus, few stratigraphic units in the area of WMA C are expected to retard downward migration of fluids and cause extensive lateral spreading. Therefore, any impacts to the groundwater from WMA C should occur near the source.

Studies of aqueous flow in sandboxes suggest that relatively narrow, vertical zones of moisture are a common flow pattern through unsaturated sediment. These zones exhibit some lateral spreading where they encounter finer-grained beds but once saturation of the fine-grained beds is reached, vertical flow commences again. Furthermore, once these vertical pathways are established by an initial infiltration event, subsequent infiltration events will prefer the same channels (Stephens 1996).

Evidence to support this type of flow behavior in the 200 East Area comes from direct observation of infiltration tests performed at the 105A mock tank site (Narbutovskih et al. 1996). Electrical resistivity tomography was used at that site to track leaked saline water, as fingered flow, from the surface to a depth of about 70 ft (21 m). Furthermore, analysis of the infiltration rate, the time to reach depth, and the total volume of leaked water, during the tests, indicates that a low-volume leak might reach groundwater in a few months (Hartman and Dresel 1997). The sandbox studies and infiltration studies suggest that relatively moderate volumes of liquid (~10,000 gal [38,000 L]) can travel rapidly through the 200 East Area vadose zone and impact groundwater in less than one year. Additional field testing to greater depths is needed to confirm these results.

Clastic dikes are sedimentary features that crosscut existing horizontal bedding and may provide preferential pathways for contaminants to move through the vadose zone to groundwater. Clastic dikes have been documented in boreholes at the 241-C Tank Farm (Price and Fecht 1976; Fecht et al. 1998). The maximum vertical extent of a clastic dike is about 150 ft (45 m) into the subsurface. As yet, it has not been documented that clastic dikes can transport leaking contaminants. However, the potential does exist.

Another preferential, vertical pathway is the outside of well casings with no, or poorly constructed, annular seals. The 241-C Tank Farm contains many drywells, used for secondary leak detection, that have no annular seals or are poorly sealed. These boreholes extend from 50 to 150 ft (15 to 46 m) below the surface.

As work progresses on the assessments of SST WMAs, more information may become available furthering our understanding of migration pathways through both the vadose zone and the sediments in the unconfined aquifer. Impacts from various driving forces may also become better understood. This conceptual model will be revised as necessary to reflect these new findings.

4.0 Detection Monitoring Program

The detection monitoring program employed at WMA C was designed to detect the presence of hazardous waste constituents at the point of compliance located along the west side of the WMA. This program currently in use, is based on the waste inventory in the tanks and on our knowledge in the early 1990s of the local hydrogeology. Although the current network may not be adequate if indeed its flow direction is southwest, it is, as yet, premature to propose new wells. A more accurate determination of the flow direction is required. Once additional information is acquired and analyzed, the adequacy of the network can be determined. Coverage for the inclusion of the 244-CR vault and diversion boxes into the Part A Permit application will also be incorporated into a new monitoring design. Plans for resolving the question of flow direction are provided in Section 4.2.3 along with a tentative schedule. Until the work can be performed and new wells installed, if found necessary, the current monitoring program will continue. The detection monitoring plan presented herein contains the:

- design of the basic interim status RCRA-compliant monitoring well network along with asbuilt diagrams of both RCRA and non-RCRA groundwater monitoring wells available for monitoring
- current methods employed to routinely determine rate and direction of groundwater flow
- indicator parameters used to detect the presence of groundwater contamination
- frequency of groundwater sampling
- sampling, analysis, and statistical procedures currently used for detection monitoring.

The following sections provide a discussion of monitoring objectives specific to WMA C. A description of the current detection monitoring plan with suggestions for needed modifications to allow reliable detection of contamination from WMA C is also included. Steps required to implement these modifications are provided. A proposed assessment monitoring plan outline is contained as required in Appendix B with details of local well construction given in Appendix C. An explanation of the statistical calculations along with the Field Sampling Plan (FSP) and Quality Assurance Program Plan (QAPP) are provided in Appendix D.

4.1 Objectives

In accordance with 40 CFR 265 by reference of WAC 173-303-400 (3), which describes requirements for a detection monitoring program, the general objectives of the WMA C groundwater monitoring plan are to:

- Monitor to detect indicator parameters, hazardous waste constituents, and reaction products that provide a reliable indication of the presence of dangerous constituents in the uppermost aquifer underlying WMA C. This includes the SSTs, diversion boxes, and the 244-CR Vault.

- Operate a groundwater monitoring system at the compliance point, i.e., at the downgradient wells to detect constituents that degrade groundwater quality. Provide evidence of leaks occurring at or near the surface to allow mitigation of groundwater pollution from WMA C.

- Collect groundwater samples at the optimal time interval specifically determined for WMA C to detect specific waste constituents and/or indicator parameters to facilitate early detection.

The manner in which these general goals are achieved at WMA C is, to some extent, dependent on the site characteristics. For example, WMA C is not surrounded by operating facilities or past-practice, liquid waste, or disposal facilities as are the other tank farms in the 200 East Area. The 216-C-8 french drain is southeast of the WMA C, but there is little potential that waste from this facility could impact the groundwater under WMA C.

Although there are a few operating and past-practice facilities adjacent to WMA C, there are regional plumes beneath the WMA that must be differentiated from waste originating from WMA C. Regional groundwater plumes beneath WMA C include tritium and ^{129}I. Since the groundwater-monitoring plan is designed to identify wastes emanating from WMA C, the upgradient monitoring wells are used to identify constituents entering the groundwater outside the area.

Site-specific goals for the groundwater monitoring program at WMA C are to monitor at locations and frequencies and for constituents such that, it can be determined whether or not WMA C is the source of the groundwater contamination. As such, an objective of this plan is to evaluate the efficiency of the existing groundwater monitoring network with the assistance of the Monitoring Efficiency Model (MEMO) (Golder 1990).

4.2 Groundwater Monitoring Plan

This section describes the existing interim-status groundwater monitoring network that is and will be used until the flow direction is verified. It was designed in accordance with RCRA, as presented in 40 CFR 265, Subpart F. The first section defines the monitoring network (number and locations of monitoring wells, well construction), provides the method currently used to determine flow direction/rate and evaluates the network with respect to flow direction. Monitoring issues are identified. The groundwater sampling parameters are presented next with the sampling frequency. The currently used sampling frequency is evaluated with respect to the program objectives of reliable and adequate contaminant detection. Next, problems with the groundwater monitoring system that were found to be deficient are reiterated and clarified so that tasks can be planned to rectify these deficiencies. Finally, this section covers the manner in which data are stored and retrieved, lists data interpretation methods and provides the reporting requirements for the program.

4.2.1 Monitoring Network

The present groundwater monitoring network consists of four RCRA standard wells and one older carbon-steel well (Figure 1.2). All five wells are used for water level measurements but data from well 299-E27-15 are historically inconsistent with data from the other wells in the WMA C network and with the regional water table map. Therefore, data from that well is not used to determine groundwater flow. Water level measurements are made over a short time period to eliminate daily earth tide effects and to reduce barometric effects caused by changing atmospheric pressure.

The monitoring system at dangerous waste sites is located along the hydraulically downgradient limit of the waste management area, defined as the area on which waste is stored at the regulated unit. Monitoring wells are placed as close as reasonably possible to the WMA. As can be seen from Figure 1.2, all five monitoring wells in the WMA C network are close to the WMA boundary.

The quarterly water level measurements are made separately from the sampling events. Sampling was done monthly during the time that sluicing operations were conducted in WMA C. Sluicing of tank 241-C-106 began in November 1998 and concluded in October 1999. Since sluicing operations at tank 241-C-106 have concluded, the groundwater will be sampled quarterly in fiscal year 2001. In Table 4.1 well-by-well information is provided on the position of each well with respect to flow direction, sampling objective, and sampling frequency. Although the location of some wells with respect to flow direction is ambiguous, upgradient and downgradient wells are marked according to the westward flow direction defined in the original monitoring plan for WMA C (Caggiano and Goodwin 1991).

The basic well design of the four RCRA wells was according to WAC 173-160, *Minimum Standards for Construction and Maintenance of Wells*. Completion dates for all four wells was 1989. A 4-in. (10-cm) inner diameter, stainless steel casing was set to within about 5 ft (1.5 m) above the water table. A 20 ft (6.1 m) length of 10-slot, stainless steel screen with channel pack was placed from 5 ft (1.5 m) above to 15 ft (4.6 m) below the water table. The open portion of the screen in the unsaturated zone provided for any rises in groundwater over time.

A 16-30 mesh (20-40 mesh for well 299-E27-14) silica sand pack was placed above and around the screen. An annular seal consisting of about 3 ft (1 m) of 0.25 in. (0.6 cm) bentonite pellets was put above the silica sand and 8-20 mesh bentonite crumbles were placed from the top of the pellets to within 18 to 20 ft (5.2 to 6.1 m) below the ground surface. Surface casing was set and sealed with cement from 20 ft

Table 4.1. Network Monitoring Wells

Well Name	Completion Date	Upgradient Downgradient	Sampling Objective	Sampling Frequency
299-E27-7	1982	Up	C, WL	SA
299-E27-12	1989	Down	C, WL	SA
299-E27-13	1989	Down	C, WL	SA
299-E27-14	1989	Up	C, WL	Q
299-E27-15	1989	Down	C, WL	SA

WL = Water level measurement. Q = Quarterly.
C = Chemistry monitoring. SA = Semi-annual.

(6.1 m) to ground level. The wells were finished with a cement pad and 4 posts for well protection. The annular seals assure that no vertical contaminant moves along the outside of the casing. Dedicated pumps are installed in each well. The wells are capped and locked when not in use.

Well 299-E27-7 was completed in 1982. The well has a 40 ft (12 m) long, 6 in. (15 cm) stainless steel screen with a 5 ft (1.2 m) section of blank casing welded to the top. A 6 in. (15 cm) carbon steel casing extends from 240 ft (73 m) depth to 1.3 ft (0.4 m) above ground surface. There is also an 8 in. (20 cm) stainless steel casing from 150 ft (46 m) depth to ground surface. The 8 in. (20 cm) casing is perforated from 150 to 25 ft (46 to 6.1 m) below ground surface. The space between the two casings is filled with cement grout as is the space outside. Details concerning well construction, well location, surveyed elevation, total depth, and general lithology for all the wells in the WMA C monitoring network are given in Appendix C.

Screened intervals below the water table range from 8 to 11 ft (2.4 to 3.35 m) in length. If the recent increase in water level decline from 0.3 ft (9 cm) per year to almost 0.8 ft (24 cm) per year continues, some wells in the WMA C network may require replacement within about 6 years.

Groundwater Flow Determination

The current water table is nearly flat throughout the 200 East Area. Although this low gradient is caused, in part, by the dissipating groundwater mound under B-Pond, it is primarily due to the high aquifer permeability in the 200 East Area compared to upgradient regions to the west where permeability is considerably less. Before formation of the groundwater mound beneath B-Pond, the groundwater flowed regionally to the southeast towards the 300 Area. As evidenced by the large tritium plume from waste disposed to the PUREX cribs, the effective flow from the southeast corner of the 200 East Area is to the east and southeast. Maximum flow rates are estimated from 2.4 to 63 ft (0.6 to 19 m) per day (Hartman et al. 2000).

When considering the flow for sites with small areas such as WMA C, knowledge of the local flow is required to ensure proper placement of downgradient wells with respect to the waste storage units and ancillary equipment. The objective of interim detection monitoring is not to discern where contamination is moving across the Hanford Site but to discern if waste from the WMA is entering the groundwater. Consequently, the regional flow directions and plume trends, as evidenced over miles, can be misleading when determining the local flow across a site that is only 500 ft wide (152 m).

Currently, the flow direction is determined from gradient calculations based on local water elevations. Unfortunately, across the 200 East Area, the differences in water elevation between wells are small, on the order of a few inches. The combined errors from water level measurements, survey elevations and slight borehole deviations from vertical are enough to cause uncertainties in local flow direction anywhere in the 200 East Area. As reported in Hartman et al. (2000), water level data alone are insufficient to determine flow direction in this area. The authors of that report suggest that other information be considered to determine flow direction in the 200 East Area.

It is especially important that an adequate understanding of flow direction be obtained at WMA C because of the highly concentrated waste stored at this site. With moderate liquid volumes of stored waste, the eventual use of sluicing to remove tank waste and the ongoing of waste transfer for interim stabilization efforts, early detection of leaking contaminants is important. The need exists to deploy an alternative technology of directly measuring groundwater flow direction and rate. Until then, water levels will continue to be the only method used to define the local site flow direction.

According to water table elevations based on surveys referenced to NAVD88, the direction of flow at WMA C appears to be southwest. The current monitoring network was designed for a flow direction to the west with two upgradient wells, 299-E27-7 and 299-E27-14, and three downgradient wells, 299-E27-12, 299-E27-13, and 299-E27-15. As seen on Figure 1.2, only well 299-E27-13 is downgradient if the flow direction is southwest or south-southwest. Most of the southwest and southeast sides lack downgradient well coverage.

The flow rate is calculated with the Darcy equation for a homogeneous, isotropic porous medium. The current estimate is between 2.4 and 4.8 ft (0.7 and 1.4 m) per day. Direct measurements of flow rates based on tracer tests and plume tracking suggest flow rates in excess of 60 ft (18 m) per day (Hartman 1999). If these fast flow rates do control contaminant movement, then early groundwater detection of tank-related contaminants leaking to the uppermost aquifer is important because 241-C Tank Farm is one of the closest SST sites to the Columbia River.

Network Evaluation

The efficiency of the groundwater monitoring network was evaluated using a simple two dimensional, horizontal transport model called the monitoring efficiency model (MEMO) (Golder 1990). This model estimates the efficiency of a monitoring network at the point of compliance. The model simulates a contaminant plume originating from a series of grid points within a WMA using the Domenico-Robbins method (Domenico and Robbins 1985). The model calculates both advective flow and dispersive flow in two dimensions and determines whether the resulting plume will be detected by a monitoring well before the plume travels some arbitrary distance beyond the WMA boundary. The arbitrary distance is termed the buffer zone. The ratio of the area within the WMA over which detection will occur before impacting the buffer zone to the total area of the WMA is the monitoring efficiency. Output from the model is a map of the WMA showing areas where leaks would not be detected under the given site-specific parameters provided as input to the model.

Figure 4.1 shows the result of three runs using the MEMO model. The figure shows that a westerly groundwater flow direction, for which the WMA C monitoring network was originally designed, results in a monitoring efficiency of 86%. The areas shown in black on the figure are the areas where leaks can occur without detection by the current monitoring network for the specified flow direction. With the current monitoring well network, the monitoring efficiency decreases as the flow direction shifts toward the south. The monitoring efficiency is 73% with a southwest flow direction and 63.2% with a southerly direction. This means that a plume emanating from one-fourth to one-third of the WMA would go undetected with the current monitoring network.

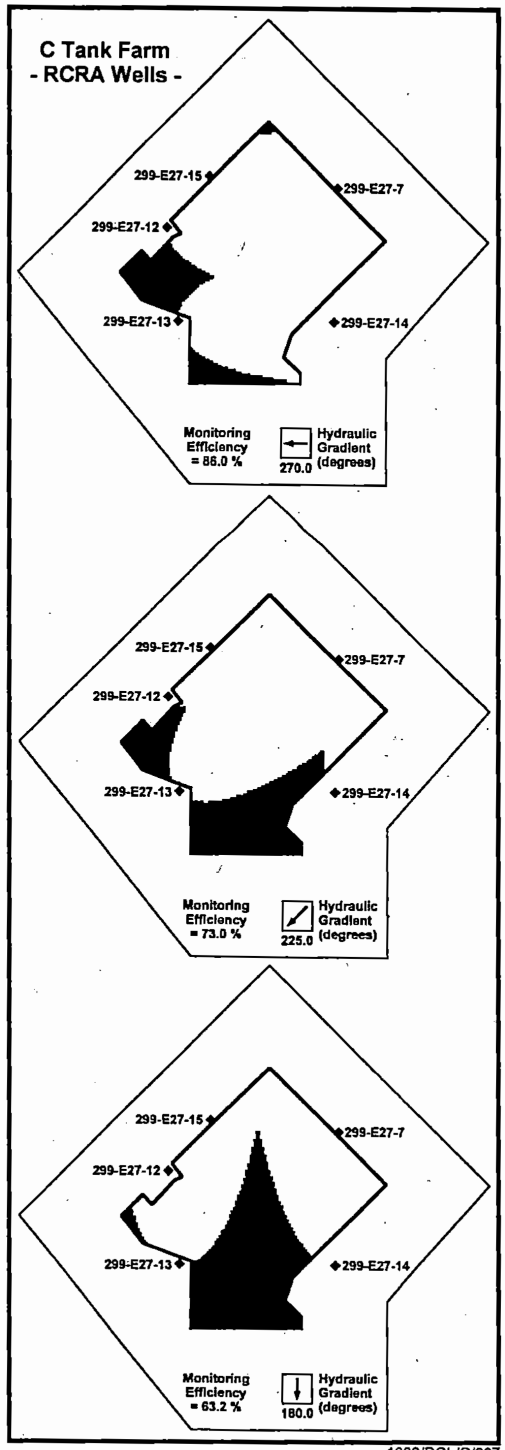


Figure 4.1. Series of MEMO Model Results Evaluating Monitoring Efficiency with Different Groundwater Flow Directions at WMA C. Black or shaded regions indicate those areas from which a leak would not be detected.

The current groundwater-monitoring network at WMA C leaves nearly a third of the site unmonitored if the flow direction is southwest. Well 299-E27-7 remains an upgradient well but well 299-E27-15 changes from a downgradient well to a marginally useful upgradient well. Well 299-E27-13 remains a downgradient well. Well 299-E27-12 may be too far west to be useful as either an upgradient or a downgradient well. Well 299-E27-14 may not be upgradient or marginally downgradient if the direction is southwest. If the groundwater flow direction beneath WMA C is to the southwest, additional wells may be necessary.

Plans to develop and implement an improved monitoring network are discussed in Section 4.2.3. Direct measurement of groundwater flow direction and flow rate within the screened intervals of WMA C monitoring wells is proposed to help evaluate and design an improved monitoring network. If the flow direction and flow rate are determined, a final design can be optimized using simple flow models such as MEMO. This approach should provide for nearly complete coverage of the WMA even as the flow direction shifts back to pre-Hanford conditions.

4.2.2 Dangerous Waste Constituents

It is required under 40 CFR 265.94(a)(2) and WAC 173-313-400 that indicator parameters (i.e., pH, conductivity, total organic carbon, total organic halogen) be monitored to provide a reliable indication of the presence of dangerous constituents in groundwater. The site-specific constituents for WMA C were determined based on:

- types and concentrations of constituents in the stored wastes
- mobility, stability, and persistence of waste constituents in the unsaturated zone beneath WMA C
- detectability of waste constituents in the groundwater
- concentrations or values of the monitoring parameters or constituents in the groundwater background chemistry.

The site-specific sampling needs and issues at WMA C are presented in the following section. The sampling and analysis plan (SAP), consisting of the field sampling plan (FSP) and the quality assurance project plan (QAPP), are provided in Appendix D.

Groundwater Sampling Parameters

According to 40 CFR 265.92, and by reference WAC 173-303-400(3), the owner/operator of an interim-status hazardous waste facility must establish initial background concentrations for the contamination indicator parameters of electrical conductivity, pH, total organic carbon, and total organic halogens. Background values for WMA C were determined first in 1992. Four replicate analyses for each indicator parameter from each monitoring well were obtained quarterly for one year. The averaged replicate t-test is the statistical method used to determine whether significant differences occur in the concentration of indicator parameters from downgradient wells compared to the initial background concentrations from upgradient wells (NWWA 1986). This test was applied to the data from an upgradient well to determine the initial background arithmetic mean and variance (40 CFR 265.93[b]).

Details of the statistical method are given in Appendix D. New critical mean values were determined in 1999. Four replicate samples were collected on a semiannual frequency between February 1997 and June 1999 from upgradient well 299-E27-14. The resulting critical means for WMA C are presented in Table 4.2. These background values will continue to be used until any new wells are installed. After the network is upgraded, interim-detection sampling will be performed to calculate new critical means for the indicator parameters.

A table of indicator parameters along with site-specific constituents are presented in Table 4.3 in conformance with 40 CFR Part 265, Subpart F. Indicator parameters are evaluated semi-annually under the current monitoring system. The sampling frequency of each site-specific constituent is provided.

The analysis for anions captures the values for nitrate, nitrite, sulfate, and chloride, which are the main mobile anionic species found in these tanks. The metals analysis provides concentrations for sodium, aluminum, calcium, iron, chromium, and potassium, the main mobile cations found in tank waste. The organics listed in tank waste with the greatest concentrations are glycolate, DBP, EDTA, HEDTA, and butanol. The analysis for total organic carbon is performed in quadruplicates to monitor for these organics. The primary radionuclides are tritium, ^{90}Sr, ^{99}Tc, ^{125}Sb, ^{60}Co, and ^{137}Cs. Of these, tritium and ^{99}Tc are the most mobile species. Various uranium isotopes are monitored with a total uranium analysis. Cyanide is included in the constituent list because it was in the waste streams routed to 241-C Tank Farm that resulted from in-tank scavenging conducted in the 244-CR vault. Specific conductance, pH, and total organic halides are indicator parameters required by regulations. Phenols, which are not significant constituents of tank waste, will be analyzed annually as required by regulation.

Table 4.2. Critical Mean Values for WMA C[(a)]

Constituent, Unit	Average Background	Standard Deviation	Critical Mean	Upgradient/ Downgradient Comparison Value
Conductivity, µhos/cm	349.812	15.202	553.5	553.5
Field pH	8.345	0.072	[7.76, 8.93]	[7.76, 8.93]
Total Organic Carbon[(b)] µg/L	516.25	128.871	1,662.9	1,662.9
Total Organic Halides,[(b,c)] µg/L	3.021	1.076	10.6	17.9

(a) Data collected from February 1997 to June 1999 for upgradient well 299-E27-14.
(b) Critical mean calculated from values reported below vendor's specified method detection limit.
(c) Upgradient/downgradient comparison value is the limit of quantitation, which is revised quarterly.

Table 4.3. Indicator Parameters, Site-Specific Waste Constituents, and Sampling Frequencies

Contaminant Indicator Parameters	Sampling Frequency
pH	Semiannual
Conductivity	Semiannual
Total Organic Carbon	Semi-annual, Quadruplicates
Total Organic Halogens	Semi-annual, Quadruplicates
Site Specific Constituents	**Sampling Frequency**
Alkalinity	Semiannual
Anions	Semiannual
Low-level gamma Scan	Semiannual
Gross Alpha	Semiannual
Gross Beta	Semiannual
Phenols	Annual
ICP Metals (filtered)	Semiannual
Technetium-99	Semiannual
Total dissolved solids	Semiannual
Total Uranium	Semiannual
Tritium	Semiannual
Iodine-129	Annual
Strontium-90	Annual
Cyanide	Semiannual

Although some of the site-specific constituents appear to be relatively immobile, it is prudent to sample at least annually for detection, especially as surface operations change due to interim stabilization and waste removal operations. Also, ^{90}Sr has the greatest activity of the listed radionuclides in WMA-C SSTs (Appendix A). Although ^{90}Sr is not considered as mobile as ^{99}Tc, it has been observed in groundwater at other sites, and consequently, is monitored annually. The WMA is located within a regional ^{129}I plume. Although ^{129}I is not a major constituent in the tanks, it is analyzed annually because it is very mobile and has a high health risk.

Recent observations at other SST sites indicate that semiannual sampling may not be frequent enough to detect short-lived pulses of waste from the tank farms (Narbutovskih 1998; Hodges F.N. 1999) MEMO monitoring efficiencies are based on continuous leak sources. Pulses of short duration, such as leaking transfer lines during limited waste transfers or remobilization of vadose zone contaminants by ruptured water lines may go undetected. This is because the lateral extent of a plume from a short-lived source would not be as dispersed as a plume from a longer-lived, continuous source. Consequently, these events may go unobserved with a semiannual monitoring frequency and coarse well spacing. When the network has been redesigned to provide adequate downgradient coverage, the sampling frequency for mobile constituents will be increased to at least quarterly.

4.2.3 Monitoring Issues and Resolutions

Monitoring issues specific to WMA C have been identified in the above discussions of the groundwater monitoring plan. These issues are reiterated in this section for clarity along with solutions of tasks to solve monitoring problems. A tentative schedule for each task is also provided. The specific issues are as follows:

- The water table is essentially flat across the 200 East Area. Without an accurate measurement of the gradient, the flow direction across the WMA is questionable. Because the local flow can be quite different from the regional flow and flow directions may change as the B-Pond mound diminishes, regional water table contours and/or regional plume directions are unreliable for determining local flow across the site.

- Based on consistent water levels referenced to a more recent well elevation survey, the current flow direction may be to the southwest.

- The current network was designed for flow specifically to the west. Determination of this flow direction was based on a presumed regional flow due to the presence of the B-Pond mound. No wells were placed to allow for changes in flow direction over time.

- Model studies using a southwest flow direction result in a monitoring efficiency of 73%, suggesting contamination entering the groundwater under one fourth of the WMA may not be detectable with the current location of wells.

- Revisions to the Part A Permit for WMA C added the 244-CR vault, eight diversion boxes, and ancillary equipment to the WMA. The existing groundwater-monitoring network was not designed to monitor the facilities recently added to the WMA

- Finally, with the present rate of water table decline, some wells in the network may be unusable in about six years.

A monitoring network that includes the existing monitoring wells and new downgradient wells has closer well spacing providing sufficient coverage to detect contamination originating from WMA C. The modified network will also account for monitoring the 244-CR vault and seven of the eight diversion boxes that were recently incorporated into the WMA. Consideration will also be given to existing wells that may eventually become unusable due to declining water levels. The design modifications to the existing network will account for current conditions and eventual changes in flow direction. Future well locations will also be chosen to allow differentiation, to the degree possible, between waste from other facilities and waste from the SSTs. MEMO studies will be performed in support of network design after a more accurate flow direction is determined.

Eight diversion boxes were added to the single-shell tanks permit. Seven of the diversion boxes are located within the 241-C Tank Farm fence line and are available for use during waste transfer operation. The eighth diversion box, 241-C-154, is located about 30 ft (9 m) southeast of the 201-C process building, which is about 1,600 ft (500 m) southwest of the 241-C Tank Farm. That diversion box is not covered by the monitoring network. The 241-C-154 diversion box was decommissioned in 1985 as part of the Semi-Works decommissioning effort, which included isolating the lines, sealing the diversion box, filling it with concrete, and covering the area with ash (DOE 1993b). It is unlikely that diversion box 241-C-154 will cause an impact on the groundwater. Consequently, it is not monitored with the current network.

A direct flow measurement device will be used to verify and refine flow direction and rate beneath WMA C. It was demonstrated successfully at the Hanford Site in 1994 and more recently in 1999. Results of the tests at the Hanford Site indicate that a direct flow measurement may be useful in the highly permeable Hanford formation sediments.

The list of specific tasks required to address monitoring issues at WMA C are presented below along with a tentative schedule for preliminary tasks. A schedule for the installation of new wells will be incorporated into the plan with a change notice. Tasks are:

- conduct investigation of degree to which monitoring well 299-E27-15 is not vertical with the downhole gyroscope
  - FY 2001
- determine flow direction and rate directly with the colloidal boroscope® used in conjunction with refined water levels
  - 3rd quarter, FY 2001
- perform flow modeling with adjusted flow rate/direction/point of compliance to obtain optimal well placement
  - 4th quarter, FY 2001
- design network with well placement such that objectives are achieved; design to account for future flow directions as changes are identified
  - 1st quarter, FY 2002
- install new groundwater monitoring wells - to be included in annual negotiations.

After the modified monitoring network is installed, the following changes to this groundwater plan will be made:

- Re-establish critical means for indicator parameters once upgradient wells have been installed.

- Determine groundwater flow rate and direction at new wells.

4.2.4 Data Management, Interpretation, and Reporting

The manner in which the data are received, handled, and stored at Pacific Northwest National Laboratory (PNNL) is described in this section along with information pertaining to data interpretation and reporting of the project results to DOE/RL and Washington State Department of Ecology.

