Environmental Restoration Division
ORNL Environmental Restoration Program

Summary of Activities of the Life Cycle Costing Workshop Conducted by the Environmental Restoration Program of Oak Ridge National Laboratory

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<td>CERCLA</td>
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<td>SWSA</td>
<td>solid waste storage area</td>
</tr>
<tr>
<td>TRU</td>
<td>transuranic</td>
</tr>
<tr>
<td>TSCA</td>
<td>Toxic Substances Control Act</td>
</tr>
<tr>
<td>UST</td>
<td>underground storage tank</td>
</tr>
<tr>
<td>VOC</td>
<td>volatile organic compound</td>
</tr>
<tr>
<td>WAG</td>
<td>waste area grouping</td>
</tr>
<tr>
<td>WOC</td>
<td>White Oak Creek</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

A five-day life cycle workshop was conducted by the Environmental Restoration (ER) Program of Oak Ridge National Laboratory (ORNL) to develop appropriate remediation scenarios for each Waste Area Grouping (WAG) at ORNL and to identify associated data needs (e.g., remedial investigations, special studies, and technology demonstrations) and required interfaces. Workshop participants represented the Department of Energy, Martin Marietta Energy Systems, Inc., Bechtel National, Radian Corporation, EBASCO Corporation, and M-K Ferguson. The workshop was used to establish a technical basis for remediation activities at each WAG. The workshop results are documented in this report and provide the baseline for estimating the technical scope for each WAG. The scope and associated budgets and schedules will be summarized in baseline reports for each WAG, which, in turn, will be compiled into an overall strategy document for ORNL ER.

The report, intended primarily for workshop attendees and those familiar with the ORNL ER Program, is organized into 3 sections and 22 appendixes. Section 1 provides background information and an overview of the workshop objectives and methods. Section 2 describes the organizational and programmatic interfaces. Section 3 summarizes the results of the individual discussions on each WAG. Appendix A includes the workshop agenda and attendance lists. Appendix B contains the introductory material presented at the workshop. Appendix C is a tabular summary of the workshop results by individual WAG. The remaining appendixes, D through V, are arranged by individual WAG and include the fact sheets, conceptual models, lists of operable units and interface issues, and summaries of data needs and early actions developed at the workshop.
1. INTRODUCTION

This section of the report provides background information on the purpose of the Life Cycle cost estimate, the approach taken in developing the estimate, and an overview of the workshop. The purpose, scope, and organization of the report are also briefly described.

1.1 BACKGROUND

As part of the Department of Energy (DOE) national Environmental Restoration (ER) Program, the Oak Ridge National Laboratory (ORNL) ER Program addresses the cleanup of areas or facilities potentially contaminated by past activities, including waste disposal. DOE Order 4700.1 requires the ORNL ER Program to develop a long-range plan for remediation of ORNL waste areas. The purpose of the ORNL plan is to develop an integrated technical scope, schedule, and budget baseline for all activities needed to complete environmental restoration over the life of the program. All assumptions used in developing the scope, schedule, and budget will be documented sufficiently to support the plan, explain variances, and justify changes. The ORNL plan is intended to include all phases of remediation activities from preliminary assessment/site investigation (PA/SI) through remedial action and to be consistent with the Federal Facilities Agreement (FFA). The plan is intended to include all waste area groupings (WAGs) as well as site characterization and program management activities that are not site-specific and include DOE Oak Ridge contractors and subcontractors. The plan will also reflect program priorities. The plan will be used to support preparation of other programmatic documents, i.e., Activity Data Sheets, Estimate of Completion sheets, Current Year Work Plans, and budgetary submittals. It will be used as a tool to evaluate impacts of changing priorities, funding, regulations, etc. It is recognized that the accuracy of the plan will vary according to whether actions are near or long term. Quantitative and qualitative uncertainties associated with the estimates of scope, schedule, and budgets will be discussed.

