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ACTIVE SITES ENVIRONMENTAL MONITORING PROGRAM FY 1995 ANNUAL REPORT

C. M. Morrissey
G. R. Cunningham

Environmental Sciences Division

Publication No. 4523

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Environmental Sciences Division

ACTIVE SITES ENVIRONMENTAL MONITORING -PROGRAM FY 1995 ANNUAL REPORT

C. M. Morrissey
Environmental Sciences Division

G. R. Cunningham
Waste Management and Remedial Action Division

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Publication No. 4523

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ABBREVIATIONS AND ACRONYMS

ASO	Analytical Services Organization
ASEMP	Active Sites Environmental Monitoring Program
DOE	U.S. Department of Energy
EASC	Emergency Avoidance Solidification Campaign
ER	Environmental Restoration
ESD	Environmental Sciences Division
FRP	fiberglass-reinforced plastic
FY	fiscal year
HDTF	Hillcut Disposal Test Facility
IWMF	Interim Waste Management Facility
IRL	Internal Reporting Level
LWOG	Liquid Waste Operations Group
LLW	low-level waste
LWSP	Liquid-Waste Solidification Project
NFS	Nuclear Fuel Services
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
PWTP	Process Waste Treatment Plant
QA	quality assurance
RCRA	Resource Conservation and Recovery Act
RSWOG	radioactive solid waste operations group
SWSA	Solid Waste Storage Area
TRU	transuranic
UND	underpad
WOC	White Oak Creek
WMRAD	Waste Management and Remedial Action Division

EXECUTIVE SUMMARY

This report summarizes the activities of the Active Sites Environmental Monitoring Program (ASEMP) from October 1994 through September 1995. The Radioactive Solid Waste Operations Group (RSWOG) of the Waste Management and Remedial Action Division (WMRAD) and the Environmental Sciences Division (ESD) at Oak Ridge National Laboratory (ORNL) established ASEMP in 1989. The purpose of the program is to provide early detection and performance monitoring at active low-level waste (LLW) disposal sites in Solid Waste Storage Area (SWSA) 6 and transuranic (TRU) waste storage sites in SWSA 5 North as required by Chapters II and III of U.S. Department of Energy (DOE) Order 5820.2A.

ASEMP continued to monitor the Interim Waste Management Facility (IWMF) during FY 1995. Monitoring results from the IWMF disposal pads indicated that no LLW leached from the storage vaults. Storm water falling on the IWMF pads was sampled using electronically controlled sampling instrumentation. None of the 56 pad runoff samples collected in FY 1995 exceeded the Internal Reporting Levels (IRLs) for gross alpha, gross beta, ^{137}Cs, or ^{60}Co activity. Tritium activity in the pad water runoff remained at background levels indicating no ^{3}H release from the vaults. The absence of water in the IWMF underpad collection system indicated that the French drain was functioning as designed to suppress the groundwater table. Samples collected from the French drain showed gross radiological and ^{3}H activity consistent with uncontaminated shallow groundwater in the SWSA 6 area. Surface soil sampling around the IWMF pads indicated that vault loading operations have not resulted in radionuclide contamination of the surrounding area.

In response to pH levels above the National Pollutant Discharge Elimination System (NPDES) permit limit in the IWMF pad runoff water, a CO_2 bubbling system continues to be used as a "best management practice" to control the elevated pH. This system is electronically controlled in response to a high pH in water flowing from the pads. The CO_2 system has proven to be an effective, low-cost means of pH control and has eliminated the necessity and expense of transporting pad runoff water to the Process Waste Treatment Plant (PWTP).

Hillcut Disposal Test Facility (HDTF) pad and underpad runoff water samples continue to be collected and analyzed for radiological constituents. Runoff from the pad occurs in significant volumes only during winter and spring. One sample of HDTF runoff collected in FY 1995 showed gross beta activity and ^{137}Cs activity above IRLs. Subsequent samples were well below the IRLs. In response to the finding that lead waste had been placed in some of the HDTF

vaults, analyses were performed for Toxicity Characteristic Leachate Procedure (TCLP) constituents, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). The HDTF runoff was found to be below any levels of regulatory concern for TCLP constituents, VOCs, and SVOCs.

Five new Liquid-Waste Solidification Project (LWSP) storage casks accumulated enough water to sample in FY 1995. Relatively high concentrations of ions such as sodium and nitrate that are associated with the solidified waste, were consistently detected in the sampled water. A low level of gross beta and ^{137}Cs activity was also found in some of the samples; however, activity above an IRL (gross beta) was present in only one sample. Residual contamination remaining on the outside of the waste-form containers after solidification may be responsible for elevated ion concentrations and radionuclide activity. The observed low level of gross beta activity may also be the result of ^{40}K leaching from the concrete. Two cask-liquid samples were reported to have ^{3}H activity above normal background.

Soil sampling in and around the LWSP cask storage site showed that loading and storage operations have not resulted in contaminant releases to the surrounding area. However, one soil sample collected from the LWSP cask area showed elevated ^{137}Cs activity. A previously collected sample from this area, prior to cask storage, also showed elevated levels of ^{137}Cs. Therefore, loading operations at LWSP are not likely the cause of the observed contamination.

Sumps that drain TRU storage areas in SWSA 5 N continue to be free from any waste-related radiological contamination. One sump consistently has elevated levels of gross beta activity. The presence of ^{40}K and the color of the water in this sump indicate that the activity is related to leaching from soil or vegetation. This annual report contains the complete historical record, dating back to 1989, of samples collected from the SWSA 5 N sumps.

Groundwater monitoring at SWSA 5 N continued to show elevated gross alpha activity in well 516. This well is hydrologically downgradient from the disposal trenches. Other wells in the SWSA 5 N show traces of alpha and beta activity, but 516 was the only well with activity above IRLs. Traces of ^{244}Cm, ^{241}Am, and associated alpha activity were also detected in seeps downgradient from SWSA 5 N trenches at the bank of White Oak Creek.

Additional monitoring activities this year included soil sampling around new facilities in SWSA 7 and continuous water level measurements in SWSA 5 N well 518.

1. INTRODUCTION

Chapter III of U.S. Department of Energy (DOE) Order 5820.2A (DOE 1988) specifies requirements for the management of facilities that were used for the disposal of radioactive solid low-level waste (LLW) on or after the date of the order (September 26, 1988). Activities in Solid Waste Storage Area (SWSA) 6 at Oak Ridge National Laboratory (ORNL) are governed by Chapter III. Chapter II of 5820.2A covers the transuranic (TRU) waste storage areas in SWSA 5 North at ORNL. Both chapters require environmental monitoring to provide early warning of leaks before such leaks pose a threat to human health or the environment. Chapter III also requires the monitoring of LLW disposal facilities so that their performance can be evaluated. In order to comply with this Order, the Environmental Sciences Division (ESD) at ORNL implements the Active Sites Environmental Monitoring Program (ASEMP) for the Radioactive Solid Waste Operations Group (RSWOG) within the Waste Management and Remedial Action Division (WMRAD) at ORNL. The scope of ASEMP includes all ORNL waste disposal sites that were active on or after the date of the Order and that are under the operational control of RSWOG of WMRAD.

This report continues a series of annual and semiannual reports that present the results of ASEMP monitoring activities (Wickliff et al. 1991a, 1991b; Ashwood et al. 1991a, 1991b; Morrissey et al. 1994a, 1994b, 1995; Yager et al. 1989). This report details monitoring data for fiscal year (FY) 1995 and is divided into three major areas: (1) SWSA 6, including the Interim Waste Management Facility (IWMF), the Hillcut Disposal Test Facility (HDTF), and the low-level Liquid-Waste Solidification Project (LWSP), (2) the TRU-waste storage areas in SWSA 5 N, and (3) storage building 7574 in SWSA 7. The detailed monitoring methodology is described in the second revision of the ASEMP program plan (Morrissey et al. 1994) and in updated ASEMP monitoring procedures included as Appendix B to this report. This report presents a summary of the methodology used to gather data for each major area along with the results obtained during FY 1995. Tables of data collected are presented in Appendix A.

2. SWSA 6 LOW-LEVEL WASTE FACILITIES

SWSA 6 is a 68-acre LLW disposal area at ORNL that opened in 1969 and began full-scale operations in 1973. A wide variety of wastes have been disposed of at SWSA 6 including LLW and chemical and biological wastes. Disposal units have consisted of unlined trenches, auger holes, silos, concrete casks, and tumulus-type facilities. Fig. 1 is an aerial view of SWSA 6 that shows the Resource Conservation and Recovery Act (RCRA) plastic caps covering old burial trenches, the below-grade high- and low-activity silos, the tumulus

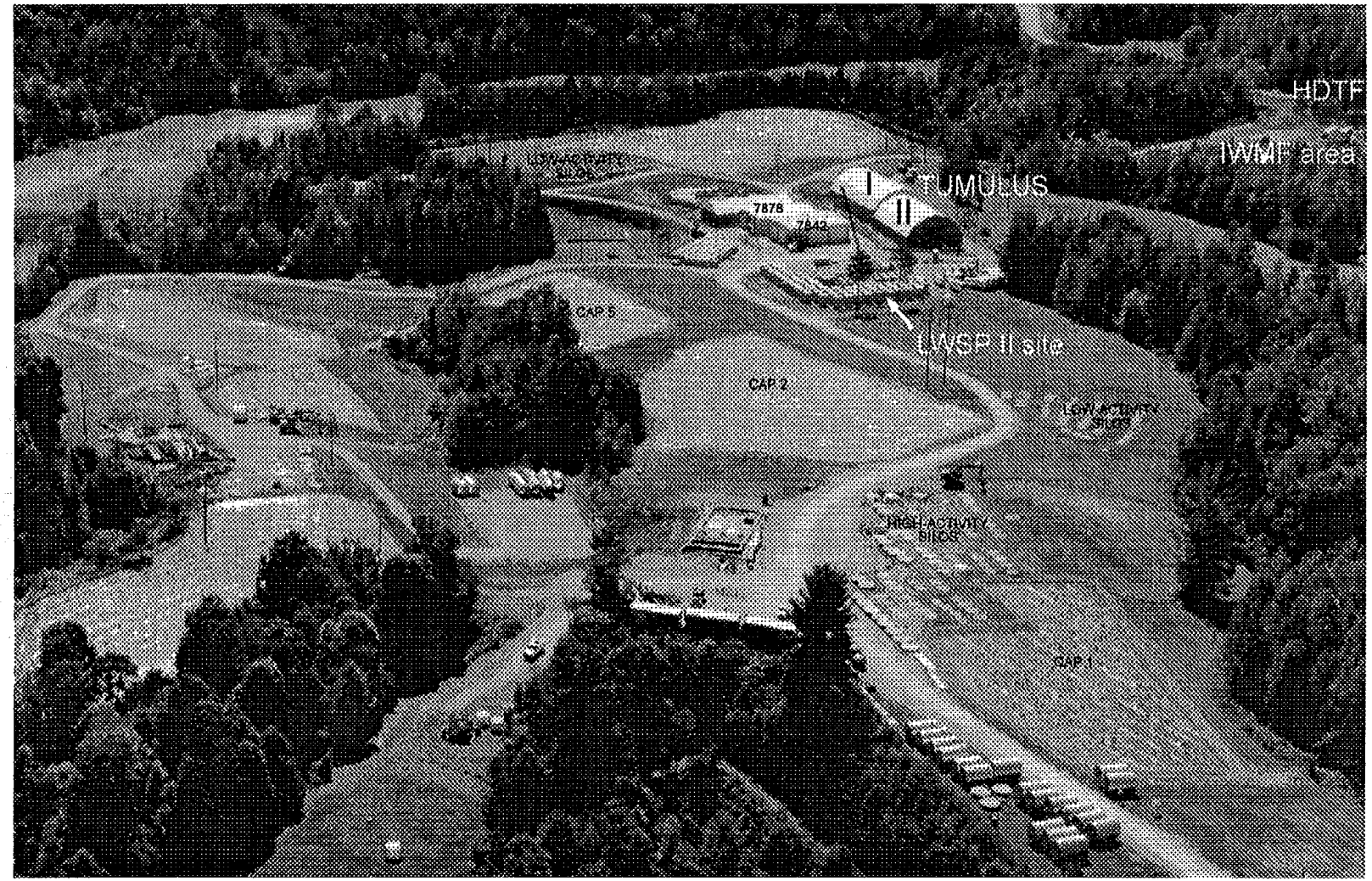

Fig. 1. Aerial view of SWSA 6 showing the IWMF area, tumulus facilities, the LWSP II site and other waste disposal and storage areas.

facilities under temporary cover, the LWSP casks, the IWMF area, the HDTF area, and various support buildings. The capped areas, disposal silos, and tumulus pads area not monitored as part of the ASEMP program. These are no longer "active" disposal areas and are under the institutional control of the Environmental Restoration Program.

Low-activity wastes are currently placed in concrete vaults on the aboveground IWMF concrete pads. During the mid-1980s, high-activity wastes were stored in concrete vaults (similar to tumulus vaults) placed on a concrete pad cut into the side of a hill as a demonstration of this method of disposal. This HDTF is not an active site, but has been historically been included in ASEMP.

Monitoring activities associated with SWSA 6 facilities are divided into three major areas: IWMF, LWSP, and HDTF. The LWSP casks and storage area are functionally similar to the earlier EASC/LWSP facility in Melton Valley, and are discussed in Section 3. Fig. 2 is a drawing of SWSA 6 showing the relative location of these facilities.

IWMF monitoring includes pad water runoff sampling and pH control, French drain outfall sampling, underpad drainage system sampling, and soil sampling around the facility. The LWSP casks are sampled for water that collects in the annular space of the casks. The soil around the LWSP site is sampled and analyzed for radiological activity. At HDTF, water that accumulates on the pad or in the underpad area is collected and sampled.

2.1 INTERIM WASTE MANAGEMENT FACILITY

IWMF became operational in December 1991 and is patterned after the earlier tumulus-type facilities. Concrete pads support concrete vaults containing LLW in a grout mixture. The concrete vaults are stacked three high on the pads so that 330 waste-containing vaults can be loaded onto each pad. At some time in the future, the pads will be covered with an engineered cap that will minimize infiltration of rain water. Eventually, the IWMF will consist of 12 concrete pads fully loaded with vaults.

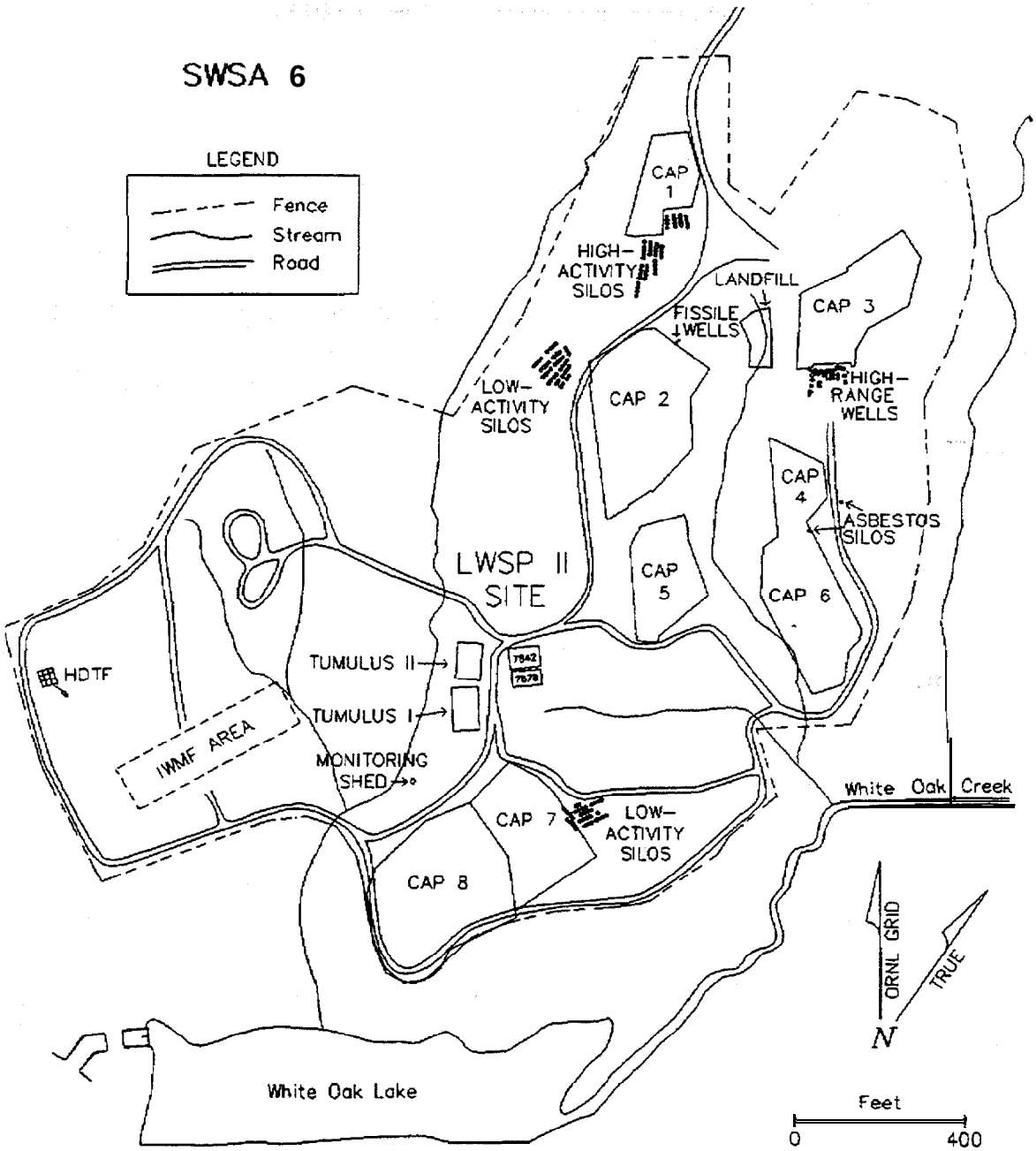

Fig. 2. Active low-level waste disposal sites and other major facilities in SWSA 6. IWMF, HDTF, and LWSP II areas are monitored under ASEMP.

Because the IWMF facility is above ground, the primary method of contaminant transport is rain water falling on the vaults and pads. During loading operations the pads are uncovered and open to direct precipitation. The resulting runoff from the pads is directed through a monitoring shed where samples are collected. The runoff then flows through a National Pollutant Discharge Elimination System (NPDES) sampling point and discharges to a nearby surface stream. Fig. 3 is an aerial view of the IWMF area showing two pads in use, two pads under construction, and the locations of the French drain outfall and the monitoring shed in relation to the pads. The location of the IWMF area in the southwest corner of SWSA 6 was shown in Fig. 2.

The conceptual model for the IWMF differs from that of the earlier tumulus facilities only in that there is a French drain between the IWMF pads and the hill to the north. This drain is designed to prevent groundwater from entering the gravel base beneath the pads. Any water that does enter the gravel base will drain to the underpad sump at the monitoring station.

Values of pH exceeding the NPDES permit limit of 9.0 have been reported for IWMF as they were for the original tumulus pads (Ashwood et al. 1991a, 1991b; Wickliff et al. 1991a, 1991b; Morrissey et al., 1994a, 1994b, 1995). Because of concerns over the release of water from the concrete pads with a pH above the NPDES permit limit, an automated CO_2 bubbling system was installed at IWMF in 1993. This system functions to maintain IWMF effluent pH below the NPDES permit limit. It is operated as a "best management practice" and is designed to bubble CO_2 into the pad water runoff when there is flow from the pad and the pH approaches the NPDES limit of 9.0.

2.1.1 Pad and Underpad Runoff

2.1.1.1 Methodology

The monitoring area at IWMF consists of three sumps for the collection of water from the active pad (*i.e.*, the pad on which waste vaults are actively being loaded), the inactive (*i.e.*, fully loaded) pad(s), and the underpads. The design of the IWMF pad drainage system allows runoff from the active pad to flow through PVC piping into a sump, designated the stormwater sump, at the monitoring station. Runoff from the inactive pad(s) drains to a separate sump, called the infiltration sump, at the monitoring station. The volume of each sump is ~7500 L (2000 gal.). Any water that accumulates in the underpad gravel base drain is routed to the monitoring station and collected in a ~3800-L (1000 gal.) sump.

