ORNL/RAP-28

ornl

OAK RIDGE NATIONAL LABORATORY

MARTIN MARIETTA

Environmental Data Package for the Melton Valley Area (WAG 8)

W. J. Boegly, Jr.
A. F. Iglar

Environmental Sciences Division
Publication No. 3000

[redacted]

3/2010

ENVIRONMENTAL SCIENCES DIVISION · OAK RIDGE NATIONAL LABORATORY

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Printed in the United States of America. Available from
the U.S. Department of Energy
Technical Information Center
P.O. Box 62, Oak Ridge, Tennessee 37830

ORNL/RAP-28

ENVIRONMENTAL SCIENCES DIVISION

ENVIRONMENTAL DATA PACKAGE FOR THE MELTON VALLEY AREA (WAG 8)

W. J. Boegly, Jr. and A. F. Iglar*

Environmental Sciences Division
Publication No. 3000

---

* ORAU Faculty Research Participant, East Tennessee State University.

Date of Issue - September 1987

NUCLEAR AND CHEMICAL WASTE PROGRAMS
(Activity No. KG 02 00 00 0; ONLKG02)

Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by

MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
DEPARTMENT OF ENERGY

under Contract No. DE-AC05-84OR21400

[redacted]

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This environmental data package was prepared as part of the effort to meet regulatory requirements for remedial action under Section 3004(u) of the Resource Conservation and Recovery Act. The report considers the 21 Solid Waste Management Units (SWMUs) in Waste Area Grouping (WAG) 8 in Melton Valley. ORNL has recommended that a remedial investigation be conducted to identify the nature of remedial actions in WAG 8.

The purpose of this data package is to provide background information on the geology, hydrology, and soils for the WAG 8 area, as well as information on releases and inventories of radionuclides and hazardous materials for individual sites within WAG 8 that will be required for additional remedial action evaluations. Areas where additional site information will be required are also identified.

The data package indicates that limited information exists on inventories of radioactive and hazardous waste constituents at most of the identified sites. Although there is information on geology, soils, and hydrology for nearby areas, additional evaluations will be required to ensure that the available data can be applied to WAG 8.

1. INTRODUCTION

U.S. Department of Energy (DOE) facilities are required to be in full compliance with all federal and state regulations. In response to these requirements, the Oak Ridge National Laboratory (ORNL) has established a Remedial Action Program (RAP) to provide comprehensive management of areas where past and current research and development and waste management activities have resulted in residual contamination of facilities or the environment. The primary objective of the RAP is to clean up releases of hazardous waste or hazardous constituents that threaten human health or the environment (Trabalka and Myrick, in press).

The initial ORNL remedial action strategy was based on the guidance of DOE Orders 5820.2 (Surplus Facilities Management) and 5480.14 (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]); the Resource Conservation and Recovery Act (RCRA) was believed to apply only to a limited number of sites. As a part of this strategy, individual sites were being addressed according to estimated priorities for site characterization, remedial actions, and decommissioning and closure planning. In 1984, the RCRA was amended to establish broad new authorities within the Environmental Protection Agency (EPA) RCRA programs. One of these new authorities was in Section 3004(u), which requires that any hazardous waste management permit issued after November 8, 1984, require corrective action for all releases from solid waste management units (SWMUs) at the facility. In a memorandum to DOE on May 2, 1986, EPA expressed concern about the length of time required to implement DOE Orders and elected to enforce regulatory requirements for remedial actions through its amended RCRA authority (Scarborough 1986).

Prior to the Hazardous and Solid Waste Amendments (HSWA), EPA's authority to require corrective action for releases of hazardous constituents was limited to groundwater releases from units that were covered by RCRA permits (Part 264, Subpart F). Since passage of the HSWA, EPA's authority has been extended to all groundwater releases at a RCRA facility regardless of when they were used and whether or not they are covered by a RCRA permit (USEPA 1986).

1.1 DESCRIPTION OF ORNL'S APPROACH TO COMPLIANCE WITH 3004(u)

The ORNL area is characterized by complex hydrogeologic conditions, and previous studies have shown a close relationship between shallow groundwater flow systems and surface drainage systems (Trabalka and Myrick, in press). It is felt that reliance on groundwater monitoring as prescribed by RCRA regulations would not be adequate or effective under ORNL site conditions; a combination of surface and groundwater monitoring should be more effective in meeting the principal performance objective of RCRA regulations; the protection of human health and the environment (Trabalka and Myrick, in press).

According to RCRA facility assessment guidance an SWMU is defined as:

> any discernible waste management unit at a RCRA facility from which hazardous constituents might migrate, irrespective of whether the unit was intended for the management of solid and/or hazardous waste. This definition includes containers, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators, and underground injection wells, including those units defined as 'regulated units' under RCRA. Also included are recycling units, wastewater treatment units and other units which EPA has generally exempted from standards applicable to hazardous waste management units, and areas contaminated by 'routine, systematic, and deliberate discharges' from process areas.

The definition does not include accidental spills from production areas and units in which <u>wastes</u> have not been managed (e.g., product storage areas) (EPA 1986).

As the first step in identifying compliance requirements under RCRA 3004(u) for ORNL, a listing of all known active and inactive waste management areas, contaminated facilities, and potential sources of continuing releases to the environment was prepared. Included in this list were waste collection and storage tanks, solid waste storage areas (SWSAs), waste treatment units, impoundments, spill sites, pipeline leak sites, underground injection wells, and areas of known contamination within buildings. Although some of the identified sites might not be regulated under 3004(u), they were included in the site listing in order to maintain a comprehensive inventory of all ORNL sites that might require some form of remedial action.

The listing compiled for ORNL includes about 250 sites that might be considered for 3004(u) remedial action (ORNL 1987b). Because of the complex hydrogeology of ORNL and the large number of sites involved, the ORNL sites were grouped into 20 geographically contiguous and hydrologically defined Waste Area Groupings or WAGs (see Trabalka and Myrick [in press] for a detailed discussion of the rationale used in developing and defining the WAG concept). Fig. 1 shows the locations of the 20 WAGs. This Environmental Data Package covers only the Melton Valley Area (WAG 8) and its 21 sites (Table 1).

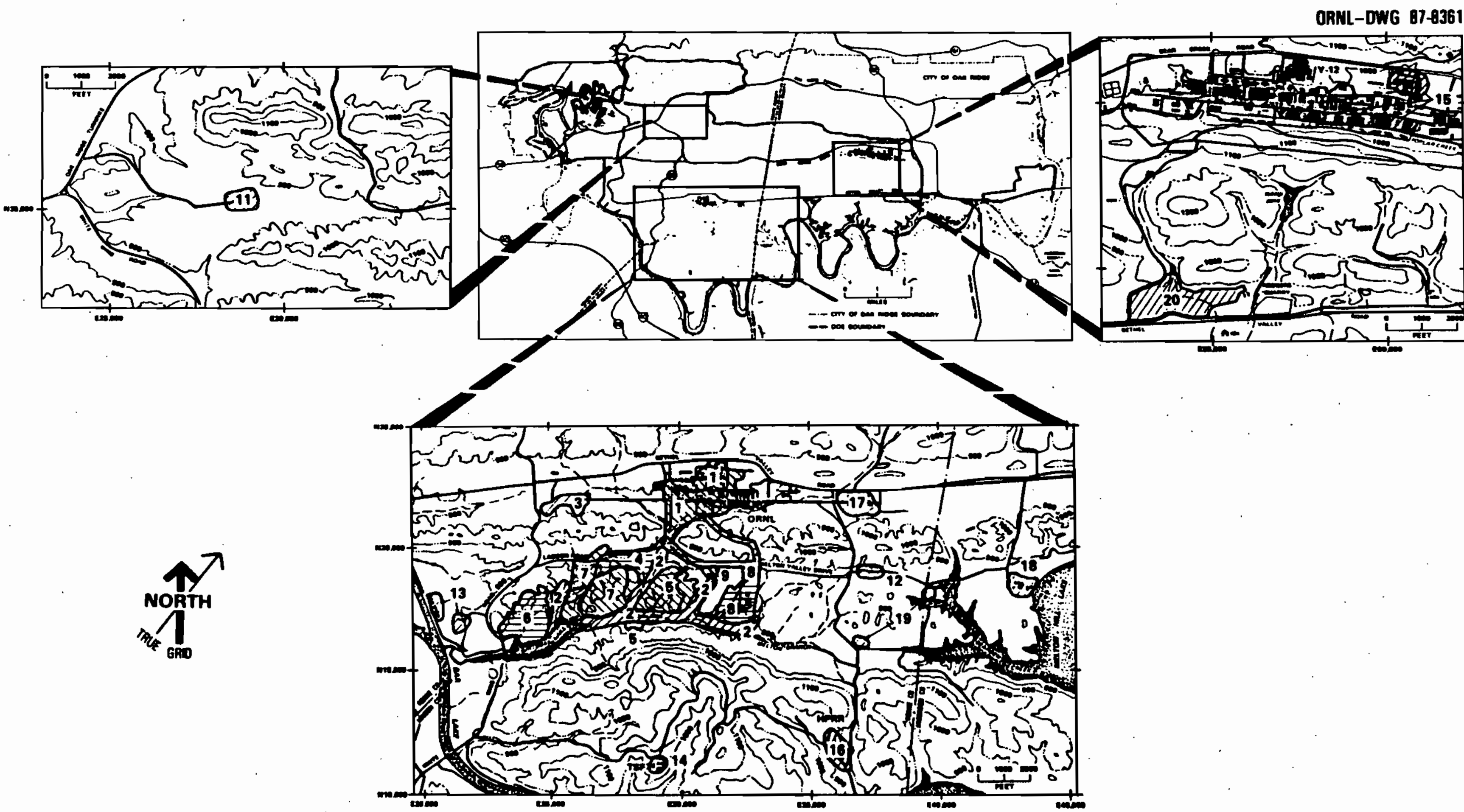

Fig. 1. Locations of the 20 Waste Area Groupings.

Table 1. SWMUs Included in WAG 8

8.1a-d	HIFR/TRU Waste Collection Basins - (7905, 7906, 7907, 7908)
8.2	Hydrofracture Experimental Site 2, Soil Contamination (HF-S2A)
8.3a-g	LLW Line and Leak Sites - Melton Valley Drive Area (7 leak sites)
	a = Melton Valley Drive
	b = Melton Valley Drive and SWSA-5 Access Road
	c = 7500 Area
	d = West of Melton Valley Pumping Station
	e = Bldg. 7920 and MV Pumping Station Area
	f = Bldg. 7920 ditch line
	g = The Melton Valley Transfer Line
8.4	Hazardous Waste Storage Facility (7507)
8.5	Active LLW Collection and Storage Tank - (WC-20)
8.6	Active LLW Collection/Storage Tank - (HFIR)
8.7a,b	Active LLW Collection/Storage Tanks - (T-1, T-2)
8.8	Mixed Waste Storage Pad - (7507W)
8.9	Sewage Treatment Plant (7904)
8.10	Silver Recovery Process (7934)
8.11	Septic Tank (7503)

1.2 PURPOSE OF THE ENVIRONMENTAL DATA PACKAGE

As currently implemented, the 3004(u) corrective action program consists of four phases: (1) a RCRA Facilities Assessment (RFA) to identify releases or potential releases requiring further investigation, (2) a RCRA Facilities Investigation (RFI) to fully characterize the extent of releases, (3) Corrective Measures Study (CMS) to determine the need for and extent of remedial measures (this step includes the selection of appropriate remedies for all problems identified), and (4) Corrective Measures Implementation to design, construct, operate, maintain, and monitor the performance of the measure(s) selected (EPA 1986).

Based on information developed by ORNL as input to the RFA, it appears that the Melton Valley Area (WAG 8) represents a source of continuing release under 3004(u) and that an RFI will be required (ORNL 1987b). The purpose of this environmental data package is to provide background information on the geology, hydrology, soils, and geochemistry of the WAG 8 area, as well as information on releases and inventories of hazardous materials for individual sites (SWMUs) within WAG 8 that will be required in the preparation of the RFI. Also identified are areas where it appears that additional information will be required.

This data package does not include all of the numerical data and information currently available on WAG 8. Only selected material which the authors feel would be pertinent to the preparation of an RFI has been included. Additional details can be obtained from the references cited.