The contract laboratories provide analytical results in written reports and on digital disk. The results are then loaded into the Hanford Environmental Information System (HEIS) database. Field-measured parameters such as field conductivity, pH, temperature, and turbidity are entered manually or through electronic transfer from the sampling subcontractor. Data from HEIS can be downloaded to smaller databases, such spreadsheets for easier handling and manipulation. The printed analytical data reports and original field records stored at PNNL are the official record copies. If questions arise concerning the validity of a data value, the official record copies are used for initial verification.

The data undergo a validation/verification process according to documented procedures as described in Appendix D.3 and according to the Hanford Groundwater Monitoring Project Quality Assurance Project Plan (QAPP). This plan is kept in project files at PNNL along with all documentation and data acquisition pertaining specifically to groundwater monitoring at WMA C. As periodic reviews of the data are released, a copy of each review is kept in these project files. Beginning with FY 1996, the annual groundwater monitoring report contains a digital disk of all chemical and water level data collected for the year (Hartman 1999). The report is also accessible on the PNNL groundwater monitoring website at: http://hanford.pnl.gov/groundwater/gwmonrep.htm

Once the laboratory data are available on HEIS, a qualitative check is performed to assure that data are reasonable with respect to historic trends for each specific constituent of concern. If changes occur from one sampling interval to the next that are unusual, trend comparisons are made with an appropriate co-contaminant to verify the change. If the value continues to appear anomalous, the results are returned to the laboratory for further checking and possible reanalysis.

After data are validated and verified, the accepted data are used to interpret groundwater conditions at the site. Interpretive techniques include but are not limited to:

- hydrographs: the water elevations are plotted versus time to determine fluctuations in groundwater levels and any changes in flow direction.

- water-table maps: normally water-table elevations are mapped from multiple wells to construct contour maps to estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential for the local region proximal to a WMA.

- surface trend analysis: flow direction can be estimated by fitting the water elevations for the same day from three or more wells to a planer surface and calculating the direction of the maximum gradient.

- flow rate determination: estimates of saturated hydraulic conductivity, porosity, and water table gradients are used to estimate flow rates.

- In situ direct flow rate/direction measurements: data from the colloidal boroscope allow direct observation of flow direction with a better understanding of relative flow rates.

- historic trend plots: concentrations and activities of chemical and/or radiological constituents are plotted versus time to determine increases, decreases, and fluctuations in groundwater chemistry. The trend plots are used to make upgradient/downgradient comparisons for indicator parameters. These plots may be used in tandem with hydrography and/or water-table maps to determine if concentrations relate to changes in water-level or in groundwater flow directions.

- plume maps: distributions of chemical concentrations or radiological activities are mapped across the local WMA to determine the extent of contamination. Changes in plume distribution where noticeable movement occurs over time aid in determining movement of plumes and the direction of flow.

- contaminant ratios are used to distinguish between different sources of contamination.

- conductivity and charge balances are used to check the quality of anionic data.

A summary of the reporting requirements for compliance with 40 CFR 265, Subpart F are listed in Table 4.4.

Table 4.4. Reports Required for Compliance with 40 CFR 265, Subpart F, for Groundwater Monitoring

Submittal	Submittal Period	Reporting Vehicle	Regulatory Requirement
First year of sampling: concentrations of interim primary drinking water constituents, identifying those that exceed limits	Quarterly	Complete[a]	40 CFR 265.94(a)(2)(i)
Concentration and statistical analyses of groundwater contamination indicator parameters, noting significant differences in upgradient wells	Annually, by March 1 of following year	Hanford Groundwater Monitoring Report (e.g., Hartman 1999)	40 CFR 265.94(a)(2)(ii)
Results of groundwater surface elevation evaluation and description of response if appropriate	Annually, by March 1 of following year	Hanford Groundwater Monitoring Report	40 CFR 265.94(a)(2)(iii)
Outline for groundwater quality assessment program	Within one year after effective date of regulations	Appendix B of this document	40 CFR 265.93(a)
Notification of statistical exceedance[b]	Within 7 days of verification	Letter to Ecology	40 CFR 265.93(c)
Assessment Plan[b]	Within 15 days of notification	PNNL document or letter	40 CFR 265.93(d)
Determinations under assessment program[b]	As soon as technically feasible; annually thereafter	PNNL document, letter, or Hanford Groundwater Monitoring Report	40 CFR 265.93(d)(5) and 265.94(b)

(a) Requirement was fulfilled during first year of sampling via published reports. Quarterly submittal of data continues via HEIS.
(b) Required if exceedance occurs and is verified.

5.0 References

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40 CFR 265, Code of Federal Regulations, Title 40, Part 265. *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.*

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Appendix A

Tank Waste Inventory

Appendix A

Tank Waste Inventory

The wastes received by the 241-C Tank Farm were alkaline slurries of mixed waste, containing dangerous constituents and radioactive fission products. Although only the dangerous and extremely hazardous waste, as defined by WAC 173-303 is regulated under RCRA monitoring programs, analyses of groundwater samples are performed to also detect the radioactive components. The combination of monitoring for both components of the mixed waste increases the ability to detect waste associated specifically with WMA C. As such, the waste inventory is provided in this appendix on a tank-by-tank basis and includes description of both hazardous and radioactive species.

These data are taken from Agnew (1997) based on the Hanford Defined Waste Model. This model estimates the whole tank inventory based on process knowledge and accounting for nuclear decay and resulting daughter products. The tank-by-tank inventories include 26 chemical constituents and 46 radionuclides. The results shown include the total of the solid and liquid fractions for each tank in WMA C. For a further description of the process by which these data are determined, the reader is referred to Agnew (1997).

In an attempt to resolve the inconsistencies between the currently used River Protection Project inventories and the Hanford Defined Waste Model developed by Los Alamos National Laboratory, the best-basis inventory was developed on both a global basis and a tank-by-tank basis for each of the 177 single- and double-shell tanks. This data set was not included at this time since results are present in total curies and not as concentrations, which are needed to compare to groundwater analytical results. The best basis data will, however, be consulted for relative differences between species in a given tank. The best basis data inventory is maintained by the River Protection Project as part of the Standard Inventory task and further description can be found in Kupfer et al. 1997.

Single-Shell Tank 241-C-101							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	5.26E+05 (kg)	(88.0 kgal)	----	----	----	----	----
Heat Load	1.53E-02 (kW)	(52.3 BTU/hr)	----	8.43E-03	9.15E-03	2.15E-02	2.23E-02
Bulk Density†	1.58 (g/cc)	----	----	1.32	1.36	1.73	1.61
Water wt%†	41.8	----	----	40.9	31.6	60.4	65.9
TOC wt% C (wet)†	4.34E-05	----	----	1.13E-06	4.94E-06	8.99E-05	9.70E-05
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	5.99	8.72E+04	4.59E+04	1.22	1.70	9.05	6.23
Al3+	3.42	5.84E+04	3.07E+04	3.33	3.37	3.47	3.52
Fe3+ (total Fe)	0.727	2.57E+04	1.35E+04	0.190	0.683	0.732	0.737
Cr3+	2.09E-03	68.7	36.2	1.60E-03	1.65E-03	2.53E-03	2.59E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	2.54E-03	323	170	2.29E-03	2.48E-03	2.57E-03	2.58E-03
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	0.133	1.74E+04	9.15E+03	9.33E-02	0.124	0.137	0.140
Ni2+	1.04E-03	38.8	20.4	7.99E-04	8.24E-04	3.20E-03	5.83E-03
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.252	6.40E+03	3.37E+03	0.135	0.137	0.276	0.294
K+	3.45E-03	85.5	45.0	1.04E-03	1.29E-03	5.62E-03	5.91E-03
OH-	14.0	1.51E+05	7.95E+04	12.4	13.7	14.3	14.6
NO3-	4.90	1.92E+05	1.01E+05	0.350	0.681	8.16	5.00
NO2-	0.347	1.01E+04	5.32E+03	0.295	0.300	0.426	0.440
CO32-	0.342	1.30E+04	6.84E+03	0.197	0.220	0.367	0.383
PO43-	3.40E-02	2.04E+03	1.08E+03	1.41E-02	1.62E-02	5.18E-02	8.99E-02
SO42-	3.16E-02	1.92E+03	1.01E+03	9.90E-03	1.22E-02	5.10E-02	5.37E-02
Si (as SiO32-)	5.82E-03	103	54.5	4.74E-03	5.27E-03	6.37E-03	1.77E-02
F-	0	0	0	0	0	0	0
Cl-	1.95E-02	437	230	4.86E-03	6.40E-03	3.26E-02	8.59E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	4.76E-06	0.633	0.333	1.03E-07	5.93E-07	8.92E-06	9.48E-06
butanol	4.76E-06	0.223	0.117	1.03E-07	5.93E-07	8.92E-06	9.48E-06
NH3	2.30E-04	2.47	1.30	8.17E-05	8.54E-05	4.63E-04	4.75E-04
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-101							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	5.26E+05 (kg)	(88.0 kgal)	----	----	----	----	----
Heat Load	1.53E-02 (kW)	(52.3 BTU/hr)	----	8.43E-03	9.15E-03	2.15E-02	2.23E-02
Bulk Density†	1.58 (g/cc)	----	----	1.32	1.36	1.73	1.61
Water wt%†	41.8	----	----	40.9	31.6	60.4	65.9
TOC wt% C (wet)†	4.34E-05	----	----	1.13E-06	4.94E-06	8.99E-05	9.70E-05
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	1.28E-06	8.10E-04	0.427	4.98E-07	5.89E-07	2.06E-06	2.18E-06
C-14	2.68E-07	1.69E-04	8.91E-02	1.62E-07	1.73E-07	3.62E-07	3.75E-07
Ni-59	5.29E-08	3.35E-05	1.76E-02	2.28E-08	2.59E-08	9.33E-08	1.43E-07
Ni-63	4.89E-06	3.10E-03	1.63	2.18E-06	2.47E-06	8.96E-06	1.39E-05
Co-60	8.53E-08	5.40E-05	2.84E-02	6.10E-08	6.36E-08	1.07E-07	1.10E-07
Se-79	3.96E-08	2.50E-05	1.32E-02	1.72E-08	1.96E-08	5.95E-08	6.22E-08
Sr-90	3.21E-03	2.03	1.07E+03	1.49E-03	1.67E-03	4.75E-03	4.96E-03
Y-90	3.21E-03	2.03	1.07E+03	1.49E-03	1.67E-03	4.75E-03	4.96E-03
Zr-93	1.87E-07	1.19E-04	6.24E-02	8.14E-08	9.25E-08	2.82E-07	2.95E-07
Nb-93m	1.54E-07	9.72E-05	5.11E-02	6.40E-08	7.35E-08	2.34E-07	2.44E-07
Tc-99	1.30E-06	8.25E-04	0.434	5.69E-07	6.46E-07	1.96E-06	2.05E-06
Ru-106	5.35E-11	3.39E-08	1.78E-05	1.64E-11	3.50E-11	7.20E-11	8.99E-11
Cd-113m	5.62E-07	3.55E-04	0.187	3.02E-07	3.30E-07	7.94E-07	8.25E-07
Sb-125	2.55E-07	1.62E-04	8.51E-02	1.33E-07	1.95E-07	3.17E-07	3.76E-07
Sn-126	6.00E-08	3.80E-05	2.00E-02	2.64E-08	2.99E-08	9.01E-08	9.41E-08
I-129	2.48E-09	1.57E-06	8.25E-04	1.09E-09	1.24E-09	3.71E-09	3.88E-09
Cs-134	1.34E-08	8.47E-06	4.46E-03	5.26E-09	9.35E-09	1.74E-08	2.13E-08
Cs-137	5.20E-03	3.29	1.73E+03	3.26E-03	3.47E-03	6.93E-03	7.16E-03
Ba-137m	4.92E-03	3.11	1.64E+03	3.09E-03	3.28E-03	6.55E-03	6.77E-03
Sm-151	1.46E-04	9.21E-02	48.5	6.25E-05	7.12E-05	2.20E-04	2.30E-04
Eu-152	5.05E-07	3.20E-04	0.168	5.02E-07	5.02E-07	5.08E-07	5.08E-07
Eu-154	1.72E-06	1.09E-03	0.572	1.27E-06	1.33E-06	2.11E-06	2.16E-06
Eu-155	3.59E-05	2.27E-02	12.0	3.57E-05	3.57E-05	3.61E-05	3.61E-05
Ra-226	1.21E-11	7.63E-09	4.01E-06	5.96E-12	6.60E-12	2.12E-11	2.76E-10
Ra-228	1.53E-08	9.68E-06	5.09E-03	1.51E-08	1.52E-08	1.54E-08	1.55E-08
Ac-227	4.69E-08	2.97E-05	1.56E-02	3.80E-08	4.48E-08	4.81E-08	4.93E-08
Pa-231	6.94E-08	4.39E-05	2.31E-02	2.02E-08	5.82E-08	7.63E-08	8.29E-08
Th-229	6.92E-09	4.38E-06	2.31E-03	6.82E-09	6.87E-09	6.98E-09	7.03E-09
Th-232	7.13E-10	4.51E-07	2.37E-04	2.14E-10	4.65E-10	9.61E-10	1.20E-09
U-232	7.89E-07	4.99E-04	0.263	9.64E-09	4.26E-07	9.58E-07	1.05E-06
U-233	3.06E-06	1.94E-03	1.02	3.65E-08	1.65E-06	3.72E-06	4.09E-06
U-234	1.25E-05	7.92E-03	4.17	8.44E-06	1.06E-05	1.34E-05	1.39E-05
U-235	5.38E-07	3.41E-04	0.179	3.71E-07	4.60E-07	5.74E-07	5.95E-07
U-236	2.18E-07	1.38E-04	7.25E-02	9.55E-08	1.61E-07	2.44E-07	2.59E-07
U-238	1.24E-05	7.87E-03	4.14	8.59E-06	1.06E-05	1.33E-05	1.37E-05
Np-237	8.34E-09	5.28E-06	2.78E-03	3.80E-09	4.28E-09	1.24E-08	1.29E-08
Pu-238	2.57E-05	1.63E-02	8.55	2.05E-05	2.45E-05	2.64E-05	2.71E-05
Pu-239	1.25E-03	0.790	416	1.03E-03	1.20E-03	1.28E-03	1.31E-03
Pu-240	2.09E-04	0.132	69.7	1.71E-04	2.00E-04	2.15E-04	2.20E-04
Pu-241	2.00E-03	1.26	665	1.58E-03	1.90E-03	2.06E-03	2.11E-03
Pu-242	6.21E-09	3.93E-06	2.07E-03	5.04E-09	5.94E-09	6.37E-09	6.53E-09
Am-241	4.97E-07	3.15E-04	0.166	2.94E-07	3.15E-07	6.79E-07	7.04E-07
Am-243	4.36E-12	2.76E-09	1.45E-06	2.94E-12	3.09E-12	5.63E-12	5.80E-12
Cm-242	8.66E-09	5.48E-06	2.88E-03	8.60E-09	8.61E-09	8.71E-09	8.72E-09
Cm-243	2.03E-10	1.28E-07	6.75E-05	2.01E-10	2.01E-10	2.04E-10	2.04E-10
Cm-244	1.63E-10	1.03E-07	5.42E-05	1.24E-10	1.33E-10	1.93E-10	2.01E-10
Totals	**M**	**μg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	2.10E-02 (g/L)	----	7.01	1.74E-02	2.02E-02	2.15E-02	2.20E-02
U	0.156	2.36E+04	1.24E+04	0.108	0.134	0.167	0.173

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-102							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	2.40E+06 (kg)	(423 kgal)	----	----	----	----	----
Heat Load	4.97E-02 (kW)	(170 BTU/hr)	----	3.02E-02	4.00E-02	6.18E-02	6.88E-02
Bulk Density†	1.50 (g/cc)	----	----	1.35	1.43	1.54	1.58
Water wt%†	51.4	----	----	46.9	48.6	54.1	58.2
TOC wt% C (wet)†	1.04E-03	----	----	2.11E-04	6.73E-04	1.09E-03	1.16E-03
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	2.09	3.20E+04	7.69E+04	1.42	1.61	2.79	3.22
Al3+	5.02	9.03E+04	2.17E+05	4.75	4.89	5.15	5.27
Fe3+ (total Fe)	0.501	1.87E+04	4.48E+04	0.366	0.470	0.516	0.525
Cr3+	2.64E-03	91.5	220	1.36E-03	2.00E-03	3.27E-03	3.89E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	4.87E-03	652	1.56E+03	4.20E-03	4.72E-03	4.94E-03	4.98E-03
Zr (as ZrO(OH)2)	2.85E-02	1.73E+03	4.16E+03	2.63E-02	2.80E-02	2.87E-02	2.88E-02
Pb2+	0.263	3.64E+04	8.73E+04	0.155	0.239	0.275	0.282
Ni2+	3.53E-03	138	332	1.17E-03	2.55E-03	9.45E-03	1.67E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.287	7.68E+03	1.84E+04	4.00E-02	0.148	0.352	0.388
K+	9.39E-03	245	588	5.33E-03	7.33E-03	1.15E-02	1.35E-02
OH-	18.7	2.12E+05	5.08E+05	16.2	17.6	19.4	20.1
NO3-	1.11	4.60E+04	1.10E+05	0.607	0.643	1.83	2.27
NO2-	0.244	7.48E+03	1.80E+04	0.120	0.181	0.308	0.372
CO32-	0.312	1.25E+04	3.00E+04	6.45E-02	0.173	0.377	0.413
PO43-	1.22E-02	772	1.85E+03	8.77E-03	1.02E-02	1.42E-02	1.84E-02
SO42-	1.50E-02	962	2.31E+03	9.77E-03	1.24E-02	1.76E-02	2.02E-02
Si (as SiO32-)	1.34E-03	25.1	60.2	1.09E-03	1.21E-03	1.47E-03	4.07E-03
F-	0.169	2.15E+03	5.15E+03	1.34E-02	0.129	0.188	0.199
Cl-	1.28E-02	303	727	8.01E-03	1.04E-02	1.52E-02	2.02E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	1.09E-04	15.2	36.6	2.28E-05	7.16E-05	1.09E-04	1.10E-04
butanol	1.09E-04	5.38	12.9	2.28E-05	7.16E-05	1.09E-04	1.10E-04
NH3	2.04E-02	231	554	6.50E-03	1.34E-02	2.73E-02	3.40E-02
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-102							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	2.40E+06 (kg)	(423 kgal)	----	----	----	----	----
Heat Load	4.97E-02 (kW)	(170 BTU/hr)	----	3.02E-02	4.00E-02	6.18E-02	6.88E-02
Bulk Density†	1.50 (g/cc)	----	----	1.35	1.43	1.54	1.58
Water wt%†	51.4	----	----	46.9	48.6	54.1	58.2
TOC wt% C (wet)†	1.04E-03	----	----	2.11E-04	6.73E-04	1.09E-03	1.16E-03
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	9.11E-07	6.08E-04	1.46	5.16E-07	6.58E-07	1.28E-06	1.74E-06
C-14	1.32E-07	8.79E-05	0.211	8.95E-08	1.11E-07	1.53E-07	1.73E-07
Ni-59	2.56E-08	1.70E-05	4.09E-02	1.36E-08	1.96E-08	1.37E-07	2.72E-07
Ni-63	2.51E-06	1.67E-03	4.02	1.31E-06	1.91E-06	1.37E-05	2.73E-05
Co-60	1.39E-07	9.28E-05	0.223	7.75E-08	1.09E-07	1.70E-07	2.00E-07
Se-79	2.76E-08	1.84E-05	4.42E-02	1.82E-08	2.29E-08	3.23E-08	3.68E-08
Sr-90	2.53E-03	1.68	4.04E+03	1.52E-03	2.03E-03	3.03E-03	3.51E-03
Y-90	2.53E-03	1.69	4.05E+03	1.53E-03	2.03E-03	3.03E-03	3.51E-03
Zr-93	1.17E-07	7.77E-05	0.187	7.23E-08	9.46E-08	1.39E-07	1.60E-07
Nb-93m	8.72E-08	5.82E-05	0.140	5.49E-08	7.12E-08	1.03E-07	1.19E-07
Tc-99	7.69E-07	5.13E-04	1.23	4.57E-07	6.14E-07	9.24E-07	1.07E-06
Ru-106	5.59E-10	3.73E-07	8.96E-04	1.97E-10	2.51E-10	1.03E-09	1.49E-09
Cd-113m	4.77E-07	3.18E-04	0.763	2.62E-07	3.70E-07	5.84E-07	6.87E-07
Sb-125	7.71E-07	5.14E-04	1.23	4.35E-07	6.04E-07	9.39E-07	1.10E-06
Sn-126	3.84E-08	2.56E-05	6.15E-02	2.41E-08	3.13E-08	4.56E-08	5.26E-08
I-129	1.61E-09	1.07E-06	2.57E-03	1.01E-09	1.31E-09	1.91E-09	2.20E-09
Cs-134	7.51E-08	5.01E-05	0.120	4.80E-08	6.14E-08	9.06E-08	1.03E-07
Cs-137	2.99E-03	1.99	4.79E+03	1.84E-03	2.42E-03	4.82E-03	5.93E-03
Ba-137m	2.83E-03	1.89	4.53E+03	1.74E-03	2.29E-03	4.56E-03	5.61E-03
Sm-151	8.05E-05	5.37E-02	129	4.65E-05	6.36E-05	9.74E-05	1.14E-04
Eu-152	6.44E-07	4.30E-04	1.03	6.36E-07	6.40E-07	6.48E-07	6.52E-07
Eu-154	3.15E-06	2.10E-03	5.05	1.93E-06	2.55E-06	3.76E-06	4.35E-06
Eu-155	4.22E-05	2.82E-02	67.6	4.17E-05	4.20E-05	4.25E-05	4.28E-05
Ra-226	4.70E-10	3.14E-07	7.53E-04	3.40E-10	4.37E-10	4.93E-10	5.14E-10
Ra-228	3.37E-06	2.25E-03	5.39	3.23E-06	3.31E-06	3.37E-06	3.37E-06
Ac-227	1.11E-05	7.39E-03	17.7	1.11E-05	1.11E-05	1.11E-05	1.11E-05
Pa-231	1.85E-05	1.24E-02	29.7	1.84E-05	1.85E-05	1.86E-05	1.86E-05
Th-229	9.91E-08	6.61E-05	0.159	9.58E-08	9.77E-08	9.93E-08	9.94E-08
Th-232	2.01E-08	1.34E-05	3.21E-02	5.69E-09	1.39E-08	2.07E-08	1.31E-07
U-232	2.24E-06	1.50E-03	3.59	1.05E-07	1.25E-06	2.71E-06	2.97E-06
U-233	8.73E-06	5.82E-03	14.0	4.15E-07	4.85E-06	1.05E-05	1.15E-05
U-234	1.41E-05	9.38E-03	22.5	2.88E-06	8.85E-06	1.65E-05	1.78E-05
U-235	5.84E-07	3.89E-04	0.935	1.25E-07	3.70E-07	6.83E-07	7.39E-07
U-236	3.93E-07	2.62E-04	0.629	5.72E-08	2.36E-07	4.66E-07	5.06E-07
U-238	1.34E-05	8.93E-03	21.4	2.83E-06	8.47E-06	1.57E-05	1.70E-05
Np-237	5.58E-09	3.72E-06	8.93E-03	3.26E-09	4.43E-09	6.74E-09	7.85E-09
Pu-238	6.40E-05	4.27E-02	102	4.98E-05	6.07E-05	6.60E-05	6.79E-05
Pu-239	2.21E-03	1.47	3.53E+03	1.61E-03	2.07E-03	2.29E-03	2.37E-03
Pu-240	4.07E-04	0.271	651	3.01E-04	3.83E-04	4.21E-04	4.36E-04
Pu-241	4.93E-03	3.29	7.90E+03	3.80E-03	4.67E-03	5.09E-03	5.25E-03
Pu-242	1.87E-08	1.25E-05	3.00E-02	1.55E-08	1.80E-08	1.92E-08	1.96E-08
Am-241	1.11E-06	7.39E-04	1.77	6.46E-07	8.73E-07	2.76E-06	5.49E-06
Am-243	1.05E-10	6.97E-08	1.67E-04	3.58E-11	6.97E-11	3.51E-10	7.58E-10
Cm-242	2.22E-08	1.48E-05	3.55E-02	2.13E-08	2.17E-08	2.26E-08	2.30E-08
Cm-243	2.02E-09	1.35E-06	3.23E-03	1.91E-09	1.96E-09	2.07E-09	2.12E-09
Cm-244	4.49E-08	3.00E-05	7.19E-02	2.20E-09	2.81E-08	5.44E-08	6.35E-08
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	3.73E-02 (g/L)	----	59.8	2.73E-02	3.51E-02	3.87E-02	4.01E-02
U	0.168	2.67E+04	6.42E+04	3.56E-02	0.107	0.197	0.213