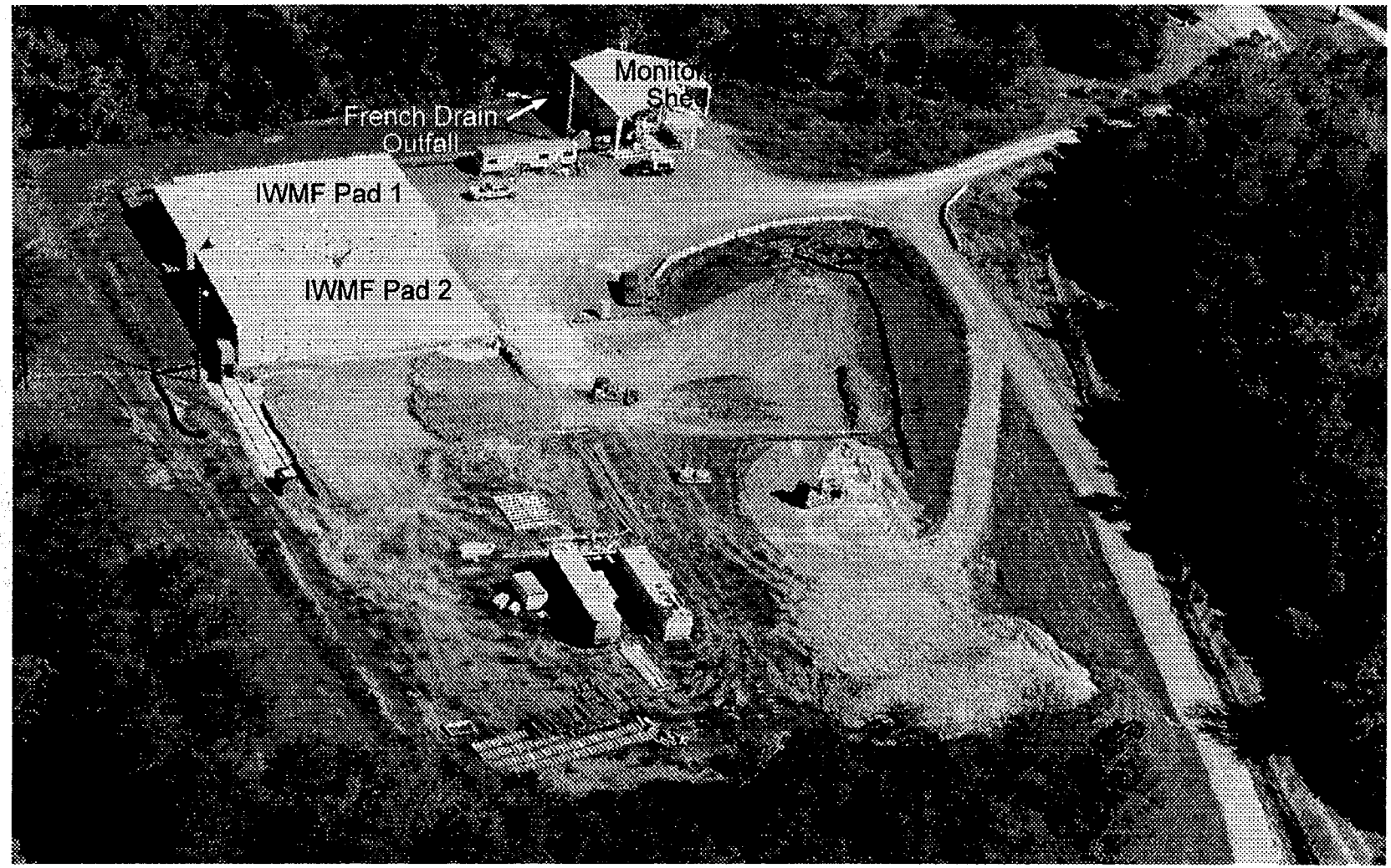

Fig. 3. Aerial view of the IWMF area showing the disposal pads, monitoring shed, and French drain outfall.

Samples of pad runoff are collected using electronically controlled automatic samplers. Each sample is analyzed for gross alpha, gross beta, and gamma activity. Samples are also occasionally analyzed for ^{3}H activity and cation and anion concentrations.

Pad runoff water pH is continuously monitored using pH probes in both the stormwater and infiltration sumps. These data are recorded electronically by a data acquisition system that was installed during FY 1994. A signal is sent to open solenoid valves in the CO_2 lines if the pH rises above 8.5. This allows flow of CO_2 into the runoff water, thus lowering the pH. This system has worked well and continued to maintain effluent pH levels below the NPDES limit.

To date, very little water has drained from the underpad even during periods of very heavy rainfall. This indicates that the upgradient French drain is functioning to route shallow groundwater around the facility. The valve controlling flow from the underpad discharge line into the underpad sump is kept closed during normal operations. When a visit is made to the site to collect pad runoff samples, this valve is opened to check for underpad drainage. If water does drain from this line, it will be collected, and samples will be taken and analyzed for gross radionuclide activity.

2.1 .1.2 Results

Radiological activity present in samples collected at IWMF and elsewhere in SWSA 6 are compared to 'internal reporting levels (IRLs)' outlined in the ASEMP program plan (Morrissey et al. 1994). The rationale for establishing these IRLs, originally set as 'action levels', is discussed by Ashwood and Ashwood (1991). The ASEMP-established IRLs are as follows:

Internal Reporting Levels (IRLs) for samples collected in SWSA 6.

Analyte	IRL (Bq/L)
gross α	1.0
gross β	5.0
^{60}Co	1.5
^{137}Cs	2.5
^{3}H	none

[a]Gross β activity does not include tritium.

Table A.1 (Appendix A) summarizes the gross radionuclide results for all samples collected from the IWMF pad runoff collection sumps and the IWMF French drain during FY 1995. Twenty-eight samples were collected from each sump and four quarterly samples were collected from the French drain.

These data show that no samples exceeded the 1.0 Bq/L IRL for gross alpha activity. Typical gross beta activity in the pad runoff water ranges from ~0.5 to ~3 Bq/L and is well below the IRL of 5.0 Bq/L. No samples exceeded the gross beta, ^{60}Co, or ^{137}Cs IRLs during FY 1995. Potassium-40, previously observed in tumulus runoff water in association with elevated levels of gross beta activity (Morrissey et al. 1994; etc.), was infrequently detected in the IWMF pad water and only at very low levels. This activity is suspected to be the result of leaching from the concrete and is assumed to account for the observed gross beta activity; however, no direct correlation was consistently observed between gross beta activity and ^{40}K in the FY 1995 data. Tritium activity in the pad runoff water was very low and well within what are considered normal background levels.

Only traces of water drained from the IWMF underpad system even after periods of heavy rainfall. Therefore, no samples were collected. The absence of water in the underpad indicated that the French drain was performing as designed to route shallow groundwater away from the IWMF underpad system.

2.1.2 pH control of pad water runoff

2.1.2.1 Methodology

In response to elevated pH, first observed at the tumulus facilities, an automatic pH control system was installed at IWMF. The system consists of a pH probe in both the infiltration and the stormwater sumps, a pressure transducer calibrated to measure water level in the stormwater sump, a supply of CO_2, solenoid valves, and an electronic data acquisition device with input and output connections. Carbon dioxide is released into a sump in response to elevated pH in that sump as long as the pressure transducer records a water level indicating flow from the pads. Flow from the pads is restricted by adjusting the opening of the sump outflow valves and by a 3-in. high stainless steel plate at the outlet of each sump. The plate causes ~3 in. of water to remain in the sumps at all times. Set points are such that if the level in the stormwater sump is >3.2 in. and the pH in either sump is >8.5 the appropriate solenoid valve in the CO_2 line is opened by an electronic signal from the data logger and gas flows into the sump. If either the water level or the pH fall below the set points, the data logger signal closes the solenoid valve and gas flow ceases. The data logger reads pH and

water level once a minute and records data every 15 min. as an average of the 1-min. values.

2.1.2.2 Results

Figures 4 through 6 show the typical pH variation in pad water runoff and outfall pH over the course of a month when the control system is working as designed. Spikes in the water level plot indicate periods of rainfall and consequent water level rise in the stormwater sump. These figures show that the CO_2 bubbler system maintained the outfall pH below the NPDES permit level of 9.0 despite several periods of time during which water flowing into the infiltration sump had a pH above 9.0.

2.1.3 Soil sampling

2.1.3.1 Methodology

Surface soil was collected at five sites around the IWMF facility by the method described in procedure ASEMP-04 in Appendix B. The purpose of collecting such samples is to monitor for radiological contamination in the area that may be caused by loading operations.

2.1.3.2 Results

The results of the FY 1995 soil sampling at the IWMF area are presented in Table A.2 of Appendix A. All radiological data are within normal background levels typically observed in the SWSA 6 area.

2.2 HILLCUT DISPOSAL TEST FACILITY

The HDTF is a demonstration project that was started in 1981 but was discontinued the following year before any wastes were emplaced (see Figs. 1 and 2 for location within SWSA 6). In 1985, the project was reactivated as part of the Low-Level Waste Disposal Development and Demonstration project. The HDTF provided a method for disposing of high-activity LLW because no suitable greater-confinement burial method was available at the time. The HDTF demonstration also provided a means by which to evaluate the use of hillslope cuts as possible sites for future engineered disposal facilities. The objective of the demonstration was to assess the degree of hydrologic isolation afforded by this type of design.

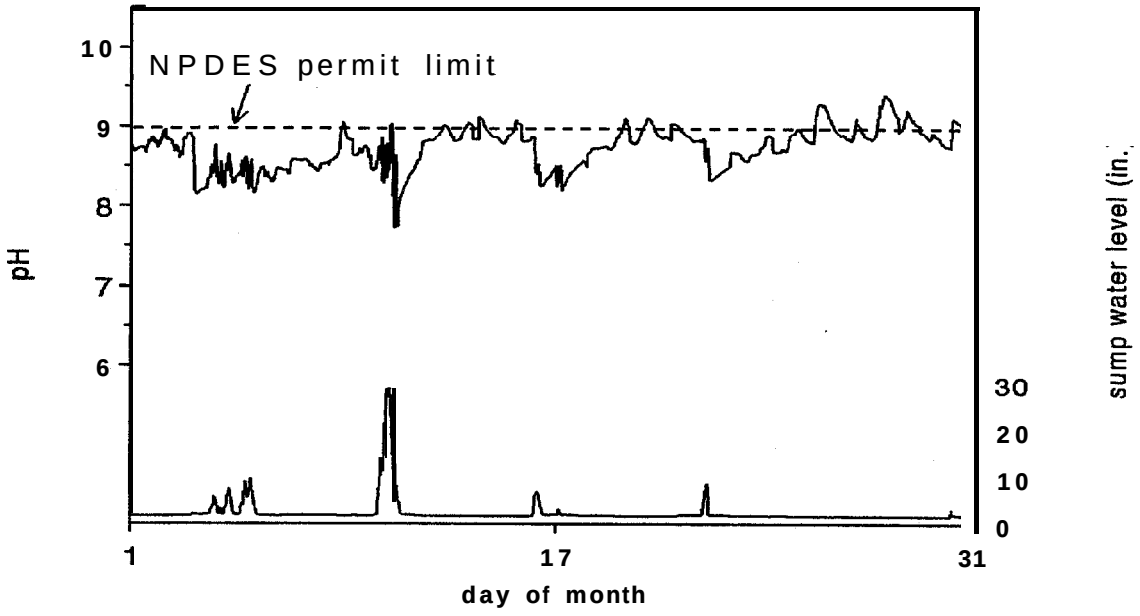

Fig. 4. IWMF infiltration sump water pH for December 1994.

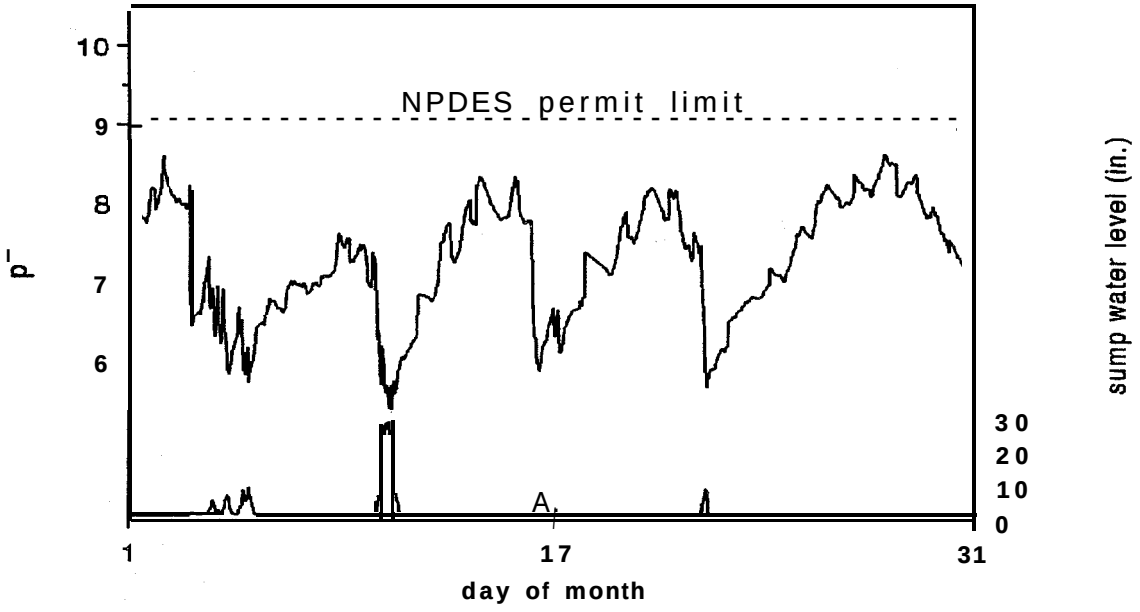

Fig. 5. IWMF stormwater sump pH for December 1994.

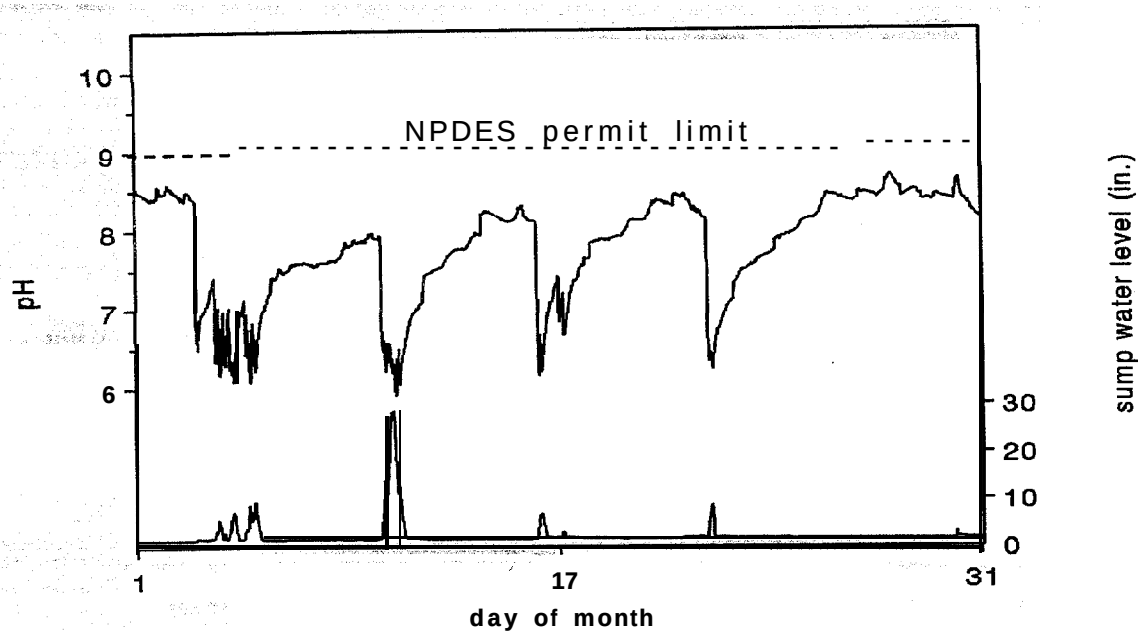

Fig. 6. **IWMF outfall water pH for December 19.94.**

Fig. 7 shows the design of the HDTF with its monitoring wells and gravity drain. The HDTF is similar to the tumulus-type facilities and consists of a concrete pad (4.6 m × 4.6 m) constructed in a cut from the side slope of a hill. The pad was installed above the expected high water table in the area. Twenty- seven concrete boxes (1.1 m × 1.1 m × 1.4 m) of high-activity LLW were placed on the pad and covered with soil. The lids of the boxes were sealed with a bitumen mastic, and the boxes were banded. A runoff collection system was installed to drain both the pad and the gravel area surrounding the pad. Runoff from the pad and the gravel drain are collected separately in two above-grade 500-gal tanks. Two monitoring wells were installed, one on the pad and one in the gravel drain.

Water can reach the buried waste vaults through infiltrating precipitation or shallow stormflow. If the water table rises following heavy rains, the gravel base below the pad should intercept water from the shallow aquifer, serving as a wick to drain the water away from the pad.

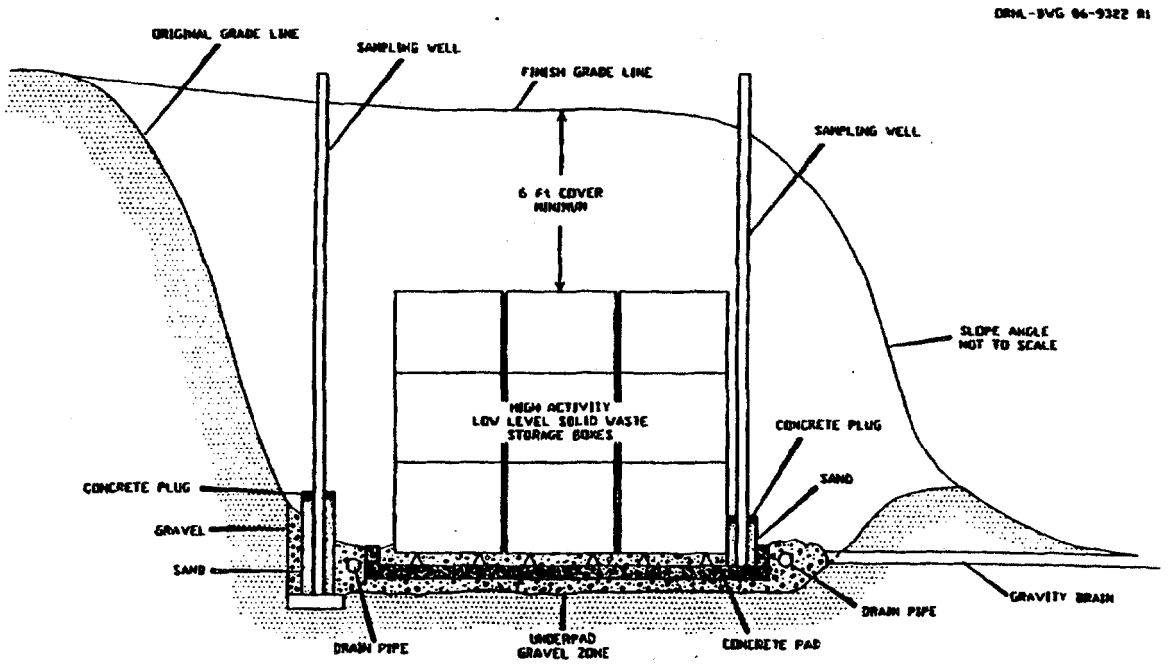

Fig. 7. Layout of the Hillcut Disposal Test Facility.

Records of the contents of three of the vaults placed on the HDTF pad indicate that these vaults cannot be certified to be free of RCRA material. The water that drains from the pad and underpad is, therefore, collected for treatment at the Process Waste Treatment Plant (PWTP).

2.2.1 Pad and underpad runoff collection and analysis

2.2.1 .1 Methodology

Water that drains from the pad surface is collected in a tank at the outfall. When water in this tank reaches ~70% of tank volume, a sample is collected and the contents of the tank are transferred to a holding tank downhill from the facility. Very little water drains from the underpad. Underpad water is allowed to drain directly to a holding tank downhill from the HDTF and is sampled as necessary prior to disposal at the PWTP.

Samples are analyzed for gross alpha, gross beta, and gamma activity. When the analytical results are received, the SWSA 6 foreman is notified. The foreman is responsible for transporting the collected water to the PWTP. If radioactivity levels are above the IRLs, the ASEMP program manager is notified.

2.2.1.2 Results

Table A.3 in Appendix A, pg. A-8, presents an historical record of the radiological measurements made on the HDTF pad and underpad runoff water dating back to 1987. These data show one exceedance of the gross beta IRL of 5.0 Bq/L in 1993 and one in 1995. The 1995 sample also exceeded the ^{137}Cs IRL. The IRL for gross alpha activity has been exceeded on two occasions; once in 1991 and again in 1993.

Tables A.4 and A.5 display cation and anion data and volatile organic compound (VOC) data for HDTF samples collected in FY 1995. All Toxicity Characteristic Leachate Procedure (TCLP) constituents were below regulatory concentrations. Only traces of VOCs that are common laboratory contaminants were detected. Also, semivolatile organic compound (SVOC) analyses confirmed the absence of SVOC contamination.

2 . 3 CONCLUSIONS

Data from the IWMF pad runoff indicate that no leakage of waste has occurred from the vaults. Only a low-level gross beta activity has been observed in the runoff water. This activity is postulated to be a result of ^{40}K leaching from the concrete. No pad-water samples exceeded the IRLs for gross alpha, gross beta, ^{137}Cs, or ^{60}Co activity.

The French drain at IWMF is performing its intended purpose of suppressing the water table beneath the pads. The absence of water in the underpad drainage system is an indication of the French drain's effectiveness.

The CO_2 bubbling system that was installed in the IWMF pad water runoff sumps is functioning well and automatically maintains effluent water below the NPDES permit pH limit of 9.0.

Water continues to drain from HDTF during the wet season. One FY 1995 sample exceeded the gross beta and ^{137}Cs IRLs, but subsequent samples did not. TCLP, VOC, and SVOC data indicated that HDTF runoff water was not contaminated with metals or organics above any regulatory limits.

3. LOW-LEVEL LIQUID WASTE SOLIDIFICATION PROJECT

The LWSP, initially referred to as the Emergency Avoidance Solidification Campaign (EASC), was undertaken to solidify the supernatant from the Melton Valley storage tanks. The supernatant was mixed with cement and other solidifying agents and allowed to cure in steel cylindrical containers with a diameter and height of 1.8 meters that weigh ~12 metric tons.