1.3 DESCRIPTION OF WAG 8

The location of WAG 8 and its SWMUs is shown in Fig. 2. Most of the reactor facilities other than those in the main ORNL plant area (WAG 1) are located in Melton Valley. WAG 8 includes the Molten Salt Reactor Experiment (MSRE) facility (formerly used as the Aircraft Reactor Experiment) and the High Flux Isotope Reactor (HFIR). Also included in this WAG are radioisotope separation and processing facilities (Transuranium Processing Plant [TRU] and the Thorium-Uranium Recycle Facility [TURF]). Radioactive wastes from these facilities are collected in on-site, low-level waste (LLW) tanks and periodically pumped to WAG 1 for storage and treatment (Berry et al. 1984). The waste transfer pipeline from WAG 8 to WAG 1 originally followed the route of Melton Valley Drive to its intersection with the LLW line from WAG 1 to the waste pits and trenches; in 1976 this pipeline was replaced with a new stainless steel line which was routed directly over Haw Ridge to the waste collection tanks in WAG 1 (Fig. 3).

Berry et al. (1984) describe operating procedures for the LLW and process waste systems in WAG 8. LLW includes demineralizer backwash, regeneration effluents, decontamination fluids, experimental coolant, drainage from the compartmental areas of filter pits, etc. The normal flow of LLW from all facilities in Melton Valley is about 3,300 gal/week (12,000 L/week), although this flow could be much higher if the process waste should become contaminated. Chemical and radiochemical analyses are not routinely conducted on the LLW; however, the major nuclides are probably ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{60}Co, and various rare earths (Binford and Orfi 1979). LLWs from the Melton Valley facilities are treated with

ORNL-DWG 87-15523

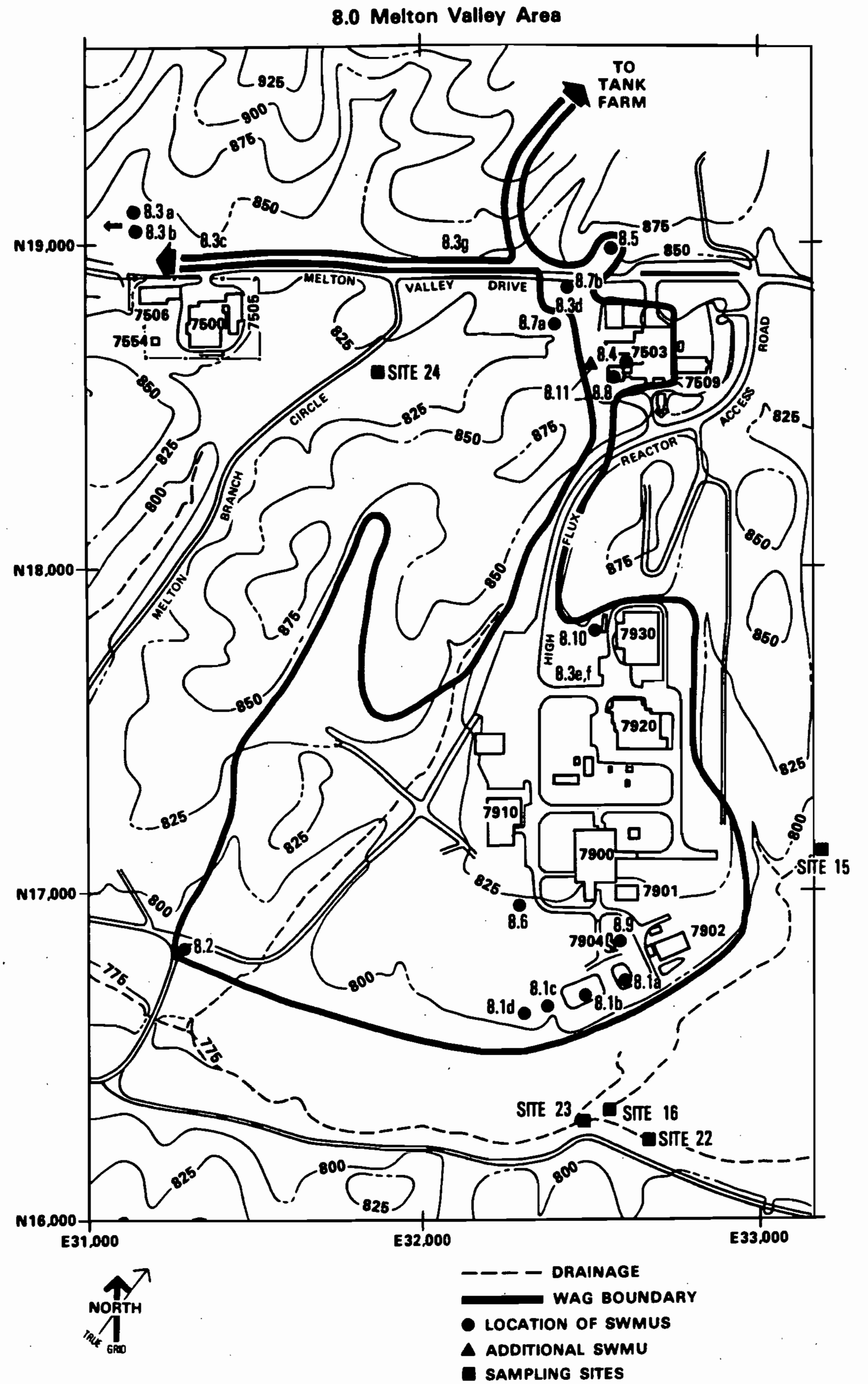

Fig. 2. WAG 8, Melton Valley area, showing locations of SWMUs.

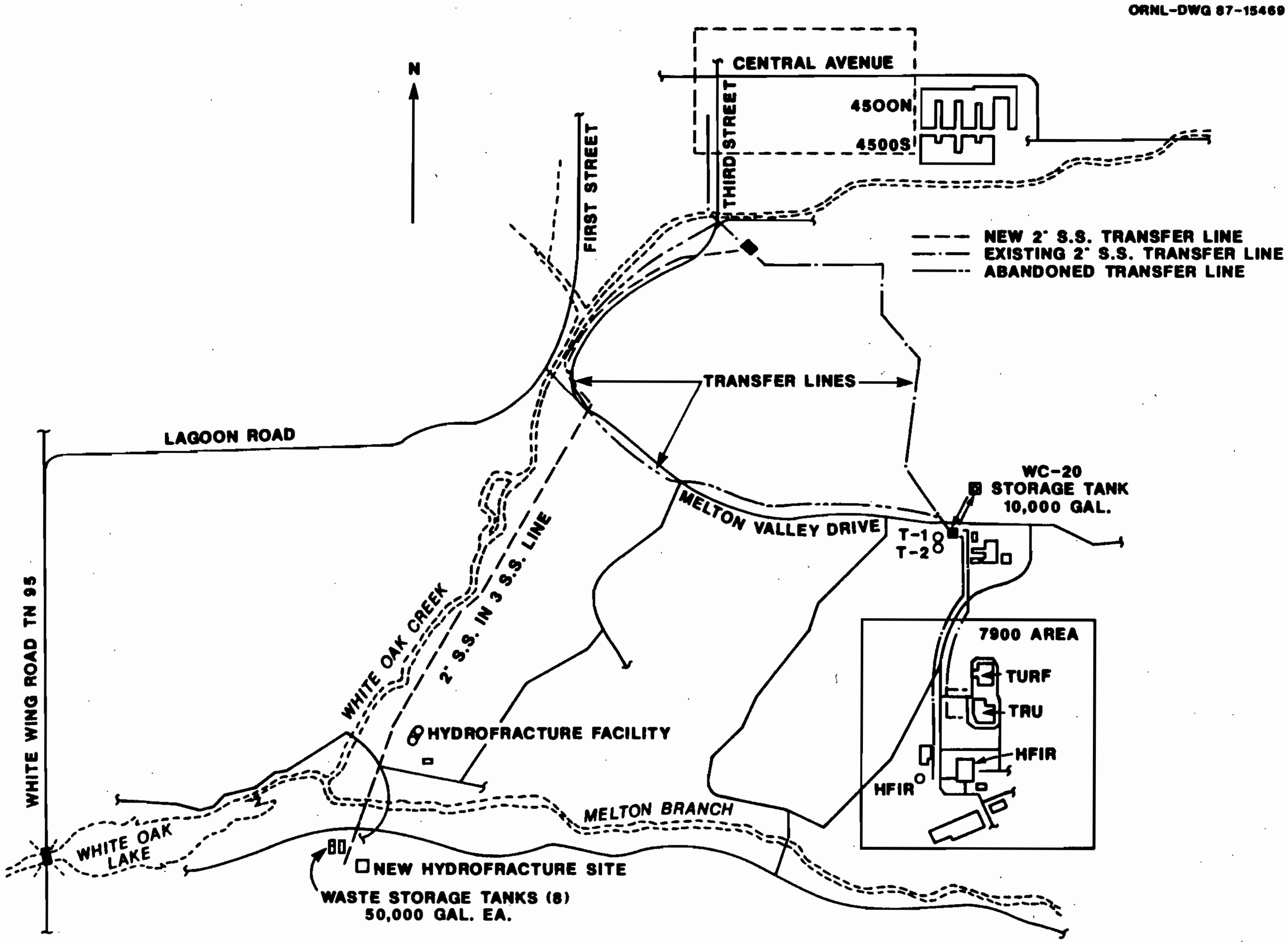

Fig. 3. WAG 8: schematic of waste transfer lines to WAG 1.

caustic, transferred to tanks T-1, T-2, and WC-20 for interim storage, and pumped to the main ORNL complex (Berry et al. 1984).

In addition to the LLW collection and storage system, two additional systems are installed to handle the process wastes and domestic sewage generated in WAG 8 facilities. Process wastes originate from sources such as equipment, experiment, and floor drains in the reactor building; filter pit; and cooling tower areas that normally do not contain radionuclides, but may contain, because of leaks, spills, etc., very low levels of radioactivity (Berry et al. 1984).

Sewage treatment for Bldg. 7503 (MSRE) is provided by a septic tank; facilities in the rest of the Melton Valley area (HFIR, TRU, TURF, etc.), are connected to a sewage holding tank (the holding tank was formerly a small sewage treatment plant) prior to transfer to the main ORNL sewage treatment plant by tank truck (ORNL 1987b,c).

Water from the HFIR cooling tower normally discharges directly into a tributary of Melton Branch but can be diverted to Pond No. 1 if radioactivity above background is found. Cooling tower blowdown from the HFIR is approximately 1.1 gpm (6.9 L/s) (Boyle et al. 1982).

Table 2 lists the 21 SWMUs that are located in WAG 8 by functional description (i.e., ponds, leak sites, storage areas). A more detailed description of each of the 21 SWMUs follows.

1.3.1 LLW Collection and Storage Tanks

Four LLW collection and storage tanks are located in WAG 8 (SWMUs 8.5, 8.6, 8.7a and 8.7b) (ORNL 1987b). Only tank WC-20 (SWMU 8.5) is contained in a concrete vault (double containment); the other three tanks are directly buried. Leaks occurring in the three buried tanks can be detected by observation of the liquid level in the tank and by monthly checks of dry wells installed next to the tanks (Binford and

Table 2. WAG 8 - Listing of sites by type.

Type of Site	Number of Sites
Collection and Storage Tanks (LLW)	
Inactive	0
Active	4
Leak/Spill Sites and Contaminated Soils	
Radioactive	8
Chemical	0
Ponds and Impoundments	
Radioactive Waste	4
Chemical Waste	0
Waste Treatment Facilities	
Radioactive Waste	0
Chemical and Sewage Waste	3
Solid Waste Storage Areas	
Radioactive Waste	0
Chemical Waste	1
Mixed Waste	1
Total Sites	21

Orfi 1979). Additional details on the construction and operation of these tanks can be found in Binford and Orfi (1979), MCI (1985), and Taylor (1986a).

Active LLW Collection and Storage Tank WC-20 (SWMU 8.5) - This is a doubly contained LLW tank with capacity of 10,000 gal (38,000 L) (operating volume 7,000 gal or 26,000 L) located north of Melton Valley Drive. This horizontal tank has a diameter of 10 ft (3 m) and length of 19 ft 6 in. (5.9 m). The tank is fabricated of 304L stainless steel and is located in a concrete vault lined with 304L stainless steel. WC-20 receives wastes from Buildings 7920 (TRU) and 7930 (TURF).

Active LLW Collection and Storage Tank HFIR (SWMU 8.6) - Located southeast of Building 7910, this tank serves HFIR. It is a horizontal tank with capacity of 13,000 gal or 49,000 L (operating volume: 9,100 gal or 34,000 L). Dimensions are 8 ft (2.4 m) in diameter and 35 ft (10.7 m) long. The tank is fabricated of 772-R-2 high-chrome iron and installed on concrete saucer with monitoring access.