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-103							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	8.92E+05 (kg)	(195 kgal)	----	----	----	----	----
Heat Load	8.40 (kW)	(2.87E+04 BTU/hr)	----	8.26	8.33	8.48	8.55
Bulk Density†	1.21 (g/cc)	----	----	1.19	1.20	1.22	1.23
Water wt%†	72.5	----	----	69.5	70.9	74.0	75.6
TOC wt% C (wet)†	1.09	----	----	0.361	0.720	1.46	1.81
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.16	6.01E+04	5.36E+04	2.67	2.91	3.41	3.63
Al3+	1.19	2.67E+04	2.38E+04	1.13	1.18	1.21	1.22
Fe3+ (total Fe)	0.200	9.26E+03	8.26E+03	0.198	0.199	0.201	0.202
Cr3+	1.25E-02	537	479	1.02E-02	1.12E-02	1.38E-02	1.56E-02
Bi3+	1.27E-04	21.9	19.5	1.10E-04	1.18E-04	1.35E-04	1.48E-04
La3+	4.94E-07	5.68E-02	5.07E-02	4.08E-07	4.45E-07	5.47E-07	6.24E-07
Hg2+	4.81E-04	79.8	71.2	4.75E-04	4.78E-04	4.83E-04	4.85E-04
Zr (as ZrO(OH)2)	6.07E-06	0.458	0.409	4.63E-06	5.18E-06	6.92E-06	8.32E-06
Pb2+	2.26E-02	3.87E+03	3.45E+03	2.10E-02	2.18E-02	2.34E-02	2.41E-02
Ni2+	1.86E-02	901	804	1.84E-02	1.85E-02	1.86E-02	1.87E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	9.32E-04	42.4	37.8	8.29E-04	8.80E-04	9.84E-04	1.03E-03
Ca2+	4.11E-02	1.36E+03	1.22E+03	3.37E-02	3.73E-02	4.50E-02	4.87E-02
K+	1.14E-02	369	329	9.34E-03	1.02E-02	1.28E-02	1.47E-02
OH-	5.04	7.09E+04	6.32E+04	4.74	4.95	5.10	5.16
NO3-	0.614	3.15E+04	2.81E+04	0.562	0.589	0.639	0.663
NO2-	0.548	2.08E+04	1.86E+04	0.439	0.485	0.616	0.635
CO32-	0.159	7.89E+03	7.04E+03	0.123	0.141	0.177	0.186
PO43-	1.37E-02	1.08E+03	962	1.09E-02	1.21E-02	1.50E-02	1.66E-02
SO42-	6.47E-02	5.14E+03	4.59E+03	4.99E-02	5.71E-02	7.34E-02	7.98E-02
Si (as SiO32-)	0.307	7.14E+03	6.37E+03	0.280	0.297	0.317	0.327
F-	7.66E-03	120	107	5.45E-03	6.36E-03	9.09E-03	1.12E-02
Cl-	3.87E-02	1.14E+03	1.01E+03	2.97E-02	3.41E-02	4.34E-02	4.79E-02
C6H5O73-	4.99E-03	780	696	4.35E-03	4.62E-03	5.38E-03	6.00E-03
EDTA4-	3.00E-02	7.16E+03	6.39E+03	8.25E-03	1.89E-02	4.13E-02	5.22E-02
HEDTA3-	5.71E-02	1.30E+04	1.16E+04	1.35E-02	3.48E-02	7.95E-02	0.101
glycolate-	6.39E-02	3.96E+03	3.54E+03	2.03E-02	4.16E-02	8.63E-02	0.108
acetate-	9.53E-03	465	415	8.44E-03	8.93E-03	1.02E-02	1.12E-02
oxalate2-	6.47E-07	4.71E-02	4.21E-02	6.10E-07	6.26E-07	6.68E-07	7.11E-07
DBP	4.26E-03	741	661	3.28E-03	3.70E-03	4.87E-03	5.76E-03
butanol	4.26E-03	261	233	3.28E-03	3.70E-03	4.87E-03	5.76E-03
NH3	3.06E-02	431	384	2.97E-02	3.00E-02	3.15E-02	3.27E-02
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-103							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	8.92E+05 (kg)	(195 kgal)	----	----	----	----	----
Heat Load	8.40 (kW)	(2.87E+04 BTU/hr)	----	8.26	8.33	8.48	8.55
Bulk Density†	1.21 (g/cc)	----	----	1.19	1.20	1.22	1.23
Water wt%†	72.5	----	----	69.5	70.9	74.0	75.6
TOC wt% C (wet)†	1.09	----	----	0.361	0.720	1.46	1.81
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	4.32E-05	3.58E-02	31.9	2.60E-05	2.77E-05	6.03E-05	8.14E-05
C-14	7.46E-06	6.17E-03	5.50	4.88E-06	4.88E-06	8.04E-06	8.34E-06
Ni-59	1.45E-05	1.20E-02	10.7	1.39E-05	1.42E-05	1.49E-05	1.52E-05
Ni-63	1.43E-03	1.18	1.05E+03	1.36E-03	1.39E-03	1.46E-03	1.49E-03
Co-60	1.05E-05	8.73E-03	7.79	6.75E-06	6.75E-06	1.17E-05	1.30E-05
Se-79	7.24E-06	5.99E-03	5.34	1.11E-06	3.01E-06	1.15E-05	1.55E-05
Sr-90	1.62	1.34E+03	1.20E+06	1.60	1.61	1.64	1.65
Y-90	1.62	1.34E+03	1.20E+06	1.60	1.61	1.64	1.65
Zr-93	3.09E-05	2.56E-02	22.8	5.40E-06	9.79E-06	5.21E-05	7.24E-05
Nb-93m	2.73E-05	2.26E-02	20.1	3.92E-06	1.25E-05	4.21E-05	5.63E-05
Tc-99	5.66E-05	4.68E-02	41.7	4.31E-05	4.91E-05	6.49E-05	7.61E-05
Ru-106	3.57E-09	2.95E-06	2.63E-03	2.45E-09	2.46E-09	1.12E-08	1.86E-08
Cd-113m	4.11E-05	3.40E-02	30.3	2.86E-05	2.87E-05	1.60E-04	2.82E-04
Sb-125	5.02E-05	4.16E-02	37.1	3.32E-05	3.32E-05	5.73E-05	6.41E-05
Sn-126	1.17E-05	9.68E-03	8.64	1.68E-06	5.36E-06	1.80E-05	2.41E-05
I-129	1.10E-07	9.06E-05	8.08E-02	8.34E-08	9.51E-08	1.26E-07	1.48E-07
Cs-134	2.61E-06	2.16E-03	1.93	9.60E-07	1.77E-06	3.46E-06	4.29E-06
Cs-137	9.56E-02	79.1	7.05E+04	6.57E-02	8.03E-02	0.111	0.126
Ba-137m	9.04E-02	74.8	6.67E+04	6.22E-02	7.60E-02	0.105	0.119
Sm-151	2.75E-02	22.8	2.03E+04	3.94E-03	1.27E-02	4.23E-02	5.66E-02
Eu-152	1.15E-05	9.49E-03	8.46	1.03E-05	1.09E-05	1.21E-05	1.27E-05
Eu-154	2.08E-04	0.172	153	1.41E-04	1.62E-04	2.25E-04	9.98E-04
Eu-155	7.44E-04	0.616	549	6.72E-04	7.08E-04	7.82E-04	8.18E-04
Ra-226	9.46E-10	7.83E-07	6.98E-04	6.89E-10	8.15E-10	1.08E-09	1.20E-09
Ra-228	6.92E-08	5.72E-05	5.10E-02	8.51E-09	8.51E-09	7.21E-08	7.52E-08
Ac-227	4.96E-09	4.10E-06	3.66E-03	3.50E-09	4.21E-09	5.70E-09	6.41E-09
Pa-231	7.42E-09	6.14E-06	5.48E-03	1.16E-09	3.29E-09	1.16E-08	1.55E-08
Th-229	1.66E-09	1.37E-06	1.22E-03	2.56E-10	2.56E-10	1.72E-09	1.79E-09
Th-232	8.10E-09	6.70E-06	5.98E-03	6.08E-10	6.08E-10	1.02E-08	1.21E-08
U-232	1.96E-07	1.63E-04	0.145	1.40E-07	1.62E-07	2.35E-07	2.77E-07
U-233	7.53E-07	6.23E-04	0.556	5.35E-07	6.22E-07	9.02E-07	1.06E-06
U-234	2.16E-06	1.79E-03	1.60	1.99E-06	2.09E-06	2.23E-06	2.28E-06
U-235	9.19E-08	7.60E-05	6.78E-02	8.47E-08	8.86E-08	9.46E-08	9.68E-08
U-236	3.94E-08	3.26E-05	2.91E-02	3.65E-08	3.81E-08	4.05E-08	4.14E-08
U-238	2.30E-06	1.91E-03	1.70	2.13E-06	2.22E-06	2.37E-06	2.42E-06
Np-237	1.86E-07	1.54E-04	0.137	1.42E-07	1.62E-07	2.13E-07	2.50E-07
Pu-238	5.05E-06	4.18E-03	3.73	4.84E-06	4.95E-06	5.16E-06	5.26E-06
Pu-239	3.05E-04	0.253	225	2.92E-04	2.98E-04	3.12E-04	3.19E-04
Pu-240	4.71E-05	3.90E-02	34.8	4.51E-05	4.61E-05	4.81E-05	4.92E-05
Pu-241	3.67E-04	0.304	271	3.52E-04	3.59E-04	3.75E-04	3.82E-04
Pu-242	1.47E-09	1.21E-06	1.08E-03	1.39E-09	1.43E-09	1.51E-09	1.55E-09
Am-241	2.27E-04	0.188	167	1.02E-04	1.63E-04	2.90E-04	3.51E-04
Am-243	5.25E-09	4.34E-06	3.87E-03	2.62E-09	3.94E-09	6.50E-09	7.65E-09
Cm-242	2.95E-07	2.44E-04	0.218	2.51E-07	2.72E-07	3.18E-07	3.41E-07
Cm-243	1.89E-08	1.56E-05	1.39E-02	1.49E-08	1.68E-08	2.09E-08	2.29E-08
Cm-244	1.30E-07	1.08E-04	9.61E-02	4.21E-08	4.24E-08	2.84E-07	4.31E-07
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	4.95E-03 (g/L)	----	3.66	4.73E-03	4.84E-03	5.07E-03	5.18E-03
U	2.77E-02	5.45E+03	4.86E+03	2.55E-02	2.67E-02	2.85E-02	2.92E-02

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-104							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	1.63E+06 (kg)	(295 kgal)	----	----	----	----	-----
Heat Load	3.70 (kW)	(1.26E+04 BTU/hr)	----	1.01	2.75	4.12	4.35
Bulk Density†	1.46 (g/cc)	----	----	1.42	1.44	1.51	1.53
Water wt%†	53.5	----	----	47.3	49.6	54.3	55.5
TOC wt% C (wet)†	0.169	----	----	6.34E-02	0.119	0.219	0.251
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	2.58	4.07E+04	6.63E+04	2.10	2.46	3.51	4.09
Al3+	3.45	6.38E+04	1.04E+05	3.38	3.42	3.49	3.53
Fe3+ (total Fe)	1.12	4.27E+04	6.97E+04	1.08	1.11	1.13	1.13
Cr3+	4.41E-03	157	256	3.93E-03	4.20E-03	4.60E-03	4.79E-03
Bi3+	1.21E-05	1.73	2.83	1.13E-05	1.17E-05	1.25E-05	1.29E-05
La3+	2.45E-07	2.33E-02	3.80E-02	1.80E-07	2.12E-07	2.79E-07	3.11E-07
Hg2+	2.97E-03	407	664	2.76E-03	2.92E-03	2.99E-03	3.00E-03
Zr (as ZrO(OH)2)	8.48E-02	5.30E+03	8.64E+03	7.83E-02	8.33E-02	8.55E-02	8.59E-02
Pb2+	0.132	1.87E+04	3.05E+04	9.94E-02	0.124	0.135	0.138
Ni2+	4.67E-02	1.88E+03	3.06E+03	3.83E-02	4.29E-02	4.98E-02	5.22E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	1.01E-04	3.81	6.21	9.26E-05	9.68E-05	1.06E-04	1.10E-04
Ca2+	0.337	9.25E+03	1.51E+04	0.263	0.295	0.368	0.398
K+	2.26E-02	605	986	1.05E-02	1.64E-02	2.88E-02	3.49E-02
OH-	15.9	1.85E+05	3.02E+05	15.2	15.6	16.1	16.3
NO3-	0.825	3.50E+04	5.71E+04	0.689	0.697	1.78	2.39
NO2-	0.402	1.27E+04	2.07E+04	0.348	0.363	0.425	0.446
CO32-	0.387	1.59E+04	2.59E+04	0.312	0.345	0.417	0.446
PO43-	1.42E-02	920	1.50E+03	9.63E-03	1.18E-02	1.51E-02	1.92E-02
SO42-	1.99E-02	1.31E+03	2.14E+03	1.67E-02	1.85E-02	2.12E-02	2.20E-02
Si (as SiO32-)	8.39E-02	1.61E+03	2.63E+03	1.74E-02	5.28E-02	9.76E-02	0.107
F-	0.494	6.42E+03	1.05E+04	2.90E-02	0.373	0.550	0.581
Cl-	1.75E-02	424	692	1.37E-02	1.58E-02	1.82E-02	1.89E-02
C6H5O73-	3.10E-04	40.1	65.5	2.89E-04	2.98E-04	3.23E-04	3.43E-04
EDTA4-	5.24E-03	1.03E+03	1.68E+03	1.44E-03	3.42E-03	7.03E-03	8.22E-03
HEDTA3-	1.04E-02	1.95E+03	3.19E+03	2.81E-03	6.77E-03	1.40E-02	1.64E-02
glycolate-	1.10E-02	566	923	3.42E-03	7.38E-03	1.46E-02	1.70E-02
acetate-	2.11E-04	8.54	13.9	1.77E-04	1.92E-04	2.32E-04	2.64E-04
oxalate2-	3.21E-07	1.94E-02	3.16E-02	2.86E-07	3.03E-07	3.39E-07	3.57E-07
DBP	2.10E-03	302	492	1.59E-03	1.88E-03	2.19E-03	2.28E-03
butanol	2.10E-03	106	174	1.59E-03	1.88E-03	2.19E-03	2.28E-03
NH3	6.84E-02	796	1.30E+03	2.71E-02	4.76E-02	8.92E-02	0.109
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-104 Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	1.63E+06 (kg)	(295 kgal)	----	----	----	----	----
Heat Load	3.70 (kW)	(1.26E+04 BTU/hr)	----	1.01	2.75	4.12	4.35
Bulk Density†	1.46 (g/cc)	----	----	1.42	1.44	1.51	1.53
Water wt%†	53.5	----	----	47.3	49.6	54.3	55.5
TOC wt% C (wet)†	0.169	----	----	6.34E-02	0.119	0.219	0.251
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	9.12E-06	6.24E-03	10.2	5.99E-06	7.11E-06	1.20E-05	1.49E-05
C-14	9.42E-07	6.45E-04	1.05	7.43E-07	7.54E-07	1.04E-06	2.22E-06
Ni-59	2.36E-05	1.61E-02	26.3	2.19E-05	2.27E-05	2.44E-05	2.52E-05
Ni-63	2.32E-03	1.59	2.59E+03	2.16E-03	2.24E-03	2.40E-03	2.48E-03
Co-60	1.39E-06	9.52E-04	1.55	9.87E-07	1.18E-06	1.58E-06	3.31E-06
Se-79	1.35E-05	9.25E-03	15.1	3.30E-06	7.23E-06	1.98E-05	2.59E-05
Sr-90	0.478	327	5.34E+05	0.125	0.354	0.533	0.563
Y-90	0.478	327	5.34E+05	0.125	0.354	0.533	0.563
Zr-93	5.86E-05	4.01E-02	65.5	1.21E-05	2.72E-05	9.01E-05	1.20E-04
Nb-93m	4.99E-05	3.41E-02	55.7	1.08E-05	2.78E-05	7.19E-05	9.30E-05
Tc-99	6.86E-06	4.69E-03	7.66	5.51E-06	6.21E-06	7.49E-06	7.91E-06
Ru-106	1.02E-07	6.98E-05	0.114	7.88E-08	9.64E-08	1.08E-07	1.13E-07
Cd-113m	1.33E-04	9.13E-02	149	1.78E-05	6.62E-05	2.94E-04	4.75E-04
Sb-125	8.24E-06	5.64E-03	9.20	5.86E-06	7.10E-06	9.36E-06	1.01E-05
Sn-126	2.17E-05	1.48E-02	24.2	5.51E-06	1.22E-05	3.11E-05	4.02E-05
I-129	1.40E-08	9.60E-06	1.57E-02	1.14E-08	1.28E-08	1.53E-08	1.61E-08
Cs-134	6.57E-07	4.50E-04	0.734	3.69E-07	5.19E-07	9.35E-07	1.10E-06
Cs-137	1.91E-02	13.1	2.13E+04	1.39E-02	1.66E-02	3.11E-02	3.83E-02
Ba-137m	1.81E-02	12.4	2.02E+04	1.32E-02	1.57E-02	2.94E-02	3.63E-02
Sm-151	5.05E-02	34.5	5.63E+04	1.30E-02	2.84E-02	7.25E-02	9.36E-02
Eu-152	1.34E-05	9.15E-03	14.9	1.32E-05	1.33E-05	1.35E-05	1.35E-05
Eu-154	3.41E-04	0.234	381	6.78E-05	7.68E-05	9.01E-04	1.87E-03
Eu-155	8.28E-04	0.567	924	8.15E-04	8.22E-04	8.34E-04	8.38E-04
Ra-226	4.37E-09	2.99E-06	4.88E-03	3.99E-09	4.18E-09	4.57E-09	4.75E-09
Ra-228	1.99E-05	1.36E-02	22.2	1.91E-05	1.95E-05	1.99E-05	1.99E-05
Ac-227	6.22E-05	4.26E-02	69.4	6.22E-05	6.22E-05	6.22E-05	6.22E-05
Pa-231	1.12E-04	7.66E-02	125	1.12E-04	1.12E-04	1.12E-04	1.12E-04
Th-229	4.42E-07	3.02E-04	0.493	4.24E-07	4.34E-07	4.42E-07	4.42E-07
Th-232	1.10E-06	7.55E-04	1.23	3.87E-08	5.99E-07	1.44E-06	1.76E-06
U-232	1.70E-05	1.16E-02	18.9	9.49E-06	1.36E-05	1.97E-05	2.18E-05
U-233	6.50E-05	4.45E-02	72.5	3.64E-05	5.20E-05	7.54E-05	8.36E-05
U-234	1.57E-05	1.08E-02	17.6	1.24E-05	1.42E-05	1.65E-05	1.72E-05
U-235	6.19E-07	4.23E-04	0.691	4.81E-07	5.55E-07	6.49E-07	6.68E-07
U-236	6.93E-07	4.74E-04	0.773	5.40E-07	6.24E-07	7.48E-07	7.92E-07
U-238	1.33E-05	9.10E-03	14.8	1.01E-05	1.18E-05	1.40E-05	1.44E-05
Np-237	2.50E-08	1.71E-05	2.79E-02	2.07E-08	2.29E-08	2.70E-08	2.83E-08
Pu-238	9.11E-05	6.23E-02	102	8.50E-05	8.99E-05	9.22E-05	9.33E-05
Pu-239	2.07E-03	1.42	2.32E+03	1.90E-03	2.03E-03	2.11E-03	2.15E-03
Pu-240	4.08E-04	0.279	456	3.77E-04	4.01E-04	4.15E-04	4.22E-04
Pu-241	6.17E-03	4.22	6.89E+03	5.74E-03	6.09E-03	6.25E-03	6.33E-03
Pu-242	3.60E-08	2.46E-05	4.01E-02	3.34E-08	3.55E-08	3.64E-08	3.68E-08
Am-241	5.66E-04	0.387	632	3.81E-04	4.72E-04	6.60E-04	7.51E-04
Am-243	2.93E-08	2.00E-05	3.27E-02	2.20E-08	2.70E-08	3.13E-08	3.32E-08
Cm-242	5.22E-07	3.57E-04	0.582	5.14E-07	5.18E-07	5.25E-07	5.28E-07
Cm-243	4.79E-08	3.28E-05	5.35E-02	4.72E-08	4.76E-08	4.83E-08	4.85E-08
Cm-244	1.84E-06	1.26E-03	2.05	1.38E-06	1.73E-06	1.95E-06	2.06E-06
Totals	**M**	**μg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	3.52E-02 (g/L)	----	39.3	3.22E-02	3.45E-02	3.59E-02	3.66E-02
U	0.167	2.73E+04	4.45E+04	0.128	0.149	0.176	0.181

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-105							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	8.31E+05 (kg)	(150 kgal)	----	----	----	----	----
Heat Load	2.03E-02 (kW)	(69.5 BTU/hr)	----	1.69E-02	1.73E-02	2.34E-02	2.38E-02
Bulk Density†	1.46 (g/cc)	----	----	1.39	1.40	1.51	1.49
Water wt%†	53.1	----	----	51.8	49.3	58.9	60.4
TOC wt% C (wet)†	1.37E-05	----	----	3.15E-07	1.66E-06	2.66E-05	2.84E-05
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.20	5.03E+04	4.18E+04	1.80	1.94	4.10	3.54
Al3+	4.64	8.56E+04	7.11E+04	4.52	4.58	4.70	4.76
Fe3+ (total Fe)	0.306	1.17E+04	9.70E+03	0.149	0.293	0.310	0.315
Cr3+	2.46E-03	87.4	72.6	2.03E-03	2.24E-03	2.68E-03	2.90E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	2.27E-03	312	259	2.25E-03	2.26E-03	2.28E-03	2.29E-03
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	0.106	1.50E+04	1.25E+04	9.84E-02	0.102	0.110	0.113
Ni2+	1.23E-03	49.4	41.0	1.01E-03	1.12E-03	1.34E-03	1.75E-03
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.143	3.91E+03	3.25E+03	0.107	0.109	0.161	0.179
K+	1.86E-03	49.7	41.3	1.15E-03	1.23E-03	2.49E-03	2.58E-03
OH-	16.4	1.91E+05	1.59E+05	15.9	16.2	16.7	17.0
NO3-	1.84	7.80E+04	6.48E+04	0.506	0.603	2.80	1.93
NO2-	0.626	1.97E+04	1.63E+04	0.509	0.566	0.686	0.745
CO32-	0.151	6.20E+03	5.15E+03	0.109	0.115	0.170	0.187
PO43-	5.98E-03	388	322	1.30E-04	7.45E-04	1.12E-02	2.24E-02
SO42-	1.60E-02	1.05E+03	874	9.67E-03	1.03E-02	2.17E-02	2.25E-02
Si (as SiO32-)	1.52E-02	292	243	1.24E-02	1.38E-02	1.67E-02	4.67E-02
F-	0	0	0	0	0	0	0
Cl-	9.61E-03	233	193	5.32E-03	5.77E-03	1.35E-02	2.91E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	1.40E-06	0.201	0.167	3.04E-08	1.74E-07	2.62E-06	2.78E-06
butanol	1.40E-06	7.07E-02	5.87E-02	3.04E-08	1.74E-07	2.62E-06	2.78E-06
NH3	2.35E-04	2.73	2.26	1.69E-04	1.92E-04	3.03E-04	3.15E-04
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-105							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	8.31E+05 (kg)	(150 kgal)	----	----	----	----	----
Heat Load	2.03E-02 (kW)	(69.5 BTU/hr)	----	1.69E-02	1.73E-02	2.34E-02	2.38E-02
Bulk Density†	1.46 (g/cc)	----	----	1.39	1.40	1.51	1.49
Water wt%†	53.1	----	----	51.8	49.3	58.9	60.4
TOC wt% C (wet)†	1.37E-05	----	----	3.15E-07	1.66E-06	2.66E-05	2.84E-05
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	1.04E-06	7.13E-04	0.592	7.65E-07	8.40E-07	1.27E-06	1.38E-06
C-14	1.49E-07	1.02E-04	8.46E-02	1.18E-07	1.21E-07	1.77E-07	1.81E-07
Ni-59	4.23E-08	2.89E-05	2.40E-02	3.34E-08	3.44E-08	5.02E-08	5.72E-08
Ni-63	4.00E-06	2.73E-03	2.27	3.20E-06	3.29E-06	4.71E-06	5.43E-06
Co-60	7.79E-08	5.33E-05	4.42E-02	6.47E-08	7.12E-08	8.47E-08	9.12E-08
Se-79	3.16E-08	2.16E-05	1.79E-02	2.50E-08	2.57E-08	3.74E-08	3.82E-08
Sr-90	2.78E-03	1.90	1.58E+03	2.28E-03	2.33E-03	3.24E-03	3.30E-03
Y-90	2.78E-03	1.90	1.58E+03	2.28E-03	2.33E-03	3.24E-03	3.30E-03
Zr-93	1.49E-07	1.02E-04	8.46E-02	1.18E-07	1.21E-07	1.77E-07	1.81E-07
Nb-93m	1.20E-07	8.19E-05	6.81E-02	9.36E-08	9.64E-08	1.43E-07	1.47E-07
Tc-99	1.04E-06	7.11E-04	0.591	8.25E-07	8.48E-07	1.23E-06	1.26E-06
Ru-106	9.65E-13	6.60E-10	5.48E-07	7.85E-13	8.73E-13	1.06E-12	1.15E-12
Cd-113m	5.04E-07	3.44E-04	0.286	4.24E-07	4.36E-07	5.72E-07	5.84E-07
Sb-125	1.56E-07	1.07E-04	8.88E-02	1.28E-07	1.42E-07	1.71E-07	1.85E-07
Sn-126	4.86E-08	3.32E-05	2.76E-02	3.87E-08	3.97E-08	5.74E-08	5.86E-08
I-129	2.00E-09	1.37E-06	1.14E-03	1.59E-09	1.64E-09	2.36E-09	2.41E-09
Cs-134	4.00E-09	2.73E-06	2.27E-03	3.27E-09	3.63E-09	4.38E-09	4.74E-09
Cs-137	3.65E-03	2.49	2.07E+03	3.08E-03	3.14E-03	4.16E-03	4.23E-03
Ba-137m	3.45E-03	2.36	1.96E+03	2.92E-03	2.97E-03	3.93E-03	4.00E-03
Sm-151	1.14E-04	7.80E-02	64.8	8.98E-05	9.24E-05	1.36E-04	1.39E-04
Eu-152	2.56E-07	1.75E-04	0.145	2.54E-07	2.55E-07	2.57E-07	2.58E-07
Eu-154	1.75E-06	1.20E-03	0.995	1.45E-06	1.60E-06	1.91E-06	2.06E-06
Eu-155	1.51E-05	1.03E-02	8.58	1.50E-05	1.51E-05	1.52E-05	1.52E-05
Ra-226	4.01E-12	2.74E-09	2.28E-06	2.22E-12	2.41E-12	6.69E-12	8.14E-11
Ra-228	4.31E-16	2.94E-13	2.45E-10	4.27E-16	4.28E-16	4.34E-16	4.34E-16
Ac-227	2.08E-11	1.42E-08	1.18E-05	1.17E-11	1.27E-11	2.90E-11	3.73E-10
Pa-231	4.88E-11	3.33E-08	2.77E-05	2.89E-11	3.10E-11	6.65E-11	6.89E-11
Th-229	8.42E-14	5.75E-11	4.78E-08	8.35E-14	8.36E-14	8.48E-14	8.49E-14
Th-232	3.58E-17	2.45E-14	2.03E-11	2.70E-17	2.79E-17	4.38E-17	4.48E-17
U-232	5.12E-10	3.50E-07	2.91E-04	4.70E-10	4.93E-10	5.28E-10	5.41E-10
U-233	1.72E-11	1.17E-08	9.75E-06	1.58E-11	1.65E-11	1.77E-11	1.81E-11
U-234	9.75E-06	6.66E-03	5.53	8.95E-06	9.38E-06	1.01E-05	1.03E-05
U-235	4.16E-07	2.84E-04	0.236	3.82E-07	4.00E-07	4.29E-07	4.39E-07
U-236	1.69E-07	1.15E-04	9.59E-02	1.55E-07	1.63E-07	1.74E-07	1.78E-07
U-238	9.98E-06	6.83E-03	5.67	9.17E-06	9.61E-06	1.03E-05	1.05E-05
Np-237	6.69E-09	4.57E-06	3.80E-03	5.36E-09	5.50E-09	7.88E-09	8.04E-09
Pu-238	2.12E-05	1.45E-02	12.0	2.02E-05	2.07E-05	2.17E-05	2.22E-05
Pu-239	1.35E-03	0.925	769	1.29E-03	1.32E-03	1.39E-03	1.42E-03
Pu-240	2.07E-04	0.142	118	1.97E-04	2.02E-04	2.12E-04	2.17E-04
Pu-241	1.54E-03	1.05	876	1.47E-03	1.51E-03	1.58E-03	1.62E-03
Pu-242	5.89E-09	4.03E-06	3.34E-03	5.61E-09	5.75E-09	6.03E-09	6.17E-09
Am-241	4.50E-07	3.08E-04	0.256	3.77E-07	3.97E-07	5.04E-07	5.24E-07
Am-243	4.22E-12	2.89E-09	2.40E-06	3.51E-12	3.85E-12	4.60E-12	4.94E-12
Cm-242	5.11E-09	3.49E-06	2.90E-03	5.06E-09	5.09E-09	5.13E-09	5.15E-09
Cm-243	1.21E-10	8.26E-08	6.86E-05	1.20E-10	1.20E-10	1.21E-10	1.22E-10
Cm-244	2.03E-10	1.39E-07	1.15E-04	1.67E-10	1.84E-10	2.21E-10	2.39E-10
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	2.27E-02 (g/L)	----	12.9	2.16E-02	2.22E-02	2.33E-02	2.38E-02
U	0.126	2.04E+04	1.70E+04	0.115	0.121	0.130	0.133