For radiation shielding purposes, each steel container was loaded inside a storage cask prior to waste solidification. The waste forms were then transported to the LWSP cask storage site where they were placed inside concrete storage casks. The LWSP cask storage site is now located within SWSA 6. The casks are stored at the site on an engineered, compacted, crushed-stone storage pad. Casks containing surrogate waste forms which are similar to the actual waste forms but do not contain radioactive waste are also stored at this site.

Each storage cask contains an integral fiberglass-reinforced plastic (FRP) liner with lid. Sampling lines were cast in place through the wall of the storage cask into the annular space between the waste form and the FRP-lined concrete storage cask. One tube extends to the bottom of the annular space and is used to collect any liquid that may be found inside the cask. The other tube extends to within a few inches of the top of the annular space and can be used to collect gas samples (Fig. 8).

3.1 CASK-LIQUID SAMPLING

3.1.1 Methodology

Liquid samples are collected annually from the LWSP casks, if liquid has collected in the sampling ports, and are analyzed for gross alpha, gross beta, and gamma activity. In addition, analyses are performed for sodium, nitrate, chloride, and other metals and anions if enough sample is available. The choice of analytes is based on the major constituents of the solidified waste. Sampling the casks for liquids is conducted by the Liquid Waste Operations Group (LWOG) of WMRAD.

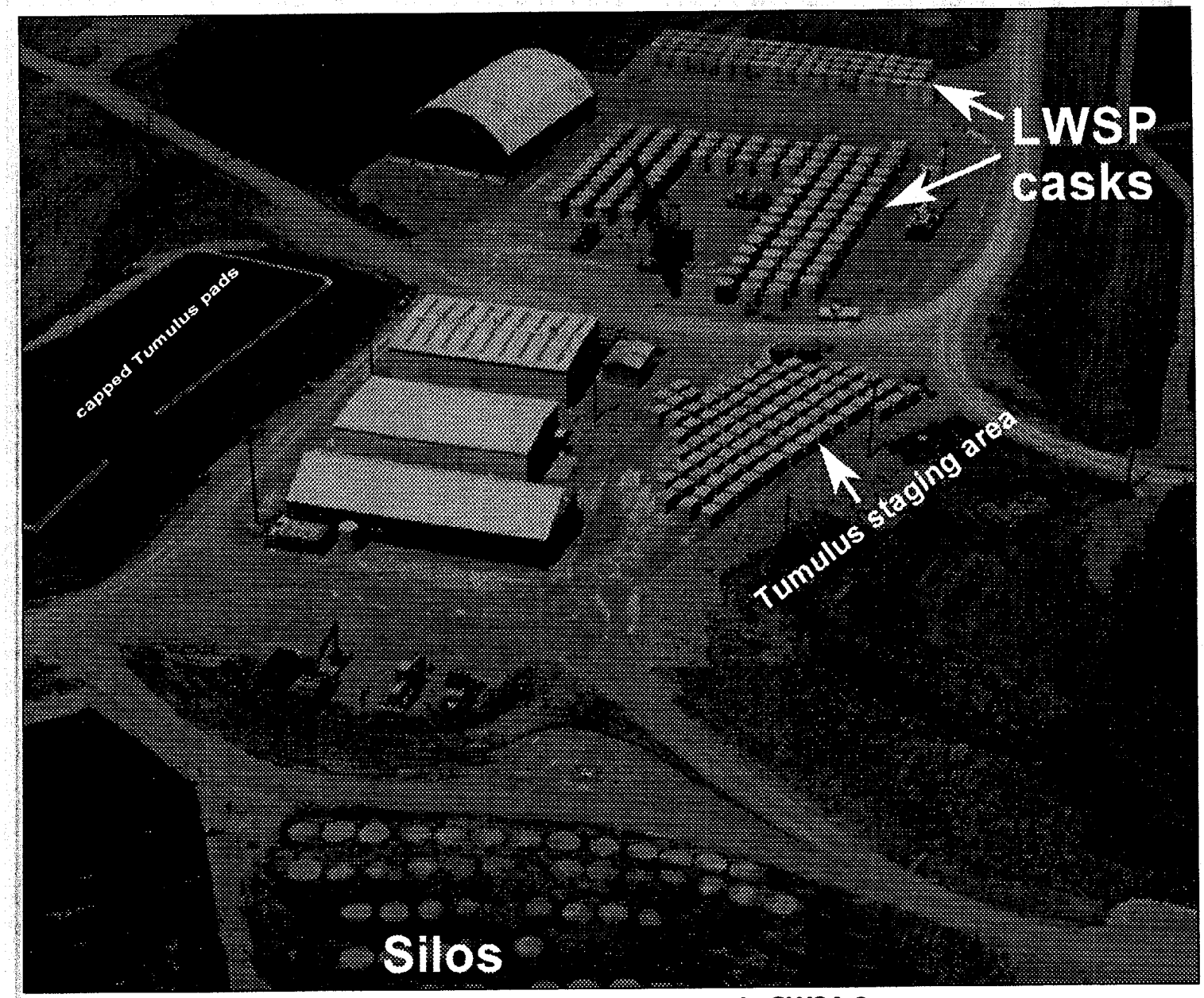

Fig. 8. LWSP cask storage area in SWSA 6.

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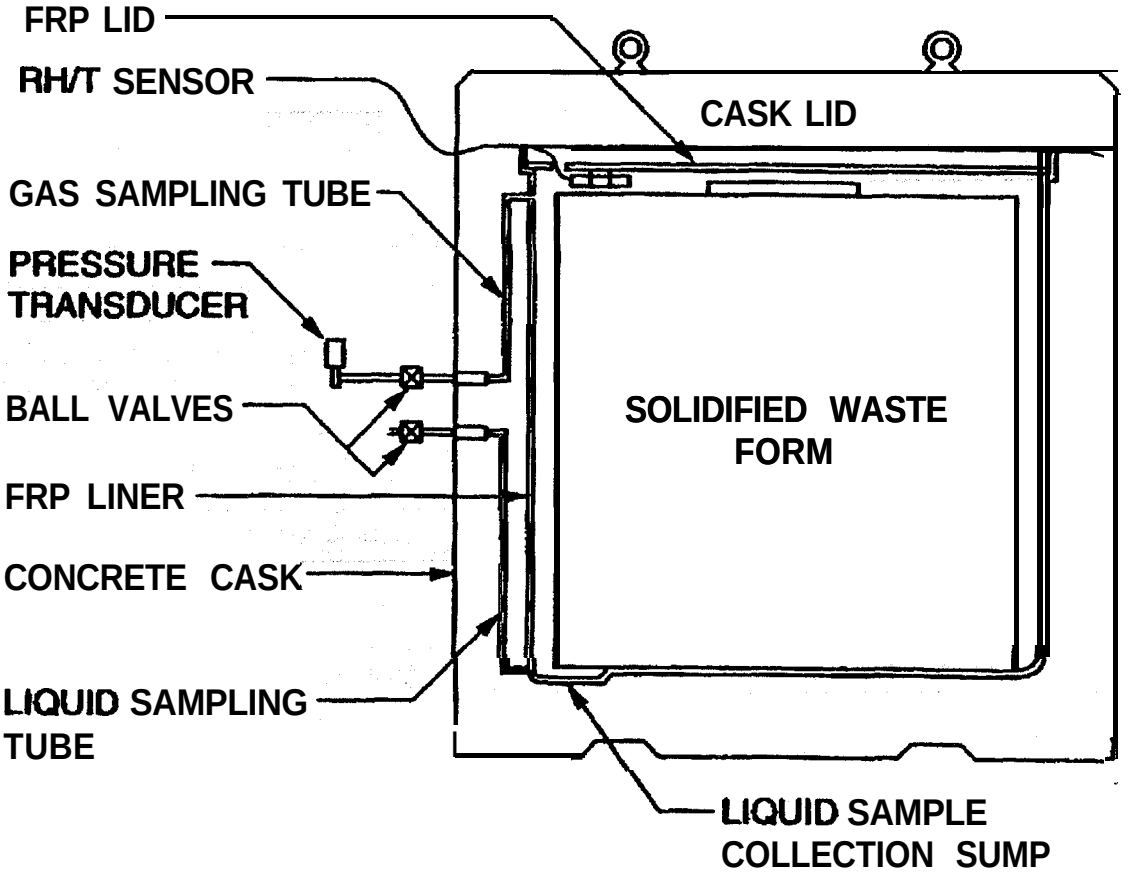

Fig. 9. EASC/LWSP waste storage casks.

3.1.2 Results

Analytical results from the FY 1995 sampling of liquid that accumulated in the LWSP storage casks is presented in Table A-6. The data are difficult to interpret due to the fact that only small volumes of sample are available from most of the casks. The FY 1995 samples have slightly elevated gross beta and ^{137}Cs activity and relatively high concentrations of ions, such as nitrate, that are associated with the solidified waste. The reason for the presence of such contamination may be that residual contamination remained on the outside of the waste form after solidification. The water that accumulates in these casks probably evaporates to some extent thus concentrating any ions present. Also, the gross beta activity in the accumulated water could be partly the result of ^{40}K leaching from the concrete. Tritium activity was also higher than typical background for water samples.

3.2 SOIL SAMPLING

3.2.1 Methodology

Soil samples are collected annually from five locations at the LWSP II site in SWSA 6. Samples are analyzed for gross alpha, gross beta, and gamma activity according to standard operating procedures.

3.2.2 Results

Table A -2 presented the FY 1995 soil data for the LWSP cask storage area. These data are similar to previous soil data from the site and indicate that no changes in soil radionuclide activity have occurred as a result of LWSP operations and storage. However, an elevated level of ^{137}Cs was observed in one sample from the area. This sample was actually intended to be a background sample for the LWSP II area since it was collected well away from the casks but still within the SWSA 6 boundary. A repeat sample confirmed the ^{137}Cs activity. Since this area of contamination was not within the region of LWSP loading operations, no further action was taken.

3.3 CONCLUSIONS

Only ~25% of the EASC/LWSP casks have consistently had sufficient water to sample. During FY 1995, only low levels of gross beta activity (maximum of 5.3 Bq/L) was detected in water that accumulated in the casks. Gross alpha activity was absent. Some of the gross beta activity could be the result of ^{40}K leaching

from the concrete casks. However, the frequent detection of elements associated with the solidified waste, such as chloride, nitrate, calcium, and sodium make it appear that some external contamination of the waste form may have occurred during loading operations.

Soil sampling in and around the LWSP II storage areas indicates that loading and storage operations have not resulted in the release of contamination from the site.

4. TRANSURANIC WASTE FACILITIES IN SWSA 5 NORTH

Transuranic wastes have been stored in SWSA 5 N since 1970 (Shoun 1987). Active TRU waste management facilities in SWSA 5 N include aboveground buildings, buildings that are below ground on three sides, and auger holes similar to the high-range wells in SWSA 6.

Before DOE Order 5820.2A went into effect, TRU wastes were also emplaced in unlined trenches in SWSA 5 N. Within the trenches, TRU wastes are contained in concrete casks and wooden and metal boxes (Stewart et al. 1989). There is evidence that the shallow aquifer extends above the bottom of at least some of the trenches during high water table conditions (Wickliff et al. 1991b). Furthermore, TRU contamination leached from wastes in the trenches has been measured in a downgradient well (Ashwood et al. 1990; Wickliff et al. 1991a, 1991b; Ashwood et al. 1991a, 1991b) and in seeps along the bank of White Oak Creek (Ashwood et al. 1991a, 1991b). Thus, transport from the trenches is known to occur through the shallow aquifer and along discrete pathways.

Groundwater well 516, immediately downgradient from a group of TRU waste trenches (Fig. 10), contains gross alpha activity varying from 30 to 210 Bq/L (Morrissey et al. 1994). The dominant radionuclide is ^{244}Cm, but traces of ^{241}Am are also detected. The TRU waste trenches also contain some RCRA-regulated wastes: primarily elemental lead (Stewart et al. 1989). Samples from Well 516 have not contained detectable concentrations of volatile organics (Wickliff et al. 1991). Metal concentrations in this well have been below regulatory concern (Ashwood et al. 1991b).

Well 516 and the TRU waste trenches are upgradient from White Oak Creek (WOC), which drains most of ORNL and eventually enters the Clinch River. The radionuclides, ^{244}Cm and ^{241}Am, were measured in two seeps (Fig. 9: WOC

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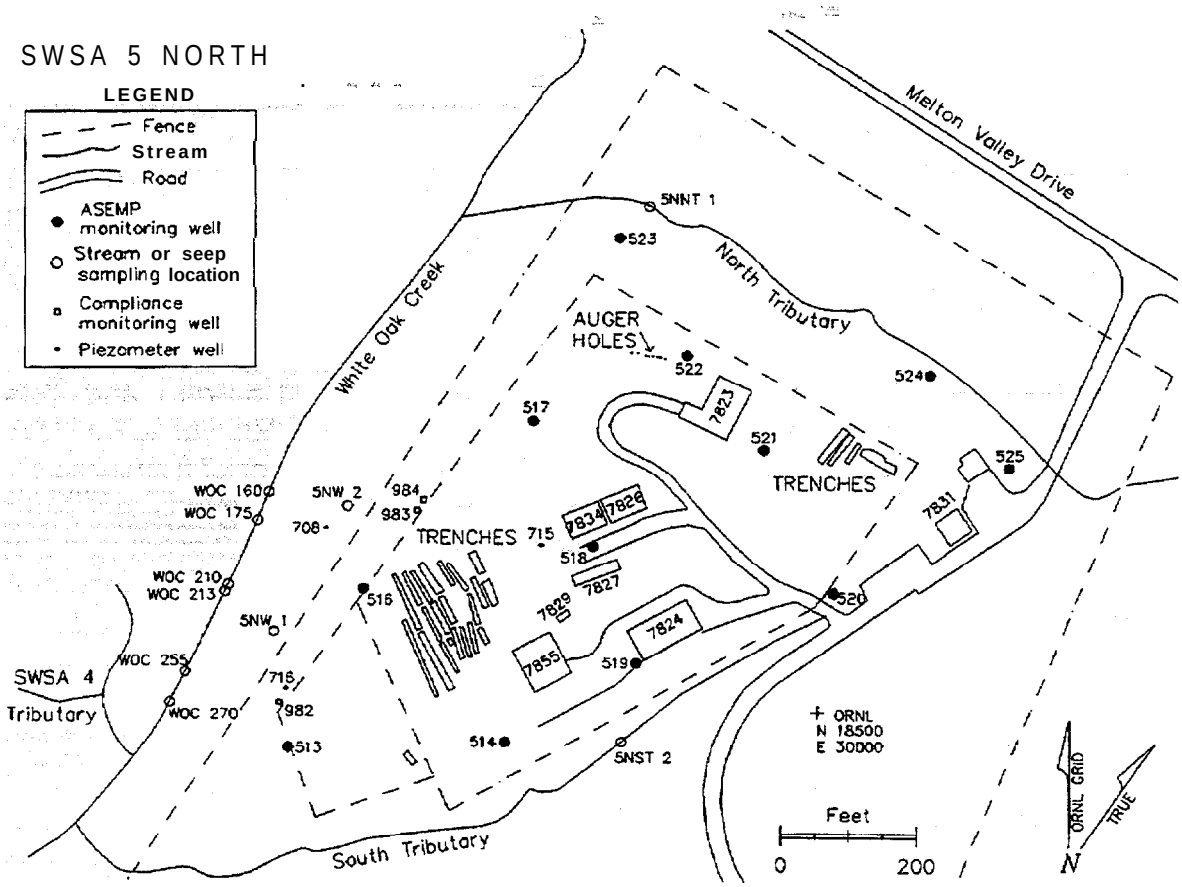

Fig. 10. Transuranic waste storage areas, groundwater monitoring wells, and other major facilities in SWSA 5 N.

213 and WOC 255) in the bank of WOC (Ashwood et al. 1991 b). These seeps are along geologic strike with the trenches.

4.1 METHODOLOGY

Fifteen groundwater wells surrounding the TRU-waste storage facilities are now sampled annually. Previously, these wells were on a quarterly sampling schedule (Ashwood et al. 1992a, 1992b).

Well samples are collected after the wells have been purged. All samples, with the exception of those collected for tritium analysis, are filtered through 0.45-µm filters and then acidified to a pH <2 with nitric acid. Analytes include gross alpha, gross beta, ^{60}Co, ^{137}Cs, ^{241}Am, ^{244}Cm, and ^{3}H. Beginning in FY 1992, tritium analysis was limited to one quarterly sample because tritium is not a contaminant of concern for this site and because the tritium data have not provided substantial insight into the transport of transuranic contaminants.

IRLs have been established for gross beta (2 Bq/L), ^{60}Co (1.5 Bq/L), and ^{137}Cs (1 Bq/L) in SWSA 5 N (Ashwood and Ashwood 1991). No IRL was established for gross alpha because gross alpha is not a reliable indicator of transuranic contamination at trace levels below 1 Bq/L. Instead, concentrations of ^{241}Am or ^{244}Cm that exceed the associated counting error by a factor of 2 are flagged as potentially contaminated samples. This approach roughly corresponds to a 5% probability that a sample would be reported as contaminated when it is not.

4.2 RESULTS

4.2.1 Storage Facility Sumps

Sumps that drain Buildings 7855, 7826, and 7834 (Fig. 11) were sampled when sufficient amounts of water accumulate in them. Samples were analyzed for gross alpha, gross beta, and gamma activity. If the gross alpha or gross beta activities exceed the IRLs for these sumps (10 and 20 Bq/L, respectively), ASEMP notifies the SWSA 5 North foreman who is responsible for pumping the water from the sump and transporting to the PWTP.

An historical record of the radiological data from the SWSA 5 N sump samples is presented in Table A -8. Gross beta activity in the water from sump 7855-2 typically exceeds the IRL. Water from this sump is consistently a yellowish-brown color indicating that the water has probably leached organic material from soil and/or decaying vegetation. The presence of ^{40}K activity provides

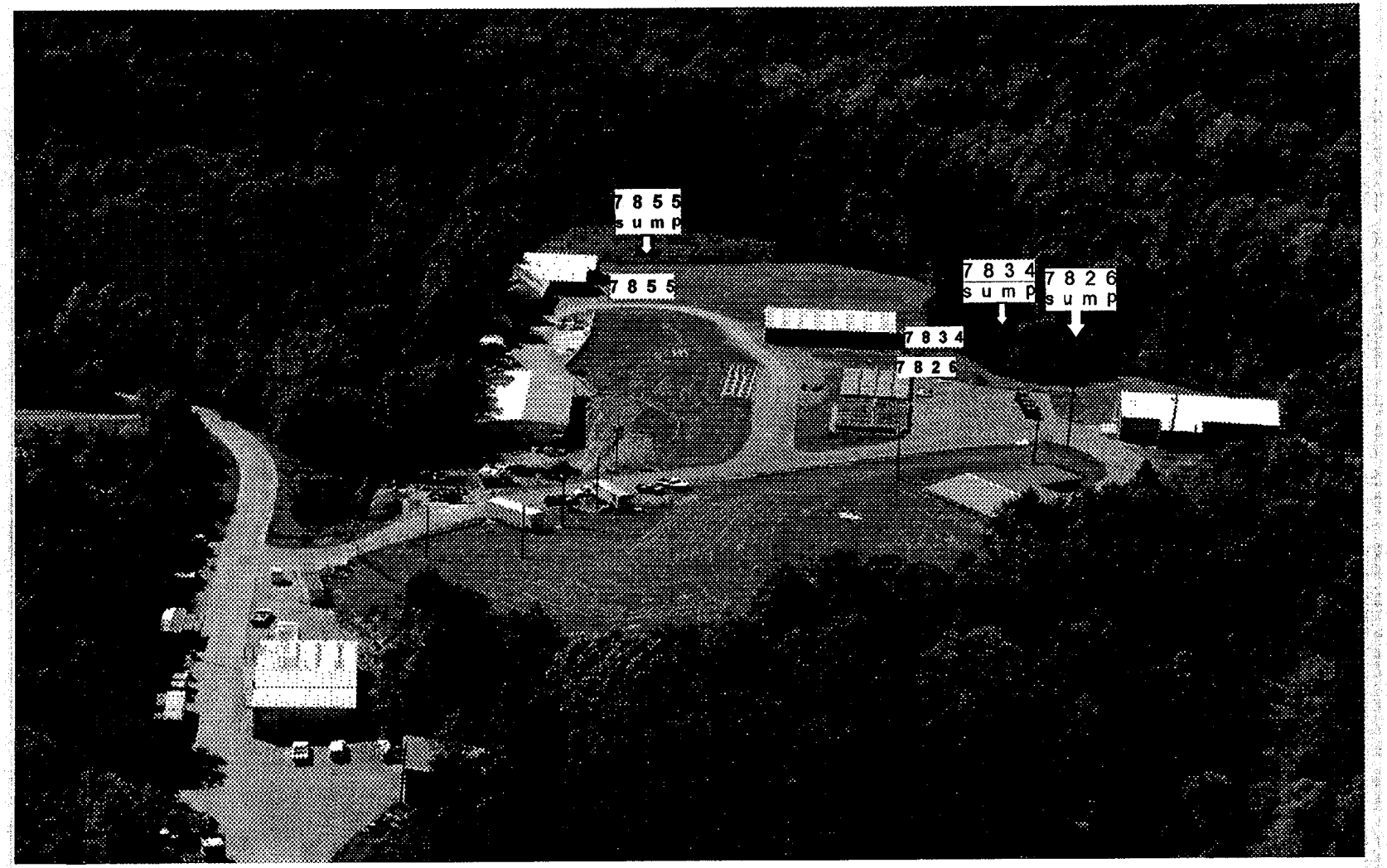

Fig. 11. Aerial view of SWSA 5 North showing location of main TRU waste storage buildings and associated sumps.

assurance that the gross beta activity is not the result of any radiological component of the waste.