Active LLW Collection and Storage Tank - T-1 (SWMU 8.7a) - Located west of the Melton Valley Pumping Station (Bldg. 7567), this tank has a volume of 15,000 gal or 57,000 L (operating capacity: 10,500 gal or 40,000 L). It is a horizontal tank with a diameter of 10 ft (3 m) and length of 27 ft 6 in. (8.4 m). This is an all-welded vessel fabricated of type 304L stainless steel, built in accordance with requirements for primary nuclear vessels. It is buried on a concrete saucer provided with monitoring access. This tank (and T-2) receives wastes from Buildings 7500, 7502, and 7503, and the HFIR tank.

Active LLW Collection and Storage Tank T-2 (SWMU 8.7b) - This tank is similar to T-1 in capacity and construction. Tanks T-1 and T-2 both serve as storage tanks for waste pumped from buildings 7500, 7502, 7503, and the HFIR tank.

1.3.2 Leak and Spill Sites and Contaminated Soils

Grimsby (1986) summarized available information on 35 LLW line leak sites at ORNL, including 8 sites in WAG 8. In many instances, specific information on individual leak sites is not documented; the volume of leakage and the extent of the leak are the major data deficiencies. According to Grimsby:

> Estimates of the extent of contamination at a given site are virtually impossible given current information. For most of the sites, uncertainty exists as to when and where a leak began, how long it lasted and how extensive was the resulting contamination, making it difficult to arrive at any accurate estimate of contaminant inventory and volume. Remedial actions would, therefore, have to locate the boundaries of these sites, and then to estimate the extent of contamination in each of these areas.

The original Melton Valley transfer line was constructed of mechanical joint steel pipe, resulting in the potential for leaks to occur at each of the gasketed joints. With time these gasketed joints failed and the only indication that a leak had occurred was a visual sighting of liquid or a discrepancy in the volumetric material balances. In addition, given the large number of modifications and corrections to the LLW system, it is probable that other leak sites may be discovered in the older waste lines during remedial investigation. The transfer line passing over Haw Ridge is welded stainless steel pipe, some portions of which consist of a pipe within a pipe (i.e., double containment) and no leaks have been reported in this system (Binford and Orfi 1979).

Hydrofracture Experimental Site 2, Soil Contamination (SWMU 8.2) - This site represents the location of the second series of experimental injections conducted to establish the viability of the application of hydrofracturing to low-level radioactive waste disposal. All that remains at the site is the injection well (ORNL Grid coordinates N 16,817 and E 31,260). Two injections of grout additives and water were conducted. Each injection included 25 Ci of ^{137}Cs to allow monitoring of the grout sheets. No spills or surface contamination have been reported. However, the subsequent drilling of observation wells could have provided a possible route for contaminants to reach the surface. The injection well is currently capped and covered by a road (ORNL 1987a).

LLW Line Leak and Spill Site, Melton Valley Drive (SWMU 8.3a) - This is a leak that occurred April-June 1960, where the Melton Valley transfer line crosses White Oak Creek at the intersection of Lagoon Road and Melton Valley Drive. The break was reported to be due to heavy equipment operation. The radiation hazard was not serious, but the creek could have been seriously contaminated if the break had occurred during a waste transfer. Repairs were made, during which the possibility of other line leaks was noted.

LLW Line Leak and Spill Site, Melton Valley Drive and SWSA 5 Access Road (SWMU 8.3b) - This SWMU refers to two leaks (July 9 and 31, 1970) in the Melton Valley transfer line near Melton Valley drive at the intersection with the SWSA 5 Access Road. The first leak was reported to be south of the Drive and just west of the SWSA 5 access road. The second site is about 300 feet east of the first, on the north side of

Melton Valley drive. Both were due to failures at mechanical pipe joints with neoprene gaskets. Contamination was removed and the line repaired.

LLW Line Leak and Spill Site, 7500 Area (SWMU 8.3c) - This leak occurred in the Melton Valley transfer line in July 1969 when a coupling failed in the line north of Building 7500. Although some 2100 gal (7950 L) was released, the contamination (^{244}Cm and fission products) was removed and the line repaired. It is reported that some low-level contamination still remains in a swampy area on the south side of Melton Valley Drive.

LLW Line Leak and Spill Site, West of Melton Valley Pumping Station (SWMU 8.3d) - On January 15, 1971, an area of 100 ft^2 (9 m^2) was contaminated west of the Melton Valley Pumping Station as waste was being transferred from Melton Valley. Subsequently the area was excavated.

LLW Line Leak and Spill Site, Bldg. 7920 and MV Pumping Station Area (SWMU 8.3e) - In July 1970, a leak occurred in a line from the Transuranium Processing Plant to the Melton Valley Pumping Station. The leak occurred at a mechanical joint (with neoprene gasket) in the line. The contamination was removed and the line repaired; however, pressure tests of the line were unsatisfactory and the line was abandoned.

LLW Line Leak and Spill Site, Bldg. 7920 Ditch Line (SWMU 8.3f) - This was a leak reported on January 31, 1972, in the line from the Transuranium Processing Plant (along the HFIR Access Road) to the Melton Valley Pumping Station. Released liquid flowed under the road through culverts and then south along natural drainage parallel to Melton Branch Circle.

LLW Line Leak and Spill Site, Melton Valley Transfer Line (SWMU 8.3g)- This SWMU represents the LLW transfer lines for the original line installed along Melton Valley Drive and the replacement line over Haw Ridge.

1.3.3 Ponds and Impoundments

Four ponds have been constructed in the southeast corner of WAG 8 to retain process wastes before they are released to Melton Branch (Fig. 2) (Taylor 1986b). Pond No. 1 (SWMU 8.1a), with a capacity of 240,000 gal (910,000 L), receives all process wastes from the HFIR building, providing a minimum detention of 12 hrs under normal conditions. Pond No. 2 (SWMU 8.1b) receives waste of higher activity than would normally be discharged to the No. 1 Pond, but not as high in activity as that processed by the LLW system. Also, the large capacity (500,000 gal or 1,900,000 L) of this pond would allow it to contain flows from use of the sprinkler system or fire-fighting equipment in contaminated areas. Waste from both ponds can be pumped into the LLW waste collection system if activity levels are too high to allow direct release to Melton Branch.

The final two ponds (SWMUs 8.1c and 8.1d) were installed to handle process waste from the TRU facility. The two ponds are filled and emptied alternately. Piping is arranged so that the contents of the ponds can be pumped to the waste equalization basin (3524, SWMU 1.13) in the Main Plant Area (WAG 1).

HFIR/TRU Waste Collection Basin, 7905 (SWMU 8.1a) - This basin is referred to as the Cold Pond and is used as an intermediate collection and storage basin for process wastes from the HFIR facility. The unlined pond (240,000 gal or 900,000 L capacity) has dimensions of 86 X 116 ft (26 X 35 m) at the top of the berm and 40 X 70 ft (12 X 21 m) at the bottom of the pond; and the maximum liquid depth is 7.0 ft (2.1 m). The reported sediment depth is about 12 in. (30 cm). The basin also serves as emergency storage for radioactively contaminated blowdown water from the HFIR cooling tower. Effluent from the basin is released to a tributary of Melton Branch or pumped to the equalization basin (3524) in the Main Plant Area for treatment.

HFIR-TRU Waste Collection Basin, 7906 (SWMU 8.1b) - This basin is called the Hot Pond because it receives wastes that are thought to contain radionuclides from the HFIR, or wastes diverted from the TURF or TRU facilities. The unlined pond (500,000 gal or 1,890,000 L capacity) has dimensions of 167 X 116 ft (51 X 35 m) at the top and 121 X 70 ft (37 X 21 m) at the bottom. The reported sediment depth is about 8 in. (20 cm).

HFIR-TRU Waste Collection Basin, 7907 (SWMU 8.1c) - This basin is located south of the HFIR building (7900) and is designed to receive the process waste streams from the TRU facility. During operation the basin is filled and emptied alternately with basin 7908 (SWMU 8.1d). The unlined pond (50,000 gal or 190,000 L capacity) has dimensions of 60 X 80 ft (18 X 24 m) at the top and is about 11 ft (3.4 m) deep. The reported sediment depth in the basin is 2.4 in. (6.0 cm). This basin is also called the No. 3 Pond or the TRU A Pond.

<u>HFIR-TRU Waste Collection Basin, 7908 (SWMU 8.1d)</u> - This basin is also located south of the HFIR building and is adjacent to the 7907 pond (SWMU 8.1c). Its function is the same as the 7907 pond in that it handles process wastes from the TRU facility. This pond (50,000 gal or 180,000 L capacity) is 60 X 80 ft (18 X 24 m) at the top and 11 ft (3.4 m) deep. Sediment depth is reported to be the same as the 7907 pond (2.4 in. or 6.0 cm). Basin is also called the No. 4 Pond or the TRU B Pond.

1.3.4 Waste Treatment Facilities

There are three waste treatment units in WAG 8; two of these (SWMU 8.9 and SWMU 8.11) are part of the domestic sewage collection and treatment systems for the buildings in WAG 8. The third SWMU (8.10) is a facility (not operational at this time) to treat photographic waste water for silver removal and recovery) (ORNL 1987b).

<u>Sewage Treatment Plant, Bldg. 7904 (SWMU 8.9)</u> - Although installed as an extended aeration plant, the entire capacity of this is used as storage. The sewage is transferred to the main sewage treatment plant in Bethel Valley (Bldg. 2521), typically 13 to 15 times per month using a 4,000-gal (15,000-L) tank truck.

<u>Silver Recovery Process, Bldg. 7934 (SWMU 8.10)</u> - This facility was to open April 1987 to separate silver from photographic fixer and developer waste solutions using a chemical precipitation process. Process chemicals that are used include sodium hydroxide, sodium hydrosulfite, and sulfuric

acid. Location is just west of TURF. Although facilities for the silver recovery process are essentially complete, operation depends on meeting certain regulatory requirements and issuance of a permit.

Septic Tank, Bldg. 7503 (SWMU 8.11) - This is a concrete tank with a capacity of 1500 gal (5900 L). It collects and disposes of domestic sewage from the MSRE Building and is located west of Bldg. 7503.

1.3.5 Solid Waste Storage Areas

Two interim permitted storage facilities for hazardous solid wastes are located in WAG 8. These facilities are utilized for storage of "lab packs" of chemical wastes, bulk quantities of hazardous wastes, and liquids and solids contaminated with polychlorinated biphenyls. One of these facilities (SWMU 8.4) is a metal building, and the other is a concrete storage pad (SWMU 8.5). Utilization of both of these facilities will cease when the Hazardous Waste Storage Facility (7652) becomes operational (ORNL 1987b).

Hazardous Waste Storage Facility, Bldg. 7507 (SWMU 8.4) - Adjacent to the MSRE, this is a building of 1467 ft^2 (136 m^2) restricted to a maximum of 200 drums/containers (normally holding 130 drums/containers) registered as an interim hazardous waste storage facility. Various hazardous wastes and PCB materials have been stored pending shipment to an approved facility for treatment/disposal. Operation will be terminated when the Hazardous Waste Storage Facility (7652) is operable.

Mixed Waste Storage Pad, Bldg. 7507W (SWMU 8.8) - This is a 40-ft X 40-ft (12-m X 12-m) concrete pad provided with dikes and a sump. Mixed radioactive and hazardous waste are stored here until disposal is resolved, or until the Long-Term Hazardous Waste Storage Facility (Bldg. 7652) is in operation.

1.4 KNOWN OR POTENTIAL RELEASES FROM WAG 8

The initial stream gravel studies of Cerling and Spalding (1981) identified WAG 8 as a major source of ^{60}Co contamination, with measurable releases of ^{137}Cs also being detected. In general, the source of this contamination appeared to be the cooling water effluent from the HFIR. ^{90}Sr was not detected above background concentrations. In the 1985 survey, essentially the same findings for radionuclides were reported; in addition, there was clear evidence that WAG 8 was also a potential source of Zn and Cr releases (Cerling and Huff 1986).

Four sampling sites were used by Morrison and Cerling (1987) in evaluating WAG 8. Two of the sites (15 and 22 in Fig. 2) are located above most of the HFIR discharges and are used as indicators of background contamination. No contamination by radionuclides or metals was detected at either site. Site 16 is below the cooling effluents from HFIR. The site is mainly contaminated by ^{60}Co, with lesser amounts of ^{137}Cs and ^{90}Sr (Table 3). The ^{137}Cs and ^{90}Sr concentrations observed were reported to have declined from those observed in previous surveys (Cerling and Spalding 1981). Based on the results of this survey, Morrison and Cerling (1987) concluded that the cooling water effluent from HFIR was the dominant discharge source of ^{60}Co from ORNL facilities. Sampling at

Table 3. Preliminary survey results for WAG 8, Site 16.