A Life Cycle workshop was used to establish a technical basis for remediation activities at each WAG. The workshop results are documented in this summary and provide the baseline for estimating the technical scope for each WAG. The scope and associated budgets and schedules will be summarized in baseline reports for each WAG, which, in turn, will be compiled into an overall strategy document for ORNL ER.

1.2 WORKSHOP OVERVIEW

A 5-day Life Cycle workshop was conducted to develop appropriate remediation scenarios for each WAG and to identify associated data needs (e.g., remedial investigations, special studies, and technology demonstrations) and required interfaces. Workshop participants included DOE, Energy Systems, the Bechtel team, Radian Corporation, EBASCO Corporation, and MK Ferguson. The workshop agenda and attendance lists are provided in Appendix A. The Observational Approach was used as a basis for developing remediation scenarios for each WAG. The workshop introduction included an overview of the concept.
for the ORNL ER Program long-range plan, current WAG priorities, and an overview of the Observational Approach. An overview of generic remedial groupings (for consideration as potential operable units (OUs)), general response actions, and remediation technologies was presented to facilitate discussion. The following topics were included on the agenda for each WAG:

- Description/status of WAGs
- Development of conceptual models
- Identification of potential operable units/early actions
- Identification of potential remedial actions (RA)
- Discussion of expected conditions and deviations for each RA
- Identification of contingent actions based on deviations for each RA
- Identification of remedial investigation (RI) needs (including site characterization, special studies, and technology demonstrations)
- Identification of potential interface issues and/or needs
- Documentation of general and specific assumptions

Prior to the discussion of individual WAGs, two previous Observational Approach workshops for WAG 5 were summarized to facilitate discussion. Introductory workshop material is presented in Appendix B.

The amount of data available for each WAG varied significantly. As a result, the level of detail in the discussion and proposed remedial actions varied considerably. An additional limitation was the time available to discuss each WAG resulted in a limitation on of remedial actions considered because there was not sufficient time to fully consider all issues. For the same reasons, individual remediation scenarios may not have been completed for each WAG and information may be missing or indicated by reference to other WAGs. The results of the workshop will be supplemented and modified as necessary to develop the WAG baselines.

1.3 PURPOSE AND SCOPE

This summary of activities documents the process and results of the workshop. The scope is limited to a general, technical description of the remediation scenarios, associated data needs, and technical interfaces identified in the workshop. This summary is primarily intended for workshop attendees and those familiar with the ORNL ER Program. Therefore, it will not include an explanation of the terms and regulatory requirements discussed at the workshop or a description (beyond the introductory material presented in Appendix B) of the Observational Approach or other methods used. The preparation of cost estimates and schedules and the completion of remediation scenarios (if not completed during the workshop) is beyond the scope of this effort, but will be included in the baseline reports.

1.4 REPORT ORGANIZATION

This report is organized into three sections and appendixes. Section 1 provides background information and an overview of the workshop objectives and methods. Section 2 describes the organizational and programmatic interfaces. Section 3 summarizes the results of the
individual discussions on each WAG. Appendix A includes the workshop agenda and attendance lists. Appendix B contains the introductory material presented at the workshop. Appendix C is a tabular summary of the workshop results by individual WAG. The remaining appendixes, D through V, are arranged by individual WAG and include the fact sheets, conceptual models, lists of operable units and interface issues, and summaries of data needs and early actions developed at the workshop.
2. PROGRAMMATIC AND GENERAL INTERFACES

Remediation of ORNL waste areas will require effective interfacing and coordination among the critical organizations and programs involved in ER activities. This section provides a brief overview of the organizations and major programs that are a part of the remediation activities. A brief summary of interface needs common to the remediation of most WAGs is also provided. A detailed list of interface needs for each WAG is provided in the appendixes.