4.2.2 Groundwater Wells

Radiological data from the FY 1995 SWSA 5 N groundwater monitoring wells is presented in Table A -9. Well 516 continues to contain elevated gross alpha and beta activity due to the presence of ^{241}Am and ^{244}Cm.

Table A -10 presents radiological data from the SWSA 5 N seep sampling. Two seeps, hydrologically downgradient from the waste trenches, show the presence of ^{244}Cm and traces of ^{241}Am.

Anion and cation analyses were also conducted for the SWSA 5 N wells. These data, presented in Table A -11, indicate typical groundwater chemistry. Bromide was detected in three wells as the result of a tracer test being conducted by bromide injection into the waste trenches. Well 516 contained the highest concentration of bromide thus confirming that this well is in direct hydrologic contact with the trenches.

4.2.3 Well 518

In response to the detection of water in a waste storage well at facility 7820, ASEMP initiated continuous water level monitoring in groundwater monitoring well 518 in SWSA 5 N. Well 518 is the well closest to the 7820 facility (Fig. 10). The purpose of water level monitoring in this well was to aid in estimating whether the water table rises above the bottom elevation of the storage well. The data indicate a relatively slow water table response to the infiltration of rainfall. Fig. 12 shows a typical response of water in 518 over the course of a month. The location of well 518 near a graveled road and other facilities and disturbed areas may affect the water table response in the well. The maximum water table elevation observed in 518 over the 6 months of monitoring was ~807 ft. above mean sea level. Analysis and interpretation of the water table data in relation to the finding of water in the 7820 storage well are ongoing.

4.3 CONCLUSIONS

Gross beta activity is consistently present in samples of water from sump 7855-2 and can be accounted for by the presence of ^{40}K.

Alpha activity continues to be present in well 516. The reported results from well 516 have varied widely over the years; for example, ^{244}Cm varied from 220 Bq/L in March 1991 to 0.36 Bq/L in September 1992 (Morrissey et al., 1994b). Thus,

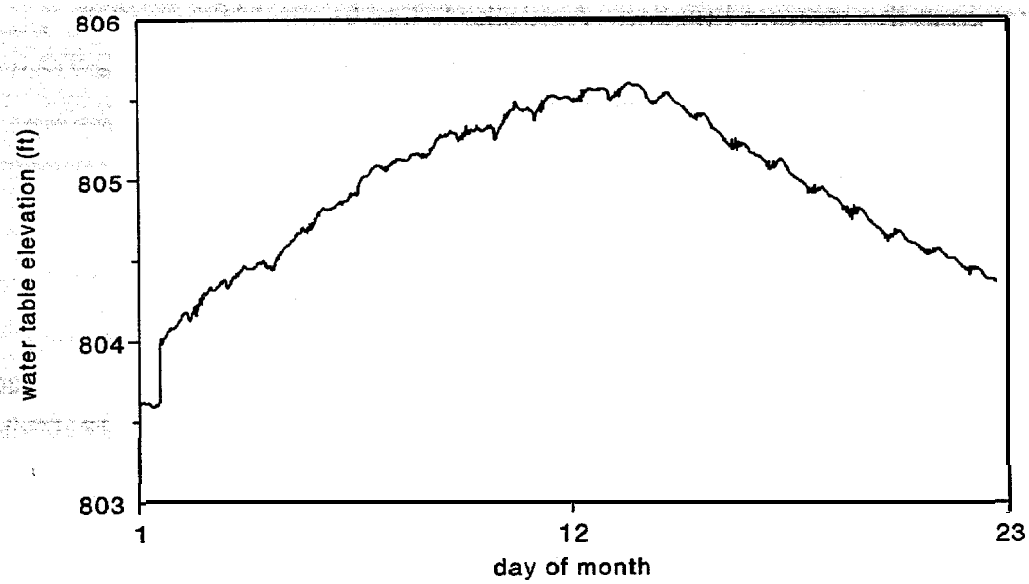

Fig 12. Groundwater elevation in SWSA 5 N well 518 for May 1995.

the measured ^{244}Cm concentrations appear to be highly dependent upon some aspect of the local conditions at the time of sample collection. As we suggested in an earlier report (Wickliff et al. 1991), water table elevation may be the most important variable. At higher water table elevations, more waste in the burial trenches is directly exposed to groundwater. If buried waste in contact with the water table is indeed the source of ^{244}Cm, then any remedial action must address either removal of the waste or isolation of the waste from the water table. Simply capping the trenches to eliminate infiltration will not prevent ground water from contacting the buried waste.

Alpha activity and the associated ^{244}Cm and ^{241}Am isotopes detected in seeps along the bank of White Oak Creek confirm the direct hydrologic contact along geologic strike from the burial trenches to well 516 and to the creek.

5. SWSA 7

Soil samples were collected from six locations around the Nuclear Fuel Services (NFS) storage building in December 1994 and submitted for radiological analyses. Data were received this month and are presented in Table 4. These samples represent background soil data in the area prior to the placement of

waste in the storage building. A relatively low level of ^{137}Cs activity was detected in one of the samples (NFS-6). This sample was collected along the dirt road to the east and above the storage building. This location is well away from areas where storage operations will be conducted and will not be used for comparison to future samples.

6. ACKNOWLEDGMENTS

Jeff Riggs and Roy Freeman of the Instrumentation and Controls Division have consistently supplied excellent guidance and craftsmanship in the design, operation, and maintenance of the electronic monitoring and sampling equipment.

7. REFERENCES

Ashwood, J. S., and T. L. Ashwood. 1991. Active sites environmental monitoring program: Action levels. ORNL/M-1569. Oak Ridge National Laboratory.

Ashwood, T. L., D. S. Wickliff, C. M. Morrissey, and H. L. Adair. 1990. Active sites monitoring at Oak Ridge National Laboratory. pp. 397~399. In Proceedings of SPECTRUM 90 Nuclear and Hazardous Waste Management International Topical Meeting, September 30~October 4, 1990, Knoxville, Tennessee. American Nuclear Society, La Grange Park, IL.

Ashwood, T. L., D. S. Wickliff, and C. M. Morrissey. 1991 a. Active Sites Environmental Monitoring Program: Mid-FY 1991 Report. ORNL/M-1442. Oak Ridge National Laboratory.

Ashwood, T. L., D. S. Wickliff, and C. M. Morrissey. 1991 b. Active sites environmental monitoring program: FY 1991 report. ORNL/M-1792. Oak Ridge National Laboratory.

Ashwood, T. L., D. S. Wickliff, and C. M. Morrissey. 1992a. Active sites environmental monitoring program: FY 1991 annual report. ORNL/M-1792. Oak Ridge National Laboratory.

Ashwood, T. L., D. S. Wickliff, and C. M. Morrissey. 1992b. Active Sites Environmental Monitoring Program: Program plan, Rev. 1. ORNL/M-1793. Oak Ridge National Laboratory.

Davis, E. C., C. W. Francis, and R. J. Luxmoore. 1989. An evaluation of water leakage into concrete low-level radioactive waste disposal silos at ORNL's Solid Waste Storage Area 6. ORNL/TM-11164. Oak Ridge National Laboratory.

Department of Energy (DOE). 1988. Radioactive waste management. DOE Order 5820.2A, September 26, 1988. U.S. Department of Energy, Washington, D.C.

Morrissey, C. M., and G. R. Cunningham. 1995. Active sites environmental monitoring program: FY 1994 annual report. ORNL/M-3788. Oak Ridge National Laboratory.

Morrissey, C. M., T. L. Ashwood, D. S. Hicks, and J. D. Marsh. 1994. Active Sites Environmental Monitoring Program: FY 1993 Annual Report. ORNL/M-3327. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Morrissey, C. M., T. L. Ashwood, and D. S. Hicks. 1994. Active sites environmental monitoring program: FY 1992 annual report. ORNL/M-3183. Oak Ridge National Laboratory.

Shoun, R. R. 1987. Environmental data package for ORNL Waste Area Grouping~Five (WAG-5), Solid Waste Storage Area~Five (SWSA-5). ORNL/RAP-19. Oak Ridge National Laboratory.

Stewart, R. C., L. S. Dickerson, S. F. Joost, and D. C. Osucha. 1989. Remote-handled transuranic solid waste characterization study: Oak Ridge National Laboratory. ORNL/TM-11050. Oak Ridge National Laboratory.

Wickliff, D. S., C. M. Morrissey, and T. L. Ashwood. 1991 a. Active sites environmental monitoring program: Mid-FY 1990 summary report. ORNL/M-1179. Oak Ridge National Laboratory.

Wickliff, D. S., C. M. Morrissey, and T. L. Ashwood. 1991 b. Active sites environmental monitoring program: FY 1990 annual report. ORNL/M-1327. Oak Ridge National Laboratory.

Yager, R. E. 1991. Emergency avoidance solidification campaign annual report. ECE-91-034. Environmental Consulting Engineers, Knoxville, TN.

Yager, R. E., J. A. Furnari, and P. M. Craig. 1989. Environmental monitoring six-month report for the tumulus disposal demonstration project: Mid-fiscal year 1989. ORNL/Sub/89-SC924/2. Oak Ridge National Laboratory.

APPENDIX A
DATA TABLES

Table A.1. Runoff and French Drain samples from the Interim Waste Management Facility for FY95.[a]

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
Stormwater sump:							
IWMF/BLK/203	10/12/94	-0.008 ± 0.01	0.05 ± 0.11		0.04 ± 0.12	0.06 ± 0.12	
IWMF/STM/204	10/12/94	0.16 ± 0.07	0.61 ± 0.14		-0.02 ± 0.09	0.04 ± 0.12	
IWMF/BLK/205	10/20/94	0.000 ± 0.01	0.039 ± 0.02		-0.01 ± 0.1	0.02 ± 0.08	
IWMF/STM/206	10/20/94	0.042 ± 0.02	0.62 ± 0.05		-0.01 ± 0.05	0.04 ± 0.06	
IWMF/BLK/207	11/02/94	0.044 ± 0.043	0.06 ± 0.10		0.09 ± 0.09	0.11 ± 0.08	
IWMF/STM/208	11/02/94	-0.05 ± 0.02	0.72 ± 0.15		0.02 ± 0.12	0.08 ± 0.12	
IWMF/BLK/209	11/22/94	0.17 ± 0.07	0.19 ± 0.11		0.07 ± 0.06	-0.01 ± 0.06	
IWMF/STM/210	11/22/94	0.07 ± 0.05	0.67 ± 0.14		0.17 ± 0.08	-0.01 ± 0.09	
IWMF/BLK/211	12/01/94	0.022 ± 0.006	0.13 ± 0.06		0.18 ± 0.08	-0.12 ± 0.12	
IWMF/STM/212	12/01/94	0.200 ± 0.060	0.54 ± 0.08		0.08 ± 0.06	0.06 ± 6.05	
IWMF/BLK/213	12/06/94	0.010 ± 0.018	0.02 ± 0.05		0.01 ± 0.09	0.01 ± 0.09	
IWMF/STM/214	12/06/94	-0.001 ± 0.014	0.35 ± 0.08		0.02 ± 0.12	0.02 ± 0.1	
IWMF/BLK/215	12/15/94	0.22 ± 0.04	1.2 ± 0.8		-0.11 ± 0.15	-0.01 ± 0.11	
IWMF/STM/216	12/15/94	-0.073 ± 0.025	-0.1 ± 0.8	5.7 ± 0.6	0.05 ± 0.08	0.02 ± 0.07	
IWMF/BLK/219	01/18/95	0.07 ± 0.06	0.40 ± 0.12		0.17 ± 0.08	0.08 ± 6.11	
IWMF/STM/220	01/18/95	0.22 ± 0.08	0.91 ± 0.16		0.01 ± 0.14	0.01 ± 0.13	
IWMF/BLK/221	01/31/95	0.017 ± 0.04	0.16 ± 0.10		-0.02 ± 0.20	0.07 ± 0.14	
IWMF/STM/222	01/31/95	0.06 ± 0.05	0.68 ± 0.15		0.05 ± 0.28	-0.10 ± 0.21	9 ± 12
IWMF/BLK/223	02/14/95	-0.02 ± 0.06	0.24 ± 0.20		-0.05 ± 0.11	0.04 ± 0.08	
IWMF/STM/224	02/14/95	0.003 ± 0.04	0.68 ± 0.10		-0.03 ± 0.09	-0.07 ± 0.08	
IWMF/BLK/225	02/20/95	-0.043 ± 0.04	0.09 ± 0.08		0.02 ± 10.10	0.05 ± 0.08	
IWMF/STM/226	02/20/95	0.11 ± 0.06	0.50 ± 0.13		0.07 ± 0.06	0.04 ± 0.08	
IWMF/BLK/227	03/01/95	-0.024 ± 0.01	0.21 ± 0.06		0.08 ± 0.08	0.11 ± 0.08	
IWMF/STM/228	03/01/95	-0.003 ± 0.01	0.80 ± 0.10		0.06 ± 0.14	-0.04 ± 0.12	14 ± 14

Table A.1 (continued)

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMF/STM/229	03/15/95	-0.020 ± 0.050	-0.07 ± 0.15		-0.06 ± 0.14	-0.01 ± 0.10	
IWMF/STM/230	03/15/95	0.044 ± 0.024	0.76 ± 0.09		0.11 ± 0.12	0.19 ± 0.10	
IWMF/STM/231	03/23/95	-0.005 ± 0.025	-0.32 ± 0.09		0.09 ± 0.13	0.13 ± 0.11	
IWMF/STM/232	03/23/95	0.025 ± 0.050	0.38 ± 0.13	6.4 ± 1.4	-0.01 ± 0.10	-0.05 ± 0.10	
IWMF/STM/233	04/14/95	0.005 ± 0.034	0.00 ± 0.10		0.03 ± 0.12	0.04 ± 0.10	
IWMF/STM/234	04/14/95	0.020 ± 0.036	0.22 ± 0.12		0.04 ± 0.10	0.03 ± 0.10	
IWMF/STM/235	04/19/95	0.043 ± 0.042	-0.12 ± 0.10		0.07 ± 0.08	0.01 ± 0.08	
IWMF/STM/236	04/19/95	0.030 ± 0.044	0.47 ± 0.12		0.14 ± 0.10	0.08 ± 0.09	
IWMF/STM/237	04/24/95	0.010 ± 0.018	0.28 ± 0.08		-0.05 ± 0.10	0.16 ± 0.08	
IWMF/STM/238	04/24/95	-0.01 ± 0.02	0.14 ± 0.06		0.08 ± 0.07	0.08 ± 0.08	
IWMF/STM/239	05/03/95	0.058 ± 0.042	0.23 ± 0.12		0.02 ± 0.09	0.03 ± 0.08	
IWMF/STM/240	05/03/95	0.01 ± 0.07	1.2 ± 0.2		-0.02 ± 0.10	0.06 ± 0.09	
IWMF/STM/241	05/10/95	0.18 ± 0.07	0.08 ± 0.11		-0.11 ± 0.10	0.07 ± 0.06	
IWMF/STM/242	05/10/95	0.020 ± 0.036	-0.02 ± 0.12		0.02 ± 0.08	0.06 ± 0.06	
IWMF/STM/243	05/19/95	0.03 ± 0.08	-0.06 ± 0.22		0.01 ± 0.14	-0.02 ± 0.14	
IWMF/STM/244	05/19/95	-0.08 ± 0.05	0.48 ± 0.26		-0.03 ± 0.14	-0.03 ± 0.14	
IWMF/STM/245	06/06/95	0.005 ± 0.046	0.14 ± 0.12		0.04 ± 0.09	-0.01 ± 0.20	
IWMF/STM/246	06/06/95	-0.03 ± 0.04	0.38 ± 0.12		0.13 ± 0.06	0.02 ± 0.08	
IWMF/STM/247	06/12/95	0.017 ± 0.018	0.051 ± 0.049		-0.13 ± 0.16	0.02 ± 0.12	
IWMF/STM/248	06/12/95	0.035 ± 0.026	0.45 ± 0.07		-0.18 ± 0.16	0.16 ± 0.09	
IWMF/STM/249	06/30/95	0.08 ± 0.07	0.27 ± 0.13		0.09 ± 0.05	0.02 ± 0.06	
IWMF/STM/250	06/30/95	0.07 ± 0.06	0.60 ± 0.15		-0.04 ± 0.10	-0.11 ± 0.10	
IWMF/STM/251	08/01/95	-0.073 ± 0.045	0.08 ± 0.10		0.02 ± 0.07	0.03 ± 0.06	
IWMF/STM/252	08/01/95	0.06 ± 0.05	1.0 ± 0.2		-0.06 ± 0.12	0.10 ± 0.10	14 ± 12
IWMF/STM/253	08/09/95	-0.13 ± 0.04	0.19 ± 0.13		0.16 ± 0.12	0.01 ± 0.13	

Table A.1 (continued)

Sample No."	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMF/STM/254	08/09/95	0.013 ± 0.049	0.42 ± 0.14		-0.08 ± 0.14	-0.09 ± 0.12	
IWMF/STM/254A	08/09/95	0.089 ± 0.037	0.57 ± 0.09		0.16 ± 0.12	0.02 ± 0.12	
IWMF/STM/257	09/20/95	0.049 ± 0.034	0.100 ± 0.06		0.02 ± 0.16	-0.02 ± 0.12	
IWMF/STM/258	09/20/95	0.069 ± 0.031	0.39 ± 0.08		0.04 ± 0.14	0.02 ± 0.12	
IWMF/STM/259	09/29/95	0.015 ± 0.022	0.08 ± 0.05		0.12 ± 0.10	-0.02 ± 0.10	
IWMF/STM/260	09129195	0.053 ± 0.032	0.72 ± 0.09		0.11 ± 0.12	-0.03 ± 0.14	
Infiltration sump:							
IWMF/INF/054	10/12/94	0.03 ± 0.044	1.2 ± 0.2		0.16 ± 0.08	-0.15 ± 0.12	
IWMF/INF/056	10/20/94	0.019 ± 0.014	1.3 ± 0.0		-0.08 ± 0.10	-0.03 ± 0.08	
IWMF/INF/058	11/02/94	0.10 ± 0.06	0.59 ± 0.16		-0.08 ± 0.12	0.02 ± 0.10	
IWMF/INF/060	11/22/94	0.05 ± 0.05	1.7 ± 0.2	3.9 ± 1.2	0.12 ± 0.08	0.06 ± 0.08	
IWMF/INF/062	12/01/94	0.066 ± 0.03	1.3 ± 0.1		0.08 ± 0.08	-0.04 ± 0.09	
IWMF/INF/064	12/06/94	0.003 ± 0.02	1.2 ± 0.1	2.6 ± 1.1	0.09 ± 0.10	-0.05 ± 0.10	
IWMF/INF/066	12/15/94	0.13 ± 0.26	1.6 ± 0.8		0.05 ± 0.06	0.02 ± 0.07	
IWMF/INF/070	01/18/95	0.08 ± 0.06	1.3 ± 0.2		-0.01 ± 0.14	-0.01 ± 0.12	
IWMF/INF/072	01/31/95	0.10 ± 0.05	1.5 ± 0.2		0.25 ± 0.16	0.11 ± 0.16	20 ± 12
IWMF/INF/074	02/14/95	0.12 ± 0.09	2.5 ± 0.7		-0.02 ± 0.10	0.13 ± 0.07	
IWMF/INF/076	02/20/95	-0.074 ± 0.046	0.49 ± 0.14		0.07 ± 0.10	-0.07 ± 0.10	
IWMF/INF/078	03/01/95	0.006 ± 0.014	1.2 ± 0.1		0.09 ± 0.11	0.03 ± 0.10	20 ± 14
IWMF/INF/080	03/15/95	0.051 ± 0.029	0.67 ± 0.09		-0.07 ± 0.10	0.04 ± 0.08	
IWMF/INF/082	03/23/95	0.021 ± 0.038	0.91 ± 0.16		0.09 ± 0.06	-0.02 ± 0.08	
IWMF/INF/084	04/14/95	0.056 ± 0.05	0.34 ± 0.14		0.04 ± 0.09	0.10 ± 0.08	
IWMF/INF/086	04/19/95	0.05 ± 0.05	0.46 ± 0.12		0.15 ± 0.08	0.01 ± 0.10	
IWMF/INF/088	04/24/95	0.07 ± 0.04	1.4 ± 0.1		-0.06 ± 0.11	0.04 ± 0.09	

Table A.1 (continued)

Sample No.[b]	Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
IWMF/INF/090	05/03/95	0.09 ± 0.06	1.2 ± 0.2		0.05 ± 0.10	-0.07 ± 0.11	
IWMF/INF/092	05/10/95	0.09 ± 0.05	1.3 ± 0.2		0.04 ± 0.09	0.03 ± 0.08	15 ± 12
IWMF/INF/094	05119/95	0.07 ± 0.09	1.5 ± 0.3		0.09 ± 0.11	0.18 ± 0.09	
IWMF/INF/096	06/06/95	0.05 ± 0.06	0.23 ± 0.2		-0.04 ± 0.14	0.11 ± 0.11	
IWMF/INF/098	06/12/95	-0.063 ± 0.008	2.2 ± 0.2		0.05 ± 0.10	0.06 ± 0.08	
IWMF/INF/100	06/30/95	0.15 ± 0.08	2.4 ± 0.2		0.04 ± 0.10	0.02 ± 0.05	
IWMF/INF/102	08/01/95	0.08 ± 0.06	2.9 ± 0.2		0.11 ± 0.13	-0.05 ± 0.12	41 ± 12
IWMF/INF/104	08/09/95	0.19 ± 0.08	3.0 ± 0.2		0.10 ± 0.15	0.04 ± 0.12	
IWMF/INF/104A	08/09/95	0.063 ± 0.037	2.9 ± 0.2		-0.04 ± 0.08	-0.02 ± 0.07	
IWMF/INF/108	09/20/95	0.26 ± 0.06	1.5 ± 0.1		-0.05 ± 0.08	0.03 ± 0.08	
IWMF/INF/110	09/29/95	0.11 ± 0.04	1.8 ± 0.1		-0.09 ± 0.16	-0.01 ± 0.12	
French drain:							
FD-122894	12/28/94	0.032 ± 0.024	0.17 ± 0.06		0.08 ± 0.08	-0.02 ± 0.09	79 ± 14
FD-042595	04/25/95	0.16 ± 0.07	0.08 ± 0.11		0.05 ± 0.11	0.06 ± 0.09	
FD-050995	05/09/95						61 ± 14
FD-080995	08/09/95	0.40 ± 0.12	0.37 ± 0.13		-0.01 ± 0.12	-0.07 ± 0.12	54 ± 8

[a] All data are in Becquerel per liter, mean ± 1 standard error (counting error only); blank spaces indicate not reported by Analytical Services Organization.
[b] IWMF = Interim Waste Management Facility; STM = stormwater; INF = infiltration; FD = French drain.
[c] Gross beta analysis does not include tritium.