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-106

Total Inventory Estimate*

Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	1.20E+06 (kg)	(229 kgal)	----	----	----	----	----
Heat Load	40.6 (kW)	(1.39E+05 BTU/hr)	----	32.7	38.1	42.1	43.0
Bulk Density†	1.38 (g/cc)	----	----	1.32	1.34	1.41	1.42
Water wt%†	59.9	----	----	58.3	57.1	64.1	65.1
TOC wt% C (wet)†	7.40E-02	----	----	4.25E-02	6.41E-02	8.16E-02	0.114
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	5.25	8.72E+04	1.05E+05	3.91	4.28	5.84	6.27
Al3+	1.49	2.91E+04	3.50E+04	1.47	1.48	1.50	1.52
Fe3+ (total Fe)	1.17	4.74E+04	5.69E+04	1.07	1.15	1.19	1.20
Cr3+	6.43E-03	242	290	6.33E-03	6.34E-03	6.51E-03	6.52E-03
Bi3+	4.04E-06	0.610	0.732	3.41E-06	3.72E-06	4.36E-06	4.67E-06
La3+	6.19E-19	6.21E-14	7.45E-14	4.47E-19	5.31E-19	7.06E-19	7.91E-19
Hg2+	3.75E-04	54.4	65.2	3.71E-04	3.73E-04	3.77E-04	3.78E-04
Zr (as ZrO(OH)2)	1.60E-08	1.05E-03	1.26E-03	1.58E-08	1.59E-08	1.60E-08	1.62E-08
Pb2+	1.75E-02	2.62E+03	3.14E+03	1.63E-02	1.69E-02	1.81E-02	1.87E-02
Ni2+	0.333	1.41E+04	1.69E+04	0.260	0.309	0.346	0.354
Sr2+	0	0	0	0	0	0	0
Mn4+	9.28E-04	36.8	44.2	6.45E-04	7.83E-04	1.07E-03	1.21E-03
Ca2+	0.133	3.85E+03	4.62E+03	8.75E-02	8.81E-02	0.199	0.249
K+	5.68E-03	160	192	4.62E-03	5.26E-03	6.09E-03	7.03E-03
OH-	9.25	1.14E+05	1.36E+05	8.68	9.06	9.37	9.59
NO3-	0.978	4.38E+04	5.25E+04	0.103	0.167	1.60	0.993
NO2-	0.515	1.71E+04	2.05E+04	0.446	0.495	0.530	0.593
CO32-	0.231	1.00E+04	1.20E+04	0.117	0.179	0.303	0.344
PO43-	1.38E-02	949	1.14E+03	1.00E-02	1.04E-02	1.73E-02	2.46E-02
SO42-	4.20E-02	2.91E+03	3.49E+03	3.78E-02	3.82E-02	4.57E-02	4.64E-02
Si (as SiO32-)	1.50	3.04E+04	3.64E+04	0.958	1.06	1.78	2.05
F-	1.36E-04	1.86	2.23	1.27E-04	1.34E-04	1.36E-04	1.37E-04
Cl-	2.12E-02	542	650	1.63E-02	1.86E-02	2.37E-02	3.39E-02
C6H5O73-	2.61E-03	357	428	1.43E-03	2.19E-03	2.94E-03	4.12E-03
EDTA4-	5.12E-13	1.07E-07	1.28E-07	3.51E-13	4.30E-13	5.94E-13	6.75E-13
HEDTA3-	4.33E-13	8.58E-08	1.03E-07	1.15E-13	2.70E-13	5.97E-13	7.57E-13
glycolate-	3.48E-02	1.89E+03	2.26E+03	1.91E-02	2.93E-02	3.92E-02	5.49E-02
acetate-	1.90E-12	8.10E-08	9.71E-08	1.54E-12	1.71E-12	2.08E-12	2.26E-12
oxalate2-	8.11E-19	5.16E-14	6.18E-14	7.18E-19	7.63E-19	8.58E-19	9.03E-19
DBP	9.15E-07	0.139	0.167	2.04E-08	1.15E-07	1.71E-06	1.82E-06
butanol	9.15E-07	4.90E-02	5.88E-02	2.04E-08	1.15E-07	1.71E-06	1.82E-06
NH3	0.106	1.30E+03	1.56E+03	8.76E-02	0.101	0.110	0.125
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-106							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	1.20E+06 (kg)	(229 kgal)	----	----	----	----	----
Heat Load	40.6 (kW)	(1.39E+05 BTU/hr)	----	32.7	38.1	42.1	43.0
Bulk Density†	1.38 (g/cc)	----	----	1.32	1.34	1.41	1.42
Water wt%†	59.9	----	----	58.3	57.1	64.1	65.1
TOC wt% C (wet)†	7.40E-02	----	----	4.25E-02	6.41E-02	8.16E-02	0.114
Radiological Constituents	**Ci/L**	**μCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	6.63E-06	4.79E-03	5.75	3.41E-06	4.95E-06	8.49E-06	1.27E-05
C-14	4.98E-06	3.60E-03	4.32	4.85E-06	4.93E-06	5.02E-06	7.65E-06
Ni-59	8.98E-05	6.49E-02	77.9	7.85E-05	8.62E-05	9.19E-05	9.35E-05
Ni-63	8.86E-03	6.40	7.68E+03	7.73E-03	8.50E-03	9.06E-03	9.22E-03
Co-60	5.39E-06	3.89E-03	4.67	5.09E-06	5.28E-06	5.47E-06	5.76E-06
Se-79	2.14E-05	1.54E-02	18.5	1.26E-06	7.49E-06	3.52E-05	6.04E-05
Sr-90	6.89	4.98E+03	5.97E+06	5.52	6.45	7.13	7.29
Y-90	6.89	4.98E+03	5.97E+06	5.52	6.45	7.14	7.29
Zr-93	8.96E-05	6.48E-02	77.7	5.87E-06	2.03E-05	1.59E-04	2.66E-04
Nb-93m	8.11E-05	5.86E-02	70.3	4.51E-06	3.25E-05	1.30E-04	2.21E-04
Tc-99	3.49E-05	2.53E-02	30.3	3.41E-05	3.46E-05	3.52E-05	3.61E-05
Ru-106	3.68E-07	2.66E-04	0.319	1.66E-07	3.01E-07	4.34E-07	4.97E-07
Cd-113m	6.52E-05	4.71E-02	56.5	2.42E-05	2.46E-05	4.55E-04	8.54E-04
Sb-125	2.17E-05	1.57E-02	18.8	1.99E-05	2.11E-05	2.22E-05	2.40E-05
Sn-126	3.48E-05	2.52E-02	30.2	1.96E-06	1.40E-05	5.56E-05	9.63E-05
I-129	6.76E-08	4.89E-05	5.86E-02	6.59E-08	6.70E-08	6.81E-08	6.98E-08
Cs-134	8.10E-07	5.85E-04	0.702	8.02E-07	8.06E-07	8.14E-07	8.20E-07
Cs-137	0.110	79.8	9.58E+04	0.109	0.110	0.111	0.112
Ba-137m	0.105	75.5	9.06E+04	0.104	0.104	0.105	0.106
Sm-151	8.20E-02	59.3	7.11E+04	4.58E-03	3.35E-02	0.131	0.223
Eu-152	6.54E-05	4.72E-02	56.7	6.53E-05	6.53E-05	6.54E-05	6.55E-05
Eu-154	1.21E-04	8.75E-02	105	1.12E-04	1.17E-04	1.25E-04	2.72E-03
Eu-155	4.01E-03	2.90	3.47E+03	4.00E-03	4.01E-03	4.01E-03	4.01E-03
Ra-226	4.45E-09	3.21E-06	3.85E-03	3.02E-09	3.37E-09	5.52E-09	6.55E-09
Ra-228	3.48E-10	2.51E-07	3.02E-04	3.48E-10	3.48E-10	3.48E-10	3.48E-10
Ac-227	2.20E-08	1.59E-05	1.90E-02	1.58E-08	1.58E-08	2.82E-08	3.42E-08
Pa-231	2.18E-08	1.57E-05	1.89E-02	1.24E-09	8.22E-09	3.53E-08	5.66E-08
Th-229	1.64E-10	1.18E-07	1.42E-04	1.64E-10	1.64E-10	1.64E-10	1.64E-10
Th-232	3.75E-11	2.71E-08	3.25E-05	3.72E-11	3.73E-11	3.77E-11	3.81E-11
U-232	2.21E-08	1.60E-05	1.92E-02	1.99E-08	2.10E-08	2.32E-08	2.43E-08
U-233	8.52E-08	6.16E-05	7.39E-02	7.67E-08	8.09E-08	8.96E-08	9.38E-08
U-234	1.68E-06	1.21E-03	1.46	1.55E-06	1.62E-06	1.73E-06	1.77E-06
U-235	7.16E-08	5.18E-05	6.21E-02	6.60E-08	6.90E-08	7.38E-08	7.55E-08
U-236	2.99E-08	2.16E-05	2.59E-02	2.76E-08	2.88E-08	3.07E-08	3.14E-08
U-238	1.72E-06	1.24E-03	1.49	1.58E-06	1.65E-06	1.77E-06	1.81E-06
Np-237	1.10E-07	7.98E-05	9.57E-02	1.08E-07	1.09E-07	1.11E-07	1.14E-07
Pu-238	6.14E-05	4.44E-02	53.2	4.15E-05	5.40E-05	6.85E-05	7.51E-05
Pu-239	1.25E-03	0.907	1.09E+03	9.06E-04	1.10E-03	1.41E-03	1.55E-03
Pu-240	2.56E-04	0.185	222	1.81E-04	2.26E-04	2.87E-04	3.16E-04
Pu-241	4.32E-03	3.12	3.74E+03	2.92E-03	3.80E-03	4.82E-03	5.28E-03
Pu-242	2.73E-08	1.98E-05	2.37E-02	1.82E-08	2.40E-08	3.05E-08	3.34E-08
Am-241	1.63E-03	1.18	1.41E+03	7.08E-04	1.11E-03	2.15E-03	2.65E-03
Am-243	8.56E-08	6.19E-05	7.42E-02	1.59E-08	4.86E-08	1.18E-07	1.46E-07
Cm-242	2.56E-06	1.85E-03	2.22	2.56E-06	2.56E-06	2.56E-06	2.57E-06
Cm-243	2.35E-07	1.70E-04	0.204	2.35E-07	2.35E-07	2.36E-07	2.36E-07
Cm-244	5.51E-06	3.99E-03	4.78	1.49E-06	4.19E-06	6.84E-06	8.11E-06
Totals	**M**	**μg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	2.09E-02 (g/L)	----	18.1	1.50E-02	1.84E-02	2.35E-02	2.60E-02
U	2.16E-02	3.72E+03	4.46E+03	1.99E-02	2.08E-02	2.22E-02	2.28E-02

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-107							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	1.45E+06 (kg)	(275 kgal)	----	----	----	----	----
Heat Load	5.02 (kW)	(1.71E+04 BTU/hr)	----	0.141	3.30	5.79	6.21
Bulk Density†	1.39 (g/cc)	----	----	1.32	1.36	1.42	1.44
Water wt%†	61.9	----	----	58.8	60.3	64.0	66.9
TOC wt% C (wet)†	0.275	----	----	7.57E-02	0.181	0.367	0.424
Chemical Constituents	mole/L	ppm	kg	-95 CI (mole/L)	-67 CI (mole/L)	+67 CI (mole/L)	+95 CI (mole/L)
Na+	4.78	7.88E+04	1.14E+05	3.25	4.11	5.31	5.79
Al3+	1.26	2.44E+04	3.55E+04	1.22	1.24	1.29	1.31
Fe3+ (total Fe)	0.434	1.74E+04	2.52E+04	0.361	0.419	0.440	0.443
Cr3+	4.16E-03	155	225	3.37E-03	3.76E-03	4.58E-03	4.98E-03
Bi3+	4.95E-02	7.41E+03	1.08E+04	3.93E-02	4.52E-02	5.26E-02	5.49E-02
La3+	0	0	0	0	0	0	0
Hg2+	8.79E-04	126	184	7.63E-04	8.53E-04	8.92E-04	8.99E-04
Zr (as ZrO(OH)2)	1.90E-04	12.4	18.0	1.51E-04	1.69E-04	2.10E-04	2.30E-04
Pb2+	4.38E-02	6.51E+03	9.45E+03	2.52E-02	3.96E-02	4.58E-02	4.71E-02
Ni2+	1.10E-03	46.5	67.5	9.10E-04	1.00E-03	2.13E-03	3.37E-03
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.114	3.26E+03	4.74E+03	7.10E-02	8.96E-02	0.125	0.131
K+	6.44E-03	180	262	5.34E-03	5.87E-03	7.01E-03	7.57E-03
OH-	6.35	7.74E+04	1.12E+05	5.93	6.17	6.49	6.60
NO3-	0.890	3.96E+04	5.75E+04	0.753	0.821	0.957	1.02
NO2-	0.258	8.50E+03	1.23E+04	0.188	0.220	0.300	0.345
CO32-	0.128	5.53E+03	8.03E+03	8.58E-02	0.104	0.141	0.172
PO43-	0.912	6.21E+04	9.02E+04	0.533	0.752	1.03	1.12
SO42-	4.89E-02	3.37E+03	4.89E+03	4.04E-02	4.45E-02	5.34E-02	5.77E-02
Si (as SiO32-)	0.308	6.21E+03	9.01E+03	0.179	0.248	0.351	0.392
F-	0.110	1.50E+03	2.18E+03	8.75E-02	9.85E-02	0.122	0.256
Cl-	2.96E-02	752	1.09E+03	2.46E-02	2.70E-02	3.23E-02	3.48E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	9.39E-03	1.94E+03	2.81E+03	2.55E-03	6.14E-03	1.26E-02	1.46E-02
HEDTA3-	1.88E-02	3.69E+03	5.36E+03	5.10E-03	1.23E-02	2.52E-02	2.92E-02
glycolate-	1.88E-02	1.01E+03	1.47E+03	5.10E-03	1.23E-02	2.52E-02	2.92E-02
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	1.90E-06	0.286	0.416	5.16E-07	1.24E-06	2.55E-06	2.96E-06
butanol	1.90E-06	0.101	0.147	5.16E-07	1.24E-06	2.55E-06	2.96E-06
NH3	7.27E-02	886	1.29E+03	6.09E-02	6.67E-02	7.87E-02	8.43E-02
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-107							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	1.45E+06 (kg)	(275 kgal)	----	----	----	----	----
Heat Load	5.02 (kW)	(1.71E+04 BTU/hr)	----	0.141	3.30	5.79	6.21
Bulk Density†	1.39 (g/cc)	----	----	1.32	1.36	1.42	1.44
Water wt%†	61.9	----	----	58.8	60.3	64.0	66.9
TOC wt% C (wet)†	0.275	----	----	7.57E-02	0.181	0.367	0.424
Radiological Constituents	Ci/L	µCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	6.38E-06	4.57E-03	6.64	7.38E-07	2.77E-06	1.15E-05	1.67E-05
C-14	5.72E-07	4.10E-04	0.595	2.13E-07	4.01E-07	7.39E-07	3.05E-06
Ni-59	4.44E-05	3.18E-02	46.2	4.12E-05	4.27E-05	4.60E-05	4.76E-05
Ni-63	4.37E-03	3.13	4.54E+03	4.05E-03	4.21E-03	4.53E-03	4.68E-03
Co-60	1.02E-06	7.33E-04	1.06	2.96E-07	6.77E-07	1.36E-06	3.57E-06
Se-79	2.47E-05	1.77E-02	25.7	4.79E-06	1.24E-05	3.70E-05	4.88E-05
Sr-90	0.703	504	7.31E+05	1.28E-02	0.459	0.809	0.867
Y-90	0.703	504	7.31E+05	1.28E-02	0.459	0.809	0.868
Zr-93	1.07E-04	7.66E-02	111	1.62E-05	4.55E-05	1.68E-04	2.27E-04
Nb-93m	9.17E-05	6.57E-02	95.4	1.54E-05	4.87E-05	1.35E-04	1.76E-04
Tc-99	3.88E-06	2.78E-03	4.04	1.46E-06	2.73E-06	5.01E-06	5.73E-06
Ru-106	1.91E-07	1.37E-04	0.199	1.46E-07	1.80E-07	2.02E-07	2.13E-07
Cd-113m	2.28E-04	0.163	237	2.57E-06	9.67E-05	5.41E-04	8.94E-04
Sb-125	5.97E-06	4.28E-03	6.22	1.69E-06	3.93E-06	7.97E-06	9.25E-06
Sn-126	3.98E-05	2.85E-02	41.4	8.22E-06	2.13E-05	5.82E-05	7.59E-05
I-129	7.50E-09	5.38E-06	7.80E-03	2.79E-09	5.26E-09	9.70E-09	1.11E-08
Cs-134	7.16E-07	5.13E-04	0.745	1.98E-07	4.70E-07	9.57E-07	1.11E-06
Cs-137	1.99E-02	14.3	2.07E+04	1.06E-02	1.55E-02	2.43E-02	2.71E-02
Ba-137m	1.89E-02	13.5	1.96E+04	1.00E-02	1.46E-02	2.30E-02	2.56E-02
Sm-151	9.25E-02	66.3	9.63E+04	1.95E-02	4.96E-02	0.136	0.177
Eu-152	2.32E-05	1.66E-02	24.1	2.28E-05	2.30E-05	2.34E-05	2.35E-05
Eu-154	5.44E-04	0.390	566	1.20E-05	2.83E-05	1.64E-03	3.52E-03
Eu-155	1.42E-03	1.02	1.48E+03	1.40E-03	1.41E-03	1.44E-03	1.44E-03
Ra-226	2.98E-09	2.14E-06	3.11E-03	2.24E-09	2.60E-09	3.37E-09	3.73E-09
Ra-228	7.24E-09	5.19E-06	7.54E-03	7.13E-09	7.19E-09	7.30E-09	7.35E-09
Ac-227	3.76E-08	2.70E-05	3.92E-02	3.33E-08	3.54E-08	3.98E-08	4.20E-08
Pa-231	5.60E-08	4.01E-05	5.83E-02	3.27E-08	4.37E-08	6.82E-08	8.00E-08
Th-229	3.28E-09	2.35E-06	3.42E-03	3.23E-09	3.26E-09	3.31E-09	3.33E-09
Th-232	3.37E-10	2.42E-07	3.51E-04	1.02E-10	2.20E-10	4.55E-10	5.69E-10
U-232	3.74E-07	2.68E-04	0.389	4.60E-09	2.02E-07	4.54E-07	4.98E-07
U-233	1.45E-06	1.04E-03	1.51	1.73E-08	7.83E-07	1.76E-06	1.93E-06
U-234	1.46E-05	1.05E-02	15.2	1.27E-05	1.37E-05	1.50E-05	1.53E-05
U-235	6.49E-07	4.65E-04	0.675	5.70E-07	6.12E-07	6.66E-07	6.76E-07
U-236	1.40E-07	1.00E-04	0.145	8.16E-08	1.13E-07	1.52E-07	1.59E-07
U-238	1.47E-05	1.05E-02	15.2	1.28E-05	1.38E-05	1.50E-05	1.53E-05
Np-237	1.39E-08	1.00E-05	1.45E-02	6.28E-09	1.03E-08	1.75E-08	1.98E-08
Pu-238	4.31E-05	3.09E-02	44.8	3.12E-05	4.07E-05	4.53E-05	4.74E-05
Pu-239	1.29E-03	0.926	1.34E+03	9.75E-04	1.21E-03	1.37E-03	1.45E-03
Pu-240	2.36E-04	0.169	245	1.77E-04	2.22E-04	2.49E-04	2.62E-04
Pu-241	3.13E-03	2.24	3.26E+03	2.29E-03	2.96E-03	3.29E-03	3.44E-03
Pu-242	1.64E-08	1.17E-05	1.70E-02	1.14E-08	1.54E-08	1.72E-08	1.81E-08
Am-241	1.05E-03	0.751	1.09E+03	6.87E-04	8.64E-04	1.23E-03	1.41E-03
Am-243	5.49E-08	3.93E-05	5.71E-02	4.06E-08	5.04E-08	5.90E-08	6.26E-08
Cm-242	8.79E-07	6.30E-04	0.915	8.65E-07	8.73E-07	8.86E-07	8.90E-07
Cm-243	7.90E-08	5.66E-05	8.22E-02	7.77E-08	7.84E-08	7.96E-08	8.00E-08
Cm-244	3.22E-06	2.31E-03	3.35	2.31E-06	3.00E-06	3.44E-06	3.65E-06
Totals	M	µg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	2.19E-02 (g/L)	----	22.8	1.65E-02	2.05E-02	2.32E-02	2.45E-02
U	0.184	3.15E+04	4.57E+04	0.161	0.174	0.189	0.192

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-108							
	Total Inventory Estimate*						
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	3.80E+05 (kg)	(66.0 kgal)	----	----	----	----	----
Heat Load	0.446 (kW)	(1.52E+03 BTU/hr)	----	0.441	0.441	0.451	0.452
Bulk Density†	1.52 (g/cc)	----	----	1.23	1.28	1.69	1.58
Water wt%†	46.1	----	----	42.1	34.1	68.9	75.8
TOC wt% C (wet)†	0.307	----	----	0.297	0.277	0.364	0.380
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	8.24	1.24E+05	4.73E+04	2.93	3.47	11.6	9.32
Al3+	0.263	4.66E+03	1.77E+03	0.263	0.263	0.263	0.263
Fe3+ (total Fe)	0.816	2.99E+04	1.14E+04	0.220	0.768	0.822	0.828
Cr3+	2.69E-03	91.9	35.0	2.15E-03	2.20E-03	3.18E-03	3.25E-03
Bi3+	2.74E-02	3.76E+03	1.43E+03	2.18E-02	2.50E-02	2.91E-02	3.04E-02
La3+	0	0	0	0	0	0	0
Hg2+	4.64E-05	6.12	2.33	3.23E-05	4.05E-05	5.08E-05	5.39E-05
Zr (as ZrO(OH)2)	1.05E-04	6.29	2.39	8.34E-05	9.39E-05	1.16E-04	1.27E-04
Pb2+	0	0	0	0	0	0	0
Ni2+	0.119	4.60E+03	1.75E+03	0.118	0.119	0.120	0.120
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.308	8.11E+03	3.09E+03	0.178	0.180	0.332	0.354
K+	7.62E-03	196	74.4	4.93E-03	5.21E-03	1.00E-02	1.03E-02
OH-	3.69	4.12E+04	1.57E+04	1.90	3.54	3.70	3.72
NO3-	5.53	2.25E+05	8.56E+04	0.469	0.837	9.15	6.76
NO2-	0.572	1.73E+04	6.57E+03	0.446	0.519	0.660	0.675
CO32-	0.340	1.34E+04	5.10E+03	0.179	0.204	0.368	0.385
PO43-	0.550	3.43E+04	1.30E+04	0.339	0.461	0.615	0.663
SO42-	5.01E-02	3.16E+03	1.20E+03	2.60E-02	2.85E-02	7.17E-02	7.46E-02
Si (as SiO32-)	9.82E-02	1.81E+03	689	5.03E-02	7.46E-02	0.122	0.145
F-	6.11E-02	762	290	4.85E-02	5.46E-02	6.77E-02	0.142
Cl-	3.90E-02	908	346	2.28E-02	2.45E-02	5.36E-02	0.113
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	5.29E-06	0.730	0.278	1.15E-07	6.59E-07	9.91E-06	1.05E-05
butanol	5.29E-06	0.257	9.79E-02	1.15E-07	6.59E-07	9.91E-06	1.05E-05
NH3	7.75E-02	865	329	7.10E-02	7.42E-02	8.08E-02	0.146
Fe(CN)64-	6.49E-02	1.15E+04	4.39E+03	6.49E-02	6.49E-02	6.49E-02	6.49E-02

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-108							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	3.80E+05 (kg)	(66.0 kgal)	----	----	----	----	----
Heat Load	0.446 (kW)	(1.52E+03 BTU/hr)	----	0.441	0.441	0.451	0.452
Bulk Density†	1.52 (g/cc)	----	----	1.23	1.28	1.69	1.58
Water wt%†	46.1	----	----	42.1	34.1	68.9	75.8
TOC wt% C (wet)†	0.307	----	----	0.297	0.277	0.364	0.380
Radiological Constituents	Ci/L	μCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	1.65E-06	1.08E-03	0.412	7.79E-07	8.80E-07	2.52E-06	2.64E-06
C-14	2.71E-07	1.78E-04	6.78E-02	1.54E-07	1.66E-07	3.77E-07	3.91E-07
Ni-59	2.14E-06	1.41E-03	0.535	2.10E-06	2.11E-06	2.17E-06	2.19E-06
Ni-63	1.93E-04	0.127	48.2	1.89E-04	1.90E-04	1.96E-04	1.97E-04
Co-60	5.87E-08	3.86E-05	1.47E-02	3.18E-08	3.46E-08	8.28E-08	8.60E-08
Se-79	5.72E-08	3.76E-05	1.43E-02	3.24E-08	3.50E-08	7.94E-08	8.24E-08
Sr-90	0.148	97.3	3.70E+04	0.146	0.146	0.150	0.150
Y-90	0.148	97.3	3.70E+04	0.146	0.147	0.150	0.150
Zr-93	2.72E-07	1.79E-04	6.80E-02	1.54E-07	1.67E-07	3.77E-07	3.92E-07
Nb-93m	2.30E-07	1.51E-04	5.75E-02	1.31E-07	1.41E-07	3.19E-07	3.31E-07
Tc-99	1.88E-06	1.24E-03	0.470	1.07E-06	1.15E-06	2.61E-06	2.71E-06
Ru-106	2.23E-14	1.47E-11	5.58E-09	1.11E-14	1.23E-14	3.24E-14	3.37E-14
Cd-113m	6.49E-07	4.26E-04	0.162	3.61E-07	3.91E-07	9.07E-07	9.42E-07
Sb-125	5.23E-08	3.44E-05	1.31E-02	2.74E-08	3.00E-08	7.46E-08	7.76E-08
Sn-126	8.60E-08	5.64E-05	2.15E-02	4.86E-08	5.26E-08	1.19E-07	1.24E-07
I-129	3.54E-09	2.33E-06	8.85E-04	2.00E-09	2.17E-09	4.92E-09	5.10E-09
Cs-134	1.35E-08	8.84E-06	3.36E-03	1.33E-08	1.33E-08	1.36E-08	1.36E-08
Cs-137	0.168	110	4.20E+04	0.166	0.166	0.170	0.170
Ba-137m	0.159	105	3.98E+04	0.157	0.157	0.161	0.161
Sm-151	2.14E-04	0.140	53.3	1.21E-04	1.31E-04	2.96E-04	3.07E-04
Eu-152	5.43E-07	3.56E-04	0.136	5.39E-07	5.40E-07	5.46E-07	5.46E-07
Eu-154	1.03E-06	6.79E-04	0.258	5.49E-07	6.00E-07	1.47E-06	1.53E-06
Eu-155	4.12E-05	2.70E-02	10.3	4.09E-05	4.09E-05	4.14E-05	4.14E-05
Ra-226	1.68E-11	1.11E-08	4.21E-06	1.01E-11	1.08E-11	2.70E-11	3.10E-10
Ra-228	2.11E-15	1.39E-12	5.27E-10	2.10E-15	2.10E-15	2.12E-15	2.12E-15
Ac-227	8.58E-11	5.63E-08	2.14E-05	5.12E-11	5.49E-11	1.17E-10	1.42E-09
Pa-231	1.85E-10	1.21E-07	4.62E-05	1.10E-10	1.18E-10	2.52E-10	2.61E-10
Th-229	4.09E-13	2.69E-10	1.02E-07	4.07E-13	4.07E-13	4.12E-13	4.12E-13
Th-232	7.84E-17	5.15E-14	1.96E-11	4.48E-17	4.84E-17	1.08E-16	1.12E-16
U-232	8.39E-11	5.51E-08	2.09E-05	7.86E-11	8.17E-11	8.55E-11	8.67E-11
U-233	5.01E-12	3.29E-09	1.25E-06	4.70E-12	4.88E-12	5.11E-12	5.18E-12
U-234	7.05E-06	4.63E-03	1.76	6.61E-06	6.86E-06	7.19E-06	7.29E-06
U-235	3.17E-07	2.08E-04	7.92E-02	2.97E-07	3.09E-07	3.23E-07	3.28E-07
U-236	4.51E-08	2.96E-05	1.13E-02	4.23E-08	4.39E-08	4.60E-08	4.66E-08
U-238	1.23E-05	8.09E-03	3.08	1.09E-05	1.21E-05	1.25E-05	1.26E-05
Np-237	1.16E-08	7.60E-06	2.89E-03	6.54E-09	7.07E-09	1.61E-08	1.67E-08
Pu-238	3.68E-08	2.41E-05	9.19E-03	2.17E-08	2.27E-08	6.57E-08	3.33E-07
Pu-239	9.39E-06	6.16E-03	2.34	4.65E-06	4.98E-06	1.85E-05	5.45E-05
Pu-240	6.07E-07	3.99E-04	0.152	3.28E-07	3.48E-07	1.14E-06	4.48E-06
Pu-241	7.98E-07	5.24E-04	0.199	5.36E-07	5.64E-07	1.85E-06	1.25E-05
Pu-242	3.19E-12	2.10E-09	7.98E-07	2.01E-12	2.14E-12	7.94E-12	5.57E-11
Am-241	4.62E-07	3.03E-04	0.115	2.36E-07	2.60E-07	6.64E-07	6.92E-07
Am-243	3.17E-12	2.08E-09	7.92E-07	1.59E-12	1.76E-12	4.58E-12	4.77E-12
Cm-242	9.88E-09	6.49E-06	2.47E-03	9.82E-09	9.83E-09	9.94E-09	9.95E-09
Cm-243	2.02E-10	1.33E-07	5.05E-05	2.01E-10	2.01E-10	2.03E-10	2.04E-10
Cm-244	7.46E-11	4.90E-08	1.86E-05	3.73E-11	4.12E-11	1.08E-10	1.13E-10
Totals	M	μg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	1.54E-04 (g/L)	----	3.84E-02	7.63E-05	8.17E-05	3.02E-04	8.97E-04
U	8.99E-02	1.40E+04	5.34E+03	8.42E-02	8.75E-02	9.16E-02	9.29E-02