Year	n	Gravels (radionuclides)[a] ^{60}Co (Bq/kg)	^{90}Sr	^{137}Cs
BKGD[b]		<2	<10	3
1978	3	29,200 ± 13,300	48 ± 15	232 ± 70
1985	1	41,000	360	130
1986	1	56,000 ± 3,000	5.6 ± 3.3	150 ± 40

Year	n	Gravels (metals)[a] Cd (μg/g)	Cr	Ni	Cu	Zn
BKGD[c]		0.05	0.9	5.6	2.4	9
1986	2	<0.1–0.4	9.8–11	7.3–7.9	15	340–400

[a]Concentrations reported on basis of dry weight of gravel sample.
[b]Backgrounds estimated for counting procedure used in this study.
[c]Backgrounds estimated from several uncontaminated samples.
Note: No measurements of metals were made for 1978 and 1985.
Source: Morrison and Cerling 1987.

Site 23 also indicated that ^{60}Co and ^{137}Cs were present in the stream gravels of Melton Branch, but ^{90}Sr was at background level. Sampling Site 24 (Table 4) indicates that ^{90}Sr and ^{137}Cs are being released from the MSRE area. (Although this sampling point is located outside the WAG 8 boundary, it receives drainage from a portion of WAG 8.) The source of these contaminants cannot be identified at this time.

Stream gravel samples from sites 16 and 23 verified contamination by Cr, Cu, and Zn (Tables 3 and 5). The presence of these metals probably results from the discharge of HFIR cooling water. Water samples were not taken at any of the sampling sites in WAG 8, and no organic analyses were conducted.

Changes in water quality in Melton Branch are related to the composition, frequency, and volume of the discharges from the TRU and HFIR process waste basins. The batch discharges from these units have high content of total dissolved solids, composed primarily of sulfates (Loar et al. 1987). The two TRU basins are emptied an average of once every 5 days. The HFIR basin is emptied when two-thirds full, or about three times per month. The batch discharge pattern of operation also apparently contributes to the variability observed for conductivity, pH, and dissolved oxygen. However, more than 90% of the loading of total dissolved solids is from the much larger discharge of cooling tower blowdown, which has an average flow more than ten times that from all the waste basins in WAG 8 (Loar et al. 1987).

The HFIR-TRU ponds were included as a part of the ORNL Part B RCRA permit application submitted to the Tennessee Department of Health and Environment (TDHE) in August 1985. On January 7, 1986, TDHE requested that additional waste analyses be submitted to demonstrate that the ponds were not receiving or accumulating hazardous waste materials. To

Table 4. Preliminary survey results for WAG 8, Site 24

Year	n	Gravels (radionuclides)[a] ^{60}Co	^{90}Sr	^{137}Cs	n	Gravels (metals)[a] Cd	Cr	Ni	Cu	Zn
		(Bq/kg)				(μg/g)				
BKGD[b]		<2	<10	3		0.05[c]	0.9[c]	5.6[c]	2.4[c]	9[c]
1978	3	11 ± 18	1,090 ± 194	294 ± 66						
1985	3	20+-8	363 ± 42	137 ± 31						
1986	1	13	290	120	3	<0.05–<0.3	7–10	3.6–5	1.9–3.5	16–17

[a]Concentrations reported on basis of dry weight of gravel sample.
[b]Backgrounds estimated for counting procedure used in this study.
[c]Backgrounds estimated from several uncontaminated samples.
Note: No samples for water or organics were taken. Blank spaces indicate no samples taken.
Source: Morrison and Cerling 1987.

Table 5. Preliminary survey results for WAG 8, Site 23.

Year	n	Gravels (radionuclides)[a] ^{60}Co	^{90}Sr	^{137}Cs
		(Bq/kg)		
BKGD[b]		<2	<10	3
1978	3	25,500 ± 12,000	<10	360 ± 170
1985	3	25,300 ± 5,100	<10	140 ± 100
1986	1	21,000	4.7	75

Year	n	Gravels (metals)[a] Cd	Cr	Ni	Cu	Zn
		(μg/g)				
BKGD[c]		0.05	0.9	5.6	2.4	9
1986	4	nd[d]–0.05	nd–18.0	4.8–5.7	4.2–8.8	170–260

[a]Concentrations reported on basis of dry weight of gravel sample.
[b]Backgrounds estimated for counting procedure used in this study.
[c]Backgrounds estimated from several uncontaminated samples.
[d]Not detected.
Note: No measurements of metals were made for 1978 and 1985.
Source: Morrison and Cerling 1987.

comply with this request, influent liquid and sludge samples were taken and analyzed for hazardous constituents (sludge samples were extracted using the EP-toxicity procedures). The results of these analyses, including determinations of organic constituents, indicated that neither the influent waste nor the sludge would not be classified as toxic (hazardous) under RCRA guidelines. In addition, the samples were tested for ignitability, reactivity, and corrosivity, and these results were also negative (Kitchings and Owenby 1986). Results of the EP-toxicity extractions of the sludge (metals and pesticides only) from each of the basins are given in Table 6. In general, only a few organics were detected, none of which approached allowable concentration limits.

Loar et al. (1987) present considerable information on chemical contaminant levels in Melton Branch. They found impacts on benthic invertebrate and fish communities in Melton Branch to be downstream of the tributary that receives discharges from the HFIR area; however, some recovery could be seen in lower reaches of Melton Branch. It was also reported that possible toxic effects on periphyton biomass could be observed in the middle reaches of Melton Branch.

Table 6. Maximum concentrations (μg/L) in EP-toxicity extracts of sludge from HIFR/TRU waste basins.

Constituent	Basin 7905	Basin 7906	Basin 7907	Basin 7908	EP-toxicity limit
		(Concentrations in μg/L)			
Ag	<0.0500	<0.0500	<0.0500	<0.0500	5.0
As	<0.1000	<0.1000	0.7400	<0.1000	5.0
Ba	0.7300	1.6000	1.7000	0.5000	100.0
Cd	0.3600	0.1000	0.0240	<0.0050	1.0
Cr	<0.0400	0.0970	<0.0400	<0.0400	5.0
Hg	<0.0001	<0.0001	<0.0001	<0.0001	0.2
Pb	<0.2000	<0.2000	0.5000	<0.2000	5.0
Se	<0.2000	<0.2000	<0.2000	<0.2000	1.0
Endrin	<0.20	<0.20	<0.20	<0.20	20
Lindane	<2.0	<2.0	<2.0	<2.0	400
Methyoxychlor	<8.0	<8.0	<8.0	<8.0	10,000
2,4,D	<10.0	<10.0	<10.0	<10.0	10,000
2,4,5-TP Silvex	23.0	<10.0	11.0	18.0	1,000
Toxaphene	<5.0	<5.0	<5.0	<5.0	500

2. CURRENT STATUS OF INFORMATION ON WAG 8

2.1 SOURCE TERMS (INVENTORIES)

In the fall of 1986 an aerial radiological survey of the White Oak Creek floodplain was conducted by EG&G Data Measurements (Fritzsche 1987). Similar surveys of the same general area were conducted in 1973, 1974, and 1980. Measurements were taken from a helicopter at an elevation of 150 ft (46 m) and used to plot count rate isopleth maps for total gamma exposure, ^{137}Cs, ^{60}Co, and ^{208}Tl. Results indicate that there is a source of ^{137}Cs contamination (elevated count rate) in the vicinity of the MSRE (approximately the area of the off-gas filter house). Another area of increased ^{137}Cs count rate was observed in the vicinity of the Hydrofracture 2 site (SWMU 8.2). The rest of WAG 8 showed essentially background count rates. The highest count rates for ^{60}Co were recorded in the vicinity of the HFIR Ponds; no evidence of contamination was observed in the MSRE, TRU, or TURF areas. There was no evidence of ^{208}Tl in WAG 8 (Fritzsche 1987). Although this type of survey does not accurately measure the amount of radioactivity present, it does provide some indication of the location of sources of gamma radioactivity.

2.1.1 LLW Collection and Storage Tanks

The four LLW tanks in WAG 8 are classified by ORNL as active (i.e., they are currently receiving, storing, or discharging waste). The liquid content of the tanks are changes constantly, and as a result, detailed sampling and analysis has not been conducted routinely. Thus, there is essentially no information on the inventory of radionuclides or hazardous chemicals in these tanks. Binford and Orfi (1979) suggest that ORNL's LLW contains an average of 30 mCi/gal (8 mCi/L). Because the total operating volume of the four tanks is 53,000 gal (201,000 L), the radionuclide content could be as high as 1,600 Ci when the tanks are full. No information exists on the volume of sludge, if any, in the tanks. Other than one reported leak in the transfer system near the Melton Valley Pumping Station, there is no reported leakage from any of the tanks.

2.1.2 Leak Sites

As noted earlier, in most cases there is little information available to estimate the amount of radioactivity (and hazardous materials) that may remain at the identified leak and spill sites. In general, some degree of remedial action was undertaken when each of the leaks was detected and repaired; however, the existing documentation does not establish the amount (if any) of radioactivity remaining at the sites.

2.1.3 Ponds and Impoundments

Samples were taken of the sludges in the bottom of the four impoundments in WAG 8 for RCRA EP toxicity testing (Kitchings and Owenby 1986). The results of these analyses (Table 6) indicate that the sludges would not be classified as RCRA toxic. Although no analyses for radionuclides in the sludges were conducted, it has been estimated that the radionuclide content of the four ponds is less than 10 Ci (Myrick et al. 1984).

2.1.4 Waste Treatment Facilities

Two of the waste treatment facilities in WAG 8 are a part of the ORNL sewage treatment system. There are no reports that indicate that radioactivity or hazardous materials were discharged to either of these units. Sludge from the septic tank (SWMU 8.11) is pumped from the tank and treated in the main ORNL sewage treatment plant. All of the sewage from the holding tank is also transported and treated in the ORNL plant. No analysis of the sludge in either system has been reported. The silver recovery facility is not in operation, and as a result does not produce waste. The photographic wastes are currently stored in SWMUs 17.4a and 17.4b in WAG 17 (ORNL Services Area) awaiting issuance of a permit for operation of the facility.

2.1.5 Solid Waste Storage Facilities

According to the Closure Plan for Bldg. 7507, the normal amount of hazardous waste stored in Bldg. 7507 is 130 drums; the maximum inventory is 200 drums or containers of waste. Types of stored hazardous waste include: laboratory chemical wastes in "lab packs"; bulk quantities of ignitable, corrosive, and/or EP-toxic wastes; and polychlorinated biphenyl contaminated liquid and solids (Oakes 1984). These wastes do not contain radioactivity.

The mixed waste storage pad, an interim facility located west of Bldg. 7507, is used to store 55-gal drums of hazardous chemical wastes that are contaminated with radionuclides (mainly scintillation vials). The drums are stored until arrangements can be made for disposal (ORNL 1987b).

2.2 GEOLOGY, SOILS, AND GEOCHEMISTRY

2.2.1 Geology

From north to south, WAG 8 includes three major geologic units: the Chickamauga Limestone, the Rome Formation, and the Conasauga Group. The new LLW transfer line from the Melton Valley Pumping Station (Conasauga Group) crosses Haw Ridge (Rome Formation) and terminates in WAG 1 (Chickamauga Limestone) (Figs. 1 and 2). The original LLW transfer line along Melton Valley Drive is located in the Pumpkin Valley Shale of the Conasauga Group. From Melton Valley Drive southward, WAG 8 overlies the geologic formations in the Conasauga Group.

Webster and Bradley (in press) describe the Conasauga Group as a clastic marine shelf deposit of variable lithology, including a complex sequence of carbonate-poor units alternating with carbonate-rich units. The geologic formations in the Conasauga, in descending order, include the Maynardville Limestone, the Nolichucky Shale, the Marysville Limestone, the Rogersville Shale, the Rutledge Limestone, and the Pumpkin Valley Shale. The Maynardville Limestone does not outcrop within the WAG 8 boundary, and the Nolichucky Shale contact is projected to be just north of the southern boundary of the WAG (Dreier et al. 1987).

Thin layers and lenses of limestone are common in the Conasauga Group, but are irregular in distribution. There are no persistent limestone beds in the formations; a very few small solution cavities have been reported in other areas underlain by the Conasauga Group. Per unit drainage area, the Conasauga Group has lower stream flow than do areas underlain by the Chickamauga Limestone.