2.1 ORGANIZATIONS

Energy Systems is the integrating contractor in the ORNL ER Program and is responsible for site assessment, RI, alternative assessment, maintenance, and surveillance activities. Radian Corporation [under direct contract with DOE-Environmental Restoration Division (ERD)] is responsible for feasibility studies, National Environmental Policy Act (NEPA) documentation, and Record of Decision (ROD) preparation. EBASCO Corporation and MK Ferguson (both also under direct contract with DOE-ERD) are responsible for remedial design and remedial action, respectively. Energy Systems is also responsible for maintenance and surveillance activities.

2.2 PROGRAM INTERFACES

The major programs involved in ER-related activities at ORNL include:

- **ER Program**—Overall responsibility for remediation of areas/facilities contaminated by past activities. Associated programs/activities include the Remedial Investigation/Feasibility Study (RI/FS), WAG 2 monitoring, and site characterization/special studies programs.

- **Decontamination & Decommissioning (D&D) Program**—Responsibility for D&D of contaminated building and structures.

- **ORNL Waste Management Program**—Overall responsibility for treatment and disposal of wastes generated at ORNL, including waste generated by remediation activities.

- **Site Characterization/Special Studies Program**—Includes characterization and studies (e.g., subsurface stormflow monitoring) needed to provide data in non-WAG-specific support of other programs and remediation.

- **Technology Demonstrations**—Demonstration of remedial investigation and remediation technologies such as in situ vitrification, grouting, and nonintrusive surveys. This activity draws on multiple programs and organizations as needed to provide resources.
2.3 GENERAL INTERFACES

Interface needs and issues were identified for each WAG as part of the individual WAG discussions. A complete list of the needs and issues identified for each WAG is provided in the appendixes. The most commonly identified needs and issues are briefly summarized below:

- **Waste management**—treatment/storage/disposal of waste media, planning of treatment/storage capacity
- **D&D Program**—coordination of remediation activities with this program
- **WAG coordination**—coordination with multicontractor activities at individual WAGs for information exchange and planning
- **Regulatory/policy**—coordinate multiple regulatory requirements such as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), NEPA, the Resource Conservation and Recovery Act (RCRA), and the Toxic Substances Control Act (TSCA) as well as DOE policy issues such as transuranic (TRU) and mixed waste disposal
- **Well plugging and abandonment (P&A)**—coordination of WAG activities with well P&A activities
- **Energy Systems Engineering Division design coordination/oversight** such as coordination on borrow requirements for cap construction

The following programmatic needs were identified during the workshop discussions:

- A retrievable documentation system for storing of well and pipeline location information, surveys, reports, and possibly a geographic information system
- A budget system to maintain and use Life Cycle cost information

It was noted that these needs were not confined to the ER Program.
3. SUMMARY OF WAG DISCUSSIONS

Brief summaries of the results of the individual WAG discussions are provided in the following sections. Each summary includes the identified potential OUs, the remediation scenarios in terms of base/contingent actions and associated data needs identified for each OU, and any special technical, organizational, or schedule issues identified for the WAG. Documentation of these results for each WAG is included in the appendixes.

3.1 WAG 1—MAIN PLANT AREA

3.1.1 General

WAG 1 consists of the ORNL main plant area. Since 1943, ORNL has been involved in research and process development that has resulted in a large variety of solid, sanitary, and process wastes. The ongoing Phase 1 RI at WAG 1 has detected primarily radiological and inorganic waste contaminants that have migrated to both on-site and off-site media. Approximately 167 solid waste management units (SWMUs) have been identified as potential sources of these contaminants. Corrective actions to date consist of limited soil removal including excavation of Solid Waste Storage Area (SWSA) 2 collection of contaminated groundwater at opportunistic locations (Tank W-1A, South Tank Farm), installation of a new low-level waste (LLW) pipeline system, closure/backfill of several impoundments (LITR, 3512), administrative controls and interim caps that limit current exposure (e.g., 3019 hotbank, 3515 release), and taking some Gunite tanks and many steel tanks out of service (including contents removal and consolidation).