Table A.2. Soil radionuclide data from the LWSP and IWMF areas.[a]

Sample No.	Date	Gross a	Gross β	^{60}Co	^{137}Cs	^{40}K
IWMF-1	09/29/94	68 ± 42	210 ± 70	1.0 ± 2.4	-1.0 ± 3.2	620 ± 40
I WMF-2	09/29/94	210 ± 60	320 ± 70	3.7 ± 2.2	3.5 ± 1.6	810 ± 45
IWMF-3	09/29/94	160 ± 55	230 ± 70	0.3 ± 2.8	-0.1 ± 3.6	870 ± 50
IWMF-4	09/29/94	160 ± 55	230 ± 70	1.4 ± 3.0	-0.9 ± 3.2	970 ± 45
IWMF-5	09/29/94	120 ± 50	290 ± 65	0.6 ± 2.4	3.5 ± 2.3	820 ± 45
LWSPII-1	09/29/94	160 ± 45	340 ± 65	-0.9 ± 2.4	4.0 ± 1.7	980 ± 40
LWSPII-2	09/29/94	93 ± 39	200 ± 65	1.5 ± 2.1	5.2 ± 1.4	630 ± 35
LWSPII-3	09/29/94	180 ± 50	170 ± 65	3.1 ± 2.7	3.6 ± 1.5	580 ± 35
LWSPII-4	09/29/94	350 ± 90	450 ± 75	-2.3 ± 3.0	3.5 ± 1.4	910 ± 40
LWSPII-5	09/29/94	130 ± 65	490 ± 80	0.7 ± 2.6	660 ± 10	870 ± 45

[a] All data are in Becquerel per kilogram, mean ± standard error (counting error only). IWMF = Interim Waste Management Facility; LWSP = Liquid Waste Solidification Project; EASC = Emergency Avoidance Solidification Campaign.

Table A.3. Runoff samples from the Hillcut Disposal Test Facility.[a]

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{141}Ce
HDTF Pad:						
1/16/87	1.2 ± 1.8	3.2 ± 2.7		< 0.20	< 0.20	
3/3/87	1.0 ± 1.8	3.3 ± 2.7		< 0.10	< 0.10	
6/26/87	3.4 i2.6	3.2 ± 2.7		< 0.10	< 0.10	0.27 k0.22
3/21/88	0.26 ± 0.34	3.8 ± 0.7		< 0.10	< 0.10	
1/4/89				< 0.40	< 0.30	
1 II 8/89	0.31 ± 0.15	1.8 ± 0.3		< 0.40	< 0.30	
2/21/89	0.50 f0.04	2 ± 0.2		< 0.40	< 0.30	
4/10/89	0.03 ± 0.04	1.4 ± 0.2		< 0.40	< 0.40	
6/26/89	0.15 ± 0.09	2.1 ± 0.3		0.27 ± 0.26	-0.01 ± 0.26	
10/18/89	-0.21 ± 0.80	2.5 ± 2.7		-0.05 ± 0.19	0.08 ± 0.19	
1/3/90	0.05 ± 0.08	3.1 ± 0.3		-0.25 ± 0.63	0.14 ± 0.41	
1/30/90	0.01 ± 0.07	0.9 ± 0.4		0.03 ± 0.43	-0.05 ± 0.53	
2/8/90	0.11 ± 0.35	1.5 ± 1.5		-0.02 ± 0.19	-0.04 ± 0.19	
2/23/90	0.12 ± 0.38	0.9 ± 1.4		-0.11 ± 0.21	0.06 ± 0.15	
3/21/90	0.18 ± 0.15	1 ± 0.3		0.06 ± 0.12	0.03 ± 0.13	
8/23/90	0.01 ± 0.05	1.2 ± 0.2		-0.08 ± 0.22	-0.03 ± 0.20	
12/28/90	0.20 ± 0.24	1.3 ± 0.5		0.02 ± 0.31	0.07 ± 0.29	
1/22/91	0.007 ± 0.058	0.26 ± 0.23			0.03 ± 0.36	
2/20/91	0.49 ± 0.57	1.2 ± 1.4		0.15 ± 0.57	0.10 ± 0.66	
3/6/91	0.07 ± 0.11	0.66 kO.26		-0.09 ± 0.26	0.22 ± 0.26	
4/2/91	0.029 ± 0.076	0.84 ± 0.3		0.18 ± 0.36	0.11 f0.38	
7/18/91	0.28 f0.13	1.8 ± 0.3		1.4 ± 1.4	0.2 ● 2.1	
3/00/92[d]			all radionuclide data below action levels[e]			
12/8/92	0.09 ± 0.11	1.5 ± 0.04		0.12 ± 0.15	-0.01 ± 0.18	
12/29/92	0.10 ± 0.08	1.4 ± 0.2		-0.06 ± 0.13	0.091 ± 0.09	
2/2/93	0.049 ± 0.070	5.2 ± 0.4		1.1 ± 0.2	1.5 ± 0.2	
3/31/93	0.075 ± 0.076	0.98 ± 0.20		-0.09 ± 0.24	0.10 kO.16	
4/27/93	0.10 ± 0.09	0.83 ± 0.20		0.21 ± 0.19	-0.02 ± 0.21	
12/07/93	0.015 ± 0.024	0.88 ± 0.10		-0.04 ± 0.12	0.03 ± 0.20	
2/23/94	0.021 ± 0.021	0.70 ± 0.08	18 ± 2	-0.06 ± 0.14	-0.02 io.12	
4/11/94	0.082 ± 0.036	0.15 ± 0.06		-0.03 ± 0.12	-0.03 ± 0.10	

Table A.3 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{3}H
4/22/94	0.003 ± 0.022	0.49 ± 0.08		0.32 ± 0.10	0.48 ± 0.09	
11/1/94	0.01 ± 0.02	1.9 ± 0.2		0.01 ± 0.14	-0.07 ± 0.15	
11/28/94	0.19 ± 0.08	1.2 ± 0.2		0.10 ± 0.11	0.13 ± 0.2	210 ±15
3/22/95[f]	0.08 ± 0.04	5.2 ± 0.2		0.11 ± 0.06	5.[illegible] ± 0.1	240 ±20
3/22/95[g]	-0.016 ± 0.038	0.65 ± 0.09		-0.10 ± 0.14	0.01 ± 0.10	200 ±15
7/17/95	0.066 ± 0.034	0.84 ± 0.10		0.06 ± 0.12	0.01 it.14	
HDTF Underpad:						
1/18/89	0.20 ± 0.11	0.39 ± 0.12		< 0.30	< 0.30	
2/23/89	0.12 ± 0.06	0.59 ± 0.09		< 0.30	< 0.30	
6/26/89	0.15 ± 0.09	0.28 ± 0.14		-0.35 ± 0.66	0.14 ± 0.51	
10/18/89	0.22 ± 0.07	0.40 ± 0.22		0.03 ± 0.19	0.15 ± 0.16	
2/20/91	4.0 ± 1.4	4.8 ± 1.6		-0.29 ± 0.86	-0.22 ± 0.19	
2/21/91[h]	0.47 ± 0.12	1.5 ± 0.2		0.11 ± 0.22	0.23 ± 0.19	
4/7/93	3.6 ± 0.7	3.1 ± 0.5		0.09 ± 0.16	0.26 ± 0.12	
4/7/93[i]	0.14 ± 0.12					
12/7/93	0.010 ± 0.042	1.0 ± 0.1		0.01 ± 0.06	0.01 ± 0.05	
2/23/94	0.067 ± 0.034	0.26 ± 0.07	5.0 ± 1.2	-0.02 ± 0.20	-0.21 ± 0.17	
4/11/94	0.026 ± 0.025	0.19 ± 0.06		0.027 ± 0.048	0.03 ± 0.06	

[a] All data are in Bq/L, mean ± 1 standard error (counting error only); blank spaces indicate not reported by Analytical Services Organization.
[b] HDTF = Hillcut Disposal Test Facility.
[c] Gross beta analysis does not include tritium.
[d] Sample collected sometime in March 1992; no date specified in previous report.
[e] See page 10, ASEMP FY 1992 Annual Report, ORNL/M-3183; no specific data given in report.
[f] Sample collected from HDTF storage tank no. 1.
[g] Sample collected from HDTF storage tank no. 2.
[h] Analyses also performed for uranium isotopes and total radium with the following results:

^{234}U	0.051 ± 0.026
^{235}U	0.008 ± 0.013
^{238}U	0.002 ± 0.007
Ra (total)	0.90 ± 0.23

[i] Analysis of archived duplicate sample.

Table A.4. Chemical data from HDTF pad runoff water.[a]

Sample No.	Date	Alk.[b]	Cond.[c]	pH	Ag	As	Ba	Ca	Cd	Cr	Cu	Hg	K	Li	Mg	Mn	Na	Pb	Sb	Si	Sn	Sr	Se	V	Zn	Br	Cl	F	NO_3	PO_4	SO_4
HDTF	11/01/94				<0.005		0.041	100	<0.005	<0.004	0.062		19	0.041	29		7.1	<0.05	0.064	8.0	0.061	0.38	<0.05	0.027		<0.1	3.0	0.57	17	<0.5	45
HDTF	11/28/94	350	798	6.95	<0.005	0.10	0.039		<0.005	<0.004		0.00008	21					<0.05					<0.05			<0.1	3.1	0.58	16	<0.5	44
HDTF-Tank 1	3/22/95				<0.005	0.062	0.12	110				<0.00005		0.048	25	0.015	7.7	<0.05	0.065	8.5		0.35		0.002	0.006						
HDTF- Tank 2.	3/22/95				<0.005	0.054	0.13	14				<0.00005		0.048	23	0.012	6.5	<0.05	0.059	7.7		0.32			0.010						
HDTF	7/17/95				0.0054		0.048	17			0.014		25	0.050	28	0.017	7.5			11		0.20		0.004	0.009						

[a] HDTF = Hillcut Disposal Test Facility. Cation and anion data are in milligram per liter. Blank spaces indicate analysis not performed.
[b] Alk. = alkalinity (as milligram $CaCO_3$ per liter).
[c] Cond. = conductivity (microsiemen per centimeter).

Table AS. Volatile organic compounds detected in HDTF pad runoff.

Volatile Organic Compound	Concentration (µg/L)	
	tank 1	tank 2
acetone	7 (est.)	2 (est.)
carbon disulfide	5 (est.)	<5
2-butanone	3 (est.; p.i.b.)	2 (est.; p.i.b.)
toluene	<5	2 (est.)

[a] Est. = Analytical Services Organization estimated these concentrations because a peak was detected but was not quantifiable; p.i.b. = present in blank; < = less than the detection limit.

Table A.6. Analytical data from the LWSP II cask sampling.”

Cask	mL	Cl	NO_3	SO_4	Al	As	B	Ba	Ca	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Si	Sn	Sr	Ti	V	Zn
8187	50				5.1	0.11	1.9	0.44	550	0.084	1.2	0.15	1.1	1.5	120	26	0.96	110	1.8	0.25	35	<0.10	1.2	0.061	0.013	2.2
8165 (12/94)	1500	17	470	110	0.58	0.11	0.44	0.14	180	0.05	0.24	0.042	0.75	0.18	16	8.4	0.033	44	0.13	0.16	14	0.17	0.41	<0.04	0.014	0.54
8185 (3/95)	200	4.6	930	22	0.81	<0.11	0.31	0.076	71	<0.01	0.31	0.047	5.8	1.1	5.4	3.8	0.17	20	0.40	0.94	5.2	<0.10	0.14	<0.04	0.008	0.66
8218	125				0.42	<0.11	0.28	0.053	130	<0.01	0.12	0.045	<0.014	<0.11	20	5.9	<0.002	28	<0.02	<0.10	13	<0.10	0.30	<0.04	0.019	0.056
7064	7500	14	840	76	0.48	<0.11	0.29	0.051	130	<0.01	0.11	0.031	0.12	0.11	19	6.2	<0.002	29	<0.02	<0.10	13	<0.10	0.30	<0.04	0.024	0.068

[a] Blank spaces indicate data not reported by Analytical Services Organization because of insufficient sample size; all data in mg/L; LWSP = low-level liquid waste solidification project.

Table A.7. Radionuclide data from the LWSP II cask sampling.”

Cask	Gross a	Gross β[b]	^{40}K	^{137}Cs	^{60}Co	^{3}H
8187		5.3 ± 0.08				
8165 (12/94)	-0.015 ± 0.02	0.77 ± 0.1		0.77 ± 0.07	-0.1 ± 0.1	620 ± 20
8165 (3/95)	0.22 ± 0.22	2.8 ± 0.6	88 ± 17	1.8 ± 1.0	1.6 ± 0.8	
8218	0.039 ± 0.04	1.8 ± 0.2		1.5 ± 0.1	0.03 ± 0.13	
7064	0.06 ± 0.04	2.6 ± 0.2		1.8 ± 0.1	0.2 ± 0.09	2200 ± 100
8217		1.4 ± 1.2				

[a] Blank spaces indicate analysis not performed due to insufficient sample size; all data in Bq/L, mean ± 1 SE (counting error only); LWSP = low-level liquid waste solidification project.
[b] Gross beta analysis does not include tritium.

Table A.8. Radionuclide data for water from SWSA 5 N building sumps.

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
			7826-I			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
03/07/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
08/20/90*	<10	<20				
09/10/90*	<10	<20				
10/10/90*	<10	<20				
11/09/90*	<10	<20				
12/06/90*	<10	<20				
12/20/90*	<10	<20				
12/27/90*	<10	<20				
01/03/91*	<10	<20				
01/17/91*	<10	<20				
02/21/91*	<10	<20				
03/13/91*	<10	<20				
03/21/91*	<10	<20				
04/04/91*	<10	<20				
05/02/91*	<10	<20				
05/23/91*	<10	<20				
05/29/91*	<10	<20				
06/06/91*	<10	<20				
06/20/91*	<10	<20				
06/27/91*	<10	<20				
07/03/91*	<10	<20				
08/07/91*	<10	<20				
08/22/91*	<10	<20				
09/26/91*	<10	<20				
11/07/91*	<10	<20				
12/03/91*	<10	<20				
12/13/91*	<10	<20				
12/20/91*	<10	<20				
01/10/92*	<10	<20				
02/27/92*	<10	<20				
03/12/92*	<10	<20				
04/02/92*	<10	<20				

Table A.8 (continued)

Date	Gross α	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
06/11/92*	<10	<20				
07/07/92*	<10	<20				
07/30/92*	<10	<20				
08/13/92*	<10	<20				
09/10/92*	<10	<20				
09/24/92*	<10	<20				
10/14/92*	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
12/30/92*	<10	<20				
01/28/93*	<10	<20				
03/24/93*	<10	<20				
03/31/93*	<10	<20				
05/28/93*	<10	<20				
07/07/93*	<1 000	<1 000				
08/11/93*	<10	<20				
08/19/93*	<10	<20				
08/25/93*	<10	<20				
09/22/93*	<10	<20				
11/09/93	0.041 ± 0.036	0.27 ± 0.07	0.3 ± 0.9	0.01 ± 0.05	0.01 ± 0.06	
11/19/93	0.11 ± 0.05	0.35 ± 0.07	1.9 ± 1.2	-0.02 ± 0.06	0.05 ± 0.06	
12/02/93*	<10	<20				
12/27/93*	<10	<20				
01/24/94	0.042 ± 0.035	0.55 ± 0.08	2.9 ± 2.6	0.01 ± 0.17	0.32 ± 0.11	
02/23/94	0.003 ± 0.19	0.66 ± 0.09	1.3 ± 1.2	0.22 ± 0.12	0.04 ± 0.13	
04/11/94	-0.016 ± 0.024	0.43 ± 0.08		-0.01 ± 0.12	0.07 ± 0.09	
06/27/94	0.003 ± 0.024	0.56 ± 0.08		-0.01 ± 0.1	-0.02 ± 0.08	
08/29/94	0.079 ± 0.046	0.52 ± 0.08		-0.04 ± 0.07	0.05 ± 0.06	
09/29/94	0.24 ± 0.12	0.58 ± 0.20		-0.04 ± 0.13	-0.05 ●	,O:A2,
10/14/94	0.091 ± 0.047	0.33 ± 0.07		0.01● 0.10	0.02±0.08	
01/25/95	0.18 ± 0.26	0.70 ± 0.80		-0.06 ± 0.13	0.01 ± 0.10	
02/17/95	0.006 ± 0.041	0.32 ± 0.14		-0.06 ± 0.09	0.08 ± 0.08	
03/16/95	0.01 ± 0.22	-0.30 ± 0.60		0.11 ± 0.14	0.15 ± 0.12	
04/25/95	0.15 ± 0.06	0.38 ± 0.13		0.05 ± 0.08	-0.01 ± 0.08	
08/09/95	-0.03 ± 0.06	0.36 ± 0.12		-0.01 ± 0.07	0.03 ± 0.06	
09/20/95	0.23 ± 0.06	1.1 ± 0.1		-0.13 ± 0.14	-0.08 ± 0.12	

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04/07/89*	<10	<20				
09/26/89*	<10	<20				
12/06/90*	<10	<20				
12/20/90*	<10	<20				
01/17/91*	<10	<20				
02/21/91*	<10	<20				

Table A.8 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
03/13/91*	<10	<20				
06/27/91*	<10	<20				
07/03/91*	<10	<20				
09/26/91*	<10	<20				
12/03/91*	<10	<20				
02/27/92*	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
08/19/93*	<10	<20				
12/02/93*	<10	<20				
12/27/93*	<10	<20				
02/23/94	0.017 ± 0.024	0.12 ± 0.06	0.9 ± 1.5	0.14 ± 0.10	0.03 ± 0.13	
04/11/94	0.031 ± 0.028	0.13 ± 0.06		0.02 ± 0.06	0.03 ± 0.05	
06/27/94	0.061 ± 0.036	0.26 ± 0.06		0.18 ± 0.11	-0.01 ± 0.12	
			7834-I			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
02/21/90*	<10	<20				
03/07/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
08/20/90*	<10	<20				
09/10/90*	<10	<20				
12/06/90*	<10	<20				
12/27/90*	<10	<20				
01/03/91*	<10	<20				
02/21/91*	<10	<20				
04/04/91*	<10	<20				
06/20/91*	<10	<20				
07/03/91*	<10	<20				
12/03/91*	<10	<20				
12/20/91*	<10	<20				
01/10/92*	<10	110				
01/13/92*	<10	<20				
02/27/92*	<10	<20				
04/16/92*	<10	<20				
07/30/92*	<10	<20				

Table A.8 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
09/24/92	<10	<20				
11/05/92*	<10	<20				
11/30/92*	<10	<20				
12/30/92*	<10	<20				
01/28/93*	<10	<20				
02/24/93*	<10	<20				
03/24/93*	<10	<20				
05/28/93*	<10	<20				
07/07/93*	<1 000	<1000				
08/11/93*	<10	<20				
11/19/93	0.22 ± 0.06	0.68 ± 0.08	17 ± 2	-0.04 ± 0.12	0.19 ± 0.08	
12/02/93*	<10	<20				
12/27/93*	<10	<20				
01/24/94	0.17 ± 0.06	Q.45 ± 0.08,	8.3 ± 1.8	0.02 ± 0.14	j.6 ± 0.1	
02/23/94	0.093 ± 0.039	0.29 ± 0.08,	-2.4 ± 1.8	-0.03 ± 0.07	0.02 ± 0.06	
04/11/94	0.094 ± 0.040	0.16 ± 0.06		0.18 ± 0.07	-0.06 ± 0.11	
06/27/94	0.11 ± 0.04	0.27 ± 0.07		0.08 ± 0.08	-0.01 ± 0.09	
08/29/94	6.04 ± 0.03	0.36 ± 0.07		-0.02 ± 0.11	0.06 ± 0.09	
09/29/94	0.07 ± 0.12	0.91 ± 0.26		0.14 ± 0.14	0.20 ± 0.14	
10/14/94	0.029 ± 0.027	0.41 ± 0.08		0.20 ± 0.06	0.02 ± 0.07	
01/25/95	-0.26 ± 0.24	1.4 ± 0.8		-0.04 ± 0.14	0.01 ± 0.10	
02/17/95	-0.003 ± 0.017	0.10 ± 0.07		0.01 ± 0.11	-0.03 ± 0.20	
03/16/95	-0.072 ± 0.024	0.5 ± 0.5		0.05 ± 0.10	-0.04 ± 0.10	
04/25/95	0.091 ± 0.009	0.64 ± 0.24		0.03 ± 0.08	0.02 ± 0.20	
08/09/95	0.16 ± 0.07	0.21 ± 0.13		-0.02 ± 0.12	-0.01 ± 0.11	
09/20/95	0.13 ± 0.04	0.48 ± 0.08		-0.09 ± 0.16	0.11 ± 0.11	
			7834-2			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
10/30/89*	<10	<20				
11/28/89*	<10	<20				
01/30/90*	<10	<20				
02/09/90*	<10	<20				
02/21/90*	<10	<20				
03/12/90*	<10	<20				
04/19/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
09/10/90*	<10	<20				
12/27/90*	<10	<20				
01/03/91*	<10	<20				
02/21/91*	<10	<20				
04/04/91*	<10	<20				