The Rome formation is lithologically heterogeneous and consists of interbedded sandstones, siltstones, and shales (Dreier et al. 1987, Haase et al. 1985). The Chickamauga formation, underlying Bethel Valley, is composed predominantly of limestone, although shales, siltstones, and bedded chert comprise a significant minor part of the formation (Webster 1976).

Although detailed geologic investigations have not been performed within WAG 8, there have been a number of studies related to the geology of adjacent areas of Melton Valley. During site characterization studies for the proposed SWSA 7 (east of WAG 8), Rothschild et al. (1984a) conducted a detailed geologic investigation. Lithologic and geophysical logs from three rock cores taken onsite at SWSA 7 were used as the basis for preparing a generalized geologic map of the site (Rothschild et al. 1984a).

Dreier et al. (1987) summarized geological data in the vicinity of the four ORNL hydrofracture sites (adjacent to and west of WAG 8). Their report addressed a need to synthesize existing borehole data into a local geologic model that would serve as a database for future hydrofracture characterization studies. A geological map and cross sections were prepared to illustrate the geologic structure of the Copper Creek Thrust Sheet in Melton Valley (Dreier et al. 1987). One of these cross sections is west of WAG 8 (Section D-D′ at ORNL E31,000), and another is in the area of the proposed SWSA 7 (Section E-E′ at ORNL E34,500). Fig. 4 illustrates the geology of the WAG 8 area. Also included in Dreier et al. (1987) is an annotated bibliography of 72 reports containing geologic information related to the Melton Valley area.

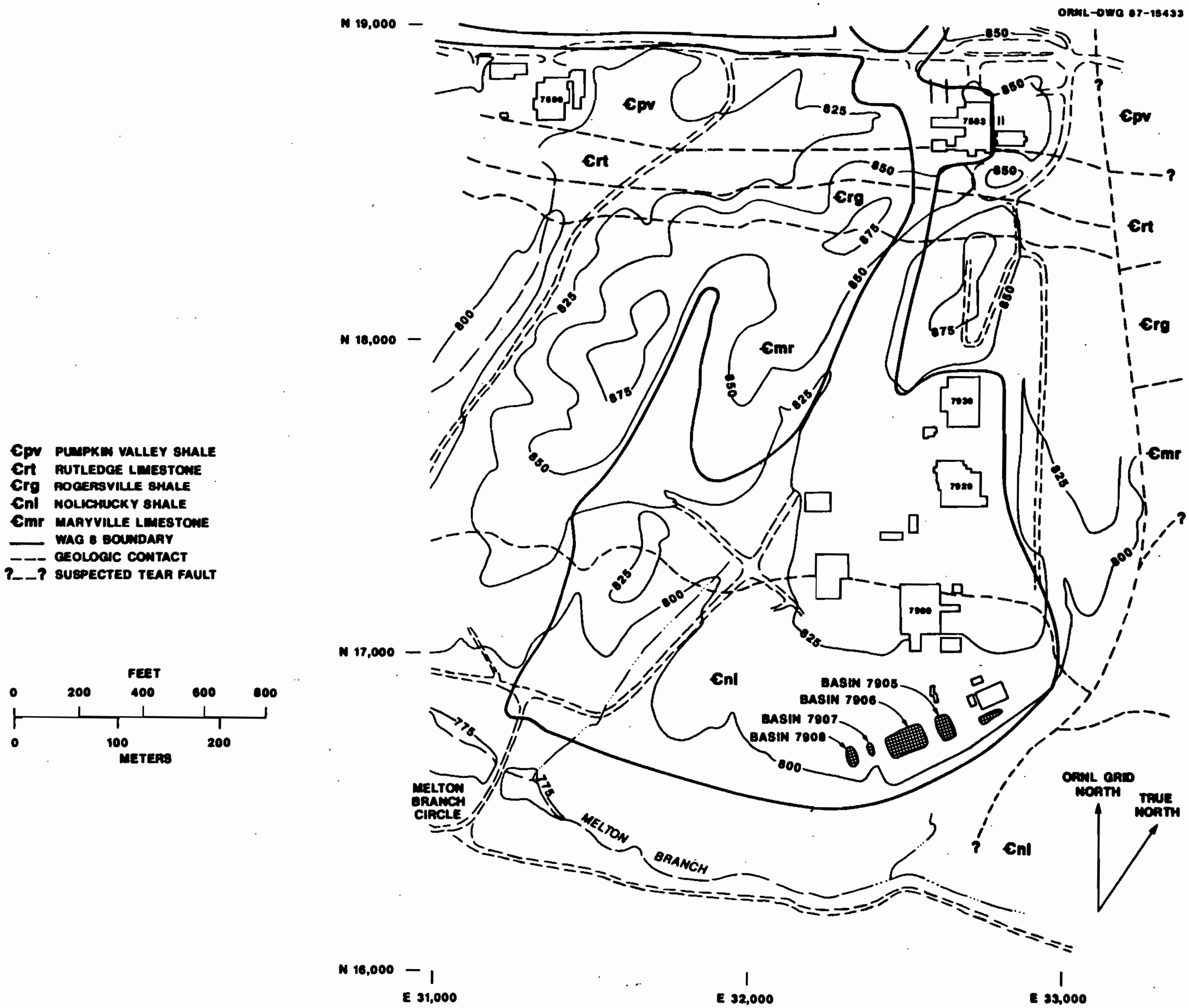

Fig. 4. Geologic map of WAG 8.

2.2.2 Soils in WAG 8

The soil survey map for Roane County (location of WAG 8) was produced during the 1930s (USDA 1942) and was prepared on a scale (1:48,000) suitable only for showing general soil conditions (Lietzke and Lee 1986). In 1986, Lietzke et al. developed a soil management plan for the Oak Ridge Reservation (ORR) which includes general information on the soil types may might be found in WAG 8.

Soils associated with formations of the Conasauga Group predominate in Melton Valley. Illite is the dominant clay mineral. Glauconite and vermiculite are abundant in some of the Conasauga Shales. Weathered illite should possess considerable cation exchange capacity (CEC), and adsorption potential should also be high (Lietzke et al. 1986). Conasauga rocks contain very little sand but have higher silt and clay content than the weathered material and have more calcium carbonate. However, because rocks of the Conasauga group dip steeply and are folded and fractured, there are complexities in relating soils to a particular formation within the group. Leaching and deep oxidation are enhanced by fractures which have greater permeability porosity than interfracture areas or areas of higher calcium carbonate (Lietzke et al. 1986). The soil horizons commonly have about 50% porosity but yield little water to gravity drainage.

Soils associated with the Rome and Chickamauga formations are less significant in WAG 8 than the Conasauga derived soils. Rome Formation soils are located on steep slopes, with a high potential for erosion if vegetation is removed. There is little reported information on the chemical and mineralogical properties of Rome soils. Chickamauga soils typically are shallow, have a high content of clay, are poorly permeable, and have a high erosion potential. These soils may contain montmorillonite and tend to have high CEC and high shrink-swell characteristics compared with other soils on the ORR (Lietzke et al. 1986).

A soil survey was included in the site characterization effort for the proposed SWSA 7 in the area east of WAG 8 (Rothschild et al. 1984b). In general, the upland soils were reported to be well drained and the soils in lower areas poorly drained. Soil profiles were examined, and soil properties and mineralogical composition of the clay fractions determined. The soils were described as well leached and acidic, and were composed of quartz (in the silt size fraction), various clay minerals (illite, kaolinite, and vermiculite) and mica. Engineering properties of the soils were also determined.

Because of the influence of soils on groundwater quality, the chemical characteristics of the soils in SWSA 7 were also investigated (Rothschild et al. 1984b). Eighteen soil and stream sediment samples were collected and evaluated for radionuclide adsorption properties. Cation exchange capacity for all of the soil samples analyzed was found to average 169 meq/kg. In general, the CEC was found to decrease with depth, with calcium found to be the dominant element on the cation exchange complex. Total cations and acidity of cuttings were considerably higher near the surface, whereas calcium was lower.

2.3 HYDROLOGIC DESCRIPTION OF WAG 8

2.3.1 Meteorology

A number of meteorological stations are located in the Oak Ridge area. Long-term precipitation and temperature records (>40 years) exist from the U.S. National Weather Service station in Oak Ridge (USDOC 1987) and Knoxville's McGhee Tyson Airport (ORO 1953).

Supplementing these sources of long-term records are additional rain gages and meteorological stations that have been installed in the vicinity of WAG 8 for area monitoring and research program support. A description of these stations (installation date, measurements recorded, and location) is given in Appendix B of "Characterization Plan for Solid Waste Storage Area 6" (Boegly et al. 1985).

2.3.2 Surface Water

Surface water runoff from WAG 8 flows predominantly southward, in the direction of Melton Branch (Fig. 2). Melton Branch is the largest tributary of White Oak Creek. Most of the Melton Branch watershed (approximately 95%), is underlain by the Rome Formation of Haw Ridge and the Conasauga Group of Melton Valley. The Rome and Conasauga formations are characterized by low base flow in the upper reaches of the stream. Zero flow can sometimes be observed in upstream Melton Branch, especially during long periods of drought (Loar et al. 1987). However, in the lower reaches of Melton Branch, stream flow is augmented by discharges from the HFIR/TRU process waste basins and cooling tower blowdown. Discharges from these sources constitute a significant fraction of the flow in Melton Branch (Loar et al. 1987). Stream flow of Melton Branch (1955-1963), at a point 0.1 mile above White Oak Creek ranged from 0 to 242 cfs (0 to 6.85 m^3/s) with an average flow of 2.50 cfs (0.071 m^3/s).

Webster and Bradley (in press) described the hydrology of the Melton Valley waste burial areas (SWSAs 4, 5, and 6). They reported that stream flow in the White Oak Creek watershed comprises overland runoff from precipitation, groundwater discharge during base flow, and wastewater discharges. It was estimated that 45% of yearly rainfall reaches streams as overland runoff and as base flow discharge from aquifers. They also observed that wastewater was the principal component of flow during dry weather.

2.3.3 Groundwater

Groundwater movement from the main portion of WAG 8 is inferred to follow the same general pathway as surface water drainage: recharge from precipitation and infiltration occurs on unpaved areas throughout the WAG 8 area and groundwater discharge occurs in the southern area along Melton Branch. Recently, several water quality monitoring wells and piezometers have been installed in the vicinity of the HFIR ponds. Data from these wells are being analyzed to develop a more refined description of the local groundwater flow system. For the LLW transfer line portion of the WAG, it is presumed that the permanent water table is below the trench and fill material associated with the line.

No groundwater studies have been performed on the area within the WAG 8 boundary; however, a number of studies related to groundwater in Melton Valley have been conducted that may provide data applicable to WAG 8. Webster and Bradley (in press) described the hydrology of

Melton Valley, with particular reference to SWSAs 4, 5, and 6. Data from 245 wells in Melton Valley have allowed preparation of water level contour maps and depth to water maps, hydrographs showing patterns of fluctuation in water levels, determination of recharge and discharge areas, and a flow net for each disposal site. The water table was observed to follow topography, with groundwater flow being from high elevations to low areas and surface drains, though somewhat skewed in the direction of strike because of remnant folds and fractures in the regolith (decomposed earthen materials constituting the weathered zone above bedrock). Evidence indicated that direction of groundwater flow was influenced by both the hydraulic gradient and by relict structure. Flow through the regolith was inferred to include (1) a zone at the water table and immediately below where the largest flow component is in the direction of the water table gradient, and (2) an underlying transitional zone where various components of flow are parallel to both strike of the beds and the water table gradient. In the bedrock, flow occurs primarily between the beds in the direction of strike to points of lower hydraulic head. This zone extends to depths of more than 200 ft, giving it the greatest thickness of the three zones. However, they suggested that the total flow in the third zone is probably less than that in the first two zones combined (i.e., more than 50% of all groundwater flow occurs in the regolith in the uppermost part of the bedrock; and less than 50% flows through deeper levels in the bedrock) (Webster and Bradley, in press). Migration of radionuclides into the Conasauga bedrock is generally considered unlikely because of the high sorption and ion exchange potential of the upper, weathered strata, and the low permeability of the bedrock. However, Webster and Bradley (in press) indicated that some of the wells drilled into bedrock in SWSAs 5 and 6 and in the Pits and Trenches area showed detectable radionuclides at depths of 100 ft into the bedrock. Information reported to date does not indicate any significant radionuclide movement in the Melton Valley bedrock.