An OU strategy is currently under development that focuses on small-scale, interim actions [e.g., Interim Record of Decision (IROD) for WAG 1 ponds] until facility shutdown. For purposes of life-cycle costing, ten WAG 1 OUs have been identified: three with the common goal of preventing near-term release risk (North and South Tank Farms and Tank TH-4); four with the goal of characterizing and controlling off-WAG migration (surface impoundments, groundwater, pipeline and storm drain network, and White Oak Creek flood plain soils); and three with the goal of characterizing and controlling on-WAG contamination (empty steel tanks, contaminated soils, the waste pile, and SWSAs 1 and 2).

3.1.2 Operable Unit 1A, 1B, and 1C: North and South Tank Farms and Tank TH-4

A separate 2-day workshop was held October 29 and 30 to develop remedial action options for the North and South Tank Farms and Tank TH-4. A summary of the workshop is provided in Appendix D. For purposes of life-cycle costing, these options are included in this report. The options include removal of the tank contents (liquid and sludge) and the tank shells (Gunite and steel), in situ treatment via grouting or vitrification, and combinations of removal and in situ treatment. Near-term potential tank management actions include stopping tank inleakage, placing a containment building over the tanks, and filling the tanks with sand. (There was some concern that filling the older tanks with sand may cause tank collapse.) The remediation of these tanks is recommended as an early action based upon perceived risk.
The RI/FS process will ultimately reduce the number of considered alternatives by characterizing the tank contents and surrounding soil, and providing more in-depth engineering, environmental risk assessment, and cost analyses of options. Special studies will focus on identifying and controlling inleakage sources, researching remote removal techniques, performing structural integrity assessments on the tanks, and developing waste management options (e.g., storage location and disposal capacity) for waste streams. Potential treatability studies/demonstrations will include remote removal techniques, waste stream separation and minimization, grout mix testing, and in situ vitrification of tanks.

3.1.3 Operable Unit 1D: Surface Impoundments

The remedial actions considered for the surface impoundments are primarily removal and treatment of the water and sludges. It is expected that the water will be treated at the Process Waste Treatment Plant (PWTP), with no pretreatment required, and the sludge will be dewatered and stabilized in situ. The surface impoundments will then be backfilled and capped. Demonstrations will be performed on sludge dewatering and stabilization techniques.

3.1.4 Operable Unit 1E: Groundwater

The general approach to groundwater remediation is to use the existing collection system (sumps and drains) and perhaps to also use the pipeline and storm drain network as a collection system. Allowance is also made for a pump and treat operation if a contaminant plume is defined. It is assumed that outflow from the existing collection network or tentative pump and treat operation will be treated at the PWTP. Information collected during the Phase II RI is assumed to be sufficient to design the remedial actions.

3.1.5 Operable Unit 1F: Pipelines and Storm Drains

Pipeline trenches and storm drain trenches south of Central Avenue are assumed to be below the water table, and trenches north of Central Avenue are assumed to be above the water table. The remedial action for the "wet" trenches is assumed to be excavation, and for the "dry" trenches is assumed to be containment (e.g., application of trench plugs or special pipe collars to cut off possible flow down the trenches). These efforts will include the "orphan" pipeline segments that connect WAGs but are not located inside a WAG boundary. Boundary containment (e.g., trenches or French drains) is also being considered for the west, south, and east perimeters of WAG 1.

The principal data collection effort will be to determine the locations of the pipelines and storm drains, and to classify the pipelines or storm drains as wet or dry. Demonstrations on special geotechnical methods for locating subsurface lines or drains, and the use of plugs and cutoff collars to isolate pipe or storm drain sections are recommended.
3.1.6 Operable Unit 1G: White Oak Creek Flood Plain Soils

Potential remedial actions discussed for White Oak Creek (WOC) flood plain soils include in situ solidification of radiological hot spots and capping the remaining, but lower risk, waste areas. Excavation of shallow hot spots was also considered.