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-109							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	3.35E+05 (kg)	(66.0 kgal)	----	----	----	----	----
Heat Load	3.06 (kW)	(1.05E+04 BTU/hr)	----	2.94	3.01	3.11	3.16
Bulk Density†	1.34 (g/cc)	----	----	1.33	1.33	1.35	1.54
Water wt%†	66.0	----	----	47.7	65.6	66.4	66.9
TOC wt% C (wet)†	1.47	----	----	1.28	1.45	1.48	1.50
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.32	5.69E+04	1.91E+04	3.03	3.19	3.42	7.37
Al3+	9.07E-02	1.82E+03	611	9.07E-02	9.07E-02	9.07E-02	9.07E-02
Fe3+ (total Fe)	0.898	3.74E+04	1.25E+04	0.890	0.894	0.902	0.906
Cr3+	1.43E-03	55.7	18.6	1.28E-03	1.36E-03	1.51E-03	1.59E-03
Bi3+	9.45E-03	1.47E+03	493	7.50E-03	8.63E-03	1.00E-02	1.05E-02
La3+	0	0	0	0	0	0	0
Hg2+	1.60E-05	2.40	0.802	1.11E-05	1.40E-05	1.75E-05	1.86E-05
Zr (as ZrO(OH)2)	3.62E-05	2.46	0.825	2.88E-05	3.24E-05	4.01E-05	4.39E-05
Pb2+	1.61E-02	2.48E+03	832	9.71E-03	1.28E-02	1.93E-02	2.24E-02
Ni2+	0.464	2.03E+04	6.81E+03	0.460	0.462	0.466	0.468
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.554	1.66E+04	5.54E+03	0.385	0.468	0.640	0.722
K+	1.60E-02	466	156	1.39E-02	1.52E-02	1.67E-02	1.74E-02
OH-	2.92	3.70E+04	1.24E+04	2.89	2.91	2.93	2.94
NO3-	0.166	7.68E+03	2.57E+03	0.140	0.153	0.179	4.78
NO2-	1.67	5.74E+04	1.92E+04	1.20	1.65	1.70	1.72
CO32-	0.554	2.48E+04	8.31E+03	0.386	0.468	0.640	0.723
PO43-	0.254	1.80E+04	6.03E+03	0.182	0.224	0.277	0.393
SO42-	2.36E-02	1.69E+03	566	2.08E-02	2.28E-02	2.45E-02	2.53E-02
Si (as SiO32-)	3.39E-02	710	238	1.74E-02	2.57E-02	4.21E-02	4.99E-02
F-	2.10E-02	298	99.9	1.67E-02	1.88E-02	2.33E-02	4.90E-02
Cl-	4.21E-02	1.11E+03	372	3.28E-02	4.15E-02	4.26E-02	4.31E-02
C6H5O73-	3.50E-03	493	165	2.84E-03	3.16E-03	3.83E-03	4.15E-03
EDTA4-	6.99E-03	1.50E+03	503	5.68E-03	6.33E-03	7.66E-03	8.30E-03
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	4.46E-02	1.96E+03	657	3.62E-02	4.03E-02	4.88E-02	5.29E-02
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	0.198	2.51E+03	841	0.181	0.193	0.203	0.456
Fe(CN)64-	0.243	4.92E+04	1.65E+04	0.243	0.243	0.243	0.243

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-109							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	3.35E+05 (kg)	(66.0 kgal)	----	----	----	----	----
Heat Load	3.06 (kW)	(1.05E+04 BTU/hr)	----	2.94	3.01	3.11	3.16
Bulk Density†	1.34 (g/cc)	----	----	1.33	1.33	1.35	1.54
Water wt%†	66.0	----	----	47.7	65.6	66.4	66.9
TOC wt% C (wet)†	1.47	----	----	1.28	1.45	1.48	1.50
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	2.43E-06	1.82E-03	0.608	1.73E-06	2.40E-06	2.47E-06	2.51E-06
C-14	4.69E-07	3.50E-04	0.117	3.50E-07	4.62E-07	4.76E-07	4.83E-07
Ni-59	1.97E-05	1.47E-02	4.93	1.75E-05	1.87E-05	2.07E-05	2.17E-05
Ni-63	1.87E-03	1.40	468	1.65E-03	1.77E-03	1.97E-03	2.06E-03
Co-60	1.32E-07	9.86E-05	3.30E-02	1.05E-07	1.29E-07	1.35E-07	3.27E-07
Se-79	2.31E-07	1.72E-04	5.76E-02	1.49E-07	1.78E-07	8.29E-06	1.95E-05
Sr-90	1.40	1.04E+03	3.49E+05	1.33	1.37	1.43	1.46
Y-90	1.40	1.04E+03	3.50E+05	1.33	1.37	1.43	1.46
Zr-93	1.05E-06	7.83E-04	0.262	6.87E-07	7.86E-07	3.31E-05	8.91E-05
Nb-93m	8.85E-07	6.60E-04	0.221	5.64E-07	7.01E-07	3.21E-05	7.13E-05
Tc-99	3.26E-06	2.43E-03	0.814	2.43E-06	3.21E-06	3.31E-06	3.35E-06
Ru-106	2.64E-10	1.97E-07	6.60E-05	2.04E-10	2.34E-10	1.93E-09	2.01E-08
Cd-113m	2.64E-06	1.97E-03	0.659	1.92E-06	2.27E-06	3.93E-06	2.93E-04
Sb-125	2.19E-07	1.63E-04	5.47E-02	1.94E-07	2.07E-07	2.31E-07	2.43E-07
Sn-126	3.60E-07	2.68E-04	8.98E-02	2.28E-07	2.81E-07	1.38E-05	3.05E-05
I-129	6.15E-09	4.59E-06	1.54E-03	4.59E-09	6.06E-09	6.24E-09	6.33E-09
Cs-134	4.93E-08	3.68E-05	1.23E-02	4.93E-08	4.93E-08	4.93E-08	4.93E-08
Cs-137	0.603	450	1.51E+05	0.603	0.603	0.604	0.604
Ba-137m	0.571	426	1.43E+05	0.571	0.571	0.571	0.571
Sm-151	8.63E-04	0.644	216	5.59E-04	6.79E-04	3.25E-02	7.17E-02
Eu-152	1.01E-05	7.54E-03	2.52	1.01E-05	1.01E-05	1.01E-05	1.01E-05
Eu-154	7.06E-06	5.27E-03	1.76	2.44E-06	3.99E-06	1.01E-05	3.09E-04
Eu-155	6.69E-04	0.499	167	6.68E-04	6.68E-04	6.70E-04	6.70E-04
Ra-226	1.06E-09	7.88E-07	2.64E-04	3.47E-10	6.94E-10	1.42E-09	2.10E-09
Ra-228	9.58E-15	7.14E-12	2.39E-09	9.56E-15	9.57E-15	9.58E-15	9.59E-15
Ac-227	5.17E-09	3.86E-06	1.29E-03	1.06E-09	3.07E-09	7.27E-09	9.90E-09
Pa-231	4.19E-10	3.13E-07	1.05E-04	3.25E-10	3.67E-10	8.25E-09	1.94E-08
Th-229	1.78E-12	1.33E-09	4.45E-07	1.78E-12	1.78E-12	1.78E-12	1.78E-12
Th-232	1.33E-16	9.89E-14	3.31E-11	9.87E-17	1.31E-16	1.35E-16	1.36E-16
U-232	3.00E-11	2.24E-08	7.50E-06	2.82E-11	2.93E-11	3.06E-11	3.10E-11
U-233	1.78E-12	1.33E-09	4.45E-07	1.67E-12	1.74E-12	1.82E-12	1.84E-12
U-234	2.49E-06	1.86E-03	0.622	2.34E-06	2.43E-06	2.54E-06	2.57E-06
U-235	1.12E-07	8.35E-05	2.80E-02	1.05E-07	1.09E-07	1.14E-07	1.16E-07
U-236	1.61E-08	1.20E-05	4.01E-03	1.51E-08	1.57E-08	1.64E-08	1.66E-08
U-238	2.19E-05	1.64E-02	5.48	1.65E-05	2.16E-05	2.22E-05	2.26E-05
Np-237	1.94E-08	1.45E-05	4.85E-03	1.43E-08	1.91E-08	1.97E-08	2.00E-08
Pu-238	9.43E-06	7.03E-03	2.36	7.14E-06	8.27E-06	1.06E-05	1.17E-05
Pu-239	4.03E-04	0.301	101	3.02E-04	3.52E-04	4.54E-04	5.64E-04
Pu-240	6.57E-05	4.90E-02	16.4	4.94E-05	5.74E-05	7.41E-05	8.20E-05
Pu-241	6.80E-04	0.507	170	5.15E-04	5.96E-04	7.63E-04	8.43E-04
Pu-242	3.34E-09	2.49E-06	8.35E-04	2.55E-09	2.94E-09	3.74E-09	4.12E-09
Am-241	1.35E-04	0.101	33.7	3.19E-06	3.95E-06	3.10E-04	4.78E-04
Am-243	3.22E-09	2.40E-06	8.05E-04	7.69E-11	8.81E-11	6.94E-09	1.02E-08
Cm-242	2.34E-07	1.75E-04	5.85E-02	2.34E-07	2.34E-07	2.34E-07	2.34E-07
Cm-243	1.22E-08	9.11E-06	3.05E-03	1.22E-08	1.22E-08	1.22E-08	1.22E-08
Cm-244	5.88E-09	4.39E-06	1.47E-03	4.69E-09	5.28E-09	8.61E-08	4.49E-07
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	6.78E-03 (g/L)	----	1.69	5.09E-03	5.91E-03	7.64E-03	9.42E-03
U	3.17E-02	5.63E+03	1.89E+03	2.98E-02	3.09E-02	3.23E-02	3.28E-02

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-110							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	9.77E+05 (kg)	(187 kgal)	----	----	----	----	----
Heat Load	6.47E-02 (kW)	(221 BTU/hr)	----	5.14E-02	5.79E-02	7.17E-02	7.85E-02
Bulk Density†	1.38 (g/cc)	----	----	1.28	1.34	1.41	1.44
Water wt%†	64.0	----	----	60.0	61.9	66.8	70.6
TOC wt% C (wet)†	0	----	----	0	0	0	0
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	5.23	8.70E+04	8.50E+04	3.30	4.38	5.89	6.50
Al3+	0.599	1.17E+04	1.14E+04	0.599	0.599	0.599	0.599
Fe3+ (total Fe)	0.352	1.43E+04	1.39E+04	0.346	0.349	0.355	0.358
Cr3+	4.86E-03	183	179	3.86E-03	4.34E-03	5.38E-03	5.89E-03
Bi3+	6.24E-02	9.44E+03	9.23E+03	4.95E-02	5.70E-02	6.63E-02	6.92E-02
La3+	0	0	0	0	0	0	0
Hg2+	1.06E-04	15.4	15.0	7.36E-05	9.22E-05	1.16E-04	1.23E-04
Zr (as ZrO(OH)2)	2.39E-04	15.8	15.4	1.90E-04	2.14E-04	2.65E-04	2.90E-04
Pb2+	0	0	0	0	0	0	0
Ni2+	1.20E-03	50.8	49.7	9.50E-04	1.07E-03	2.11E-03	3.41E-03
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	7.62E-02	2.21E+03	2.16E+03	4.74E-02	6.41E-02	8.75E-02	9.84E-02
K+	6.72E-03	190	186	5.34E-03	6.01E-03	7.45E-03	8.15E-03
OH-	4.06	5.00E+04	4.89E+04	3.97	4.03	4.10	4.12
NO3-	1.04	4.65E+04	4.54E+04	0.862	0.948	1.12	1.20
NO2-	0.236	7.86E+03	7.68E+03	0.148	0.188	0.289	0.346
CO32-	7.62E-02	3.31E+03	3.24E+03	4.74E-02	6.41E-02	8.75E-02	9.84E-02
PO43-	1.15	7.92E+04	7.74E+04	0.672	0.949	1.30	1.41
SO42-	5.20E-02	3.62E+03	3.54E+03	4.13E-02	4.65E-02	5.76E-02	6.30E-02
Si (as SiO32-)	0.224	4.55E+03	4.45E+03	0.115	0.170	0.278	0.330
F-	0.139	1.91E+03	1.87E+03	0.110	0.124	0.154	0.323
Cl-	3.09E-02	794	776	2.46E-02	2.77E-02	3.43E-02	3.75E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	7.94E-02	978	955	6.45E-02	7.18E-02	8.70E-02	9.40E-02
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-110							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	9.77E+05 (kg)	(187 kgal)	----	----	----	----	----
Heat Load	6.47E-02 (kW)	(221 BTU/hr)	----	5.14E-02	5.79E-02	7.17E-02	7.85E-02
Bulk Density†	1.38 (g/cc)	----	----	1.28	1.34	1.41	1.44
Water wt%†	64.0	----	----	60.0	61.9	66.8	70.6
TOC wt% C (wet)†	0	----	----	0	0	0	0
Radiological Constituents	Ci/L	µCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	3.39E-07	2.45E-04	0.240	1.99E-07	2.62E-07	4.27E-07	5.20E-07
C-14	8.66E-08	6.27E-05	6.13E-02	6.88E-08	7.75E-08	9.60E-08	1.05E-07
Ni-59	2.47E-08	1.79E-05	1.75E-02	1.96E-08	2.21E-08	4.37E-08	7.05E-08
Ni-63	2.17E-06	1.57E-03	1.53	1.72E-06	1.94E-06	3.83E-06	6.19E-06
Co-60	1.21E-08	8.75E-06	8.55E-03	9.59E-09	1.08E-08	1.34E-08	1.46E-08
Se-79	1.82E-08	1.32E-05	1.29E-02	1.45E-08	1.63E-08	2.02E-08	2.21E-08
Sr-90	7.61E-03	5.51	5.39E+03	6.04E-03	6.80E-03	8.43E-03	9.22E-03
Y-90	7.61E-03	5.51	5.39E+03	6.04E-03	6.81E-03	8.44E-03	9.23E-03
Zr-93	8.69E-08	6.29E-05	6.15E-02	6.90E-08	7.77E-08	9.63E-08	1.05E-07
Nb-93m	7.49E-08	5.42E-05	5.30E-02	5.95E-08	6.69E-08	8.30E-08	9.07E-08
Tc-99	5.99E-07	4.34E-04	0.424	4.76E-07	5.36E-07	6.64E-07	7.26E-07
Ru-106	2.85E-16	2.06E-13	2.01E-10	2.26E-16	2.55E-16	3.15E-16	3.45E-16
Cd-113m	1.77E-07	1.28E-04	0.125	1.40E-07	1.58E-07	1.96E-07	2.14E-07
Sb-125	6.52E-09	4.72E-06	4.61E-03	5.18E-09	5.83E-09	7.22E-09	7.90E-09
Sn-126	2.71E-08	1.96E-05	1.92E-02	2.15E-08	2.42E-08	3.00E-08	3.28E-08
I-129	1.12E-09	8.08E-07	7.90E-04	8.86E-10	9.98E-10	1.24E-09	1.35E-09
Cs-134	1.03E-10	7.49E-08	7.32E-05	8.22E-11	9.25E-11	1.15E-10	1.25E-10
Cs-137	8.58E-03	6.21	6.07E+03	6.81E-03	7.67E-03	9.51E-03	1.04E-02
Ba-137m	8.11E-03	5.88	5.74E+03	6.44E-03	7.26E-03	8.99E-03	9.84E-03
Sm-151	6.89E-05	4.99E-02	48.8	5.47E-05	6.16E-05	7.64E-05	8.35E-05
Eu-152	8.46E-09	6.13E-06	5.99E-03	8.30E-09	8.37E-09	8.54E-09	8.62E-09
Eu-154	1.62E-07	1.18E-04	0.115	1.29E-07	1.45E-07	1.80E-07	1.97E-07
Eu-155	1.28E-06	9.26E-04	0.905	1.25E-06	1.27E-06	1.29E-06	1.30E-06
Ra-226	7.77E-12	5.63E-09	5.50E-06	6.18E-12	6.95E-12	8.62E-12	9.43E-12
Ra-228	1.15E-16	8.34E-14	8.15E-11	1.13E-16	1.14E-16	1.16E-16	1.17E-16
Ac-227	3.92E-11	2.84E-08	2.77E-05	3.11E-11	3.50E-11	4.34E-11	4.75E-11
Pa-231	8.16E-11	5.91E-08	5.78E-05	6.48E-11	7.30E-11	9.05E-11	9.89E-11
Th-229	2.22E-14	1.61E-11	1.57E-08	2.18E-14	2.20E-14	2.24E-14	2.26E-14
Th-232	2.69E-17	1.95E-14	1.91E-11	2.14E-17	2.41E-17	2.98E-17	3.26E-17
U-232	1.89E-10	1.37E-07	1.34E-04	1.77E-10	1.84E-10	1.93E-10	1.95E-10
U-233	1.13E-11	8.20E-09	8.01E-06	1.06E-11	1.10E-11	1.15E-11	1.17E-11
U-234	1.60E-05	1.16E-02	11.3	1.49E-05	1.55E-05	1.63E-05	1.65E-05
U-235	7.18E-07	5.20E-04	0.508	6.72E-07	6.98E-07	7.31E-07	7.42E-07
U-236	1.02E-07	7.38E-05	7.21E-02	9.54E-08	9.92E-08	1.04E-07	1.05E-07
U-238	1.62E-05	1.17E-02	11.4	1.51E-05	1.57E-05	1.65E-05	1.67E-05
Np-237	3.60E-09	2.61E-06	2.55E-03	2.86E-09	3.22E-09	3.99E-09	4.36E-09
Pu-238	5.36E-08	3.88E-05	3.79E-02	1.92E-08	2.16E-08	1.20E-07	1.83E-07
Pu-239	1.68E-05	1.22E-02	11.9	6.00E-06	6.76E-06	3.74E-05	5.72E-05
Pu-240	9.89E-07	7.16E-04	0.700	3.54E-07	3.98E-07	2.21E-06	3.37E-06
Pu-241	6.33E-07	4.59E-04	0.448	2.26E-07	2.55E-07	1.41E-06	2.16E-06
Pu-242	1.93E-12	1.40E-09	1.37E-06	6.92E-13	7.79E-13	4.31E-12	6.60E-12
Am-241	3.01E-08	2.18E-05	2.13E-02	2.39E-08	2.69E-08	3.34E-08	3.65E-08
Am-243	8.42E-14	6.09E-11	5.96E-08	6.68E-14	7.52E-14	9.33E-14	1.02E-13
Cm-242	3.39E-11	2.46E-08	2.40E-05	3.33E-11	3.36E-11	3.43E-11	3.46E-11
Cm-243	5.04E-13	3.65E-10	3.56E-07	4.94E-13	4.99E-13	5.09E-13	5.14E-13
Cm-244	1.29E-12	9.33E-10	9.12E-07	1.02E-12	1.15E-12	1.43E-12	1.56E-12
Totals	M	µg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	2.74E-04 (g/L)	----	0.194	9.81E-05	1.10E-04	6.12E-04	9.36E-04
U	0.203	3.50E+04	3.43E+04	0.190	0.198	0.207	0.210

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-111 Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	3.00E+05 (kg)	(57.0 kgal)	----	----	----	----	----
Heat Load	0.193 (kW)	(658 BTU/hr)	----	0.190	0.191	0.194	0.195
Bulk Density†	1.39 (g/cc)	----	----	1.33	1.36	1.41	1.43
Water wt%†	62.4	----	----	59.9	61.1	64.1	66.4
TOC wt% C (wet)†	0.162	----	----	0.158	0.160	0.165	0.170
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	4.16	6.88E+04	2.06E+04	2.95	3.63	4.58	4.97
Al3+	1.82	3.54E+04	1.06E+04	1.79	1.81	1.84	1.86
Fe3+ (total Fe)	0.300	1.21E+04	3.62E+03	0.296	0.298	0.302	0.304
Cr3+	3.79E-03	142	42.5	3.16E-03	3.46E-03	4.12E-03	4.44E-03
Bi3+	3.94E-02	5.92E+03	1.78E+03	3.13E-02	3.60E-02	4.19E-02	4.37E-02
La3+	0	0	0	0	0	0	0
Hg2+	7.76E-04	112	33.6	7.56E-04	7.67E-04	7.82E-04	7.87E-04
Zr (as ZrO(OH)2)	1.51E-04	9.90	2.97	1.20E-04	1.35E-04	1.67E-04	1.83E-04
Pb2+	3.30E-02	4.92E+03	1.48E+03	3.07E-02	3.18E-02	3.42E-02	3.53E-02
Ni2+	5.82E-02	2.46E+03	737	5.77E-02	5.79E-02	5.88E-02	5.96E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.152	4.37E+03	1.31E+03	0.130	0.141	0.163	0.173
K+	5.53E-03	155	46.6	4.65E-03	5.08E-03	5.99E-03	6.43E-03
OH-	7.60	9.29E+04	2.79E+04	7.43	7.51	7.69	7.77
NO3-	0.812	3.62E+04	1.09E+04	0.702	0.757	0.865	1.40
NO2-	0.537	1.78E+04	5.33E+03	0.477	0.507	0.571	0.607
CO32-	0.152	6.54E+03	1.96E+03	0.130	0.141	0.163	0.173
PO43-	0.737	5.03E+04	1.51E+04	0.435	0.610	0.831	0.900
SO42-	3.71E-02	2.56E+03	768	3.03E-02	3.36E-02	4.06E-02	4.41E-02
Si (as SiO32-)	0.146	2.95E+03	885	7.71E-02	0.112	0.180	0.213
F-	8.78E-02	1.20E+03	360	6.97E-02	7.85E-02	9.73E-02	0.204
Cl-	2.54E-02	647	194	2.14E-02	2.34E-02	2.75E-02	2.96E-02
C6H5O73-	0	0	0	0	0	0	0
EDTA4-	0	0	0	0	0	0	0
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0	0	0	0	0	0	0
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	7.07E-02	864	259	6.13E-02	6.59E-02	7.55E-02	0.104
Fe(CN)64-	3.13E-02	6.09E+03	1.83E+03	3.13E-02	3.13E-02	3.13E-02	3.13E-02

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-111

Total Inventory Estimate*

Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	3.00E+05 (kg)	(57.0 kgal)	----	----	----	----	----
Heat Load	0.193 (kW)	(658 BTU/hr)	----	0.190	0.191	0.194	0.195
Bulk Density†	1.39 (g/cc)	----	----	1.33	1.36	1.41	1.43
Water wt%†	62.4	----	----	59.9	61.1	64.1	66.4
TOC wt% C (wet)†	0.162	----	----	0.158	0.160	0.165	0.170
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	7.71E-07	5.54E-04	0.166	6.80E-07	7.23E-07	8.27E-07	8.85E-07
C-14	1.46E-07	1.05E-04	3.15E-02	1.31E-07	1.40E-07	1.52E-07	1.57E-07
Ni-59	1.04E-06	7.45E-04	0.224	1.02E-06	1.03E-06	1.05E-06	1.07E-06
Ni-63	9.35E-05	6.72E-02	20.2	9.15E-05	9.25E-05	9.46E-05	9.60E-05
Co-60	4.21E-08	3.03E-05	9.09E-03	3.80E-08	4.00E-08	4.43E-08	4.63E-08
Se-79	3.08E-08	2.21E-05	6.64E-03	2.76E-08	2.96E-08	3.20E-08	3.32E-08
Sr-90	7.44E-02	53.5	1.60E+04	7.34E-02	7.39E-02	7.49E-02	7.54E-02
Y-90	7.44E-02	53.5	1.60E+04	7.34E-02	7.39E-02	7.49E-02	7.54E-02
Zr-93	1.46E-07	1.05E-04	3.15E-02	1.31E-07	1.40E-07	1.52E-07	1.58E-07
Nb-93m	1.22E-07	8.80E-05	2.64E-02	1.09E-07	1.17E-07	1.28E-07	1.32E-07
Tc-99	1.01E-06	7.28E-04	0.219	9.07E-07	9.73E-07	1.05E-06	1.09E-06
Ru-106	3.05E-13	2.20E-10	6.59E-08	2.49E-13	2.77E-13	3.34E-13	3.62E-13
Cd-113m	3.78E-07	2.72E-04	8.15E-02	3.41E-07	3.65E-07	3.91E-07	4.03E-07
Sb-125	6.24E-08	4.48E-05	1.35E-02	5.36E-08	5.79E-08	6.68E-08	7.12E-08
Sn-126	4.64E-08	3.34E-05	1.00E-02	4.16E-08	4.46E-08	4.83E-08	5.00E-08
I-129	1.91E-09	1.37E-06	4.13E-04	1.71E-09	1.84E-09	1.99E-09	2.06E-09
Cs-134	7.60E-09	5.47E-06	1.64E-03	7.37E-09	7.49E-09	7.72E-09	7.83E-09
Cs-137	8.36E-02	60.1	1.80E+04	8.25E-02	8.31E-02	8.42E-02	8.48E-02
Ba-137m	7.91E-02	56.9	1.71E+04	7.81E-02	7.86E-02	7.97E-02	8.02E-02
Sm-151	1.14E-04	8.21E-02	24.6	1.02E-04	1.10E-04	1.19E-04	1.23E-04
Eu-152	1.90E-07	1.36E-04	4.09E-02	1.89E-07	1.89E-07	1.90E-07	1.90E-07
Eu-154	8.33E-07	5.99E-04	0.180	7.38E-07	7.85E-07	8.82E-07	9.28E-07
Eu-155	1.34E-05	9.63E-03	2.89	1.34E-05	1.34E-05	1.34E-05	1.34E-05
Ra-226	8.73E-12	6.28E-09	1.88E-06	7.72E-12	8.21E-12	1.00E-11	1.43E-10
Ra-228	6.06E-16	4.36E-13	1.31E-10	6.05E-16	6.06E-16	6.07E-16	6.08E-16
Ac-227	4.44E-11	3.19E-08	9.57E-06	3.93E-11	4.17E-11	4.70E-11	6.52E-10
Pa-231	9.53E-11	6.85E-08	2.06E-05	8.47E-11	8.98E-11	1.01E-10	1.06E-10
Th-229	1.18E-13	8.47E-11	2.54E-08	1.17E-13	1.18E-13	1.18E-13	1.18E-13
Th-232	4.09E-17	2.94E-14	8.83E-12	3.66E-17	3.91E-17	4.28E-17	4.45E-17
U-232	2.79E-10	2.01E-07	6.02E-05	2.66E-10	2.73E-10	2.84E-10	2.88E-10
U-233	1.25E-11	9.00E-09	2.70E-06	1.21E-11	1.23E-11	1.27E-11	1.28E-11
U-234	1.31E-05	9.44E-03	2.83	1.25E-05	1.29E-05	1.33E-05	1.35E-05
U-235	5.83E-07	4.19E-04	0.126	5.55E-07	5.71E-07	5.92E-07	5.99E-07
U-236	1.17E-07	8.42E-05	2.53E-02	1.13E-07	1.15E-07	1.19E-07	1.20E-07
U-238	1.58E-05	1.14E-02	3.41	1.51E-05	1.56E-05	1.60E-05	1.62E-05
Np-237	6.27E-09	4.51E-06	1.35E-03	5.62E-09	6.03E-09	6.52E-09	6.75E-09
Pu-238	6.65E-06	4.78E-03	1.43	6.34E-06	6.49E-06	6.81E-06	6.96E-06
Pu-239	4.33E-04	0.311	93.5	4.13E-04	4.23E-04	4.46E-04	4.59E-04
Pu-240	6.52E-05	4.69E-02	14.1	6.22E-05	6.37E-05	6.68E-05	6.83E-05
Pu-241	4.82E-04	0.346	104	4.59E-04	4.70E-04	4.93E-04	5.04E-04
Pu-242	1.84E-09	1.32E-06	3.97E-04	1.75E-09	1.79E-09	1.88E-09	1.93E-09
Am-241	2.45E-07	1.76E-04	5.29E-02	2.16E-07	2.34E-07	2.57E-07	2.68E-07
Am-243	1.97E-12	1.42E-09	4.25E-07	1.75E-12	1.86E-12	2.08E-12	2.19E-12
Cm-242	3.53E-09	2.54E-06	7.61E-04	3.52E-09	3.52E-09	3.54E-09	3.54E-09
Cm-243	7.72E-11	5.55E-08	1.67E-05	7.68E-11	7.70E-11	7.74E-11	7.75E-11
Cm-244	7.82E-11	5.62E-08	1.69E-05	6.70E-11	7.25E-11	8.40E-11	8.95E-11
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	7.26E-03 (g/L)	----	1.57	6.93E-03	7.09E-03	7.47E-03	7.68E-03
U	0.168	2.87E+04	8.61E+03	0.160	0.164	0.170	0.172