Table A.8 (continued)

Date	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
12/03/91*	<10	<20				
01/13/92*	<10	<20				
09/24/92*	<10	<20				
12/30/92*	<10	<20				
08/11/93*	<10	<20				
12/27/93*	<10	<20				
01/24/94	0.077 ± 0.043	0.32 ± 0.08	1.7 ± 1.7	0.06 ± 0.07	0.53 ± 0.07	
02/23/94	0.050 ± 0.030	0.14 ± 0.06	19 ± 1.5	0.03 ± 0.14	-0.08 ± 0.12	
04/11/94	0.047 ± 0.028	0.13 ± 0.06		0.03 ± 0.07	-0.01 ± 0.09	
06/27/94	0.036 ± 0.033	2.9 ± 0.2		0.11 ± 0.10	0.04 ± 0.10	
01/25/95	-0.15 ± 0.04	0.4 ± 0.7		0.16 ± 0.08	'0.11 ± 0.09	
03/16/95	-0.05 ± 0.29	0.4 ± 0.6		0.07 ± 0.08	0.07 ± 0.10	
08/09/95	0.11 ± 0.08	0.86 ± 0.17		0.20 ± 0.08	0.06 ± 0.20	
09/20/95	0.24 ± 0.06	0.58 ± 0.08		0.01 ± 0.08	0.01 ± 0.08	
			78343			
09/26/89*	<10	<20				
02/09/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
02/23/94	0.33 ± 0.08	4.4 ± 0.2	4.0 ± 1.5	0.02 ± 0.16	0.04 ± 0.14	
04/11/94	0.003 ± 0.020	1.0 ± 0.1		0.09 ± 0.10	-0.05 ± 0.10	
03/16/95	-0.14 ± 0.22	0.6 ± 0.5	8.8 ± 1.1	0.14 ± 0.10	-0.02 ± 0.11	
			7834-4			
09/26/89*	<10	<20				
02/09/90*	<10	<20				
05/21/90*	<10	<20				
06/14/90*	<10	<20				
02/23/94	0.61 ± 0.10	4.1 ± 0.2	3.5 ± 1.3	0.23 ± 0.12	0.06 ± 0.12	
04/11/94	0.044 ± 0.032	0.96 ± 0.10		0.10 ± 0.10	-0.02 ± 0.10	
03/16/95	0.24 ± 0.28	1.2 ± 0.6		0.03 ± 0.15	0.08 ± 0.13	
08/09/95	0.00 ± 0.07	1.9 ± 0.2		0.01 ± 0.15	0.14 ± 0.12	
			7855-l			
04/07/89*	<10	<20				
09/26/89*	<10	<20				
02/21/90*	<10	<20				
12/29/92*	<10	46	72	<10	<10	<10
02/23/94	0.023 ± 0.024	2.2 ± 0.2	2.9 ± 1.2	-0.02 ± 0.14	0.21 ± 0.11	
04/11/94	0.09 ± 0.06	1.4 ± 0.2		0.01 ± 0.06	0.01 ± 0.06	
			7855-2			
04/07/89*	<10	<20				
09/26/89*	<10	<23				
02/09/90*	<10	<20				

Table A.8 (continued)

Date	Gross a	Gross β[c]	^{40}K	^{60}Co	^{137}Cs	^{90}Sr
05/21/90*	<10	<20				
06/14/90*	<10	<20				
07/10/90*	<10	32				
09/10/90*	<10	44				
12/27/90*	<10	<20				
02/21/90*	<10	<20				
05/29/91*	<10	<20				
06/06/91*	<10	41				
06/12/91*	<10	44				
07/11/91*	<10	58				
07/12/91*	<10	53				
08/07/91*	<10	49				
12/03/91*	<10	75				
03/12/92*	<10	<20				
04/16/92*	<10	<20				
[illegible]	<10	<[illegible]				
10/06/92*	<10	90				
07/12/91*	<10					
12/29/92*	<10	48	57	<10	<10	<10
03/16/93*	<10	<20			3.3 ± 1	<20
05/26/93*	<10	<20		<10	<10	<20
06/21/93*	<10	46				46
08/23/93*	<10	80		<10	<10	
11/19/93	0.099 ± 0.045	0.44 ± 0.08	7.4 ± 1.2	0.1 ± 0.13	0.24 ± 0.06	
12/27/93*	<10	<20				
02/23/94	0.03 ± 0.20	11 ± 1	'IO ± 2	0.11 ± 0.14	0.06 ± 0.15	
04/11/94	0.09 ± 0.07	3.7 ± 0.2	4.5 il.2	0.08 ± 0.08	0.10 ± 0.08	
06/27/94[d]						
09/29/94	4.6 ± 3.2	58 ± 6	100 ± 5	0.24 ± 0.18	0.49 ± 0.10	
10/14/94	-0.09 ± 0.50	76 ± 4	91 ± 2	-0.02 ± 0.16	0.64 ± 0.09	
01/25/95	0.4 ± 0.6	65 ± 4	75 ± 3	-0.01 ± 0.14	0.54 ± 0.10	
02/17/95	-0.04 ± 0.20	43 ± ?	69 ± 2	-0.08 ± 0.14	0.31 ± 0.08	
03/16/95	0.47 ± 0.44	61 ± 2	73 ± 2	0.13 ± 0.10	0.37 ± 0.08	
08/09/95	1.0 ± 0.6	51 ± 2	74 ± 2	-0.17 ± 0.18	0.36 ± 0.08	
09/20/95	1.3 ± 0.6	39 ± 2	76 ± 2	0.04 ± 0.14	0.51 ± 0.10	

[a] Radionuclide data are in Becquerel per liter, mean ± 1 standard error (counting error only); blank spaces indicate data not reported by ASO.
[b] Asterisk indicates sample collected by RSWO and analyzed at TRU. All other samples collected by ASEMP and analyzed at the AS0 low-level lab.
[c] Gross beta analysis does not include tritium.
'This sample was not acidified at the-time of collection and was therefore not analyzed by ASO.

Table A.9. Radionuclide data from the 1995 annual sampling of SWSA 5 N groundwater.[a]

Well	Gross a	Gross β[b]	^{137}Cs	^{60}Co	^{3}H
513	0.26 ± 0.09	0.64 ± 0.14	0.04 ± 0.10	0.08 ± 0.10	36 ± 13
514	0.062 ± 0.046	0.16 ± 0.11	0.13 ± 0.08	0.16 ± 0.08	40 ± 12
516	22 ± 0.5	2.2 ± 0.20	0.08 ± 0.08	0.14 ± 0.08	31 ± 13
517	-0.054 ± 0.01	0.08 ± 0.12	0.01 ± 0.08	0.12 ± 0.08	42 ± 12
518	0.14 ± 0.07	0.14 ± 0.10	0.01 ± 0.07	-0.01 ± 0.08	11 ± 12
519	0.26 ± 0.09	0.08 ± 0.10	0.02 ± 0.08	0.01 ± 0.10	15 ± 12
520	0.05 ± 0.10	0.14 ± 0.20	-0.01 ± 0.12	0.11 ± 0.08	38 ± 12
521	0.18 ± 0.12	0.19 ± 0.11	-0.07 ± 0.11	0.18 ± 0.09	14 ± 12
522	0.049 ± 0.048	0.46 ± 0.12	0.03 ± 0.08	-0.01 ± 0.09	2 ± 12
523	0.39 ± 0.14	0.44 ± 0.20	0.04 ± 0.11	0.07 ± 0.12	30 ± 12
524	0.011 ± 0.029	0.23 ± 0.11	0.23 ± 0.11	0.02 ± 0.10	220 ± 15
525	0.005 ± 0.038	0.09 ± 0.12	0.01 ± 0.13	-0.13 ± 0.17	21 ± 12
708	0.16 ± 0.08	0.48 ± 0.14	0.03 ± 0.09	0.02 ± 0.12	81 ± 14
715	0.10 ± 0.06	0.06 a 0.12	0.03 ± 0.09	0.09 ± 0.11	38 ± 13
716	0.14 ± 0.07	0.26 ± 0.13	0.03 ± 0.11	0.01 ± 0.12	18 ± 13

[a] All data are in Becquerelperliter, mean ± 1 standard error(counting error only).
[c] Gross beta analysis does not include tritium.

Table A.10. Radionuclide data from annual sampling of SWSA 5 N seeps.[a]

Seep	Gross a	^{241}Am	^{244}Cm	Gross β[b]	^{137}Cs	^{60}Co
160	-0.074 ± 0.011	0.0089 ± 0.0037	-0.0052 ± 0.0018	0.27 ± 0.11	0.3 ± 1.4	-0.8 ± 1.5
175	0.018 ± 0.036	0.015 ± 0.006	-0.0080 ± 0.0026	0.36 ± 0.13	-0.7 ± 1.3	-0.2 ± 1.7
210	0.73 ± 0.10	0.0092 ± 0.0046	0.66 ± 0.02	0.10 ± 0.06	0.02 ± 0.08	0.07 ± 0.07
258	0.13 ± 0.04	0.010 ± 0.004	0.12 ± 0.01	0.14 ± 0.06	-0.01 ± 0.07	0.01 ± 0.08

[a] All data are in Becquerel per liter, mean ± 1 standard error(counting error only).
'Gross beta analysis does notincludetriium.

Table A.ll. Analytical data from the 1995 SWSA 5 N groundwater sampling."

Well	Br	Cl	F	NO,	SO,	Al	B	Ba	Ca	Co	Cu	Fe	K	Li	Mg	Mn	Na	Ni	Si	Sn	Sr	V	Zn
513	<0.1	4.3	0.3	2.4	15	<0.05	<0.08	0.21	72	<0.004	<0.007	<0.05		0.015	7.4	0.017	5.9	<0.01	9.1	0.05	0.12	<0.002	0.0091
514	<0.1	4.2	<0.1	3.1	14	<0.05	<0.08	0.17	90	<0.004	<0.007	0.16		0.013	9.4	0.031	7.6	0.16	9.4	<0.05	0.13	0.0022	0.012
516	250	4.4	<0.1	4.7	18	<0.05	<0.08	0.46	170	<0.004	<0.007	<0.05		0.018	200	<0.001	15	<0.01	7.5	<0.05	0.23	<0.002	0.015
517	<0.1	8.2	<0.1	0.8	320	<0.05	<0.08	0.021	130	<0.004	<0.007	0.14		0.029	58	0.47	22	<0.01	7.3	<0.05	0.20	<0.002	0.012
518	<0.1	4	<0.1	2.9	170	0.055	<0.08	0.038	97	<0.004	<0.007	0.14		0.012	34	0.13	22	co.01	5.7	<0.05	0.14	<0.002	0.030
519	0.24	4.5	<0.1	1.2	26	<0.05	<0.08	0.086	130	<0.004	<0.007	<0.05		0.017	31	0.025	11	<0.01	6.8	<0.05	0.26	co.002	0.094
520	<0.1	5.9	<0.1	1.5	61	<0.05	<0.08	0.25	100	<0.004	<0.007	0.78		0.017	10	0.68	8.5	<0.01	11	co.05	0.17	<0.002	G0.005
521	0.38	30	<0.1	1.3	1300	<0.05	<0.08	0.017	300	<0.004	<0.007	3.9		0.14	140	4.3	46	<0.01	16	co.05	0.41	<0.002	0.010
522	<0.1	1.3	<0.1	2.3	180	0.91	<0.08	0.087	83	40.004	<0.007	0.11	2.8	0.053	2.4	0.023	13	<0.01	7.5	<0.05	0.60	0.0041	0.048
523	<0.1	2.4	<0.1	1.5	28	0.17	<0.08	0.11	98	co.004	<0.007	0.44		<0.005	13	0.53	4.5	co.01	5.4	<0.05	0.19	co.002	0.014
524	0.7	12	2.0	1.9	51	0.52	0.16	0.076	60	0.0072	<0.007	1.7		0.028	10	0.5	77	0.25	8	co.05	0.20	co.002	0.008
525	<0.1	46	<0.1	11	19	<0.05	<0.08	0.15	110	0.0041	<0.007	0.78		0.0075	17	0.7	19	<0.01	7.5	<0.05	0.28	X0.002	0.014
708	<0.1	5.3	0.3	2.0	26	<0.05	<0.08	0.074	42	<0.004	0.019	<0.05		<0.005	6.1	0.022	5.1	<0.01	3.1	<0.05	0.084	<0.002	0.055
715	<0.1	5.8	<0.1	2.1	88	0.24	<0.08	0.14	130	<0.004	<0.007	1.1	3.1	0.018	28	0.43	10	<0.01	8.6	<0.05	0.28	G0.002	0.028
716	<0.1	0.9	<0.1	1.7	11	0.15	0.23	0.20	18	<0.004	<0.007	0.78	5.7	0.033	2.2	0.085	70	<0.01	4.6	<0.05	0.36	<0.002	0.028

"All data are in mg/L. Blankspacesindicate data not repotted by Analytical Services Organization.

Table A.12. Radionuclide data from soil samples collected at the NFS storage building.[a]

Sample	Gross a	Gross β	^{40}K	^{60}Co	^{137}Cs
NFS-1	120 ± 45	420 ± 70	800 ± 45	-1 ± 2.8	1.4 ± 2.4
NFS-2	200 ± 50	180 ± 60	920 ± 35	0.3 ± 1.8	0.3 ± 1.6
NFS-3	90 ± 50	240 ± 65	740 ± 30	-0.4 ± 1.8	-0.2 ± 1.4
NFS-4	250 ± 40	280 ± 20	120 ± 50	2.4 ± 1.8	-0.4 ± 1.8
NFS-5	280 ± 40	270 ± 25	990 ± 35	-0.9 ± 2.2	0.2 ± 1.6
NFS-6	230 ± 65	540 ± 80	780 ± 50	-1.3 ± 3.1	16 ± 2

[a] All data in Bq/kg, mean ± 1 SE (counting error only).

APPENDIX B
ASEMP PROCEDURES

Procedure ID: ASEMP-01
Revision No.: 5
Date of Revision: 1 October 1995
Date Implemented: 1 October 1995

PROCEDURE FOR COLLECTING SAMPLES OF INTERIM WASTE MANAGEMENT FACILITY 'PAD AND UNDERPAD RUNOFF

Prepared by: C. M. Morrissey
Environmental Sciences Division
Earth and Engineering Sciences Section
Environmental Engineering Group

1.0 PURPOSE

'This' procedure, based upon Environmental Surveillance Quality 'Control Program (ES/ESH/INT-14) method ESP 301-3, documents methods for collecting samples of water draining the Interim Waste Management Facility (IWMF) disposal pads using ISCO automated samplers. The procedure also documents the manual collection of samples from the IWMF underpad drain. The purpose of the procedure is to-provide consistent samples of water so that results may be compared between pads and over time. The procedure also provides a check on the effectiveness of the IWMF French drain system in preventing the accumulation of water in the tertiary 'containment barrier (i.e., the underpad drainage system). The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of water samples, preparation of samples, and submission of samples for analyses.

3.0 EQUIPMENT

These materials are stored at the IWMF monitoring area storage shed or in the offices of the Project Manager or field support personnel.

1. 'Five I-L glass or plastic collection bottles for gross a, gross β, and y scan samples.
2. Four glass bottles (at least 100 mL) if tritium analysis will be requested.

3. Two large (10 L or larger) plastic carboys.
4. Sampling gloves.
5. Carboy containing distilled water.
6. Acids: 50% HNO,.
7. Adjustable pipette and pipette tips.
8. Labels for sample collection bottles.
9. Site visit checksheet (SVC) and ball point pen. See page 4 of this procedure for the SVC.
10. Safety glasses.
11. One ten-gallon bucket or other similar container.

4.0 PROCEDURES

The IWMF site is visited and inspected weekly. Samples are collected after each rainfall that is sufficient to provide ar least 3 full ISCO sample bottles in each sampler. The stormwater sump is the middle of the three sumps, the infiltration sump is the sump on the east side of the monitoring station, and the underpad sump is the sump on the west end of the station.

1. Complete the IWMF SVC as appropriate.
2. Remove cover from one of the ISCO samplers and record on the SVC the ISCO LCD display readings for current sample bottle number and pulses to next sample. Stop programming sequence as per ISCO operating manual.
3. If at least three sample bottles have been collected, remove (after donning gloves) all bottles containing any sample from the ISCO. Combine contents of ISCO sample bottles into the appropriate large plastic carboy. The carboys are marked "stormwater sump" or "infiltration sump". Shake or swirl carboys to mix.
4. Label collection bottles as follows:
   a. Sample ID - for example, samples from the stormwater sump (i.e., the active pad) - IWMF/STM/012 (sample), IWMF/STM/012A (archive), IWMF/STM/013 (blank); for samples from the infiltration sump (inactive pads) - IWMF/INF/002, etc. Note that even numbers are for samples and odd numbers are for blanks. One sample of distilled water will serve as a blank for both sets of sump samples. If samples for tritium analysis are to be collected, label tritium sample bottles in the same manner as above.
   b. Initials of collector.
   c. Date and time of collection.
   d. Analyses requested.
   e. Preservative added.
5. Collect two, I-L samples from each carboy for gross a, gross β, y scan analyses. One sample will be transported to the Analytical Services Organization (ASO) and one will be stored in the IWMF shed as an archive until data are received. Collect samples for tritium analysis, if required, and be sure analysis requested is tritium (approximately once each month collect two samples from each sump for ^3H analysis and an archive).
6. Drain 1 L of distilled water (from the carboy containing distilled water) into a I-L collection bottle for a gross a, gross β, and y scan blank. Collect an appropriate amount of distilled water for a tritium blank if tritium analysis is being requested.

7. Acidify samples as follows: 1 mL of 50% HNO_3 into gross a, gross β, and y scan sample, archive and blank. Tiitium sample is not acidified.
8. Rinse ISCO sample bottles with distilled water and return to the sampler.
9. Resume ISCO program and replace sampler cover.
10. Repeat the above steps for the other ISCO sampler.
11. After heavy rainfall events, open valve U-l that drains the underpads. If more than just a trickle of water drains from this valve, place the IO-gallon container in the underpad sump under the drain line and collect whatever water drains. If sufficient water drains from the underpad line to fill the bucket, collect a sample for gross α, gross β, and y analyses as above. Also collect a sample for tritium and an archive if enough water is available.
12. Complete an Analytical Services Request (ASR) form and take samples to the sample receiving room in Building 4500S. On the ASR form, note that these samples are for the ASEMP and that the samples for radionuclide analyses are to be counted for sufficient time to provide counting errors of <0.5 Bq/L for all radionuclide analyses except tritium. Note that ^{40}K data is desired if the activity is calculated from an actual. ^{40}K peak. The acidified archived samples are stored in the IWMF monitoring shed and retained until the analytical data have been received.
13. Notify the Radioactive Solid Waste Operations Group if any changes are made to the valving configuration at the facility.
14. When data are received from ASO, the archived samples are transferred to a carboy designated for holding “analyzed samples”. When this carboy is full, the pH is checked with pH paper. If the pH is ≥2 and ≤10, the contents of the carboy are poured into the infiltration sump. If the pH is outside this range, liquid waste disposal personnel are contacted for pickup and transport to the Process Waste Treatment Plant..

5. APPROVALS

ASEMP project manager: _____
ORNL, Environmental Sciences Division

ASEMP Program Manager: _____
ORNL, Waste Management and Remedial Action Division

IWMF SITE VISIT CHECKSHEET

Initials: _____ Date: _____ Time: _____
weather conditions: _____
Have you been trained in the current revision of this sampling procedure? Y N
CO, tank: pressure in tank psi change tank? Y N
sump transducer: logger reading (channel 4) in. calibrate? Y N
pH probes:
outfall pH (chan. 8)____ stormwater sump pH (chan. 9)____ infiltration sump pH (chan. 10)____
calibrate pH probes? Y N
remove DSM for downloading? Y N
Stormwater sump ISCO sampler: Stormwater sump sample number:
sample bottle number pulses to next sample ____
program halted? Y N remove samples? Y N
number of bottles. removed restart program? Y N
bottle number/pulses
number of composite samples prepared for analysis
types of analyses for which samples collected:
gross a, gross β, and y scan? Y N archive? Y N tritium? Y N
other _____
Infiltration sump ISCO sampler: Infiltration sump sample number:
sample bottle number pulses to next sample
program halted? Y N remove samples? Y N
number of bottles removed restart program? Y N
bottle number/pulses
number of composite samples prepared for analysis
types of analyses for which samples collected:
gross a, gross β, and y scan? Y N archive? Y N tiium? Y N
other _____
Underpad sump: Underpad valve opened? Y N
estimated volume of water drained _____
sample collected? Y N sample ID: _____
types of analyses for which samples collected:
gross a, gross β, and y scan? Y N archive? Y N tritium? Y N
other _____
French drain:
sample collected? Y N sample ID: _____
types of analyses for which samples collected:
gross a, gross β, and y scan? Y N archive? Y N tritium? Y N
other _____

problems and comments: _____

actions taken to resolve problems: _____

Procedure ID: ASEMP-02
Revision No.: 4
Date of Revision: 30 September 1995
Date Implemented: 1 October 1995

PROCEDURE FOR OPERATION OF INTERIM WASTE MANAGEMENT FACILITY PAD RUNOFF pH CONTROL SYSTEM

Prepared by: C. M. Morrissey
Environmental Sciences Division
Earth and Engineering Sciences Section
Environmental Engineering Group

1.0 PURPOSE

This procedure documents the methods for the operation and maintenance of a carbon dioxide based-system designed to control the pH of Interim Waste Management Facility (IWMF) pad runoff waters. The purpose of the procedure is to insure proper operation of the pH control system so that pad runoff water pH remains below the National Pollutant Discharge Elimination System permitted level of 9.0 at the IWMF outfall. The procedure will also serve to train. new project personnel.