Tucci (1986) reported the results of a preliminary model analysis of groundwater flow in Melton Valley. In the bedrock, flow was thought to be mainly through faults and joints in the upper 200 ft of the system. Tucci applied a computer program to simulate three-dimensional groundwater flow in Melton Valley. Groundwater levels predicted by the model generally compared well with observed or estimated actual conditions in 1978.

Rothschild et al. (1984a) reported that the SWSA 7 area was structurally complex, with small-scale features including several joint systems, small-scale faulting, and folding. Several linear features were reported to cross the SWSA 7 site, appearing to be tear faults or other types of fracture zones. To determine aquifer properties and evaluate the groundwater flow system at the SWSA 7 site, a network of 18 wells was installed (Rothschild et al. 1984a). Slug tests were performed on these wells to measure the hydraulic conductivity of the subsurface materials. Average values for hydraulic conductivity ranged from 1.13×10^{-6} cm/s to 2.98×10^{-4} cm/s, with a geometric mean of 2.57×10^{-5} cm/s. Various other aquifer characteristics were also reported.

A network of RCRA monitoring wells was installed in the vicinity of the four impoundments in WAG 8 (MCI 1986). Fig. 5 shows the general location of the eight wells constructed in WAG 8. Fig. 6 is a

ORNL-DWG 87-15521

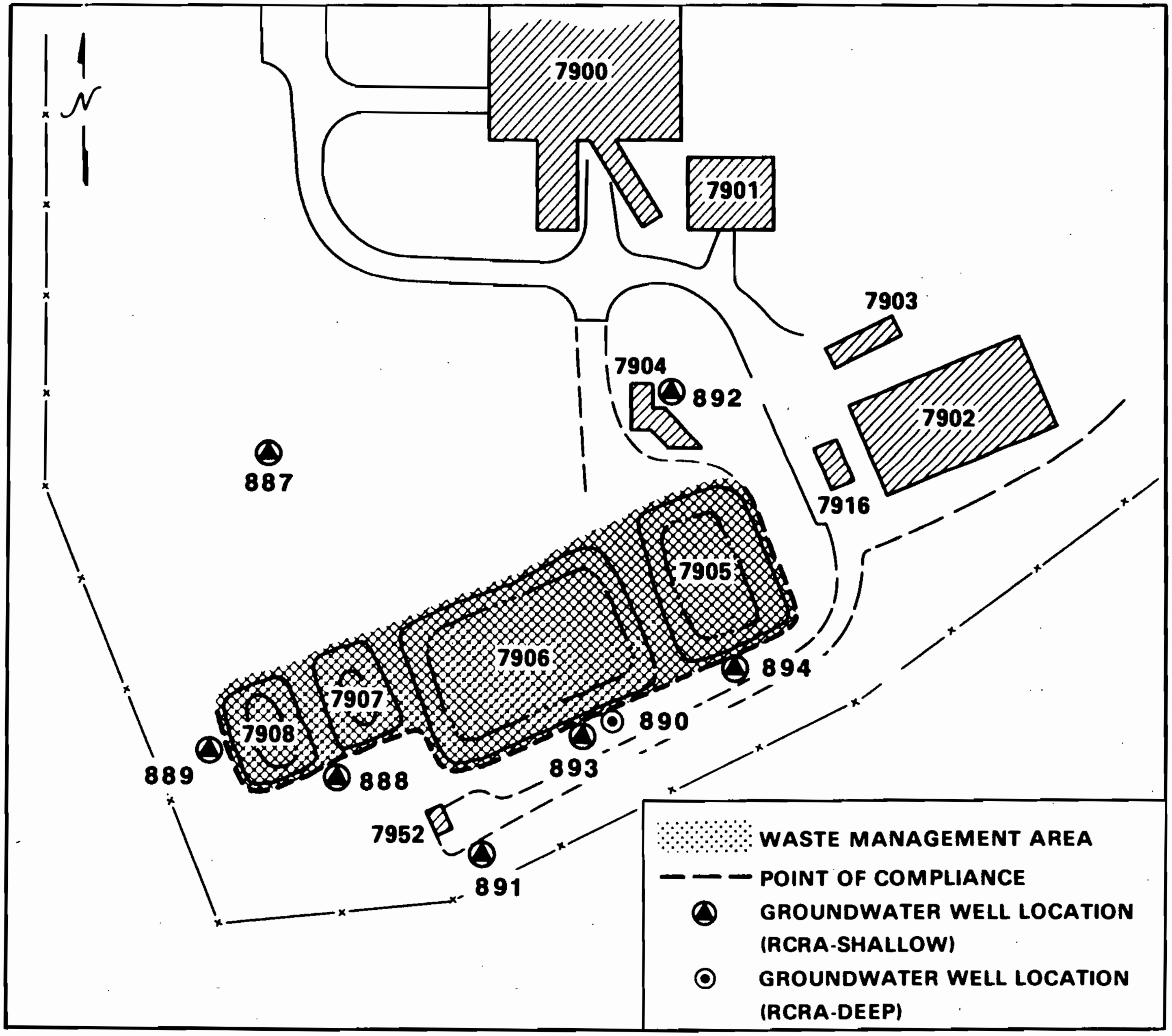

Fig. 5. Locations of monitoring wells around the HFIR-TRU ponds, WAG 8.

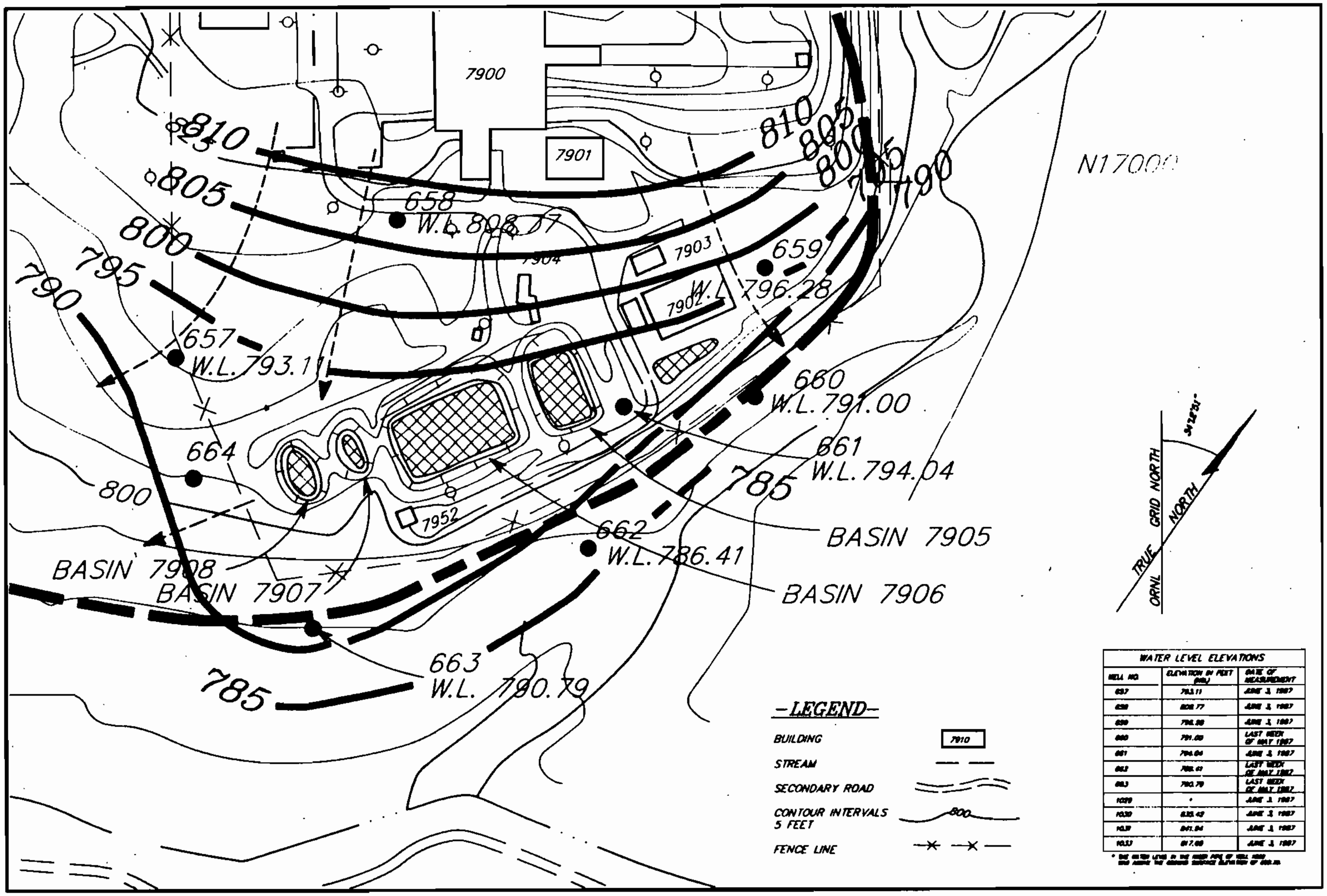

Fig. 6. Potentiometric map of groundwater in the HFIR-TRU pond area, WAG 8.

potentiometric map of groundwater in the 7900 area and indicates that the direction of maximum hydraulic gradient is southeast, following the topographic gradient toward Melton Branch (MCI 1987). Most groundwater flow is along fractures in the directions of lower potentiometric heads.

Recently, 17 piezometer wells have been installed within and around the perimeter of WAG 8. In addition, three piezometers have been installed in the Melton Branch watershed south of WAG 8. To date, only a few sets of water level measurements have been taken from these wells. Slug tests have been conducted on 8 of the 17 piezometer wells (designated 657 to 664) to determine hydraulic conductivity, transmissibility, and aquifer thickness. The results of these tests are given in Table 7. Water level measurements in the piezometers are stored in the RAP computerized database (Voorhees et al. 1986).

2.4 ENVIRONMENTAL MONITORING

2.4.1 Surface Water

A number of monitoring stations provide information on surface water in the vicinity of WAG 8 (Fig. 7). Sherwood and Loar (1987) described the National Pollutant Discharge Elimination System (NPDES) stations in the White Oak Creek (WOC) watershed. One of these stations (NPDES discharge point 002, ORNL station 4) is located on Melton Branch before its confluence with WOC. This station measures any contaminant contributions from WAGs 5, 7, 8, and 9. Other stream flow and water quality monitoring stations in the WAG 8 area are stations 4A (on an unnamed tributary to the east of SWSA 5) and 4B (located upstream of station 4 on Melton Branch) (see Fig. 7). In addition to the stream

Table 7. Results of slug tests for WAG 8 piezometers

Well No.	Hydraulic conductivity (cm/s)	Transmissivity (m^2/day)	Aquifer thickness[a] (m)
657	4.5×10^{-5}	0.25	6.4
658	3.2×10^{-5}	0.10	3.6
659	4.3×10^{-5}	0.59	16.0
660	6.7×10^{-5}	0.45	7.8
661	3.0×10^{-5}	0.41	16.0
662	17.4×10^{-5}	0.40	2.7
663	2.0×10^{-5}	0.067	3.9
664	2.0×10^{-5}	0.07	4.1