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-112							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	5.38E+05 (kg)	(104 kgal)	----	----	----	----	----
Heat Load	2.78 (kW)	(9.51E+03 BTU/hr)	----	2.77	2.78	2.79	2.80
Bulk Density†	1.37 (g/cc)	----	----	1.35	1.36	1.37	1.57
Water wt%†	65.2	----	----	47.1	64.8	65.6	66.1
TOC wt% C (wet)†	1.32	----	----	1.15	1.31	1.32	1.33
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.43	5.77E+04	3.10E+04	3.15	3.31	3.52	7.54
Al3+	0.900	1.78E+04	9.55E+03	0.883	0.891	0.908	0.916
Fe3+ (total Fe)	0.386	1.58E+04	8.49E+03	0.381	0.385	0.387	0.388
Cr3+	1.15E-03	43.8	23.6	1.01E-03	1.08E-03	1.23E-03	1.30E-03
Bi3+	9.00E-03	1.38E+03	740	7.14E-03	8.22E-03	9.57E-03	9.98E-03
La3+	0	0	0	0	0	0	0
Hg2+	5.02E-04	73.6	39.6	4.77E-04	4.96E-04	5.04E-04	5.06E-04
Zr (as ZrO(OH)2)	3.45E-05	2.30	1.24	2.74E-05	3.08E-05	3.82E-05	4.18E-05
Pb2+	2.56E-02	3.87E+03	2.08E+03	2.16E-02	2.46E-02	2.61E-02	2.66E-02
Ni2+	0.453	1.95E+04	1.05E+04	0.449	0.451	0.456	0.458
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	0.585	1.72E+04	9.23E+03	0.415	0.498	0.673	0.757
K+	9.19E-03	263	141	7.14E-03	9.07E-03	9.31E-03	9.42E-03
OH-	4.01	4.99E+04	2.68E+04	3.92	3.97	4.05	4.09
NO3-	0.243	1.10E+04	5.94E+03	0.218	0.231	0.256	4.93
NO2-	1.70	5.72E+04	3.07E+04	1.22	1.67	1.72	1.75
CO32-	0.586	2.57E+04	1.38E+04	0.415	0.499	0.673	0.757
PO43-	0.247	1.72E+04	9.24E+03	0.178	0.218	0.268	0.388
SO42-	1.96E-02	1.38E+03	742	1.68E-02	1.88E-02	2.04E-02	2.12E-02
Si (as SiO32-)	3.44E-02	706	380	1.86E-02	2.66E-02	4.22E-02	4.96E-02
F-	2.00E-02	279	150	1.59E-02	1.79E-02	2.22E-02	4.66E-02
Cl-	3.94E-02	1.02E+03	550	3.00E-02	3.89E-02	4.00E-02	4.05E-02
C6H5O73-	3.17E-04	43.8	23.6	2.57E-04	2.86E-04	3.47E-04	3.76E-04
EDTA4-	6.33E-04	134	71.8	5.15E-04	5.73E-04	6.94E-04	7.52E-04
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	4.04E-03	174	93.8	3.28E-03	3.65E-03	4.42E-03	4.80E-03
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	0.176	2.18E+03	1.18E+03	0.158	0.170	0.181	0.437
Fe(CN)64-	0.247	4.90E+04	2.63E+04	0.247	0.247	0.247	0.247

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-112							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	5.38E+05 (kg)	(104 kgal)	----	----	----	----	----
Heat Load	2.78 (kW)	(9.51E+03 BTU/hr)	----	2.77	2.78	2.79	2.80
Bulk Density†	1.37 (g/cc)	----	----	1.35	1.36	1.37	1.57
Water wt%†	65.2	----	----	47.1	64.8	65.6	66.1
TOC wt% C (wet)†	1.32	----	----	1.15	1.31	1.32	1.33
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	2.58E-06	1.89E-03	1.01	1.86E-06	2.54E-06	2.62E-06	2.65E-06
C-14	4.65E-07	3.40E-04	0.183	3.44E-07	4.58E-07	4.72E-07	4.79E-07
Ni-59	9.07E-06	6.64E-03	3.57	8.87E-06	8.98E-06	9.16E-06	9.25E-06
Ni-63	8.26E-04	0.605	325	8.06E-04	8.17E-04	8.35E-04	8.44E-04
Co-60	1.16E-07	8.52E-05	4.58E-02	8.88E-08	1.15E-07	1.18E-07	1.34E-07
Se-79	1.10E-07	8.05E-05	4.33E-02	8.45E-08	1.05E-07	8.40E-07	1.85E-06
Sr-90	0.624	456	2.45E+05	0.617	0.621	0.626	0.629
Y-90	0.624	456	2.46E+05	0.617	0.621	0.627	0.629
Zr-93	5.18E-07	3.79E-04	0.204	3.97E-07	4.94E-07	3.43E-06	8.49E-06
Nb-93m	4.36E-07	3.19E-04	0.172	3.34E-07	4.20E-07	3.26E-06	6.81E-06
Tc-99	3.23E-06	2.36E-03	1.27	2.39E-06	3.18E-06	3.28E-06	3.32E-06
Ru-106	2.95E-11	2.16E-08	1.16E-05	2.41E-11	2.67E-11	1.81E-10	1.82E-09
Cd-113m	1.29E-06	9.47E-04	0.509	9.98E-07	1.26E-06	1.41E-06	2.76E-05
Sb-125	1.42E-07	1.04E-04	5.60E-02	1.17E-07	1.36E-07	1.49E-07	1.55E-07
Sn-126	1.67E-07	1.22E-04	6.56E-02	1.28E-07	1.60E-07	1.38E-06	2.90E-06
I-129	6.09E-09	4.45E-06	2.40E-03	4.51E-09	5.99E-09	6.18E-09	6.27E-09
Cs-134	5.16E-08	3.78E-05	2.03E-02	5.08E-08	5.12E-08	5.21E-08	5.25E-08
Cs-137	0.613	449	2.41E+05	0.613	0.613	0.613	0.613
Ba-137m	0.580	424	2.28E+05	0.580	0.580	0.580	0.580
Sm-151	4.09E-04	0.300	161	3.15E-04	3.93E-04	3.28E-03	6.82E-03
Eu-152	1.88E-06	1.37E-03	0.738	1.87E-06	1.88E-06	1.88E-06	1.88E-06
Eu-154	2.57E-06	1.88E-03	1.01	2.07E-06	2.29E-06	2.85E-06	2.99E-05
Eu-155	1.32E-04	9.69E-02	52.1	1.32E-04	1.32E-04	1.32E-04	1.33E-04
Ra-226	1.20E-10	8.75E-08	4.71E-05	5.54E-11	8.68E-11	1.52E-10	1.18E-09
Ra-228	1.55E-09	1.14E-06	6.11E-04	1.53E-09	1.54E-09	1.56E-09	1.58E-09
Ac-227	5.35E-09	3.91E-06	2.10E-03	4.45E-09	5.14E-09	5.54E-09	1.01E-08
Pa-231	7.35E-09	5.38E-06	2.89E-03	2.35E-09	6.20E-09	8.06E-09	9.07E-09
Th-229	7.04E-10	5.15E-07	2.77E-04	6.93E-10	6.99E-10	7.09E-10	7.14E-10
Th-232	7.24E-11	5.30E-08	2.85E-05	2.18E-11	4.72E-11	9.76E-11	1.22E-10
U-232	8.02E-08	5.87E-05	3.16E-02	1.05E-09	4.33E-08	9.73E-08	1.07E-07
U-233	3.11E-07	2.28E-04	0.122	3.71E-09	1.68E-07	3.78E-07	4.15E-07
U-234	4.15E-06	3.03E-03	1.63	3.73E-06	3.95E-06	4.24E-06	4.29E-06
U-235	1.82E-07	1.33E-04	7.15E-02	1.65E-07	1.74E-07	1.85E-07	1.87E-07
U-236	5.13E-08	3.76E-05	2.02E-02	3.89E-08	4.56E-08	5.40E-08	5.55E-08
U-238	2.39E-05	1.75E-02	9.41	1.83E-05	2.36E-05	2.42E-05	2.45E-05
Np-237	1.99E-08	1.46E-05	7.83E-03	1.47E-08	1.96E-08	2.02E-08	2.05E-08
Pu-238	5.62E-06	4.11E-03	2.21	5.09E-06	5.50E-06	5.72E-06	6.69E-06
Pu-239	3.05E-04	0.223	120	2.83E-04	3.00E-04	3.16E-04	4.68E-04
Pu-240	4.84E-05	3.54E-02	19.1	4.45E-05	4.75E-05	4.93E-05	6.24E-05
Pu-241	4.20E-04	0.308	165	3.78E-04	4.11E-04	4.28E-04	4.62E-04
Pu-242	1.53E-09	1.12E-06	6.02E-04	1.41E-09	1.49E-09	1.57E-09	1.72E-09
Am-241	1.30E-05	9.55E-03	5.14	1.12E-06	1.18E-06	2.89E-05	4.41E-05
Am-243	2.98E-10	2.18E-07	1.17E-04	1.29E-11	1.39E-11	6.35E-10	9.30E-10
Cm-242	3.88E-08	2.84E-05	1.53E-02	3.87E-08	3.87E-08	3.88E-08	3.88E-08
Cm-243	1.47E-09	1.08E-06	5.78E-04	1.47E-09	1.47E-09	1.47E-09	1.47E-09
Cm-244	6.90E-10	5.05E-07	2.72E-04	5.82E-10	6.35E-10	7.96E-09	4.08E-08
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	5.12E-03 (g/L)	----	2.01	4.75E-03	5.03E-03	5.30E-03	7.81E-03
U	5.27E-02	9.17E+03	4.94E+03	4.78E-02	5.04E-02	5.37E-02	5.43E-02

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-201							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	1.18E+04 (kg)	(2.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(707 BTU/hr)	----	0.190	0.199	0.214	0.221
Bulk Density†	1.56 (g/cc)	----	----	1.53	1.55	1.58	1.59
Water wt%†	45.4	----	----	44.2	44.7	46.2	47.1
TOC wt% C (wet)†	0.651	----	----	0.533	0.591	0.710	0.768
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.44	5.06E+04	599	2.61	3.05	3.79	4.07
Al3+	0	0	0	0	0	0	0
Fe3+ (total Fe)	2.89	1.03E+05	1.22E+03	2.86	2.87	2.91	2.93
Cr3+	3.98E-03	132	1.57	3.36E-03	3.66E-03	4.30E-03	4.60E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	0	0	0	0	0	0	0
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	7.57E-02	1.00E+04	119	4.58E-02	6.05E-02	9.11E-02	0.106
Ni2+	9.28E-02	3.48E+03	41.2	7.53E-02	8.48E-02	9.95E-02	0.105
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	4.40E-02	1.13E+03	13.4	3.12E-02	3.75E-02	5.07E-02	5.70E-02
K+	3.67E-02	916	10.9	2.99E-02	3.32E-02	4.02E-02	4.36E-02
OH-	14.3	1.55E+05	1.84E+03	14.2	14.3	14.4	14.4
NO3-	3.68E-02	1.46E+03	17.3	3.13E-02	3.41E-02	3.96E-02	4.20E-02
NO2-	0.451	1.33E+04	157	0.367	0.408	0.494	0.535
CO32-	0.945	3.63E+04	429	0.681	0.822	1.05	1.14
PO43-	0.200	1.21E+04	144	8.59E-02	0.146	0.246	0.284
SO42-	7.28E-02	4.47E+03	53.0	6.63E-02	6.96E-02	7.61E-02	7.89E-02
Si (as SiO32-)	8.52E-04	15.3	0.181	7.29E-04	7.91E-04	9.13E-04	9.67E-04
F-	0	0	0	0	0	0	0
Cl-	2.09E-02	474	5.62	1.72E-02	1.90E-02	2.29E-02	2.48E-02
C6H5O73-	1.65E-02	1.99E+03	23.6	1.34E-02	1.49E-02	1.81E-02	1.96E-02
EDTA4-	3.29E-02	6.07E+03	71.8	2.68E-02	2.98E-02	3.61E-02	3.92E-02
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0.210	7.92E+03	93.8	0.171	0.190	0.230	0.250
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	0.126	1.37E+03	16.2	9.58E-02	0.111	0.141	0.156
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-201

Total Inventory Estimate*

Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	1.18E+04 (kg)	(2.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(707 BTU/hr)	----	0.190	0.199	0.214	0.221
Bulk Density†	1.56 (g/cc)	----	----	1.53	1.55	1.58	1.59
Water wt%†	45.4	----	----	44.2	44.7	46.2	47.1
TOC wt% C (wet)†	0.651	----	----	0.533	0.591	0.710	0.768
Radiological Constituents	**Ci/L**	**µCi/g**	**Ci**	**-95 CI (Ci/L)**	**-67 CI (Ci/L)**	**+67 CI (Ci/L)**	**+95 CI (Ci/L)**
H-3	5.82E-07	3.72E-04	4.41E-03	5.03E-07	5.41E-07	6.26E-07	6.69E-07
C-14	1.51E-06	9.65E-04	1.14E-02	1.11E-06	1.32E-06	1.67E-06	1.81E-06
Ni-59	5.59E-05	3.57E-02	0.423	4.53E-05	5.11E-05	6.05E-05	6.51E-05
Ni-63	5.48E-03	3.50	41.5	4.44E-03	5.01E-03	5.93E-03	6.38E-03
Co-60	1.80E-07	1.15E-04	1.36E-03	1.51E-07	1.65E-07	1.95E-07	1.10E-06
Se-79	6.88E-07	4.40E-04	5.21E-03	3.01E-07	4.40E-07	3.87E-05	9.14E-05
Sr-90	4.06	2.60E+03	3.07E+04	3.73	3.91	4.21	4.34
Y-90	4.06	2.60E+03	3.08E+04	3.73	3.91	4.21	4.35
Zr-93	3.05E-06	1.95E-03	2.31E-02	1.34E-06	1.81E-06	1.54E-04	4.18E-04
Nb-93m	2.57E-06	1.64E-03	1.95E-02	1.06E-06	1.70E-06	1.50E-04	3.34E-04
Tc-99	2.22E-06	1.42E-03	1.68E-02	2.02E-06	2.12E-06	2.32E-06	2.41E-06
Ru-106	1.24E-09	7.95E-07	9.41E-06	9.64E-10	1.10E-09	9.12E-09	9.47E-08
Cd-113m	7.76E-06	4.96E-03	5.87E-02	4.37E-06	6.04E-06	1.39E-05	1.38E-03
Sb-125	6.16E-07	3.94E-04	4.66E-03	5.03E-07	5.59E-07	6.74E-07	7.30E-07
Sn-126	1.09E-06	6.99E-04	8.28E-03	4.74E-07	7.22E-07	6.43E-05	1.43E-04
I-129	4.20E-09	2.69E-06	3.18E-05	3.83E-09	4.01E-09	4.40E-09	4.59E-09
Cs-134	5.97E-10	3.81E-07	4.52E-06	4.88E-10	5.41E-10	6.53E-10	7.07E-10
Cs-137	1.20E-03	0.766	9.08	1.04E-03	1.12E-03	1.28E-03	1.35E-03
Ba-137m	1.13E-03	0.725	8.58	9.80E-04	1.06E-03	1.21E-03	1.28E-03
Sm-151	2.58E-03	1.65	19.5	1.15E-03	1.71E-03	0.152	0.336
Eu-152	4.30E-05	2.75E-02	0.325	4.29E-05	4.30E-05	4.30E-05	4.31E-05
Eu-154	2.52E-05	1.61E-02	0.191	3.46E-06	1.08E-05	3.97E-05	1.45E-03
Eu-155	2.80E-03	1.79	21.2	2.80E-03	2.80E-03	2.81E-03	2.81E-03
Ra-226	4.92E-09	3.14E-06	3.72E-05	1.59E-09	3.22E-09	6.63E-09	8.26E-09
Ra-228	2.76E-14	1.77E-11	2.09E-10	2.76E-14	2.76E-14	2.77E-14	2.77E-14
Ac-227	2.39E-08	1.53E-05	1.81E-04	4.55E-09	1.41E-08	3.38E-08	4.33E-08
Pa-231	8.01E-10	5.12E-07	6.06E-06	3.55E-10	5.53E-10	3.77E-08	9.05E-08
Th-229	5.01E-12	3.20E-09	3.79E-08	5.00E-12	5.01E-12	5.02E-12	5.02E-12
Th-232	8.79E-17	5.62E-14	6.65E-13	8.03E-17	8.41E-17	9.16E-17	9.50E-17
U-232	8.14E-10	5.20E-07	6.16E-06	8.12E-10	8.13E-10	8.16E-10	8.17E-10
U-233	4.87E-11	3.11E-08	3.69E-07	4.86E-11	4.87E-11	4.88E-11	4.89E-11
U-234	6.86E-05	4.39E-02	0.520	6.85E-05	6.86E-05	6.88E-05	6.89E-05
U-235	3.09E-06	1.97E-03	2.34E-02	3.08E-06	3.09E-06	3.10E-06	3.10E-06
U-236	4.38E-07	2.80E-04	3.32E-03	4.37E-07	4.38E-07	4.39E-07	4.40E-07
U-238	6.95E-05	4.44E-02	0.526	6.93E-05	6.95E-05	6.97E-05	6.98E-05
Np-237	1.02E-08	6.51E-06	7.71E-05	9.17E-09	9.68E-09	1.07E-08	1.11E-08
Pu-238	4.43E-05	2.83E-02	0.335	3.35E-05	3.88E-05	4.97E-05	5.49E-05
Pu-239	1.87E-03	1.20	14.2	1.40E-03	1.63E-03	2.11E-03	2.35E-03
Pu-240	3.08E-04	0.197	2.33	2.31E-04	2.69E-04	3.47E-04	3.85E-04
Pu-241	3.20E-03	2.04	24.2	2.42E-03	2.80E-03	3.59E-03	3.97E-03
Pu-242	1.57E-08	1.01E-05	1.19E-04	1.20E-08	1.38E-08	1.76E-08	1.94E-08
Am-241	6.32E-04	0.404	4.78	1.12E-05	1.48E-05	1.46E-03	2.25E-03
Am-243	1.52E-08	9.68E-06	1.15E-04	3.36E-10	3.89E-10	3.27E-08	4.81E-08
Cm-242	1.02E-06	6.50E-04	7.70E-03	1.02E-06	1.02E-06	1.02E-06	1.02E-06
Cm-243	5.57E-08	3.56E-05	4.22E-04	5.57E-08	5.57E-08	5.59E-08	5.59E-08
Cm-244	2.71E-08	1.73E-05	2.05E-04	2.15E-08	2.42E-08	4.05E-07	2.12E-06
Totals	**M**	**µg/g**	**kg**	**-95 CI (M or g/L)**	**-67 CI (M or g/L)**	**+67 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	3.15E-02 (g/L)	----	0.238	2.35E-02	2.74E-02	3.56E-02	3.95E-02
U	0.875	1.33E+05	1.58E+03	0.873	0.874	0.877	0.878

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-202							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	5.48E+03 (kg)	(1.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.200	0.215	0.221
Bulk Density†	1.45 (g/cc)	----	----	1.42	1.44	1.46	1.47
Water wt%†	43.6	----	----	41.6	42.6	44.6	45.8
TOC wt% C (wet)†	1.41	----	----	1.16	1.28	1.53	1.65
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	1.83	2.90E+04	159	1.48	1.65	2.00	2.17
Al3+	0	0	0	0	0	0	0
Fe3+ (total Fe)	5.67	2.19E+05	1.20E+03	5.59	5.63	5.71	5.74
Cr3+	6.59E-03	237	1.30	5.36E-03	5.96E-03	7.22E-03	7.83E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	0	0	0	0	0	0	0
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	0.152	2.17E+04	119	9.16E-02	0.121	0.182	0.212
Ni2+	0.185	7.51E+03	41.1	0.150	0.169	0.198	0.209
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	4.04E-03	112	0.613	3.28E-03	3.65E-03	4.43E-03	4.80E-03
K+	7.31E-02	1.98E+03	10.8	5.94E-02	6.61E-02	8.01E-02	8.68E-02
OH-	17.8	2.09E+05	1.14E+03	17.5	17.6	17.9	18.0
NO3-	2.34E-08	1.00E-03	5.48E-06	7.15E-09	1.28E-08	4.27E-08	7.87E-08
NO2-	0.897	2.85E+04	156	0.729	0.812	0.983	1.07
CO32-	4.04E-03	167	0.917	3.28E-03	3.65E-03	4.43E-03	4.80E-03
PO43-	0	0	0	0	0	0	0
SO42-	5.56E-02	3.69E+03	20.2	4.52E-02	5.03E-02	6.09E-02	6.60E-02
Si (as SiO32-)	0	0	0	0	0	0	0
F-	0	0	0	0	0	0	0
Cl-	4.05E-02	992	5.44	3.29E-02	3.67E-02	4.44E-02	4.81E-02
C6H5O73-	3.30E-02	4.31E+03	23.6	2.68E-02	2.98E-02	3.61E-02	3.92E-02
EDTA4-	6.59E-02	1.31E+04	71.9	5.36E-02	5.96E-02	7.22E-02	7.83E-02
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0.420	1.71E+04	93.9	0.342	0.380	0.461	0.499
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	0.252	2.96E+03	16.2	0.192	0.221	0.282	0.311
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-202							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	5.48E+03 (kg)	(1.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.200	0.215	0.221
Bulk Density†	1.45 (g/cc)	----	----	1.42	1.44	1.46	1.47
Water wt%†	43.6	----	----	41.6	42.6	44.6	45.8
TOC wt% C (wet)†	1.41	----	----	1.16	1.28	1.53	1.65
Radiological Constituents	Ci/L	µCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	2.16E-07	1.49E-04	8.19E-04	1.42E-07	1.77E-07	2.60E-07	3.06E-07
C-14	2.98E-07	2.06E-04	1.13E-03	2.42E-07	2.70E-07	3.27E-07	3.54E-07
Ni-59	1.12E-04	7.72E-02	0.423	9.05E-05	1.02E-04	1.21E-04	1.30E-04
Ni-63	1.10E-02	7.57	41.5	8.88E-03	1.00E-02	1.19E-02	1.28E-02
Co-60	3.14E-07	2.17E-04	1.19E-03	2.55E-07	2.84E-07	3.44E-07	2.15E-06
Se-79	1.31E-06	9.02E-04	4.94E-03	5.31E-07	8.09E-07	7.73E-05	1.83E-04
Sr-90	8.13	5.62E+03	3.08E+04	7.46	7.83	8.41	8.69
Y-90	8.13	5.62E+03	3.08E+04	7.47	7.83	8.42	8.69
Zr-93	5.76E-06	3.98E-03	2.18E-02	2.35E-06	3.27E-06	3.08E-04	8.36E-04
Nb-93m	4.85E-06	3.35E-03	1.84E-02	1.83E-06	3.12E-06	2.99E-04	6.68E-04
Tc-99	2.10E-06	1.45E-03	7.95E-03	1.71E-06	1.90E-06	2.30E-06	2.49E-06
Ru-106	2.49E-09	1.72E-06	9.42E-06	1.93E-09	2.20E-09	1.82E-08	1.89E-07
Cd-113m	1.48E-05	1.03E-02	5.62E-02	8.05E-06	1.14E-05	2.71E-05	2.75E-03
Sb-125	1.21E-06	8.34E-04	4.57E-03	9.81E-07	1.09E-06	1.32E-06	1.43E-06
Sn-126	2.08E-06	1.44E-03	7.88E-03	8.42E-07	1.34E-06	1.28E-04	2.87E-04
I-129	4.06E-09	2.81E-06	1.54E-05	3.30E-09	3.67E-09	4.45E-09	4.82E-09
Cs-134	1.17E-09	8.06E-07	4.42E-06	9.49E-10	1.06E-09	1.28E-09	1.39E-09
Cs-137	1.46E-04	0.101	0.554	1.19E-04	1.32E-04	1.60E-04	1.74E-04
Ba-137m	1.39E-04	9.57E-02	0.524	1.13E-04	1.25E-04	1.52E-04	1.64E-04
Sm-151	4.90E-03	3.38	18.5	2.03E-03	3.16E-03	0.303	0.673
Eu-152	8.59E-05	5.94E-02	0.325	8.58E-05	8.59E-05	8.60E-05	8.61E-05
Eu-154	4.98E-05	3.44E-02	0.189	6.30E-06	2.09E-05	7.87E-05	2.90E-03
Eu-155	5.60E-03	3.87	21.2	5.59E-03	5.60E-03	5.61E-03	5.61E-03
Ra-226	9.71E-09	6.71E-06	3.68E-05	3.03E-09	6.31E-09	1.31E-08	1.64E-08
Ra-228	5.45E-14	3.76E-11	2.06E-10	5.44E-14	5.44E-14	5.45E-14	5.46E-14
Ac-227	4.75E-08	3.28E-05	1.80E-04	8.76E-09	2.78E-08	6.73E-08	8.63E-08
Pa-231	1.28E-09	8.88E-07	4.86E-06	3.91E-10	7.88E-10	7.51E-08	1.81E-07
Th-229	9.86E-12	6.81E-09	3.73E-08	9.84E-12	9.85E-12	9.87E-12	9.88E-12
Th-232	7.10E-17	4.91E-14	2.69E-13	5.77E-17	6.42E-17	7.78E-17	8.43E-17
U-232	7.72E-14	5.34E-11	2.92E-10	6.28E-14	6.98E-14	8.46E-14	9.17E-14
U-233	2.03E-15	1.40E-12	7.68E-12	1.65E-15	1.84E-15	2.22E-15	2.41E-15
U-234	1.11E-09	7.64E-07	4.19E-06	8.99E-10	1.00E-09	1.21E-09	1.31E-09
U-235	4.66E-11	3.22E-08	1.76E-07	3.79E-11	4.21E-11	5.10E-11	5.53E-11
U-236	2.57E-11	1.78E-08	9.74E-08	2.09E-11	2.33E-11	2.82E-11	3.06E-11
U-238	1.10E-09	7.59E-07	4.16E-06	8.93E-10	9.94E-10	1.20E-09	1.30E-09
Np-237	6.36E-09	4.39E-06	2.41E-05	5.17E-09	5.75E-09	6.97E-09	7.55E-09
Pu-238	8.86E-05	6.12E-02	0.335	6.71E-05	7.77E-05	9.95E-05	1.10E-04
Pu-239	3.74E-03	2.58	14.2	2.79E-03	3.26E-03	4.22E-03	4.69E-03
Pu-240	6.15E-04	0.425	2.33	4.61E-04	5.37E-04	6.94E-04	7.69E-04
Pu-241	6.40E-03	4.42	24.2	4.84E-03	5.61E-03	7.19E-03	7.94E-03
Pu-242	3.15E-08	2.18E-05	1.19E-04	2.40E-08	2.77E-08	3.53E-08	3.88E-08
Am-241	1.26E-03	0.874	4.79	2.24E-05	2.95E-05	2.91E-03	4.50E-03
Am-243	3.03E-08	2.10E-05	1.15E-04	6.72E-10	7.77E-10	6.54E-08	9.61E-08
Cm-242	2.04E-06	1.41E-03	7.71E-03	2.03E-06	2.03E-06	2.04E-06	2.04E-06
Cm-243	1.12E-07	7.71E-05	4.22E-04	1.11E-07	1.11E-07	1.12E-07	1.12E-07
Cm-244	5.42E-08	3.75E-05	2.05E-04	4.30E-08	4.85E-08	8.11E-07	4.23E-06
Totals	M	µg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	6.29E-02 (g/L)	----	0.238	4.70E-02	5.48E-02	7.11E-02	7.89E-02
U	1.38E-05	2.27	1.25E-02	1.12E-05	1.25E-05	1.51E-05	1.64E-05