Surveys to identify the hot spots will be performed during the field investigation.

3.1.7 Operable Unit 1H: SWSA 1, SWSA 2, and the Waste Pile

Containment (e.g., groundwater intercept, cap) was the remedial action recommended during the workshop for SWSA 1. SWSA 2 will be considered for a No Further Action (NFA) alternative after subsurface anomalies are sampled and, if necessary, removed. The waste pile will also receive limited remediation consisting of hot spot removal. The sampling and geophysical tests conducted during the RI will provide the data required for delineation of alternatives.

3.1.8 Operable Unit 1I: Contaminated Soils

For the remediation of mercury-contaminated soils, the preferred alternative is excavation, treatment, and off-site RCRA landfill disposal. Several types of treatment (e.g., Y-12 Hg roasting, bioremediation, soil washing) were suggested during the workshop. It was assumed that, for tanks, pipes, and other facilities, the contaminated material can be consolidated and contained using a cap and/or slurry wall. It was noted that mercury contamination may be present (under or adjacent) at Buildings 4501, 3503, and possibly 4508 and that remedial action will not consider the logistics of Building 4508 operations. It was also assumed that radioactively contaminated material or soil at the 3001 exhaust ducts, 3019 hot blank, 3515, and Isotope Circle could be handled by conventional radioactive material handling techniques (i.e., robotics would not be required for excavation).

The RI will locate and inventory subsurface facilities, determine the nature and extent of soil contamination, and assess the fate and transport of the contaminants. Based on the variety of hazardous constituents in the soil, some technological development of treatment technologies will be required for purposes of the life cycle baseline.

3.1.9 Operable Unit 1J: Empty Steel Tanks

For purposes of the life cycle baseline, it is assumed, that approximately one-half of the 52 empty steel tanks will be removed and decontaminated, and one-half will be left in place and filled with grout. The grout will immobilize any residual sludges and provide structural stability for the tanks. Decontamination techniques, such as surface etching, will be demonstrated prior to tank shell removal.
3.1.10 Special Considerations

Implementation of remedial actions requires coordination with other ongoing programs. Interface will be required with Waste Management Programs for the storage, treatment, and disposal of wastes; the Tanks Program for structural integrity assessment; the Integrated Technology Demonstration Program; Planning and Site Redevelopment; and other WAG programs. Interface will also be required with DOE regarding classification and disposal of waste, WAG boundary definition, and funding and contracting approaches. Construction activities that may impact the schedule and viability of the proposed actions include the new low-level liquid waste (LL LW) pipelines and other new pipeline networks, and the new, planned capacity increase for the Melton Valley Storage Tanks.

3.2 WAG 2—WHITE OAK CREEK AND WHITE OAK LAKE

3.2.1 General

WAG 2 covers WOC drainage and the associated floodplain and groundwater. Releases from upgradient WAGs, National Pollution Discharge Elimination System (NPDES) permitted sources, and nonpoint discharges have been sorbed into floodplain sediments and released into the WOC drainage. Contaminants include tritium, fission products, TRUs, inorganics, polychlorinated biphenyls (PCBs), and volatile organic compounds (VOCs). A draft RI work plan has been submitted for review, but no corrective actions have been initiated yet.

WAG 2 has two operable units: (1) the sediment in Reaches 1 and part of 2, and (2) the sediment and soil in Reaches 3, 4, and part of 2.

3.2.2 Operable Unit 2A: Sediment (Reach 1 and Lower Reach 2)

The final remedial action considered for the sediment is containment. Specifically, WOC is diverted to a concrete channel, and then White Oak Lake is filled and capped. This remedial action assumes that the risk from TRU or long-lived radionuclides in the sediment is small. Potential early actions for OU 2A include the annual removal and disposal of sediment from the weirs and stabilization of the creek banks in several areas. In preparation for the remedial action, channel armor and filtration technologies should be demonstrated. Also, treatment technologies to remove radionuclides from the sediment should be evaluated.