2.0 SCOPE

This procedure addresses the operation and maintenance of the pH control system that serves as a "Best Management Practice" to control the pH of the runoff water from the IWMF pads.

3.0 EQUIPMENT

These materials are either in use at the IWMF site, stored in the IWMF monitoring shed, or in the appropriate ASEMP notebook.

1. Campbell Scientific data logger and data storage module (DSM).
2. IWMF Site Visit Checksheet (SVC) and ball point pen. SVC is attached.
3. pH buffers 7.0 and 10.0.
4. Gloves.
5. Desiccant packs.

6. Tissue or soft towel.
7. Yard stick or other measuring device of similar length and construction.

4.0 PROCEDURES

A check of the system is performed when collecting samples of pad runoff or during weekly inspections of the site.

1. Fill out the IWMF Site Visit Checksheet as appropriate.
2. Check pressure in carbon dioxide tank; if less than 50 psi change to a new tank.
3. Open logger box and read and record on the SVC the pHs, sump water level, and other requested information. Enter *6A0 and use the A key to advance to position 4 for the water level, position 8 for the outlet pH, position 9 for the stormwater sump pH, and position 10 for the infiltration sump pH. Enter *5 when finished to return the display to the time of day.
4. On the first workday of each month, remove the DSM and download data. DSM may be taken back to the office computer for downloading. The logger will continue to collect data that will be written to the DSM when it is returned to the logger.
5. During site inspections, measure water level in the stonnwater sump; if measured level is >20% different from the data logger value, recalibrate the pressure transducer as per transducer calibration procedure (procedure ASEMP-12).
6. Approximately once a month, carefully remove sump and outfall pH probes and check for algal growth and other accumulations on the probes. Clean gently with a soft cloth or tissue if necessary. Also, verify the accuracy of the pH probes as follows:
   a. Immerse probe in pH 7.0 buffer and record logger reading.
   b. Immerse probe in pH 10.0 buffer and record reading.
   c. If either reading is >10% above or below expected value then inform ESD I&C personnel. They will electronically calibrate the probe(s).
7. Check desiccant packs in the data logger box; if the packs appear to have turned mostly pink then replace with fresh desiccant packs (available from I&C office in Building 1505).
8. Notify Solid Waste Operations personnel of any changes made to the valving configuration at the facility.

6. APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

ASEMP program manager: _____
Waste Management and Remedial Action Division

IWMF SITE VISIT CHECKSHEET

Initials: _____ Date: _____ Time: _____

weather conditions: _____

Have you been trained in the current revision of this sampling procedure? Y' N

CO, tank: pressure in tank psi change tank? Y N

sump transducer: logger reading (channel 4) in. calibrate? Y N

pH probes:

outfall pH (chan. 8)____ stormwater sump pH (chan. 9)____ infiltration sump pH (chan. 10)____

calibrate pH probes? Y N

remove DSM for downloading? Y N

Stormwater sump ISCO sampler: Stormwater sump sample number:

sample bottle number pulses to next sample

program halted? Y N remove samples? Y N

number of bottles removed _____ restart program? Y N

bottle number/pulses

number of composite samples prepared for analysis

types of analyses for which samples collected:

gross a, gross β, and γ scan? Y N archive? Y N tritium? Y N

other _____

Infiltration sump ISCO sampler: Infiltration sump sample number: _____

sample bottle number pulses to next sample _____

program halted? Y N remove samples? Y N

number of bottles removed _____ restart program? Y N

bottle number/pulses

number of composite samples prepared for analysis

types of analyses for which samples collected:

gross a, gross β, and y scan? Y N archive? Y N tritium? Y N

other _____

Underpad sump: Underpad valve opened? Y N

estimated volume of water drained _____

sample collected? Y N sample ID: _____

types of analyses for which samples collected:

gross a, gross β, and y scan? Y N archive? Y N triium? Y N

other _____

French drain:

sample collected? Y N sample ID: _____

types of analyses for which samples collected:*

gross a, gross β, and y scan? Y N archive? Y N tritium? Y N

other _____

problems and comments: _____

_____

_____

_____

actions taken to resolve problems: _____

_____

_____

_____

_____

Procedure ID: ASEMP-03
Revision No.: 1
Date of Revision: 21 April 1993
Date Implemented: 21 April 1993

PROCEDURE FOR COLLECTING SAMPLES FROM THE IWMF FRENCH DRAIN OUTFALL

Prepared by: C.M. Morrissey
Geosciences Section

1.0 PURPOSE

This procedure documents the methods for collecting samples of water discharging from the IWMF French drain. The purpose of the procedure is to collect representative samples of groundwater upgradient of the IWMF disposal pads. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

These materials are stored in the Tumulus monitoring shed or in the adjacent storage shed.

1. Three I-L glass or plastic bottles for gross a, gross β, and gamma scan.
2. Two glass or plastic bottles at least 100 mL for tritium.
3. One I-L wide mouth glass jar for pH and specific conductance measurements
4. A pH probe and meter and a specific conductance probe and meter.
5. Gloves.
6. Stainless steel wide-mouth sampler and funnel.
7. Deionized water.
8. Acids: 50% HNO,.
9. Pipette and pipette tips for dispensing 0.5 mL.
10. Labels for sample bottles.
11. Site visit checksheet and ball point pen.
12. Safety glasses.

"4.0 PROCEDURES

Samples are collected periodically (at least once a quarter).

1. Label sample bottles as follows:
   a. Sample ID: FD-012 (sample), FD-012A (archive), FD-013 (blank). Note that even numbers are for sample and odd numbers are for blank.
   b. Name of collector.
   c. Date and time of collection. ____ ___
   d. Analysis requested.
2. Using the stainless steel sampler and funnel, collect enough water from the sampling vault to rinse the sampler and funnel.
3. Collect more water with the-sampler and add to appropriate bottles. Samples collected are as follows:
   a. 1 L for gross alpha, gross beta, and gamma scan'to be submitted to Analytical Chemistry Division (ACD);
   b. 1 L for the same parameters stored to be stored as an archive;
   c. 100 mL for tritium analysis by ACD;
   d. 100 mL for a tritium archive;
   e. 1 L for pH and specific conductance measurements.
4. Collect a blank sample for gross radionuclide parameters by first rinsing the stainless steel sampler with deionized water located. in the monitoring shed and then refilling with deionized water. Collect 1 L for analysis by ACD for gross radionuclide parameters.
5. Place 'calibrated pH probe in water collected in the I-L wide mouth jar. Allow reading to stabilize and record on site visit checksheet.
6. Place specific conductance probe in the same water used for pH measurement. Allow reading to stabilize and record on site visit checksheet.
7. Acidify only the samples submitted for gross radiochemical analysis as follows: 1 mL of 50% HNO, to each 1 L sample and archive.
8. Complete Analytical Services Request (ASR) form and take samples to sample receiving room in Building 4500S. On the ASR form, note that these samples are for the ASEMP and that the samples are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all analyses except ttitium. The acidified archive samples are stored in the Tumulus monitoring shed and retained until the analytical data have been received. The unacidified tritium archive is stored in the refrigerator located in the monitoring shed until the analytical data have been received.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			
5.			

6. APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

ASEMP program manager: _____
Waste Management and Remedial Action' Division

Procedure ID: ASEMP-04
Revision No.: 1
Date of Revision: 15 July 1993
Date Implemented: 15 July 1993

PROCEDURE FOR COLLECTING SOIL SAMPLES FROM THE EASC/LWSP and LWSP II CASK STORAGE AREAS

Prepared by: C. M. Morrissey
Environmental Sciences Division
Earth and Engineering Sciences Section
Environmental Engineering Group

1.0 PURPOSE

This procedure documents the, methods for collecting samples of soil from the sediments in the. overland flow channels around the EASC/LWSP cask storage areas. The purpose of the procedure is to collect representative samples of soil from areas surrounding the cask storage areas in order to detect radioactive contamination that might result from leaking casks or other waste storage activities. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of soil samples, preparation of the samples, and submission of the samples for analysis.

3.0 EQUIPMENT

These materials are stored in the Tumulus monitoring shed or the adjacent storage shed.

1. Wide-mouth glass jars of 250 mL capacity.
2. Ball-point pen and sample labels.
3. A carboy, equipped with drain valve, of deionized water for equipment cleaning.
4. Stainless steel scoop.
5. Gloves.
6. Safety glasses.
7. Drying oven.

8. Number 5 sieve.
9. Mortar and pestle.
10. Analytical request forms.

4.0 PROCEDURES

These samples are collected and prepared quarterly by ASEMP personnel and submitted to ORNL's Analytical Chemistry Division for radiochemical analysis. Samples are to be taken from each soil monitoring location. In addition, two duplicate samples shall be taken from one soil monitoring location.

Sample collection:

1. Label each glass jar with an appropriate sample ID number, date and time of collection, name of collector, and analyses requested. All labels shall include Sample ID number, date and time of collection, name of collector and analysis parameters requested. Sample ID's are as "EASC/LWSP-*site-moyr-Lid*", where *site* is either the storage site near the hydrofracture facility (HYDRO) or the site in SWSA 6 (SWSA6); mo is the numeric month; yris the last two digits of the year; *id* is the sampling location number (e.g. "L2" for location #2 within the particular site). A duplicate sample is indicated by with a "D" at the end of the sample number.

2. Using 'a clean stainless steel scoop, collect a sample of soil/sediment from an approximately six inch square area to a depth of about ½ inch at each of the sampling locations. Collect approximately 400 grams.

3. Place each sample in an the appropriate sample jar.

4. Clean the stainless steel scoop with deionized water between each sample collection.

5. Contact Health Physics (HP) to have samples checked for radiological contamination and "Green-tagged" if non-contaminated.

Sample preparation:

1. Remove tops from sample jars and dry samples at a temperature of 105° C for a period of 24 hours.

2. Remove samples from oven and pass sediment sample material through a No. 5 Sieve (crush with mortar & pestle if necessary).

3. Decontaminate the mortar and pestle (or other tools and materials that may contact more than one sample) with deionized water before each sample preparation.

4. Return sieved samples to appropriate jars.

5. Submit samples to Analytical Services Organization and request analyses for gross alpha (a), gross beta (β), and gamma (y) activity. Request that ^{40}K be reported only if the data is from a true ^{40}K peak.

I, ... 5 . . . PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			
4.			
5.			

6. APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

ASEMP program manager: _____
Waste Management and Remedial Action Division

Procedure ID: ASEMP-05
Revision No.: 2
Date of Revision: 1 October 1993
Date Implemented: 1 October 1993

SAMPLING AND FIELD SERVICE PROCEDURE FOR THE HILLCUT DISPOSAL TEST FACILITY

Prepared by : S. M. Gregory
Revised **by:** D. S. Hicks
Environmental Engineering Division
Geosciences Section
Surface Water Hydrology Group

1.0 PURPOSE

This procedure documents the routine service procedures for the Hillcut Disposal Test Facility site at SWSA6. It will also serve as a guide for a fill-in site servicer or new project personnel. The procedure is used to minimize risk to the health and safety of project personnel and to guard against release of contaminants to the environment. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure includes those activities that involve routine servicing of the HDTF, winterizing the facility, sampling and emptying the tanks, and recording the data.

3.0 EQUIPMENT

3.1 Weekly Service

1. Water level measuring device for wells.
2. Ball point pen.
3. Data sheet.
4. Approx. 5-gal. bucket.

3.2 Sampling and Transferring Water

1. 2-in. diameter flexible hoses (kept on site).
2. One clean, I-L widemouthed sample bottle per tank being sampled.

3. One Analytical Services Request form.
4. Ball point pen and black permanent marker.
5. Nitric acid.
6. Rubber gloves
7. Approx. 5-gal. bucket.
8. Catch pan.

4.0 PROCEDURES

4.1 Weekly Service

1. Measure the depth to water in the two wells on'top of the hill: 'The wells are identified by well'numbers, 2455 and 2454, marked on the riserwith a black permanent marker.

a. Well 2455 is the on-pad well.

b. Well 2454 is the off-pad well.

c. Remove the well caps and measure the. depth to water in the wells.

d. Record the measurements in, the field logbook. Check the current measurements against the previous weeks' measurements to see if they look reasonable. If they don't, make the measurements again.

e. Replace the well Caps before leaving the well area.

2. Proceed to the tank area.

a. Begin by making a visual inspection of the tank area. Look for any leaks' in-the tanks or piping.

b. Confirm that the white plastic stopcock at the end of the measuring assembly is closed.

c. Confirm that-the cap is installed'on the fitting for the 2-in. transfer hose. This is located between the 2-in. ball valve and the-stand pipe on the measurement assembly.

d. Tank 1 drains the pad. Tank 2, originally meant to catch drainage from the-trench around the pad, is bypassed such that any water draining from the trench goes directly to the storage tank. Tank 1 will almost always have water in it. Water in tank 1 is measured by opening the 2-in. ball valves.. This allows water from the tank to flow into a clear, vertical, plastic standpipe. Here the water level can be viewed beside the scale attached to the stand pipe. Open the ball valve from the tank and allow the water. level to equilibrate.

f. Close, the 2-in. ball valves.

g. Place the bucket, found at the site, under the white plastic stopcock at the end of the tank level measuring apparatus. Open the stopcock to drain the water in the stand pipe into the bucket.

h. Confirm that the drain valve at the bottom of the holding tank is closed. Empty the contents of the bucket into the holding tank. "It is 'especially 'important to drain the stand pipe during cold weather to prevent freeze damage to the piping.

4.2 Winterizing the Site

1. In November, have Plant and Equipment staff deliver bales of straw to the 'site and stack them around the tanks and around. the piping up to the valves and measuring standpipes. This helps to reduce the chance of freeze damage.

4.3 Sampling the Tanks and Transferring the Contents to Holding Tanks

1. When tank 1 reaches approximately two-thirds full, it should be sampled and the contents transferred to a holding tank. The tank fills fastest in the spring, so you may want to sample and transfer before a tank reaches two-thirds full if a lot of rain is forecast.
2. Before transferring the water from tank 1 to the holding tank, a sample must be collected.
3. To sample tank 1, open the 2-in. ball valve.
4. After the water level stabilizes in the stand pipe, record the level in the tank, as described in step 2 of section 4.1.
5. Label the sample bottle with a black permanent marker. The label should have a sample number, and should say “groundwater” and "pH <2". The sample number should look like this: #-YYMMDD-1 for the standard analysis. The # is for the number of the tank that was sampled. The YYMMDD is the year, month, and day the sample was collected. The number "1" at the end indicates that it is the standard analysis: gross alpha, gross beta, and gamma scan. Example: 1-990130-I for tank one, sample date 30 January 1999, standard analysis.
6. Put on a pair of rubber gloves as a precaution. Wear them for the whole sampling and transferring process.
7. Fill the sample bottle with tank water using the plastic stopcock at the end of the tank measuring apparatus.
8. Close the 2-in. ball valve.
9. Place the bucket under the stopcock. Open the stopcock to drain the contents of the measuring assembly into the bucket.
10. Close the stopcock.
11. Place the catch pan under the hose connection located between the 2-in. ‘ball valve and the riser pipe.
12. Remove the cap from the hose connection, making sure that any water remaining in the measuring assembly is caught by the catch pan.
13. The 2-in. transfer hose is left at the site, stretched from tank 1 to the holding tank. Connect the transfer hose to the fitting at tank 1.
14. Confirm that the drain valve at the bottom of the holding tank is closed.
15. Empty the contents of the catch pan and the bucket into the holding tank through the port at the top of the tank.
16. Install the loose end of the transfer **hose** into the holding tank through the port at the top.
17. After confirming that the stop cock was closed in step 10, open the 2-in. ball valve. The water will begin transferring to the holding tank by gravity drain.
18. After the transfer is complete, place the catch pan back under the hose connection at the tank 1 measuring apparatus.
19. Close the 2-in. ball valve.
20. Disconnect the hose connection from the measuring apparatus, making sure that any water left in the apparatus is caught by the catch pan. There shouldn’t be any water left here; this is just a precaution.
21. Replace the cap to the hose connection on the tank measuring apparatus.
22. Raise the end of the hose at the tank 1 end to make sure that all water drains from the hose to the holding tank. This is especially important during freezing weather.
23. Remove the loose end of the hose from the holding tank.
24. If any water remains in the catch pan, pour it into the holding tank.
25. Install the plug in the port at the top of the holding tank.
26. If you brought nitric acid with you, add enough to the sample to bring the pH down to 2.
27. If you need to, take the sample back to the lab to perform this step. Check the sample with pH paper to confirm that the pH is at or below 2.

28. Fill out an Analytical Services Request form for the sample and take it to the sample receiving room in Building 4500S. For the standardanalysis, request a gamma scan, gross alpha, and gross beta analyses. On the request form, fill in the deadline blank to make sure that you get the results back before, the next.. time the measuring tanks need to be transferred. A week from the submit date is typical but may need to be shortened during very rainy periods, and may be lengthened during typically dry summer months.
29. In the event that the results are late in being received and more water needs to be transferred, there is a second holding tank at the site'. Kit-becomes necessary to use this second tank, call Analytical Chemistry Division to expedite the sample analysis, and alert the project manager immediately.

4.4 Emptying the Holding Tanks

1. Results from the sample analysis should be given to the project manager, who will contact the SWSA 5 foreman. The SWSA 5 foreman will assure. that the water is pumped from the tanks and transported to the ORNL Process Waste Treatment Plant.

5.0 RESULTS AND RECORDS

All data are to be recorded in the field logbook or on the HDTF Site Visit Checksheet. In addition, a copy of all Analytical Services Request forms should be kept in a separate notebook. Analytical results are to be given to the project manager.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			
4.			
5.			

7.0 APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

WMRAD program manager: _____
Waste Management and Remedial Action Division

Procedure ID: ASEMP-06
Revision No.: 1
Date of Revision: 4 November 1991
Date Implemented: 4 November 1991

PROCEDURE FOR GROUNDWATER SAMPLING IN SWSA 5 NORTH

Prepared by:
D. S. Wickliff
Geosciences Section
T. L. Ashwood
Environmental Biotechnology Section
Environmental Sciences Division

1.0 PURPOSE

This procedure documents the methods for collecting samples from groundwater wells in SWSA 5 North. The purpose of the procedure is to provide consistent samples of water so that results may be compared between wells and over time. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses measurement of water levels, collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

See specific equipment requirements in procedure subsections 4.1 .1, 4.2.1 .1, and 4.2.2.1.

4.0 PROCEDU-RES

4.1 Water Level Measurements

4.1.1 Equipment

1. Electronic water level indicator with measurements in feet (e.g., M scope).
2. Field logbook.
3. Black permanent pen.
4. Protective clothing-see Project Safety Summary.
5. Radiation monitors:
   a. Pocket visual dosimeter.
   b. GM detector.

4.1.2 Procedures

The following steps should be conducted at each well prior to sampling or at any other time that water level measurements are needed.

1. Record well number, date, time, and any other pertinent information in field logbook.
2. Locate reference mark at top of well casing;
3. Lower probe of water level indicator into well. When the alarm sounds, stop lowering the probe. Pull up on the probe until alarm no longer sounds; then lower the probe again slowly, stopping at the instant the alarm sounds.
4. Using the mark on top of the casing as the reference point, determine the depth on the tape to the nearest 0.01 ft. Repeat the procedure to verify measurement. Record the measurement as depth to water in field logbook.
5. Rinse the probe and any portion-of the tape that contacted well water with deionized water. The rinse water should be placed in the purge water drums at each well. If no drum is available, the rinse water should be collected and disposed of as liquid low-level waste.

4.2 Groundwater Sampling

Groundwater samples will be collected annually for radionuclide analysis (gross alpha, gross beta, and a gamma scan). In addition, a sample for tritium analysis will be collected from each of the wells. Prior to. sample collection, wells will be purged to ensure that the sample is representative of the groundwater.

4.2.1 Well Purging

4.2.1.1 Equipment

1. Pump and associated equipment:
   a. Portable Waterra pump for all wells except 516.
   b. Gasoline powered compressor and controller for dedicated bladder pump in well 516.
2. Extension tubing for each well. This tubing is marked for each well and may be reused.
3. Screwdriver (flat), hose clamps, and fittings to connect tubing to Hydrolab and to extension tubing.