[a] Aquifer thickness = transmissivity/hydraulic conductivity

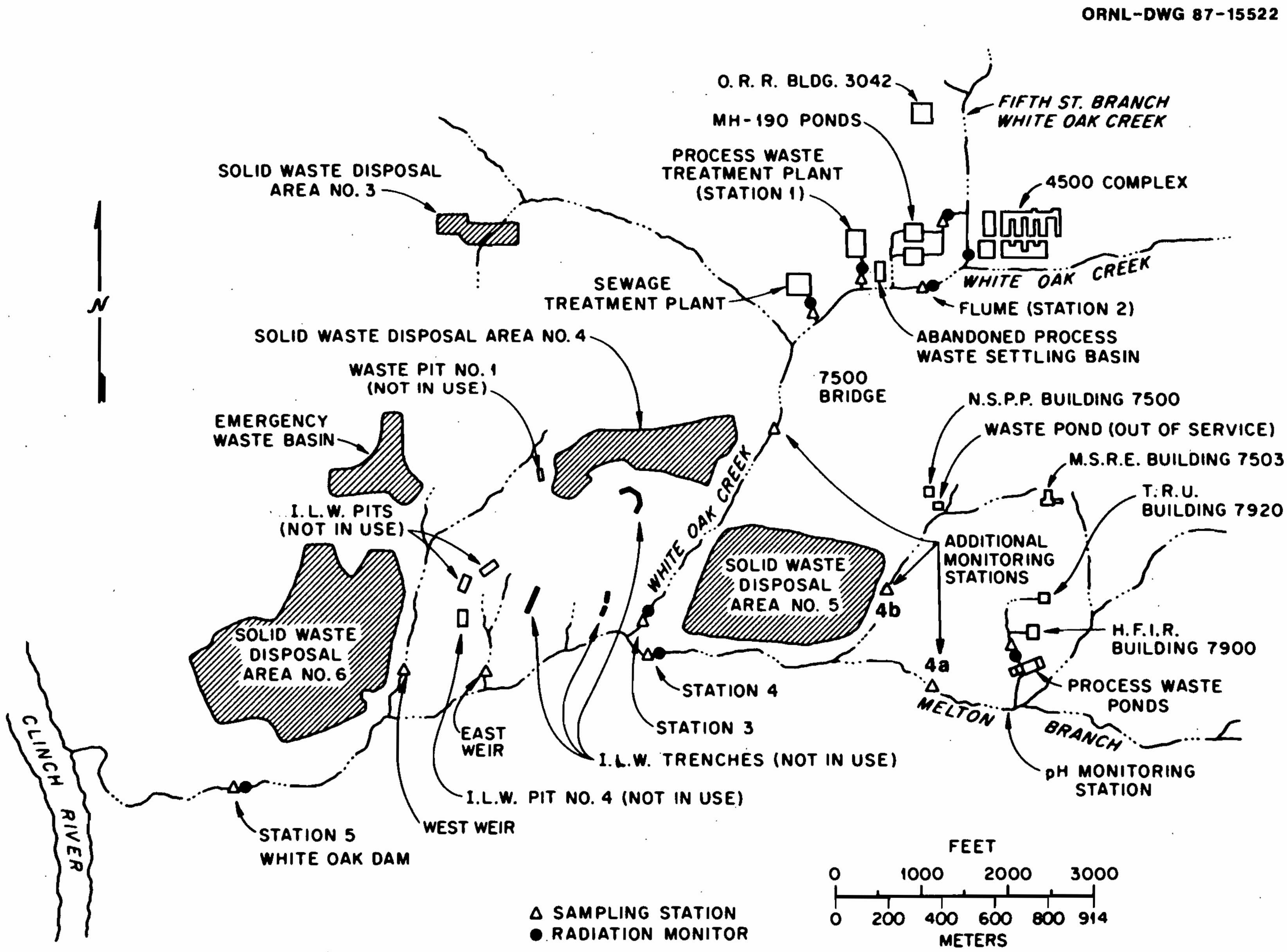

Fig. 7. Surface water monitoring stations in the WOC watershed.

monitoring stations, the NPDES permit designates the HFIR ponds (X09) and the TRU ponds (X09) as point source outfalls and requires sampling and analysis of these discharges at periodic intervals.

Sherwood and Loar (1987) suggested the installation of additional stream flow and water quality stations on three unnamed tributaries that would provide information on discharges from WAG 8; these stations would be in the same general location as the Morrison and Cerling (1987) preliminary sampling sites 16, 22, and 24 (see Fig. 2). To date these stations have not been installed.

Loar et al. (1987) described locations of sampling stations used in the Biological Monitoring and Abatement Program (BMAP) required by the NPDES permit. Locations of these sites are shown in Fig. 8.

2.4.2 Groundwater

As previously discussed (Sect. 2.3.3), eight monitoring wells have been installed in the vicinity of ponds 7905, 7906, 7907, and 7908 (MCI 1986). Sampling of these wells is performed quarterly, with results of analyses available from the Department of Environmental Management (DEM 1987). Table 8 includes sampling results for the eight monitoring wells obtained during the third quarter of 1987.

Suggested locations for nine additional water quality monitoring wells in WAG 8 have been proposed (MCI 1987). Installation of these wells is scheduled to begin in 1987. Analytical data from the proposed water quality wells will be stored in the RAP computerized data base (Voorhees et al. 1987).

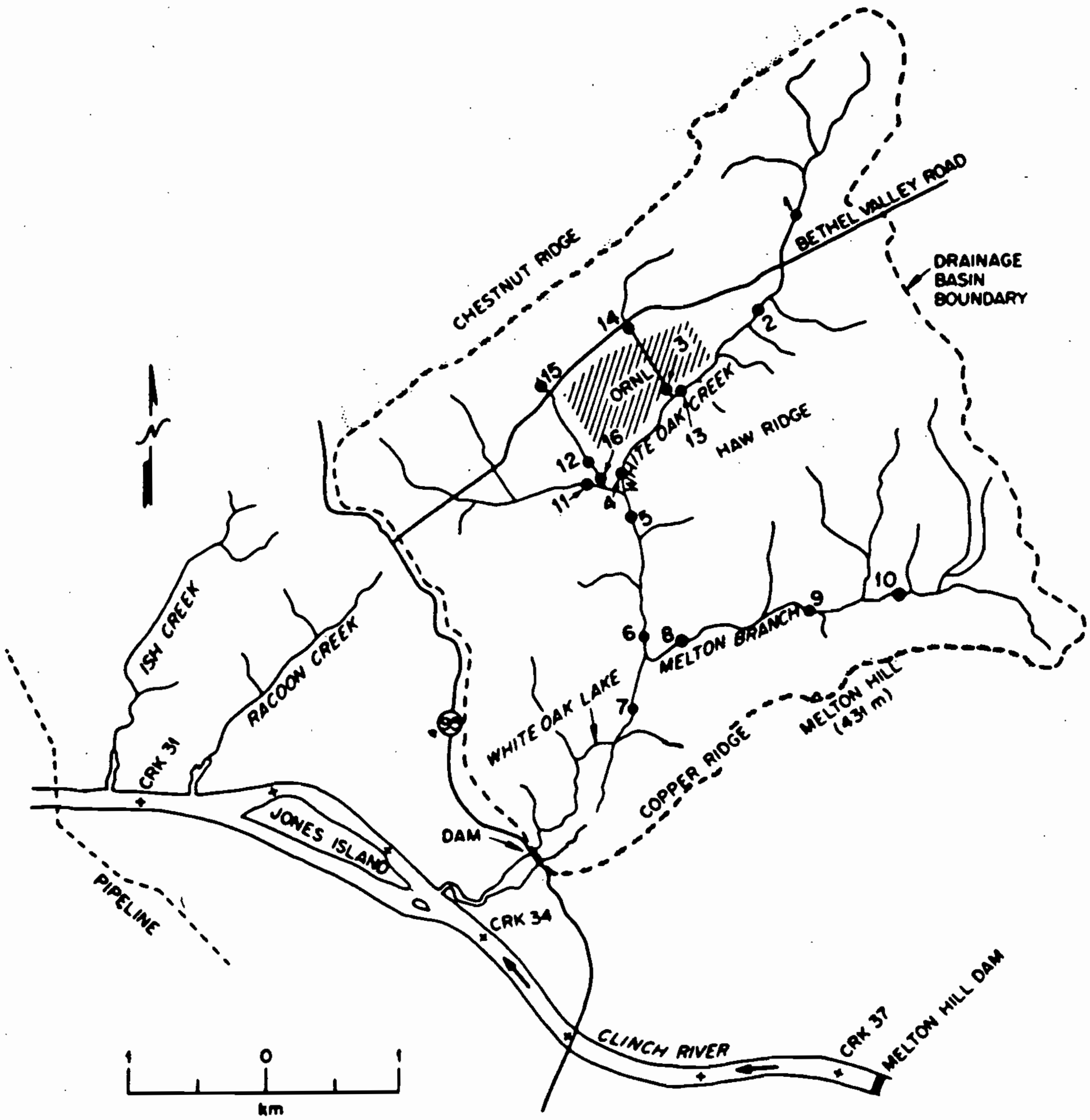

Fig. 8. Biological monitoring stations in the WOC watershed.

Table 8. Water quality data for wells near HFIR-TRU Ponds
(Concentrations in mg/L unless otherwise noted)
(samples taken March 9, 1987)

	Well Number							
Constituent	887	888	889	890	891	892	893	894
Temperature[a]	14.4	15.3	14.3	15.6	15.6	14.7	13.3	
pH[b]	7.7	7.4	7.4	7.6	7.5	7.4	6.7	7.2
Specific Conductance[c]	0.04	0.17	0.01	0.11	0.16	0.22	0.05	
Ag	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00
As	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ba	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Cd	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.00
Cl	6	22	2	10	12	57	11	15
Cr	<0.02	<0.02	<0.02	<0.02	<0.02	0.07	<0.02	<0.02
F	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Fe	<0.05	<0.05	<0.05	0.48	0.15	0.62	0.2	<0.05
Hg	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00
Mn	0.03	0.04	0.04	0.13	0.21	0.07	0.32	0.05
Na	5.8	5.8	3.6	8.1	6.3	6.5	23	51
NO_3	< 5	< 5	< 5	< 5	< 5	< 5	23	40
Pb	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Se	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00
SO_4	23	18	6	42	50	76	84	146
TOC	0.4	0.4	0.6	0.4	0.5	0.4	0.1	0.6
TOX	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00
Lindane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.00
Methoxychlor	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.00
Toxaphene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00
2,4-D	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,4,5-TPSilvex	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total phenols	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.00
Fecal Coliform[d]	0	0	0	0	0	0	0	0
Gross Alpha[e]	0.22	0.1	0.14	<0.1	<0.1	0.09	1	0.49
Gross Beta[e]	0.44	0.25	<0.2	0.43	0.06	0.29	40	22
Total radium[e]	<0.05	<0.05	0.1	,0.01	0.24	<0.05	0.058	<0.05

[a] in degrees C
[b] in pH units
[c] In mmhos
[d] in colonies per 100 ml
[e] in Bq/L

Source: Data compiled by the Environmental Monitoring and Compliance Department of the Environmental Compliance and Health Protection Division, ORNL.

Data is stored in the ORNL RAP Data Base Management (DBM) System (Voorhees et al. 1987).

3. ADDITIONAL INFORMATION REQUIREMENTS FOR WAG 8

3.1 SOURCE TERMS

More detailed information on the the source term(s) in WAG 8 will be required any pathways analyses or performance assessments are performed. As indicated in Sect. 2.1, little is known about the amount of radioactivity or hazardous chemicals present in most of the SWMUs. The following tabulation suggests areas in which additional source term (inventory) information will probably be required.

1. HFIR/TRU Waste Collection Basins (SWMUs 8.1a-d): Additional information on radionuclide contaminants present in basin sludge should be obtained.

2. LLW Leak and Spill Sites (SWMU 8.3a-g and SWMU 8.2): Generally, information is lacking regarding the identification and quantification of contamination remaining at these sites. Soil sampling and a "walk-over" radiation survey should be conducted to identify the extent, if any, of the reported contamination. Presence and extent of hazardous waste materials should be included in the soil sampling.

3. Active LLW Collection and Storage Tanks (SWMUs 8.5, 8.6, and 8.7a-b): No information is available on residual material (sludge) in the WAG 8 LLW tanks. A program of sampling and analysis is suggested to determine the nature and amount of radioactivity and hazardous chemicals present.

4. Other SWMUs in WAG 8: The remaining SWMUs in WAG 8 are either sewage treatment facilities, solid waste storage facilties, or chemical waste treatment facilities. None of these SWMUs appears to be a source of release of hazardous waste constituents.

3.2 GEOLOGY, SOILS, AND GEOCHEMISTRY

A considerable amount of geologic information has been accumulated for Melton Valley since waste disposal operations were initiated (Webster 1976, De Laguna et al. 1968, Webster and Bradley in press). Recent studies in areas adjacent to WAG 8 by Rothschild et al. (1984a), Haase et al. (1985), and Dreier et al. (1987) have provided more detailed information on the geologic setting of WAG 8; however, specific information on geologic features within the WAG perimeter can only be inferred from these studies. It is suggested that geophysical surveys and field mapping studies similar to those conducted in SWSA 7 by Rothschild et al. (1984a) and proposed for SWSA 6 (Boegly et al. 1985) be conducted. The level of detail required for other types of geologic characterization in WAG 8 will depend on the data requirements of the models selected for pathways analyses and performance assessments. Because current information does not indicate that there were past releases of radioactivity or hazardous chemicals (at sites other than the ponds and leak sites), there are no additional requirements for further geological characterization in WAG 8 at this time.

No studies have been conducted on the soils of WAG 8 although soil information is available for adjacent areas. In order to establish if similar soil types exist in WAG 8, it will be necessary to conduct a soil survey and produce a soil map. Data requirements for soils would include mineralogical analysis, measurement of sorptive properties, and determination of physical and engineering properties.