3.2.3 Operable Unit 2B: Sediment and Soil (Reaches 3 and 4, and Upper Reach 2)

The potential early and final actions are similar to those for OU 2A above with the exception that the floodplain soils are capped. A potential contingent action is the removal and disposal of contaminated soils by entombment.

3.2.4 Special Considerations

From a technical perspective, the hydrologic impact of upstream WAG needs to be better understood. Such an understanding may point to new stream reaches that should be added to...
WAG 2. Interface will be required for community relations activities, the upgradient SWSA 7 waste disposal development, and DOE TRU policy. The weirs may be replaced in the future with new flow measurement devices that do not silt up. Until then the weirs will continue to be monitored, and Waste Management will need to assist in disposing of the sediments from the weirs.

3.3 WAG 3—SWSA 3, SCRAP METAL AREA, AND CONTRACTOR’S LANDFILL

3.3.1 General

WAG 3 is a 17.1-acre site consisting of SWSA 3, a closed scrap metal area, and a contractor’s landfill. The draft RI plan has been completed for this WAG. SWSA 3 operated from 1946 to 1951 as a subsurface disposal area and, until 1979, as an above-ground storage area for slightly contaminated equipment. By 1979, the SWSA 3 area was partially cleaned up by removing the contaminated items stored above ground, and surface water runoff was diverted to the Northwest Tributary, a tributary of WOC. A spectrum of radionuclides has been detected at SWSA 3. The scrap metal area, used from 1950 to 1960, was initially used as a contractor’s landfill, and later for scrap metal storage. The 2-acre contractor’s landfill began operating in 1975 under a TDEC permit for solid waste from construction activities. Stabilized sludge from the coal yard was also disposed of there in 1986. Landfill contaminants include strontium-90, cesium-137, and cobalt-60.

Four OUs have been identified for WAG 3: (1) SWSA 3; (2) contractor’s landfill and scrap metal yard surface soil; (3) groundwater; and (4) surface water and sediments (i.e., Raccoon Creek; WAG 2 may also include the Northwest Tributary of WOC).

3.3.2 Operable Unit 3A: SWSA 3 (Trenches and Buried Solvent Tank)

The proposed remedial action is containment using a cap, storm flow control using drains, and surface water control. During the field investigation, the trench boundaries will be identified, and the trenches characterized using geophysics. Existence and location of the buried solvent tank will be investigated.

3.3.3 Operable Unit 3B: Contractor’s Landfill and Scrap Metal Yard Surface Soil

The contractor’s landfill is divided into a "new" closed landfill (eastern portion) which is already capped and is assumed to require no further action, and an "old" landfill (western portion) that is assumed to require a RCRA cap. The cap will be designed to divert surface runoff. At the scrap metal yard, the remedial action is excavation of the residual contamination and disposal under the planned RCRA cap of the west contractor’s landfill. The sampling and survey activities of the RI field work will provide the information needed to design the remedial actions.
3.3.4 Operable Unit 3C: Groundwater

The groundwater is assumed to be collected at the WAG boundary using collection drains and then treated. Seismic surveys, hydrology tests, and a water balance study will aid in defining depth to bedrock and groundwater collection criteria.

3.3.5 Operable Unit 3D: Surface Water and Sediments

The collection drains mentioned for the groundwater OU above will also be used to collect the surface water. Sediments will be removed mechanically, dried, and buried under the cap. Potential early actions considered in the workshop are to install a sediment trap on Raccoon Creek and to locate and divert the culvert located under SWSA 3. Sampling and analysis will be performed to characterize the nature and extent of contamination. Discharge areas from seeps will also be identified and quantified.