4. Hydrolab II.
5. Stop watch.
6. Container of known volume.
7. Calculator.
8. Field logbook.
9. Black permanent pen.
IO. Protective clothing-see Project Safety Summary.
11. Radiation monitors:
    a. Pocket visual dosimeter.
    b. GM detector.
12. Appropriate containers for waste.
13. Drum(s) for purge water. These drums should be on site at each well. If they are not, call Solid Waste Operations to have drums delivered.

4.2.1.2 Procedures

1. Measure groundwater level as indicated in Sect. 4.1, and calculate the volume of water in the well by using the formula on the Groundwater Monitoring Summary Sheet. Table 1 provides a list of well depths, diameters, and typical depths to water and well volumes. Compare your calculated well volume with the typical volume. If there is a large discrepancy, review your calculation and/or your depth to water measurement.
2. Connect the Waterra pump to the dedicated hose in well, and connect well tubing to extension tubing. Connect extension tubing to drum. For well 516, connect the controller to the compressor and dedicated tubing in the well and connect extension tubing to Hydrolab.
3. Begin pumping and record the time of initiation on the Groundwater Monitoring Summary Sheet. Determine rate of evacuation by timing the filling of the container of known volume. Record the pumping rate on the Groundwater Monitoring Summary Sheet. Empty the container into the purge water drum.
4. Note the appearance of the water (color, cloudy, clear, etc.), and record the data on the Groundwater Monitoring Summary Sheet.
5. Continue pumping until the well is dry, until three well volumes have been removed, or until field parameters have stabilized as follows.
    a. For wells 514, 517, 518, 519, 521, 522, 523, 524, 525, and 716, pump wells until they are dry.
    b. For wells 513, 516, 520, and 708, pump three well volumes or pump at least one well volume and then pump until temperature, pH, and specific conductance have stabilized (temperature ± 0.5“ C, pH ± 0.1 unit, specific conductance ± 5%).
6. All purge water is to be collected and drummed. The water will be kept until analytical results are available. If the analytical results indicate that the water contains radionuclides above the ASEMP action levels, contact Solid Waste Operations for disposal of the water; otherwise the drums may be emptied on site.

Table 1. Groundwater monitoring information for SWSA 5 North

Well no.	Well diam. (in.)	Total well depth from Mp[a] (ft)	Depth to water in 11/90 (ft)	Approx. well volume in 1 1/90 (gal)
		Wells that should be pumped dry		
514	6	30.4	20.81	14
517	6	32.4	14.35	27
518	6	31.6	17.92	20
519	6	25.6	13.53	18
521	4	87.6	25.63	40
522	6	69.2	44.97	36
523	3	11.2	5.43	2
524	3	12.0	3.84	3
525	6	29.4	16.24	19
716	2	100.7	6.52	15
		Wells that should be pumped for 1–3 volumes		
513	6	20.6	8.5	18
516	4	26.8	15.42	7
520	6	24.6	1.57	34
708	2	18.0	4.12	2
715	2	41.0	14.9	4
		Water *level measurement only*		
562	2	150.0	45.73	

[a] MP = measurement point.

4.2.2 Sample Collection

4.2.2.1 Equipment

1. Pump and associated equipment:
   a. Portable Waterra pump for all wells except 516.
   b. Gasoline-powered compressor and controller for dedicated bladder pump in well 516.
2. Extension tubing for each well. This tubing is marked for each well and may be reused.
3. Screwdriver (fiat), hose clamps, and fittings to connect tubing to Hydrolab and to extension tubing.
4. Hydrolab II.
5. In-line filters.
6. Appropriate sample containers:
   a. I-L bottles for gross alpha, gross beta, and gamma scan.
   b. 125-mL bottles for tritium.

7. Black permanent markers for labeling.
8. Paper towels.
9. Waste bags.
10. Plastic bags for samples.

4.2.2.2 Procedures

Sampling should be done as soon as possible after the well has been evacuated. Allow 1 day for recovery of those wells that were pumped to dryness.

1. If not already connected, connect pump as described in Sect. 4.2.1.2. Connect extension tubing to the Hydrolab and to the in-line filter making sure that water flow will be in the direction indicated by the arrow on the filter. Direct the discharge of the filter to the purge water drum.
2. Adjust the pump to provide a steady stream of water from the filter discharge.
3. Before collecting samples, measure the pH, specific conductance, and temperature of the well water. Record the information in field logbook.
4. From each well collect one sample in a I-L bottle (for gross alpha and beta analyses, and gamma scan) and one sample in the 125-mL bottle (for tritium analysis).
5. Label each bottle carefully and clearly with the well number, date, time, and preservative (see step 8). Enter information in the field logbook.
6. Sample bottles should be placed in plastic bags and screened with GM detector before returning to Building 1505.
7. Rinse the Hydrolab and extension tubing with deionized water. Collect rinse water in purge water drum.
8. After returning to the lab, add 1 mL of 50% HNO, to samples in I-L bottles. Do not add acid to the tritium samples.
9. Complete Analytical Services Request form and take samples to sample receiving room in Building 4500S. On the Analytical Services Request form, note that these samples are for the ASEMP and that the samples are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all analyses except tritium.

5.0 RESULTS AND RECORDS

As noted in Sect. 4.0, all data are to be recorded in the field logbook or on the Groundwater Monitoring Summary Sheet. After completion, each Groundwater Monitoring Summary Sheet is to be glued into the field logbook on a separate page. In addition, a copy of all Analytical **Services** Request forms should be glued into the field logbook. Analytical results are to be given to the principal investigator.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			
4.			
5.			

7.0 APPROVALS

ASEMP project manager: _____

Environmental Sciences Division

WMRAD program manager: _____

Waste Management and Remedial Action Division

GROUNDWATER MONITORING SUMMARY SHEET

Well Number: _____ Date: _____

Well Casing Volume Determination

A. Depth of well: ft B. Measured depth to water: _____ ft
C. Height of water column (A - B): ft
D. Casing diameter: in

Volume = C x D
(1.47 x C for 6-in. casing diameter) = _____ gal
(0.65 x C for 4-in. casing diameter) = _____ gal
(0.37 x C for 3-in. casing diameter) = _____ gal
(0.16 x C for 2-in. casing diameter) = _____ gal

Well Evacuation

Initiation time: _____ Evacuation rate: _____ gal/min

Measurement	Value 1	Value 2	Value 3	Value 4	Value 5
Date:					
Time:					
pH:					
Temperature:					
Specific conductance:					
Gallons evacuated:					
Well volumes purged:					

Sample Collection

Date: _____
Time: _____

Comments and Observations

Appearance of water at initiation: _____
Appearance of water at completion: _____
Comments: _____
_____

Procedure ID: ASEMP-07
Revision No.: 0
Date of Revision: 4 November 1991
Date Implemented: 4 November 1991

PROCEDURE FOR SURFACE WATER SAMPLING IN SWSA 5 NORTH

Prepared by:
T. L. Ashwood
Environmental Biotechnology Section
D. S. Wickliff
Geosciences Section
Environmental Sciences Division

1.0 PURPOSE

This procedure documents the methods for collecting samples from seeps and streams around SWSA 5 North. The purpose of the procedure is to provide consistent samples of water so that results may be compared among Wells and over time. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses collection of water samples, preparation of the samples, and submission of the samples for analyses.

3.0 EQUIPMENT

I. Field logbook.
2. Black permanent marker.
3. Protective clothing-see Project Safety Summary.
4. Chest waders for bank seeps or rubber boots for stream samples.
5. Radiation monitors:
    a. Pocket visual dosimeter.
    b. GM detector.
6. I-L and 250-mL sample bottles.
7. Metal spatulas.
7. Paper towels.

8. Waste bags.
9. Plastic bags for samples.

4.0 PROCEDURES

Approximate sample locations are indicated on the map of the area in the program plan, and these locations are marked in the field by flags. Bank seeps may be located by measuring in a downstream direction from the south bank of the North Tributary. Seeps are identified by their distance, in meters, downstream from this point.

1. If water is present at the stream locations, dip a I-L bottle into the water and fill as far as possible, being careful not to stir up sediment. Finish filling I-L bottle by dipping 250-mL bottle into water and pouring contents into I-L bottle.
2. If water is present at bank seeps, push a metal spatula into the bank at the seep to provide a spout for the water. After the water has cleared, hold 250-mL bottle under the spout until full.
3. If water is present at other seeps, fill a I-L sample bottle by repeatedly submerging a 250-mL bottle in the seep and pouring the contents into the I-L bottle. Be careful to minimize the amount of sediment suspended by this process.
4. Wipe off excess moisture from the outside of the sample bottles in the field. Scan the bottles with the GM detector before taking them into Building 1505. If the bottles read more than 50 counts per minute above background, contact Health Physics. Dispose of the paper towels in the waste bags as solid low-level waste.
5. After returning to the lab in Building 1505, filter each sample through 0.45-µm filters and into clean sample bottles. Mark the filters with the number of the sample, and place the filters in a 15-cc petri dish. Submit this dish to the ESD counting room for an overnight gamma scan.
6. Complete Analytical Services Request form, and take samples to sample receiving room in Building 4500S. On the Analytical Services Request form, note that these samples are for the ASEMP and that the samples are to be counted for sufficient time to provide counting errors of <0.5 Bq/L on all analyses except tritium.

5.0 RESULTS AND RECORDS

The date, location, time, and any unusual conditions are to be recorded in the field logbook for each sample. For each sample, the volume of sample filtered and the number of filters required are to be recorded in the field logbook. Copies of the Analytical Services Request are to be glued into the field logbook. Results from the ESD counting room and from Analytical Chemistry Division are to be given immediately to the project principal investigator.

6.0 PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			
4.			
5.			

7.0 APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

WMRAD program manager: _____
Waste Management and Remedial Action Division

Procedure ID: ASEMP-08
Revision No.: 1
Date of Revision: 12 December 1994
Date Implemented: 12 December 1994

PROCEDURE FOR COLLECTING WATER SAMPLES FROM THE EASC AND LWSP CONCRETE STORAGE CASKS

Prepared by: C. M. Morrissey
Environmental Sciences Division
Geosciences Section
Environmental Engineering Group

1 .O PURPOSE

This procedure documents the methods for collecting water samples from the Emergency Avoidance Solidification Campaign (EASC) and Liquid Waste Solidification Project (LWSP) storage casks. These casks are located in facilities 7856 and 7842A. The purpose of the procedure is to collect all liquid that accumulates in the liquid sample collection sump within the casks. The purpose of collecting this water is to detect radioactive or chemical contamination that might. result from improperly solidified waste forms. Contamination might also result from accidental contamination of the exterior of the waste form during solidification. The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure addresses only the collection of water samples from the EASC/LWSP casks.

3.0 EQUIPMENT

1. Sample pump: Randolph model 610 with ⅜ in. i.d. x ⅝ in. o.d. tygon tubing of appropriate length to reach all casks.
2. Honda generator model EM 2200X or equivalent.
3. Ball-point pen and labels for sample bottles.
4. Connectors appropriate for attaching sample tubing to casks

5. Gloves.
6. Safety glasses.
7. One-liter glass sample bottles.
8. Other protective clothing as appropriate under supervisory requirements.
9. Shallow plastic tray or other similar container to collect any spillage while sampling.
10. Beta/gamma activity portable field survey instrument.

4.0 PROCEDURES

Facility 7842A is located in Solid Waste Storage Area (SWSA) 6. Facility 7856 is located behind the new hydrofracture facility in Melton Valley. Both facilities are used for interim storage of solidified liquid low-level radioactive waste.

Samples are collected and prepared quarterly for the newest casks and annually for the older casks. Liquid Waste Operations personnel collect the samples and transfer them to ASEMP personnel. ASEMP personnel divide and acidify samples as appropriate and submit them to ORNL's Analytical Services Organization (ASO). AS0 analyzes the samples for gross a and gross β activity, metals (of primary interest is sodium), chloride, and nitrate. The number of analyses performed depends upon sample volume collected. Gross β analysis receives the highest 'priority. An archived sample is collected if sample volume permits.

<u>Sample collection and preparation:</u>

1. Don personal safety equipment as appropriate per supervisory and Radiation Protection requirements.
2. Stand to the side of the gas venf tube.
3. Remove the plug from the gas vent tube.
4. Remove the plug from the liquid sampling tube.
5. Attach the sample tubing to the casks liquid sampling tube.
6. Place a I-L sample collection bottle in the'shallow plastic tray or similar non-breakable container to collected any spillage.
7. Start the sample pump.
8. Collect liquid in the I-L sample bottle and continue pumping for 2 min. or' until all liquid is collected."
9. Survey sample bottle with portable field instrument for beta/gamma activity away from the influence of the casks. If any reading above background is obtained, note on sample label the approximate counts observed. ASEMP personnel will have any sample showing above-background activity tagged appropriately by Health Physics.
10. Label each sample bottle with an appropriate sample ID number (cask number), date, time of collection, name of collector, and estimated volume collected.
11. Remove the sampling apparatus, replace the liquid sampling tube and gas vent plugs.
12. If the sample has an above-background activity reading, replace the sample tubing before collecting the next sample.

13. Enter appropriate data on the "Check List for EASC/LWSP Cask Liquid Sampling".
14. Proceed to next cask. Repeat steps 3 through 13.
15. Deliver samples to the IWMF storage shed in SWSA 6. ASEMP personnel will divide and acidify samples as appropriate. ASEMP personnel will also fill out analytical request forms and transfer samples to the appropriate Analytical Services Organization laboratory.
16. Forward copy "Check List for EASC/LWSP Cask Liquid Sampling" to C.M. Morrissey, 1505, MS-6038.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

	Name	Organization	Trained by
1.			
2.			
3.			

6. APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

WMRAD program manager: _____
Waste Management and Remedial Action Division

ATTACHMENT 1

Date: _____ Sampler(s): _____

Cask/Sample No.	Estimated Sample Volume	Length of Time Pumped (min.)	Comments

Procedures ASEMP-09 through ASEMP-12 are reserved

Procedure ID: ASEMP-13
Revision No.: 0
Date of Revision: 1 October 1995
Date Implemented: 1 October 1995

SAMPLING STORAGE FACILITY SUMPS AT SOLID WASTE STORAGE AREA 5 NORTH

Prepared by : C. M. Morrissey
Environmental Engineering Division
Earth and Engineering Sciences Section
Environmental Engineering Group

1.O PURPOSE-

Procedure ASEMP-13 documents the method for collecting samples from sumps that drain waste storage facilities at SWSA 5 North. Samples are collected in order to detect the release of any radioactive constituents. to the environment in accordance with DOE Order 5820.2A. The procedure is based upon applicable sections of Environmental Sampling Procedure ESP-308-3, "Container Sampling: Drums and Tanks" (ES/ESH/INT-14). The procedure will also serve to train new project personnel.

2.0 SCOPE

This procedure describes the method for collecting water samples from the sumps, sample preservation and storage, and submission of samples to the analytical laboratory.

3 . 0 EQUIPMENT

1. Ball' point 'pen.
2. SWSA 5 N sumps Site Visit Checksheet (SVC).
3. Two clean I-L glass or plastic sample bottles per sump sampled (there are a total of eight sumps).
4. One Analytical Services Request (ASR) form.
5. 50% nitric acid (stored in IWMF storage shed).
6. Bottle labels.
7. Rubber gloves
8. Safety glasses.

4.0 PROCEDURES

The SWSA 5 N building sumps are below-grade concrete structures that contain any water draining from storage facilities 7826, 7834, and 7855. The concrete sumps are covered with removal metal covers to prevent rainfall infiltration. A bottle attached to a string is left at each sump to serve as a sample collection vessel. Samples are collected after periods of significant rainfall from those sumps that fill to greater than half their capacity. The attached SWSA 5 N map indicates the location of the facilities.

1. Remove the cover from the sumps to be sampled.
2. For each sump that is over half full, label sample bottles as follows:
   a. Sample ID: Use the sump number including the individual sump within each group. For example, there are four individual sumps within sump 7834. In all cases, the individual sumps are numbered from left to right. Therefore, within sump 7834, sample IDs will be 7834-1, 7834-2, 7834-3, and 7834-4. Also, label bottles for archive samples as 7834-1A, etc.
   b. Initials of collector.
   c. Date and time of collection.
   d. Preservative used.
   e. Analysis requested.
3. Don gloves and submerge the I-L glass collection bottle that is already present in the sump.
4. Retrieve the sample collection bottle using the attached string.
5. Transfer the contents of the retrieved bottle to the labeled. sample bottle. Two 1 L samples are collected from each sump sampled for gross a, gross β, and y scan analyses.
6. Complete the Site Visit Checksheet (see attached).
7. After all samples have been collected, transport them to the IWMF storage shed in SWSA 6. Use -1 mL per liter of the 50% nitric acid located in the shed to acidify all samples. Verify, using pH paper, that the pH of each sample is <2 after acidification.
8. Store the archive samples in an appropriate location within the IWMF storage shed.
9. Complete the Analytical Request Form as per the attached example. Be sure to request a counting error <0.5 Bq/L and that ^{40}K be reported only if a true peak is present in the gamma scan.
10. Transport samples to be submitted for analysis to the Analytical Services Organization sample receiving room in Bldg. 4500S.
11. When analytical data are received, report any activity above internal reporting levels (IRLs) to the SWSA 5 N foreman by electronic mail (WHITERL1). IRLs for SWSA 5 N are 1 Bq/L for gross a, 2 Bq/L for gross β, 1.5 Bq/L for ^{60}Co, and 1 Bq/L for ^{137}Cs.

5. PERSONNEL

The following personnel have been trained and are qualified to carry out this procedure:

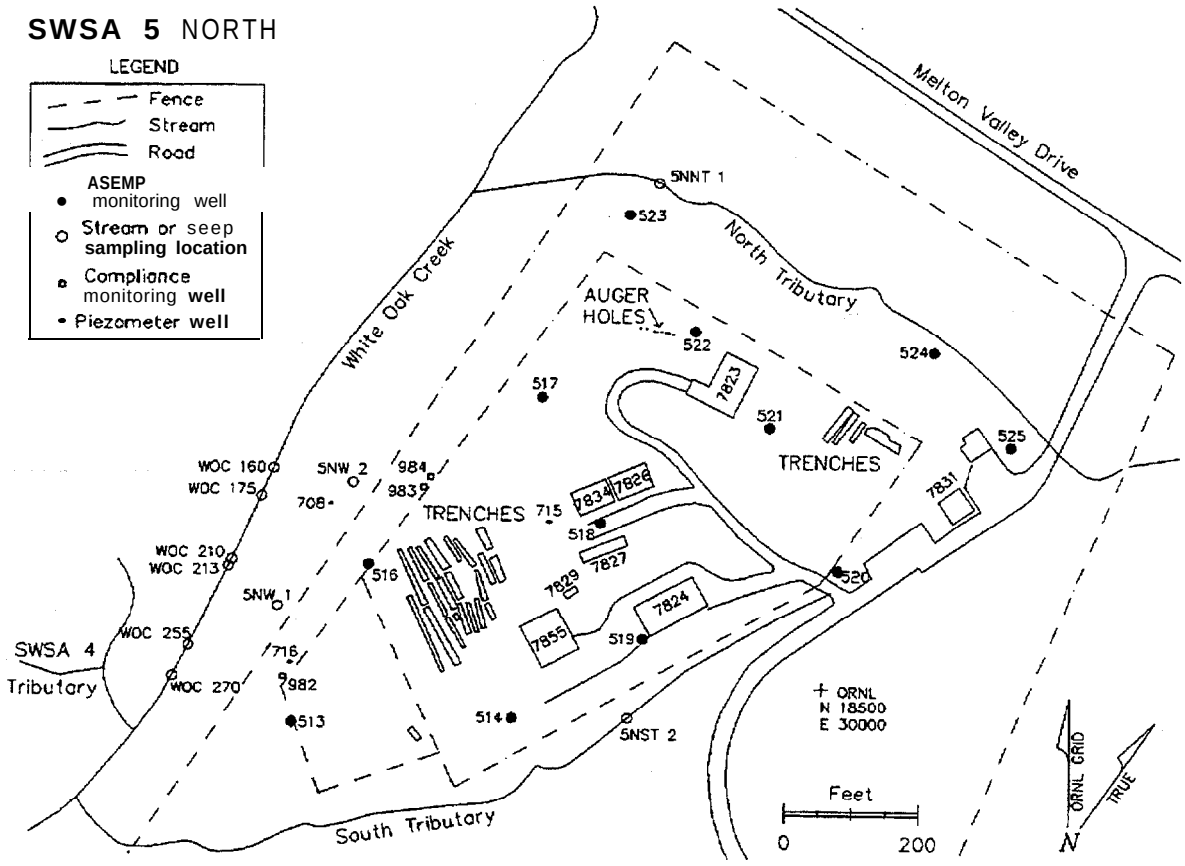
	Name	Organization	Trained by
1.			
2.			
3.			
4.			

6. APPROVALS

ASEMP project manager: _____
Environmental Sciences Division

WMRAD program manager: _____
Waste Management and Remedial Action Division

ORNL-DWG 91-15062 R1



Solid Waste Storage Area 5 North

SWSA 5 NORTH SUMPS SITE VISIT CHECKSHEET

initials: Date: Time:

weather conditions: _____

Have you been trained in the current revision of this sampling procedure? Y N

Sumps sampled: describe sample color, etc.

7826-l : Y N _____

7826-2: Y N _____

7834-l : Y N _____

7834-2: Y N _____

7834-3: Y N _____

7834-4: Y N _____

7855-l : Y N _____

7855-2: Y N _____

problems and comments: _____

_____

_____

_____

_____

_____

actions taken to resolve problems: _____

_____

_____

_____

_____

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