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-203							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	3.10E+04 (kg)	(5.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.199	0.214	0.221
Bulk Density†	1.64 (g/cc)	----	----	1.58	1.61	1.66	1.68
Water wt%†	46.4	----	----	44.6	45.4	47.6	49.0
TOC wt% C (wet)†	0.248	----	----	0.203	0.225	0.272	0.294
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	4.42	6.21E+04	1.92E+03	3.08	3.79	4.96	5.41
Al3+	0	0	0	0	0	0	0
Fe3+ (total Fe)	1.23	4.18E+04	1.30E+03	1.21	1.22	1.23	1.24
Cr3+	2.41E-03	76.5	2.37	2.16E-03	2.28E-03	2.54E-03	2.66E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	0	0	0	0	0	0	0
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	3.03E-02	3.83E+03	119	1.83E-02	2.42E-02	3.64E-02	4.23E-02
Ni2+	3.75E-02	1.34E+03	41.7	3.05E-02	3.43E-02	4.02E-02	4.23E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	6.81E-02	1.67E+03	51.7	4.75E-02	5.76E-02	7.87E-02	8.88E-02
K+	1.48E-02	354	11.0	1.21E-02	1.34E-02	1.62E-02	1.76E-02
OH-	12.2	1.27E+05	3.94E+03	12.2	12.2	12.3	12.3
NO3-	5.90E-02	2.24E+03	69.2	5.01E-02	5.46E-02	6.34E-02	6.73E-02
NO2-	0.183	5.15E+03	159	0.150	0.166	0.200	0.217
CO32-	1.51	5.54E+04	1.72E+03	1.09	1.31	1.68	1.83
PO43-	0.320	1.86E+04	575	0.138	0.234	0.394	0.454
SO42-	8.33E-02	4.89E+03	151	7.28E-02	7.81E-02	8.84E-02	9.30E-02
Si (as SiO32-)	1.37E-03	23.4	0.726	1.17E-03	1.27E-03	1.46E-03	1.55E-03
F-	0	0	0	0	0	0	0
Cl-	9.20E-03	199	6.17	7.69E-03	8.43E-03	9.98E-03	1.07E-02
C6H5O73-	6.58E-03	760	23.5	5.35E-03	5.95E-03	7.21E-03	7.82E-03
EDTA4-	1.32E-02	2.32E+03	71.8	1.07E-02	1.19E-02	1.44E-02	1.56E-02
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	8.39E-02	3.03E+03	93.7	6.82E-02	7.59E-02	9.20E-02	9.97E-02
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	5.02E-02	522	16.2	3.83E-02	4.42E-02	5.63E-02	6.22E-02
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-203 Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	3.10E+04 (kg)	(5.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.199	0.214	0.221
Bulk Density†	1.64 (g/cc)	----	----	1.58	1.61	1.66	1.68
Water wt%†	46.4	----	----	44.6	45.4	47.6	49.0
TOC wt% C (wet)†	0.248	----	----	0.203	0.225	0.272	0.294
Radiological Constituents	Ci/L	μCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	8.03E-07	4.90E-04	1.52E-02	6.75E-07	7.36E-07	8.72E-07	9.41E-07
C-14	2.24E-06	1.37E-03	4.24E-02	1.60E-06	1.94E-06	2.50E-06	2.71E-06
Ni-59	2.24E-05	1.37E-02	0.424	1.82E-05	2.05E-05	2.42E-05	2.61E-05
Ni-63	2.19E-03	1.34	41.5	1.78E-03	2.00E-03	2.38E-03	2.55E-03
Co-60	1.00E-07	6.13E-05	1.90E-03	8.86E-08	9.43E-08	1.06E-07	4.68E-07
Se-79	3.17E-07	1.94E-04	6.01E-03	1.63E-07	2.18E-07	1.55E-05	3.66E-05
Sr-90	1.62	992	3.07E+04	1.49	1.56	1.68	1.74
Y-90	1.62	993	3.07E+04	1.49	1.56	1.68	1.74
Zr-93	1.42E-06	8.68E-04	2.69E-02	7.40E-07	9.25E-07	6.19E-05	1.67E-04
Nb-93m	1.20E-06	7.35E-04	2.28E-02	5.98E-07	8.56E-07	6.00E-05	1.34E-04
Tc-99	2.29E-06	1.40E-03	4.33E-02	2.02E-06	2.15E-06	2.42E-06	2.54E-06
Ru-106	4.97E-10	3.04E-07	9.40E-06	3.85E-10	4.40E-10	3.64E-09	3.78E-08
Cd-113m	3.51E-06	2.15E-03	6.65E-02	2.16E-06	2.82E-06	5.95E-06	5.50E-04
Sb-125	2.61E-07	1.60E-04	4.95E-03	2.16E-07	2.38E-07	2.84E-07	3.07E-07
Sn-126	5.00E-07	3.06E-04	9.47E-03	2.53E-07	3.52E-07	2.57E-05	5.73E-05
I-129	4.29E-09	2.62E-06	8.12E-05	3.78E-09	4.04E-09	4.54E-09	4.76E-09
Cs-134	2.55E-10	1.56E-07	4.82E-06	2.11E-10	2.33E-10	2.77E-10	2.98E-10
Cs-137	1.83E-03	1.12	34.7	1.57E-03	1.70E-03	1.96E-03	2.07E-03
Ba-137m	1.73E-03	1.06	32.8	1.49E-03	1.61E-03	1.85E-03	1.96E-03
Sm-151	1.19E-03	0.728	22.6	6.20E-04	8.46E-04	6.08E-02	0.135
Eu-152	1.72E-05	1.05E-02	0.326	1.72E-05	1.72E-05	1.72E-05	1.72E-05
Eu-154	1.05E-05	6.39E-03	0.198	1.76E-06	4.68E-06	1.62E-05	5.79E-04
Eu-155	1.13E-03	0.688	21.3	1.12E-03	1.13E-03	1.13E-03	1.13E-03
Ra-226	2.05E-09	1.25E-06	3.88E-05	7.16E-10	1.37E-09	2.73E-09	3.38E-09
Ra-228	1.16E-14	7.06E-12	2.19E-10	1.15E-14	1.16E-14	1.16E-14	1.16E-14
Ac-227	9.76E-09	5.97E-06	1.85E-04	2.02E-09	5.82E-09	1.37E-08	1.75E-08
Pa-231	5.11E-10	3.12E-07	9.67E-06	3.33E-10	4.12E-10	1.53E-08	3.63E-08
Th-229	2.10E-12	1.28E-09	3.97E-08	2.10E-12	2.10E-12	2.10E-12	2.10E-12
Th-232	9.81E-17	5.99E-14	1.86E-12	8.59E-17	9.20E-17	1.04E-16	1.09E-16
U-232	1.30E-09	7.96E-07	2.47E-05	1.30E-09	1.30E-09	1.31E-09	1.31E-09
U-233	7.80E-11	4.77E-08	1.48E-06	7.78E-11	7.79E-11	7.82E-11	7.82E-11
U-234	1.10E-04	6.72E-02	2.08	1.10E-04	1.10E-04	1.10E-04	1.10E-04
U-235	4.95E-06	3.02E-03	9.36E-02	4.93E-06	4.94E-06	4.95E-06	4.96E-06
U-236	7.02E-07	4.29E-04	1.33E-02	7.00E-07	7.01E-07	7.03E-07	7.04E-07
U-238	1.11E-04	6.80E-02	2.11	1.11E-04	1.11E-04	1.12E-04	1.12E-04
Np-237	1.25E-08	7.63E-06	2.36E-04	1.09E-08	1.17E-08	1.33E-08	1.40E-08
Pu-238	1.77E-05	1.08E-02	0.335	1.34E-05	1.55E-05	1.99E-05	2.19E-05
Pu-239	7.49E-04	0.458	14.2	5.60E-04	6.53E-04	8.46E-04	9.39E-04
Pu-240	1.23E-04	7.51E-02	2.33	9.22E-05	1.07E-04	1.39E-04	1.54E-04
Pu-241	1.28E-03	0.781	24.2	9.67E-04	1.12E-03	1.44E-03	1.58E-03
Pu-242	6.28E-09	3.84E-06	1.19E-04	4.78E-09	5.53E-09	7.04E-09	7.75E-09
Am-241	2.53E-04	0.154	4.78	4.56E-06	5.99E-06	5.82E-04	8.98E-04
Am-243	6.06E-09	3.70E-06	1.15E-04	1.34E-10	1.55E-10	1.31E-08	1.92E-08
Cm-242	4.07E-07	2.48E-04	7.69E-03	4.06E-07	4.06E-07	4.07E-07	4.07E-07
Cm-243	2.23E-08	1.36E-05	4.22E-04	2.22E-08	2.23E-08	2.23E-08	2.23E-08
Cm-244	1.08E-08	6.61E-06	2.05E-04	8.59E-09	9.69E-09	1.62E-07	8.45E-07
Totals	M	μg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	1.26E-02 (g/L)	----	0.239	9.43E-03	1.10E-02	1.42E-02	1.58E-02
U	1.40	2.04E+05	6.31E+03	1.40	1.40	1.40	1.41

†Volume average for density, mass average Water wt% and TOC wt% C.

Single-Shell Tank 241-C-204							
Total Inventory Estimate*							
Physical Properties				**-95 CI**	**-67 CI**	**+67 CI**	**+95 CI**
Total Waste	1.82E+04 (kg)	(3.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.200	0.214	0.221
Bulk Density†	1.61 (g/cc)	----	----	1.55	1.58	1.63	1.64
Water wt%†	46.0	----	----	44.4	45.1	47.0	48.2
TOC wt% C (wet)†	0.423	----	----	0.345	0.383	0.462	0.500
Chemical Constituents	**mole/L**	**ppm**	**kg**	**-95 CI (mole/L)**	**-67 CI (mole/L)**	**+67 CI (mole/L)**	**+95 CI (mole/L)**
Na+	3.99	5.71E+04	1.04E+03	2.87	3.46	4.44	4.81
Al3+	0	0	0	0	0	0	0
Fe3+ (total Fe)	1.97	6.84E+04	1.25E+03	1.94	1.95	1.98	1.99
Cr3+	3.11E-03	101	1.83	2.70E-03	2.90E-03	3.32E-03	3.52E-03
Bi3+	0	0	0	0	0	0	0
La3+	0	0	0	0	0	0	0
Hg2+	0	0	0	0	0	0	0
Zr (as ZrO(OH)2)	0	0	0	0	0	0	0
Pb2+	5.05E-02	6.52E+03	119	3.05E-02	4.03E-02	6.07E-02	7.05E-02
Ni2+	6.21E-02	2.27E+03	41.4	5.04E-02	5.68E-02	6.65E-02	7.01E-02
Sr2+	0	0	0	0	0	0	0
Mn4+	0	0	0	0	0	0	0
Ca2+	5.74E-02	1.43E+03	26.1	4.03E-02	4.87E-02	6.62E-02	7.46E-02
K+	2.45E-02	598	10.9	2.00E-02	2.22E-02	2.69E-02	2.91E-02
OH-	13.2	1.39E+05	2.54E+03	13.1	13.1	13.2	13.2
NO3-	4.92E-02	1.90E+03	34.6	4.18E-02	4.55E-02	5.28E-02	5.61E-02
NO2-	0.302	8.66E+03	158	0.246	0.274	0.331	0.358
CO32-	1.26	4.71E+04	859	0.907	1.09	1.40	1.53
PO43-	0.267	1.58E+04	288	0.115	0.195	0.328	0.378
SO42-	7.87E-02	4.71E+03	85.8	6.99E-02	7.43E-02	8.29E-02	8.67E-02
Si (as SiO32-)	1.14E-03	19.9	0.363	9.72E-04	1.05E-03	1.22E-03	1.29E-03
F-	0	0	0	0	0	0	0
Cl-	1.44E-02	318	5.80	1.19E-02	1.31E-02	1.57E-02	1.70E-02
C6H5O73-	1.10E-02	1.29E+03	23.6	8.93E-03	9.93E-03	1.20E-02	1.30E-02
EDTA4-	2.20E-02	3.94E+03	71.8	1.79E-02	1.99E-02	2.41E-02	2.61E-02
HEDTA3-	0	0	0	0	0	0	0
glycolate-	0	0	0	0	0	0	0
acetate-	0.140	5.15E+03	93.8	0.114	0.127	0.153	0.166
oxalate2-	0	0	0	0	0	0	0
DBP	0	0	0	0	0	0	0
butanol	0	0	0	0	0	0	0
NH3	8.38E-02	888	16.2	6.38E-02	7.37E-02	9.40E-02	0.104
Fe(CN)64-	0	0	0	0	0	0	0

†Water wt% derived from the difference of density and total dissolved species.

Single-Shell Tank 241-C-204							
Total Inventory Estimate*							
Physical Properties				-95 CI	-67 CI	+67 CI	+95 CI
Total Waste	1.82E+04 (kg)	(3.00 kgal)	----	----	----	----	----
Heat Load	0.207 (kW)	(708 BTU/hr)	----	0.190	0.200	0.214	0.221
Bulk Density†	1.61 (g/cc)	----	----	1.55	1.58	1.63	1.64
Water wt%†	46.0	----	----	44.4	45.1	47.0	48.2
TOC wt% C (wet)†	0.423	----	----	0.345	0.383	0.462	0.500
Radiological Constituents	Ci/L	µCi/g	Ci	-95 CI (Ci/L)	-67 CI (Ci/L)	+67 CI (Ci/L)	+95 CI (Ci/L)
H-3	7.05E-07	4.39E-04	8.00E-03	5.98E-07	6.50E-07	7.63E-07	8.20E-07
C-14	1.92E-06	1.19E-03	2.18E-02	1.38E-06	1.67E-06	2.13E-06	2.31E-06
Ni-59	3.73E-05	2.32E-02	0.423	3.02E-05	3.41E-05	4.04E-05	4.34E-05
Ni-63	3.66E-03	2.28	41.5	2.96E-03	3.34E-03	3.96E-03	4.26E-03
Co-60	1.36E-07	8.46E-05	1.54E-03	1.16E-07	1.26E-07	1.46E-07	7.48E-07
Se-79	4.82E-07	3.00E-04	5.48E-03	2.24E-07	3.17E-07	2.58E-05	6.09E-05
Sr-90	2.71	1.69E+03	3.08E+04	2.49	2.61	2.80	2.90
Y-90	2.71	1.69E+03	3.08E+04	2.49	2.61	2.80	2.90
Zr-93	2.14E-06	1.34E-03	2.43E-02	1.01E-06	1.32E-06	1.03E-04	2.79E-04
Nb-93m	1.81E-06	1.13E-03	2.06E-02	8.03E-07	1.23E-06	9.98E-05	2.23E-04
Tc-99	2.26E-06	1.41E-03	2.56E-02	2.03E-06	2.14E-06	2.37E-06	2.46E-06
Ru-106	8.29E-10	5.16E-07	9.41E-06	6.42E-10	7.34E-10	6.07E-09	6.31E-08
Cd-113m	5.40E-06	3.37E-03	6.13E-02	3.14E-06	4.25E-06	9.47E-06	9.17E-04
Sb-125	4.19E-07	2.61E-04	4.76E-03	3.44E-07	3.81E-07	4.58E-07	4.95E-07
Sn-126	7.64E-07	4.76E-04	8.68E-03	3.51E-07	5.16E-07	4.29E-05	9.56E-05
I-129	4.25E-09	2.65E-06	4.83E-05	3.83E-09	4.04E-09	4.46E-09	4.64E-09
Cs-134	4.07E-10	2.53E-07	4.62E-06	3.34E-10	3.70E-10	4.44E-10	4.80E-10
Cs-137	1.55E-03	0.966	17.6	1.33E-03	1.44E-03	1.66E-03	1.75E-03
Ba-137m	1.47E-03	0.914	16.7	1.26E-03	1.36E-03	1.57E-03	1.66E-03
Sm-151	1.81E-03	1.13	20.5	8.54E-04	1.23E-03	0.101	0.224
Eu-152	2.87E-05	1.79E-02	0.325	2.86E-05	2.86E-05	2.87E-05	2.87E-05
Eu-154	1.70E-05	1.06E-02	0.193	2.52E-06	7.38E-06	2.66E-05	9.65E-04
Eu-155	1.87E-03	1.17	21.3	1.87E-03	1.87E-03	1.87E-03	1.88E-03
Ra-226	3.33E-09	2.07E-06	3.78E-05	1.10E-09	2.19E-09	4.46E-09	5.55E-09
Ra-228	1.87E-14	1.17E-11	2.12E-10	1.87E-14	1.87E-14	1.87E-14	1.88E-14
Ac-227	1.61E-08	1.00E-05	1.82E-04	3.15E-09	9.48E-09	2.27E-08	2.90E-08
Pa-231	6.40E-10	3.99E-07	7.27E-06	3.42E-10	4.75E-10	2.52E-08	6.04E-08
Th-229	3.39E-12	2.11E-09	3.85E-08	3.39E-12	3.39E-12	3.40E-12	3.40E-12
Th-232	9.36E-17	5.83E-14	1.06E-12	8.34E-17	8.85E-17	9.85E-17	1.03E-16
U-232	1.09E-09	6.77E-07	1.23E-05	1.08E-09	1.08E-09	1.09E-09	1.09E-09
U-233	6.50E-11	4.05E-08	7.38E-07	6.48E-11	6.49E-11	6.51E-11	6.52E-11
U-234	9.16E-05	5.71E-02	1.04	9.13E-05	9.15E-05	9.18E-05	9.19E-05
U-235	4.12E-06	2.57E-03	4.68E-02	4.11E-06	4.12E-06	4.13E-06	4.13E-06
U-236	5.85E-07	3.64E-04	6.64E-03	5.83E-07	5.84E-07	5.86E-07	5.87E-07
U-238	9.28E-05	5.78E-02	1.05	9.25E-05	9.27E-05	9.29E-05	9.30E-05
Np-237	1.15E-08	7.14E-06	1.30E-04	1.01E-08	1.08E-08	1.21E-08	1.27E-08
Pu-238	2.95E-05	1.84E-02	0.335	2.23E-05	2.59E-05	3.31E-05	3.66E-05
Pu-239	1.25E-03	0.777	14.2	9.32E-04	1.09E-03	1.41E-03	1.56E-03
Pu-240	2.05E-04	0.128	2.33	1.54E-04	1.79E-04	2.31E-04	2.56E-04
Pu-241	2.13E-03	1.33	24.2	1.61E-03	1.87E-03	2.39E-03	2.64E-03
Pu-242	1.05E-08	6.53E-06	1.19E-04	7.98E-09	9.22E-09	1.17E-08	1.29E-08
Am-241	4.21E-04	0.262	4.78	7.53E-06	9.91E-06	9.71E-04	1.50E-03
Am-243	1.01E-08	6.29E-06	1.15E-04	2.24E-10	2.59E-10	2.18E-08	3.20E-08
Cm-242	6.78E-07	4.22E-04	7.70E-03	6.77E-07	6.78E-07	6.79E-07	6.80E-07
Cm-243	3.72E-08	2.32E-05	4.22E-04	3.71E-08	3.71E-08	3.72E-08	3.72E-08
Cm-244	1.81E-08	1.12E-05	2.05E-04	1.43E-08	1.62E-08	2.70E-07	1.41E-06
Totals	M	µg/g	kg	-95 CI (M or g/L)	-67 CI (M or g/L)	+67 CI (M or g/L)	+95 CI (M or g/L)
Pu	2.10E-02 (g/L)	----	0.238	1.57E-02	1.83E-02	2.37E-02	2.63E-02
U	1.17	1.73E+05	3.16E+03	1.16	1.17	1.17	1.17

†Volume average for density, mass average Water wt% and TOC wt% C.

Appendix B

Outline for First Determination Assessment Plan

Appendix B

Outline for First Determination Assessment Plan

This appendix presents a basic approach for an assessment-monitoring program, as required by 40 CFR 265.93(a). The assessment program must be capable of determining whether dangerous waste or dangerous waste constituents from the facility have compromised groundwater, and if so, to determine the concentration, the rate and the extent of migration in the groundwater [40 CFR 265.93(d)].

An assessment plan will be prepared and submitted to Ecology if an indicator parameter at a downgradient well exceeds the initial background value. The plan will include the following:

- description of the approach to determine whether dangerous waste or dangerous waste constituents entered the groundwater from the WMA or from a source external to the WMA (false positive rationale)
- description of the investigative approach to fully characterize the rate and extent of contaminant migration
- number, locations, and depths of groundwater wells in the monitoring network
- sampling and analytical methods
- data evaluation procedures
- an implementation schedule.

A generic flowchart for the assessment program is presented in Figure B.1 with a proposed plan outline provided in Table B.1.

The first determination is conducted as soon as technically feasible and a report of the findings sent to the Washington State Department of Ecology. If a further determination investigation is required based on the results of the first determination, a detailed assessment plan appropriate to WMA C will be developed as required by 40 CFR 265.

Table B.1. Contents of Proposed Groundwater Quality Assessment Monitoring Plan

1.0 Introduction 1.1 Plan Objectives 1.2 Approach 1.3 Scope and Organization	4.0 Assessment Monitoring Program 4.1 Monitoring Network 4.2 Groundwater Flow Direction and Rate 4.3 Dangerous Waste Constituents 4.4 Investigative Tasks 5.0 Assessment Schedule and Budget
2.0 Background Information 2.1 Facility Description 2.2 Facility Operational History 2.2.1 Past Operational Tank History 2.2.2 Tank Leak History 2.2.3 Present Operational History 2.3 Waste Characteristics 2.4 Geology 2.4.1 General Stratigraphy 2.4.2 Site Specific Stratigraphy 2.4.3 Aquifer properties 2.5 Groundwater Chemistry	
3.0 Conceptual Model 3.1 Contaminant Sources 3.2 Driving Forces 3.3 Migration Pathways	6.0 References Appendix A–Sampling and Analysis Plan Appendix B–As-Built Diagrams of Single-Shell Tank System Waste Management Area C Groundwater Monitoring Wells

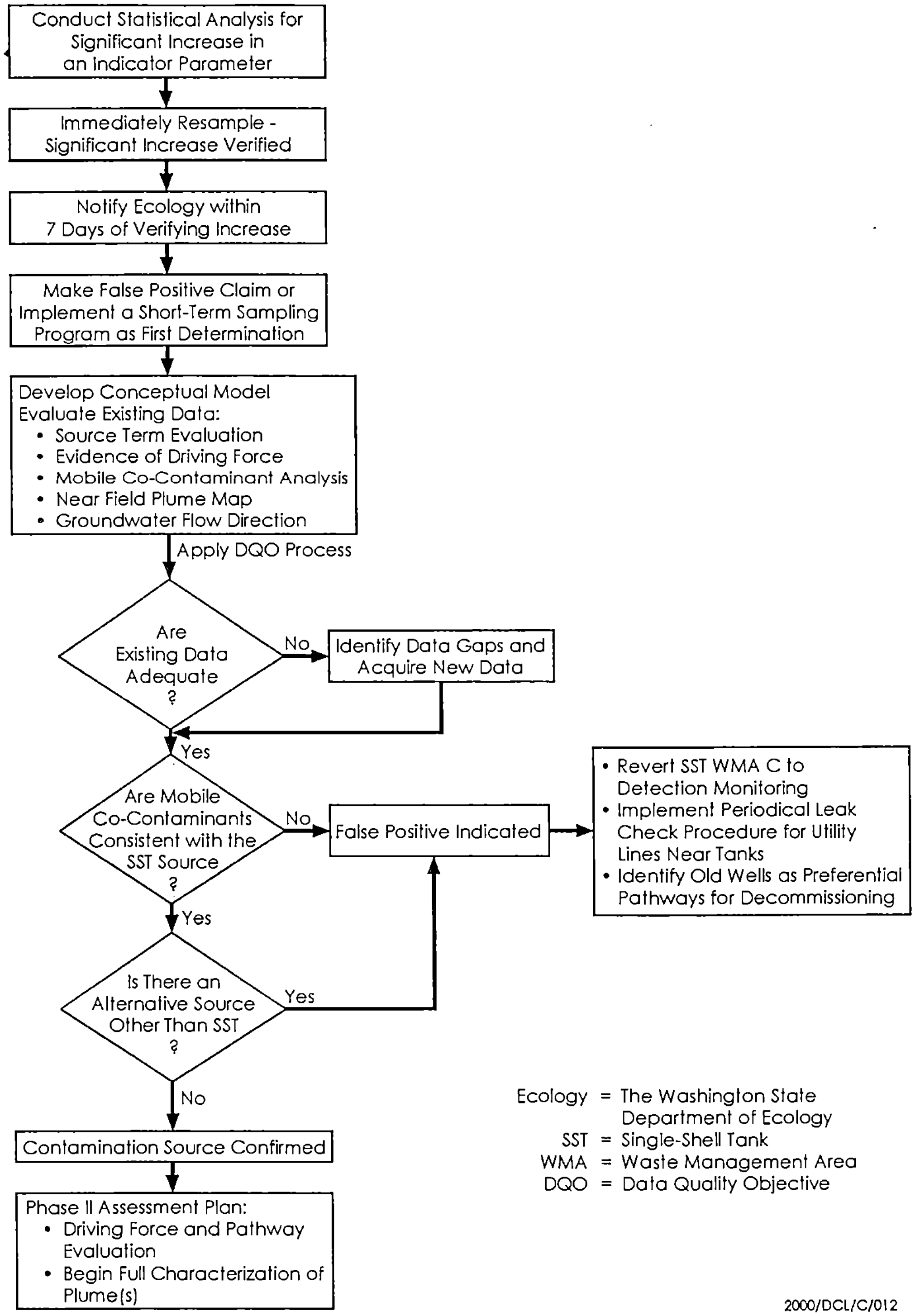


Figure B.1. Flow Chart for First Determination Groundwater Quality Assessment Monitoring Program

Appendix C

As-Built Diagrams of Waste Management Area C Groundwater Monitoring Wells

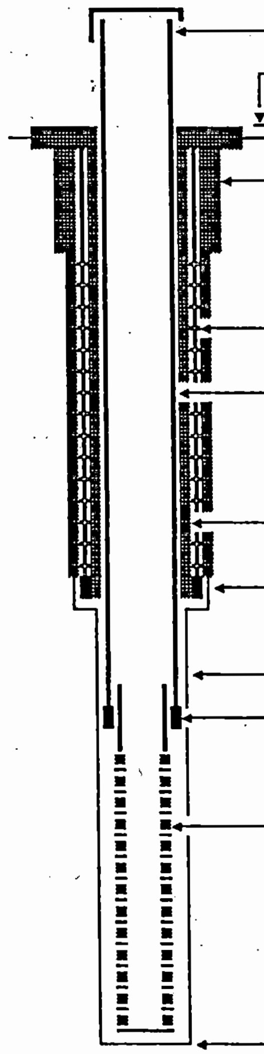
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Hard tool (nom)	WELL NUMBER: 299-E27-7 TEMPORARY WELL NO:
Drilling Fluid Used: Bentonite mud	Additives Used: Not documented	Hanford Coordinates: N/S N 43,097.6 E/W W 48,132.0
Driller's Name: David	WA State Lic Nr: Not documented	State NAD83 N 136,619.7m E 575,220.8m Coordinates: N 448,276 E 2,247,082
Drilling Company: Not documented	Company Location: Not documented	Start Card #: Not documented T___ R___ S___
Date Started: 23Jul82	Date Complete: 04Oct82	Elevation Ground surface: 633.32-ft Brass cap