3.3.6 Special Considerations

DOE will determine if WAG 2 includes the Northwest Tributary, and will interface with TDEC to determine if the east "new" landfill is actually closed in a regulatory sense. Some interface will be required with Waste Management regarding groundwater treatment capacity and waste acceptance criteria at the PWTP/Nonradioactive Waste Treatment Plant (NRWTP).

3.4 WAG 4—SWSA 4, ILLW TRANSFER LINES, AND EPA

3.4.1 General

WAG 4 consists of SWSA 4, abandoned intermediate-level liquid waste (ILLW) transfer lines, and the Experimental Pilot Pit Area (EPA). SWSA 4 was used from 1951 to 1959 for disposal of low- and high-level radioactive wastes in trenches and auger holes. From 1959 to 1973 it was also used for storage of construction and demolition debris. The buried ILLW transfer lines were used from 1952 to 1975 to transfer liquid waste from the main plant area to other areas. The EPA was used periodically until 1983 to conduct experiments on fixation of high-level waste into a stable solid. Some experimental equipment (e.g., concrete bunkers, plastic tanks) still remains at the site. The RI work plan has been completed for WAG 4. Prior corrective actions focused on surface water diversion around SWSA 4.

Five OUs have been identified for WAG 4. These include SWSA 4, groundwater and seeps, the ILLW pipeline, the EPA, and an explosives trench.

3.4.2 Operable Unit 4A: SWSA 4 (Trenches and Auger Holes)

The final remedial action proposed during the workshop for SWSA 4 was containment. The trenches (with the exception of the explosives trench) will be stabilized by dynamic compaction and a cap will be placed over the area. Special consideration of erosion potential is required for stormwater runoff from the cap through the floodplain. A French drain will be placed on the north side of SWSA 4 to divert surface water and storm flow around the
Data requirements to institute the remedial action include determining the location (outline) of the trenches, evaluating the feasibility of dynamic compaction, and determining if the water from the subsurface drains requires treatment.

3.4.3 Operable Unit 4B: Shallow Groundwater and Seeps

The recommended remedial action is installation of downgradient drains along the length of the eastern boundary to capture water contaminated by the source, and subsequent treatment of the captured water at the PWTP. The location, volume, and characteristics of the seep discharges will need to be evaluated to determine if seep collection and treatment is needed. This action was also proposed as an early action. For the known "bathtubbing" area, a demonstration of the Russian (wet trench) grouting procedure will be performed.

3.4.4 Operable Unit 4C: ILLW Pipeline

The pipeline will be plugged and abandoned. If pipeline leaks are known to have occurred, the contaminated soil and associated pipeline segments will be removed and placed under the SWSA 4 cap.

3.4.5 Operable Unit 4D: Experimental Pilot Pit Area

The proposed remedial action is to collect the remaining equipment and contaminated waste, demolish structures, and consolidate them under the SWSA 4 cap. A walkover radiological survey will be performed to determine if any surface soil contamination also exists on-site. Municipal waste will be disposed of in accordance with noncontaminated trash disposal practices.

3.4.6 Operable Unit 4E: Explosives Trench

Containment is the preferred remedial action for the explosives trench. The area will be capped, and surface water/storm flow controls will be installed to divert water from the cap. It is assumed that, during construction, conventional health and safety methods (e.g., blast mats) will be used. A literature review of in situ treatment will be performed (using sulfides) as a technique for desensitizing the trench and reducing the risk of explosion during construction.