3.3 Hydrology

A considerable amount of information has been reported regarding the hydrology of Melton Valley; however, most of this information is related to the areas occupied by the SWSAs and pits and trenches east of WAG 8 (Webster 1976, Webster and Bradley in press, Tucci 1986). Recently, drilling has been conducted around WAG 8 for piezometer well installation, and drilling of additional water quality wells is in the planning stages.

Despite this progress, various aspects of the groundwater hydrology of the Melton Valley are incompletely understood. This is due to the complex geology of the area and to the control of groundwater flow directions by fractures and folds. Particular needs include determining the applicability to WAG 8 of information gathered in nearby areas, such as the site of the proposed SWSA 7 and SWSA 6. In addition, there needs to be a study of the potential for contamination of bedrock in the area of WAG 8, as well as the presence of joints, solution channels, and faults that may divert or control groundwater flows.

Plans to develop a water balance for the WAG 8 area should be considered. Two items in particular require additional work before the hydrologic regime in WAG 8 can be defined. A field reconnaissance of springs, seeps, and emergent streams and their location and flow volumes should be conducted. A complete inventory of plant discharges to the Melton Branch and other unnamed tributary creeks should also be compiled.

3.4 MONITORING

The locations for nine new water quality monitoring wells in WAG 8 have been selected (MCI 1987). Because the existing water quality wells in the vicinity of the HFIR-TRU ponds are considered adequate to identify contaminant movement in the pond area of WAG 8, the new wells will provide groundwater quality data for the northern (upper) part of the WAG and the two extensions of the WAG containing the LLW transfer lines.

The existing surface water monitoring stations appear to provide an adequate monitoring network for contaminant releases from WAG 8; however, it appears that contamination from WAG 8 might enter the drainage west of the WAG, and it is suggested that a scoping survey be conducted in this area (near Site 24 in Fig. 2) to determine if an additional monitoring station is warranted. There are also plans to provide a station on the unnamed tributary just east of Station 4A (personal communication, D.D. Huff).

REFERENCES

Berry, J. B., S. E. Breeding, K. G. Jefferies, and J. J. Maddox. 1984. Operating procedures for the low-level and process waste collection and transfer systems. ORNL/CF-84/370/R1. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Binford, F. T., and S. D. Orfi. 1979. The intermediate-level liquid waste system at the Oak Ridge National Laboratory: Description and systems analysis. ORNL/TM-6959. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Boegly, W. J., Jr. et al. 1985. Characterization plan for Solid Waste Storage Area 6. ORNL/TM-9877. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Boyle, J. W., et al. 1982. Environmental analysis of the operation of Oak Ridge National Laboratory (X-10 site). ORNL-5870. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Cerling, T. E., and D. D. Huff. 1986. 1985 White Oak Creek and tributaries streambed contaminant survey. ORNL/RAP/LTR-86/47. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Cerling T. E., and B. P. Spalding. 1981. Areal distribution of Co-60, Cs-137, and Sr-90 in streambed gravels of White Oak Creek Watershed, Oak Ridge, Tennessee. ORNL/TM-7318. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Davis, E. C., and R. R. Shoun. 1986. Environmental data package for ORNL Solid Waste Storage Area Four, the adjacent intermediate-level liquid waste transfer line, and the liquid waste pilot pit area. ORNL/TM-10155. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

de Laguna, W., T. Tamura, H. O. Weeren, E. G, Struxness, W. C. McClain, and R. C. Sexton. 1968. Engineering development of hydraulic fracturing as a method for permanent disposal of radioactive wastes. ORNL-4259. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Department of Environmental Management (DEM). 1986. Environmental surveillance data report for the second quarter of 1986. ORNL/M-173. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Dreier, R. B., C. S. Haase, C. M. Beaudoin, H. L. King, and J. Switek. 1987. Summary of Geological Data in the Vicinity of the Hydrofracture Facilities. ORNL/RAP/LTR-87/26. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

REFERENCES
(continued)

Fritzsche, A. E. 1987. An aerial radiological survey of the White Oak Creek floodplain, Oak Ridge Reservation. EGG-10282-1136. EG&G/Energy Measurements, Las Vegas, Nevada.

Grimsby, H. J. 1986. Identification of low-level waste line leak sites at Oak Ridge National Laboratory. ORNL/RAP/LTR-86/8. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Haase, C. S. et al. 1985. Stratigraphic and structural data for the Conasauga Group and the Rome Formation on the Copper Creek fault block near Oak Ridge, Tennessee: Preliminary results from test borehole ORNL-JOY No. 2. ORNL/TM-9159. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Huff, D. D., and B. J. Frederick. 1984. Hydrologic investigations in the vicinity of the proposed Central Waste Disposal Facility, Oak Ridge National Laboratory, Tennessee. ORNL/TM-9354. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Kitchings, J. T., and R. K. Owenby. 1986. Applicability of RCRA Part B permitting requirements to ORNL's surface impoundments 3524, 3539, 3540, 7905, 7906, 7907, and 7908. ORNL/RAP/LTR-87/43. Oak Ridge, National Laboratory, Oak Ridge, Tennessee.

Lietzke, D. A., S. Y. Lee, and T. Tamura. 1986. Resource management plan for the Oak Ridge Reservation - Volume 20: Soil conservation plant for the Oak Ridge Reservation. ORNL/ESH-1/V20. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Lietzke, D. A., and S. Y. Lee. 1986. Soil survey of Solid Waste Storage Area 6. ORNL/TM-10013. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Loar, J. M. et al. 1987. First annual report on the ORNL biological monitoring and abatement program. (1987). ORNL/TM-10399. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

MCI Consulting Engineers and H&R Technical Associates. 1985. Liquid low-level waste system - active storage tanks: Closure plan. Prepared for the Oak Ridge National Laboratory, Oak Ridge, Tennessee by MCI and H&R Technical Associates, Inc., Knoxville, Tennessee.

MCI Consulting Engineers. 1986. RCRA monitoring well installation report, surface impoundments 3524, 3539, 3540, 7905, 7906, 7907, 7908. Prepared for the Oak Ridge National Laboratory, Oak Ridge, Tennessee by MCI Consulting Engineers, Knoxville, Tennessee.

REFERENCES
(continued)

MCI Consulting Engineers. 1987. Preliminary geohydrologic site characterization and proposed water quality well locations for WAG 7, WAG 8, and WAG 9. ORNL/RAP/Sub-86/72139/2. Prepared for the Oak Ridge National Laboratory, Oak Ridge, Tennessee by MCI Consulting Engineers, Knoxville, Tennessee.

Morrison, S. J., and T. E. Cerling. 1987. Survey of metal, radionuclide and organic contamination at 20 waste area groups (WAGs), ORNL facilities, Oak Ridge, Tennessee. ORNL/RAP/SUB-87/27463/1. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Myrick, T. E., L. E. Stratton, and F. J. Homan. 1984. The ORNL site corrective measures program long range plan. ORNL/NFW-84/46. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

National Climatic Data Center (NOAA). 1987. Local climatological data, 1985 annual summary with comparative data, Oak Ridge, Tennessee. National Oceanic and Atmospheric Administration, Asheville, North Carolina.

Oak Ridge National Laboratory (ORNL). 1987a. Remedial investigation for the subsurface characterization of the ORNL hydrofracture sites. ORNL/RAP-7. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Oak Ridge National Laboratory (ORNL). 1987b. RCRA facilities assessment (RFA) - Oak Ridge National Laboratory. ORNL/RAP-12/V1. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Oak Ridge National Laboratory (ORNL). 1987c. RCRA facilities assessment (RFA) - Oak Ridge National Laboratory - Addendum August 25, 1987. ORNL/RAP-12/V3. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Oak Ridge Operations Office (ORO). 1953. A meteorological survey of the Oak Ridge area. ORO-99. Technical Information Service, Oak Ridge, Tennessee.

Oakes, T. W. 1984. Letter to Bobby Joe Davis. U.S. Department of Energy, Oak Ridge, Tennessee. "Submittal of Closure Plan for ORNL'S Existing Hazardous Waste Storage Facility - Building 7507." March 20, 1984. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Rothschild, E. R., D. D. Huff, C. S. Haase, R. B. Clapp, B. P. Spalding, C. D. Farmer, and N. D. Farrow. 1984a. Geohydrologic Characterization of Proposed Solid Waste Storage Area (SWSA) 7. ORNL/TM-9314. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

REFERENCES
(continued)

Rothschild, E. R., D. D. Huff, B. P. Spalding, S. Y. Lee, R. B. Clapp, D. A. Lietzke, R. G. Stansfield, N. D. Farrow, C. D. Farmer, and I. L. Munro. 1984b. Characterization of soils at proposed Solid Waste Storage Area (SWSA) 7. ORNL/TM-9326. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Scarborough, J. H. 1986. Letter to J. Lenhard, U.S. Department of Energy, Oak Ridge, Tennessee. "Draft Permit for the 1984 RCRA Amendments, Hazardous Waste Storage Facility -- Building 7652, Oak Ridge National Laboratory, EPA I.D. Number TN1 890 090 003." May 2, 1986. U.S. Environmental Protection Agency - Region IV, Atlanta, Georgia.

Sherwood, C. B., and J. M. Loar. 1987. Environmental data for the White Oak Creek/White Oak Lake Watershed. ORNL/TM-10062. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Taylor, F. G. 1986a. Inventory of ORNL remedial action sites: 10, radwaste facilities. ORNL/RAP/LTR-86/22/R1. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Taylor, F. G. 1986b. Inventory of ORNL remedial action sites: 3, process ponds. ORNL/RAP/LTR-86/14/R1. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Trabalka, J. R., and T. E. Myrick. In press. ORNL remedial action program strategy and long-range planning (FY 1986-FY 1991). ORNL/TM-10244. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Tucci, Patrick. 1986. Ground-water flow in Melton Valley, Oak Ridge Reservation, Roane County, Tennessee Preliminary model analysis. Water Resources Investigations Report 85-4221. U.S. Geological Survey, Nashville, Tennessee.

U.S. Department of Agriculture, Bureau of Plant Industry, Roane County, Tennessee, Soil Survey, Supr. Doc., Washington, D.C. 1942.

U.S. Environmental Protection Agency (EPA). 1986. RCRA facility assessment guidance. (Draft dated June 19, 1986). Permits and State Programs Division, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C.

Voorhees, L. D., et al. 1987. Annual report of data base management activities for the Remedial Action Program at ORNL: Calendar year 1986. ORNL/RAP-11. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

REFERENCES
(continued)

Webster, D. A. 1976. A review of hydrologic and geologic conditions related to the radioactive solid-waste burial grounds at Oak Ridge National Laboratory, Tennessee. Open-File Report 76-727, U.S. Geological Survey, Knoxville, Tennessee.

Webster, D. A., and M. W. Bradley. In Press. Hydrology of the Melton Valley radioactive waste burial grounds at Oak Ridge National Laboratory, Tennessee. Open-File Report. US Geological Survey, Knoxville, Tennessee.

ORNL/RAP-28

INTERNAL DISTRIBUTION

1. T. L. Ashwood
2. J. S. Baldwin
3-7. W. J. Boegly, Jr.
8. T. A. Bowers
9. J. B. Cannon
10-11. K. W. Cook
12. N. H. Cutshall
13. D. D. Huff
14. R. H. Ketelle
15. L. W. Long
16. L. L. McCauley
17. L. E. McNeese
18. L. J. Mezga
19. M. E. Mitchell
20. F. R. Mynatt
21. T. E. Myrick
22. C. E. Nix
23-37. P. T. Owen
38. D. C. Parzyck
39. T. A. Perry
40. D. E. Reichle
41. P. S. Rohwer
42. T. H. Row
43. F. E. Sharples
44. S. H. Stow
45-46. L. E. Stratton
47. J. H. Swanks
48. T. O. Tallant
49-53. J. R. Trabalka
54. L. D. Voorhees
55. R. S. Wiltshire
56-58. Laboratory Records-RC
59. Central Research Library
60. Y-12 Technical Library
61. ORNL Patent Section

EXTERNAL DISTRIBUTION

62. A. F. Iglar, East Tennessee State University, Box 22960A, Johnson City, Tennessee 37614-0002

63. Assistant Manager, Energy Research and Development, DOE/ORO, Post Office Box E, Oak Ridge, Tennessee 37831

64-65. Office of Scientific and Technical Information, Post Office Box 62, Oak Ridge, Tennessee 37831