Depth to water: 232-ft Oct82
(Ground surface) 231.1-ft 23Jun93

GENERALIZED STRATIGRAPHY   Driller's Log

0↔40: Fine SAND and GRAVEL
40↔140: Fine SAND
140↔150: Fine SAND and GRAVEL
150↔160: SAND and GRAVEL
160↔200: Fine SAND
200↔210: Fine SAND and GRAVEL
210↔220: GRAVEL and SAND
220↔235: SAND and GRAVEL
235↔250: Fine SAND and GRAVEL
250↔260: GRAVEL, fine SAND and Ringold Fm.
260↔275: Fine SAND, GRAVEL and Ringold Fm.
275↔280: Ringold



Elevation of reference point: [634.67]
(top of casing)

Height of reference point above ground surface [1.3-ft]

Depth of surface seal [0↔20-ft]
Type of surface seal:
Cement grout around 8-in casing to 20-ft, poorly documented
2-ft round collar

8-in ID carbon steel casing, ‾0↔150-ft, perforated 20↔150-ft, 2 cuts/rd/ft

6-in ID carbon steel casing, +1.3↔240-ft

Cement grout, 0↔150-ft

Hole diameter,
20↔150-ft, 9-in nominal
150↔281-ft, 7-in nominal

6-in casing to 240-ft
Pulled back from total depth

6-in stainless steel telescoping screen, 241↔281-ft, #20-slot
5-ft blank welded on top

Borehole drilled depth: [281-ft]

Drawing By: RKL/2E27-07.ASB
Date : 09Sep93
Reference : HANFORD WELLS

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-7

WELL DESIGNATION	:	299-E27-7
RCRA FACILITY	:	SST
CERCLA UNIT	:	200 Aggregate Area Management Study
HANFORD COORDINATES	:	N 43,097.6 W 48,132.0 [17Sep90-200E]
LAMBERT COORDINATES	:	N 448,276 E 2,247,082 [HANCONV] N 136,619.7m E 575,220.8m [17Sep90-NAD83]
DATE DRILLED	:	Oct82
DEPTH DRILLED (GS)	:	281-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	232-ft, Oct82; 231.1-ft, 23Jun93
CASING DIAMETER	:	8-in, carbon steel, 0↔150-ft; 6-in, carbon steel, +1.3↔240-ft
ELEV TOP CASING	:	634.67-ft, [17Sep90-200E]
ELEV GROUND SURFACE	:	633.32-ft, Brass cap [17Sep90-200E]
PERFORATED INTERVAL	:	8-in casing, 20↔150-ft
SCREENED INTERVAL	:	241↔281-ft, 6-in telescoping, #20-slot stainless steel
COMMENTS	:	FIELD INSPECTION, 01Feb90, 6-in carbon steel casing. Capped, not locked 2-ft pad, no posts. no permanent identification. Not in radiation zone.
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	20Mar90 - 6-in casing in good condition.
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 31Mar88↔23Jun93;
CURRENT USER	:	WHC ES&M RCRA sampling. PNL sitewide w/l monitoring
PUMP TYPE	:	Electric submersible
MAINTENANCE	:	

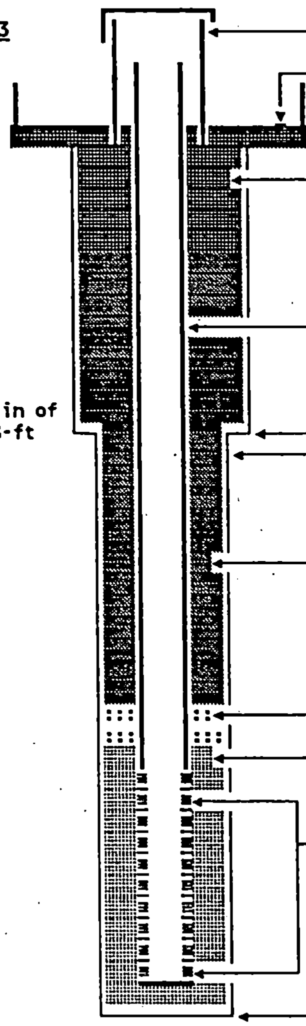
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E27-12 TEMPORARY WELL NO:
Drilling Fluid Used: 200 W Water Supply	Additives Used: None	Hanford Coordinates: N/S N 42,981.4 E/W W 48,678.4
Driller's Name: L. Watkins	WA State Lic Nr: Not documented	State NAD83 Coordinates: N 136,583.8m E 575,054.3m; N 448,158 E 2,246,536
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T___ R___ S___
Date Started: 28Aug89	Date Complete: 09Oct89	Elevation Ground surface: 657.64-ft (Brass cap)

Depth to water: 252.1-ft Sep89
(Ground surface) 255.7-ft 23Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log
Sl=slightly

0-10: Gravelly SAND
10-15: Sl gravelly SAND-MUD
15-30: Gravelly SAND
30-70: SAND
70-115: Gravelly SAND
115-120: SAND
120-125: Gravelly SAND (COBBLES)
125-135: SAND (cemented)
135-155: Sl gravelly SAND
155-160: Sandy GRAVEL
160-165: Sl gravelly SAND
165-225: SAND
225-230: Muddy sandy GRAVEL, 10-in of Gravelly sandy MUD @228-ft
230-245: Sandy GRAVEL
245-255: Muddy sandy GRAVEL
255-270: Sandy GRAVEL



Elevation of reference point: [660.96-ft]
(top of casing)
Height of reference point above ground surface [3.3-ft]
Depth of surface seal [2.0-18.9-ft]
Type of surface seal:
Cement grout, 2.0-18.9-ft, w/concrete 4x4-ft x 6-in surface pad extending 2.0-ft into annulus

4-in ID stainless steel casing, +1.8-246.5-ft

Hole diameter,
0-127.2-ft, 11-in nominal
127.2-270.0-ft, 9-in nominal

Bentonite crumbles, 18.9-239.8-ft, 8-20-mesh

¼-in Volclay tablets, 239.8-243.1-ft

Silica sand pack, 243.1-270.0-ft, 16-30-mesh

4-in stainless steel screen, 246.5-267.6-ft, #10-slot with channel pack

Borehole drilled depth: [270.0-ft]

Drawing By: RKL/2E27-12.ASB
Date: 09Sep93
Reference: WHC-MR-0209

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-12

WELL DESIGNATION	:	299-E27-12
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	SST WMA C, 241-C Tank Farm
HANFORD COORDINATES	:	N 42,981.4 W 48,678.4 [04Jan90-200E]
LAMBERT COORDINATES	:	N 448,158 E 2,246,536 [HANCONV] N 136,583.8m E 575,054.3m [04Jan90-NAD83]
DATE DRILLED	:	Sep89
DEPTH DRILLED (GS)	:	279.0-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	252.1-ft, Oct89; 255.7-ft, 23Jun93
CASING DIAMETER	:	4-in stainless steel, +1.8↔246.5-ft; 6-in stainless steel, +3.3↔¯0.5-ft
ELEV TOP CASING	:	660.96-ft, [04Jan90-200E]
ELEV GROUND SURFACE	:	657.64-ft, Brass cap [04Jan90-200E]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	246.5↔267.6-ft, 4-in #10-slot stainless steel w/channel pack
COMMENTS	:	FIELD INSPECTION, 02Feb90; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 01Dec89↔23Jun93;
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: M. Thoresen
Drilling Company: Kaiser Engineers
Date Started: 01Sep89

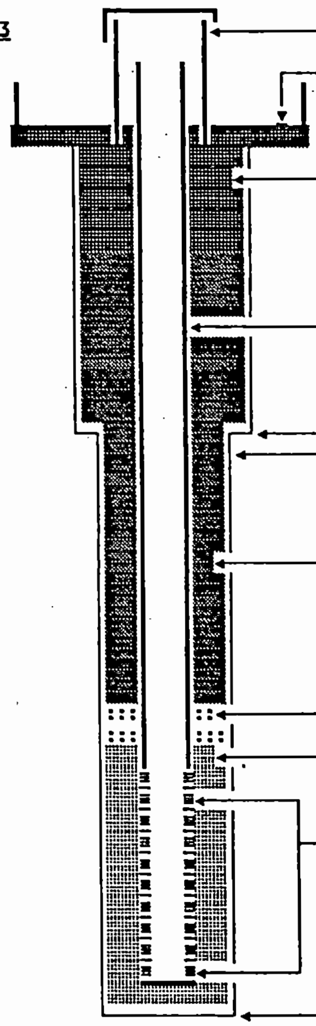
Sample Method: Drive barrel Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 12Oct89

WELL NUMBER: 299-E27-13
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 42,671.9 E/W W 48,644.0
State (NAD83) N 136,498.5m E 575,065.1m
Coordinates: N 447,849 E 2,246,572
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 666.02-ft (Brass cap)

Depth to water: 260.7-ft Oct89
(Ground surface) 264.0-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0–15: Sandy GRAVEL
15–20: Sl gravelly muddy SAND
20–30: Gravelly SAND
30–40: Sandy GRAVEL
40–65: SAND
65–80: Sl gravelly SAND
80–85: SAND
85–100: Sl gravelly SAND
100–115: Gravelly SAND
115–120: Sl gravelly SAND
120–155: SAND
155–160: Sl gravelly SAND
160–165: Gravelly SAND
165–170: SL gravelly SAND
170–185: SAND
185–205: Sl gravelly SAND
205–210: SAND
210–215: Sl gravelly SAND
215–225: Gravelly SAND
225–240: SAND
240–270: Sandy GRAVEL
270–275.5: GRAVEL



Elevation of reference point: [668.99-ft]
(top of casing)
Height of reference point above ground surface [3.0-ft]

Depth of surface seal [2.0–19.4-ft]
Type of surface seal:
Cement grout, 2.0–19.4-ft, w/concrete 4x4-ft x 6-in surface pad extending 2.0-ft into annulus

4-in ID stainless steel casing, +1.8–253.6-ft

Hole diameter,
0–138.5-ft, 11-in nominal
138.5–275.5-ft, 9-in nominal

Bentonite crumbles, 19.4–247.5-ft, 8–20-mesh

-in Volclay tablets 247.5–250.6-ft

Silica sand pack, 250.6–275.6-ft, 16–30-mesh

4-in stainless steel screen, 253.6–274.7-ft, #10-slot w/channel pack

Borehole drilled depth: [275.6-ft]

Drawing By: RKL/2E27-13.ASB
Date : 09Sep93
Reference : WHC-MR-0209

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-13

WELL DESIGNATION	:	299-E27-13
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	SST WMA C, 241-C Tank Farm
HANFORD COORDINATES	:	N 42,671.9 W 48,644.0 [04Jan90-200E]
LAMBERT COORDINATES	:	N 447,849 E 2,246,572 [HANCONV] N 136,498.5m E 575,065.1m [04Jun90-NAD83]
DATE DRILLED	:	Oct89
DEPTH DRILLED (GS)	:	275.5-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	260.7-ft, 12Oct89; 264.0-ft, 23Jun93
CASING DIAMETER	:	4-in stainless steel, +1.8↔253.6-ft; 6-in stainless steel, +3.0↔~0.5-ft
ELEV TOP CASING	:	668.99-ft [04Jun90-200E]
ELEV GROUND SURFACE	:	666.02-ft, Brass cap [04Jun90-200E]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	253.6↔274.7-ft, 4-in #10-slot stainless steel w/channel pack
COMMENTS	:	FIELD INSPECTION, 05Feb90; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 01Dec89↔23Jun93;
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Watkins
Drilling Company: Kaiser Engineers
Date Started: 19Sep89

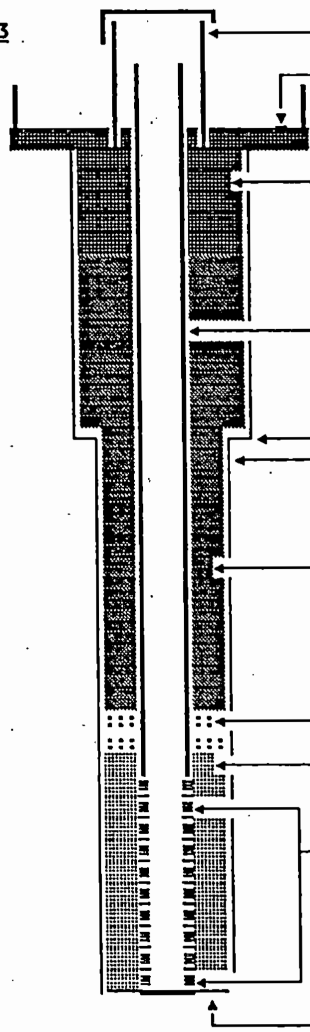
Sample Method: Drive barrel
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 17Oct89

WELL NUMBER: 299-E27-14
TEMPORARY WELL NO: ____
Hanford Coordinates: N/S N 42 700.1 E/W W 48,143.6
State NAD83 N 136,498.5m E 575,217.6m
Coordinates: N 447,878 E 2,247,072
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 655.34-ft (Brass cap)

Depth to water: 249.8-ft Oct89
(Ground surface) 253.3-ft 23Jun93

GENERALIZED STRATIGRAPHY Geologist's Log
Sl=slightly

0↔10: Muddy SAND
10↔15: Gravelly SAND
15↔40: Sandy GRAVEL
40↔48: SAND
48↔49: Sl muddy SAND (wet)
49↔65: SAND
65↔85: Sandy GRAVEL
85↔90: Gravelly SAND
90↔94: SAND
94↔94.5: CLAY lens
94.5↔100: Sl muddy SAND
100↔140: SAND
140↔145: Sl gravelly SAND
145↔150: Gravelly SAND
150↔160: SAND
160↔165: Sl gravelly SAND
165↔170: SAND
170↔200: Gravelly SAND
200↔205: Sl gravelly SAND
205↔230: SAND
230↔235: Muddy sandy GRAVEL
235↔245: Sandy GRAVEL
245↔250: Muddy sandy GRAVEL
250↔260: Sandy GRAVEL
260↔265: Gravelly SAND
265↔266.8: SAND



Elevation of reference point: [658.34-ft]
(top of casing)
Height of reference point above ground surface [3.0-ft]

Depth of surface seal [2.8↔19.8-ft]
Type of surface seal:
Cement grout, 2.8↔19.8-ft, w/concrete 4x4-ft x 6-in surface pad extending 2.0-ft into annulus

4-in ID stainless steel casing, +0.6↔245.8-ft

Hole diameter,
0↔137.6-ft, 11-in nominal
137.6↔266.8-ft, 9-in nominal

Bentonite crumbles, 19.8↔239.4-ft, 8↔20-mesh

¼-in Volclay tablets, 239.4↔242.7-ft

Silica sand pack, 242.7↔266.8-ft, 16↔30-mesh

4-in stainless steel screen, 245.8↔266.8-ft, #10-slot w/channel pack

Borehole drilled depth: [266.8-ft]

Drawing By: RKL/2E27-14.ASB
Date : 09Sep93
Reference : WHC-MR-0209

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-14

WELL DESIGNATION	:	299-E27-14
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	SST WMA C, 241-C Tank Farm
HANFORD COORDINATES	:	N 42,700.1 W 48,143.6 [04Jan90-200E]
LAMBERT COORDINATES	:	N 447,878 E 2,247,072 [HANCONV] N 136,498.5m E 575,217.6m [04Jan90-NAD83]
DATE DRILLED	:	Oct89
DEPTH DRILLED (GS)	:	266.8-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	249.8-ft, 17Oct89; 253.3-ft, 23Jun93
CASING DIAMETER	:	4-in stainless steel, +0.6↔245.8-ft; 6-in stainless steel, +3.0↔¯0.5-ft
ELEV TOP CASING	:	658.34-ft, [04Jan90-200E]
ELEV GROUND SURFACE	:	655.34-ft, Brass cap [04Jan90-200E]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	245.8↔266.8-ft, 4-in #10-slot stainless steel w/channel pack
COMMENTS	:	FIELD INSPECTION, 02Feb90; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 01Dec89↔23Jun93;
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

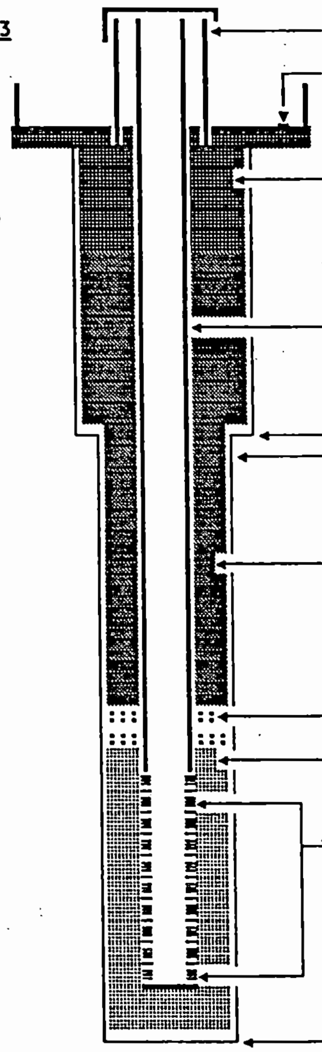
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel Hard tool	WELL NUMBER: 299-E27-15 TEMPORARY WELL NO:
Drilling Fluid Used: 200 W Water Supply	Additives Used: None	Hanford Coordinates: N/S N 43,134.7 E/W W 48,543.0
Driller's Name: C. Walmsley	WA State Lic Nr: Not documented	State NAD83 N 136,630.6m E 575,095.5m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 448,3126 E 2,246,671
Date Started: 23Aug89	Date Complete: 03Oct89	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 649.83-ft (Brass cap)

Depth to water: 244.8-ft Oct89
(Ground surface) 248.2-ft 23Jun93

GENERALIZED STRATIGRAPHY
Geologist's Log
Sl=slightly

0↔10: SAND
10↔15: Sandy GRAVEL
15↔30: SAND
30↔40: Gravelly↔sl gravelly SAND
40↔45: SAND
45↔60: Sl gravelly SAND
60↔100: SAND, (trace GRAVEL)
100↔130: Gravelly SAND
130↔135: Sandy GRAVEL
135↔140: SAND
140↔150: Sl gravelly SAND
150↔155: SAND
155↔165: Sl gravelly SAND
165↔170: Sandy GRAVEL
170↔175: Gravelly SAND
175↔225: SAND
225↔245: Sandy GRAVEL
245↔262.5: Muddy sandy GRAVEL



Elevation of reference point: [652.67-ft] (top of casing).
Height of reference point above ground surface [2.8-ft]
Depth of surface seal [1.8↔18.2-ft]
Type of surface seal: Cement grout, 1.8↔18.2-ft, w/concrete 4x4-ft x 6-in surface pad extending 1.8-ft into annulus
4-in ID stainless steel casing, +2.4↔238.0-ft
Hole diameter, 0↔128.3-ft, 11-in nominal; 128.3↔262.5-ft, 9-in nominal
Bentonite crumbles, 18.2↔231.2-ft, 8↔20-mesh
¼-in Volclay tablets, 231.2↔234.8-ft
Silica sand pack, 234.8↔262.5-ft, 16↔30-mesh
4-in stainless steel screen, 238.0↔259.0-ft, #10-slot w/channel pack
Borehole drilled depth: [262.5-ft]

Drawing By: RKL/2E27-15.ASB
Date : 09Sep93
Reference : WHC-MR-0209

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E27-15

WELL DESIGNATION	:	299-E27-15
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	SST WMA C, 241-C Tank Farm
HANFORD COORDINATES	:	N 43,134.7 W 48,543.0 [04Jan90-200E]
LAMBERT COORDINATES	:	N 448,312 E 2,246,671 [HANCONV] N 136,630.6m E 575,095.5m [04Jan90-NAD83]
DATE DRILLED	:	Oct89
DEPTH DRILLED (GS)	:	262.5-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	244.8-ft, 03Oct89; 248.2-ft, 23Jun93
CASING DIAMETER	:	4-in stainless steel, +2.4↔238.0-ft; 6-in stainless steel, +2.8↔~0.5-ft
ELEV TOP CASING	:	652.67-ft
ELEV GROUND SURFACE	:	649.83-ft (Brass cap)
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	238.0↔259.0-ft, 4-in #10-slot stainless steel w/channel pack
COMMENTS	:	FIELD INSPECTION, 02Feb90; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Geologist, driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 01Dec89↔23Jun93;
CURRENT USER	:	WHC ES&M w/l monitoring and RCRA sampling
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

Appendix D

Sampling and Analysis Plan

Appendix D

Sampling and Analysis Plan

This appendix consists of a description of the statistical method used for data evaluation, the field sampling plan (FSP), and the quality assurance project plan (QAPP). The t-test required to calculate the critical means in Table 4.2 is provided. The FSP specifies the location of procedures guiding sample and field data collection. The QAPP includes the procedures and project management controls intended to ensure the analyzed data and associated measurement errors meet the quantitative and qualitative needs of the groundwater monitoring program at WMA C. Together the FSP and QAPP form the Sampling and Analysis Plan (SAP). The SAP is used as a principal controlling document for conducting the work identified in Section 4.2.2.

Activities identified in Section 4.2.3 that relate to compliance issues are not included in the SAP. After the tasks required to determine the flow direction and to redesign the network have been completed, a wel installation plan will be developed with well locations and a schedule to guide installation of these wells.

D.1 Statistical Methods

The goal of RCRA detection monitoring is to determine if WMA C has affected groundwater quality. This is determined based on the results of a statistical test. According to 40 CFR 265.92 (and by reference of WAC 173-303-400[3]) the owner/operator of an interim-status hazardous waste facility must establish initial background concentrations for the contamination indicator parameters: specific conductance, pH, total organic carbon, and total organic halogen. This has been done for WMA C by obtaining at least four replicate measurements for each parameter from each well quarterly for 1 year. Data from an upgradient well was used to determine the initial background arithmetic mean and variance.

Monitoring data collected after the first year are compared with the initial background data to determine if there is an indication that contamination may have occurred. A t-test is required to make this determination (40 CFR 265.93[b]). A recommended method is the averaged replicate t-test method described in Appendix B of the *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1986b). The averaged replicate t-test method for each contamination indicator parameter is calculated as:

$$t = \left(\bar{x}_1 - \bar{x}_b\right) / S_b * \sqrt{1 + 1/n_b} \quad (D.1)$$

where t = test statistic

$\bar{x}_i$ = average of replicates from the i^{th} monitoring well

$\bar{x}_b$ = background average

S_b = background standard deviation

n_b = number of background replicate averages.

A test statistic larger than the Bonferroni critical value, t_c, (i.e., $t > t_c$) indicates a statistically significant probability of contamination. These Bonferroni critical values depend on the overall false-positive rate required for each sampling period (i.e., 1% for interim status), the total number of wells in the monitoring network, and the number of degrees of freedom (n_b - 1) associated with the background standard deviation. Because of the nature of the test statistic in the above equation, results to be compared to background do not contribute to the estimate of the variance. The test can be reformulated, without prior knowledge of the results of the sample to be compared to background (i.e., $\bar{x}_i$), in such a way that a critical mean, CM, can be obtained:

$$CM = \bar{x}_b + t_c * S_b * \sqrt{(1 + 1/n_b)} \text{ (one tailed)} \quad (D.2)$$

$$CM = \bar{x}_b \pm t_c * S_b * \sqrt{(1 + 1/n_b)} \text{ (two tailed)} \quad (D.3)$$

If downgradient data exceed the CM, they are determined to be statistically different from background. For pH, a two-tailed CM (or critical range) is calculated and downgradient data beyond the range are considered to be statistically different from background. If a statistical exceedance is detected, the well will be resampled to determine if the originally detected increase (or pH decrease) was a result of laboratory or measurement error (verification sampling). If verification sampling confirms the exceedance, the owner/operator must notify Ecology within 7 days and submit a groundwater quality assessment plan within 15 days following the notification (40 CFR 265.93[d]). The goal of the assessment monitoring program is to determine if dangerous waste or dangerous waste constituents from the facility have entered the groundwater and, if so, to determine their concentration and the rate and extent of migration in groundwater (40 CFR 265.93[d]). Critical mean values for WMA C are presented in Table 4.2 in Section 4.2.3.

D.2 Field Sampling Plan

Sampling and analyses for the WMA C is part of the Hanford Groundwater Monitoring Project. Procedures for groundwater sampling, sample documentation and preservation, shipment, and chain-of-custody requirements are described in subcontractor manuals, currently ES-SSPM-001 (1998), and in the latest quality assurance project plan (PNNL 1998). Samples are collected after a minimum of three casing volumes of water have been purged from the well and/or after field parameters (pH, temperature, conductivity, and turbidity) are stable. For routine groundwater samples, labels and preservatives are added to the collection bottles prior to transport to the field. Samples to be analyzed for metals are filtered in the field to assure results represent dissolved metals and do not include particulates. Procedures for field measurements are specified in the subcontractor's and/or manufacturer's manuals.

D.3 Quality Assurance Project Plan

The groundwater monitoring project's quality assurance/quality control (QA/QC) program is designed to assess and improve the reliability and validity of groundwater data. The primary quantitative measures or parameters used to assess data quality are accuracy, precision, completeness, and the method detection limit. The QC parameters are evaluated through laboratory checks (e.g., matrix spikes, laboratory blanks), duplicate sampling and analysis, and analysis of blind standards and blanks. When required, interlaboratory comparisons are made. Acceptance criteria have been established for each of these parameters (PNNL 1998), based on guidance from the U.S. Environmental Protection Agency (EPA 1986a). When a parameter is outside the criteria, corrective actions are taken to prevent a future occurrence. Affected data are either rejected with a reanalysis of the sample or flagged in the database as suspect.

Furthermore, the data undergo a validation/verification process according to a documented procedure in the Hanford Groundwater Monitoring Project QAPP. Quality control data are evaluated against criteria provided in the QAPP. In addition, the project scientist for WMA C, who has specific site knowledge of historic chemical trends, the facility operations, and the local hydrogeology, screens the data. If the data are suspect, the lab is requested to check calculations and/or reanalyze the sample. Suspect data are either rejected with the reanalysis value or flagged in the database. If after reanalysis, the data are still questionable and pertain to exceedences in the DWS, a new sample is collected and analyzed.

Qualitative measures include representativeness and comparability. For this groundwater monitoring program, the location of the wells with respect to WMA facilities, with respect to groundwater flow direction and rate and the interwell spacing address the goal of acquiring representative samples. In addition, the materials used in well construction, the well construction design, and the length of the screened interval are designed to provide samples representative of groundwater conditions in the uppermost aquifer under the WMA. The sampling frequency is also examined with each sampling event to assure adequacy to detect changes in groundwater quality occurring across the site. Sampling techniques are addressed in the FSP in Section D.2. Analysis techniques are specified in contracts with the analytical laboratories used by the Hanford Groundwater Monitoring Project. Most techniques are standard methods from *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA 1986a). Alternative procedures meet the guidelines of SW-846, Chapter 10. Analytical methods are described in Gillespie (1999).

Comparability is the confidence with which one data set can be compared to another. The degree to which this can be accomplished depends upon the degree to which the data are accurate, precise, complete, and representative of the groundwater conditions at the WMA. When comparisons between data sets indicate data may be problematic, the data validation/verification process is followed until comparisons can be made with confidence.

D.4 References

40 CFR 265, Code of Federal Regulations, Title 40, Part 265. *Interim Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities.*

Gillespie, B. M. 1999. "Analytical Methods," Appendix C of *Hanford Site Groundwater Monitoring for Fiscal Year 1998.* PNNL-12086, Pacific Northwest National Laboratory, Richland, Washington.

PNNL. 1998. *The Hanford Ground-Water Monitoring Project Quality Assurance Project Plan*, QA Plan ETD-012, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.

U.S. Environmental Protection Agency (EPA). 1986a. *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods, 3rd Ed.* Office of Solid Waste and Emergency Response, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1986b. *RCRA Groundwater Monitoring Technical Enforcement Guidance Document.* Washington, D.C.

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code, Olympia, Washington (as amended).

ES-SSPM-001. 1998. *Sampling Services Procedure Manual*, Waste Management Northwest.