3.4.7 Special Considerations

The WAG boundaries enclose only a portion of the ILLW pipeline. Responsibility for the remaining pipeline segments outside of the WAG will be assigned through remediation activity at individual WAGs. Planning and coordination are needed with WAG 2 and 4 management regarding efforts on the contaminated floodplain; with D&D and ER Program regarding cleanup efforts on EPA and the pipeline; with Waste Management on collected water treatment; with the K-25 D&D facility with regard to the EPA; and with the safety committee regarding the explosives trench. The DOE TRU policy will also impact remedial actions on the trenches and auger holes.
3.5 WAG 5—SWSA 5, ILLW PIPELINE, HYDROFRACTURE SURFACE FACILITIES, AND OTHERS

3.5.1 General

WAG 5 is primarily a 50-acre landfill that operated from 1959 to 1973. Principal waste areas include SWSA 5, hydrofracture surface facilities [Old Hydrofracture Facility (OHF) and New Hydrofracture Facility (NHF)], ILLW and LLLW pipelines to the hydrofracture facilities and associated leak sites, a sludge basin, OHF waste storage tanks, and a 10-acre TRU waste storage area. With the exception of the subsurface tanks and pipelines, the hydrofracture surface facilities are not included in the life cycle baseline. The TRU waste storage area is also not included in the life cycle baseline. Identified contaminants are radionuclides and metals, but the nature and extent of contamination is still largely unknown. A revised RI work plan has been submitted to the Environmental Protection Agency, but RI field work has not yet started. Prior corrective actions include isolation of the Seep 4 source.

Operable units defined for this WAG focus on the impoundments, tanks associated with the hydrofracture facilities, subsurface disposal areas, pipelines and leak sites, and the groundwater. As previously stated, potential remedial actions for WAG 5, as discussed in the following sections, were developed at previous workshops.

3.5.2 Operable Unit 5A: Surface Impoundments

Remedial actions recommended at the workshop include removal and treatment of the liquids in the impoundments, in situ solidification of the underlying sediments, and capping. Characterization and treatability studies during the RI/FS process are needed for both the liquids and sediment.

3.5.3 Operable Unit 5B: Tanks

For purposes of the life cycle baseline, in situ stabilization was selected as the remedial action. Options for in situ stabilization of the tank contents and in situ vitrification of the tanks and contents were identified during the workshop. Tank content characterization will indicate if the contents can be pumped out of the tanks and treated using current processes at ORNL.

3.5.4 Operable Unit 5C: Subsurface Disposal

The action proposed during the workshop for the subsurface disposal units is containment. The trenches will be delineated using geophysical surveys and then stabilized prior to capping to prevent subsidence. French drains will be installed for diverting/collecting subsurface water, thereby lowering the water table. It is assumed that the collected water is not contaminated and will not require treatment at the PWTP (direct discharge).
3.5.5 Operable Unit 5D: Buried Pipelines

A geophysical survey is needed to establish the location of the pipes. If a pipeline is located under the proposed cap (see OU 5C), the pipeline is assumed to be abandoned in place. If the pipeline route falls outside the cap boundary, then the pipeline (and backfill, if contaminated because of leaks) is assumed to be excavated and consolidated under the cap.

3.5.6 Operable Unit 5E: Groundwater

The remedial action assumes that only the upper groundwater zone (regolith) is contaminated, and that the contaminated groundwater can be collected at surface seeps. It was assumed that the groundwater will be collected at the WAG 5 boundary and treated at the PWTP. Hydrogeologic data and contaminant concentrations in the upper and lower zones are needed to confirm the suitability of the remedial action. Although remedial actions for groundwater were identified, the consensus from the workshop was that groundwater remediation would likely be performed as part of the groundwater area-wide OU.

3.5.7 Special Considerations

Interface needs for WAG 5 include D&D programs, with regard to the schedules of D&D activities for the building or tanks; Waste Management, with regard to capacity and waste acceptance criteria for treatment of contaminated groundwater and tank contents; and WAG 2 management, for coordination of streams and seeps investigation/remediation.

3.6 WAG 6

The workshop did not address WAG 6 because a proposed remediation plan is currently being prepared. An updated baseline design report is also being prepared.

3.7 WAG 7—PITS AND TRENCHES, DECONTAMINATION FACILITY, AND HRE FUEL

3.7.1 General

The WAG 7 area, in service from 1951 to 1966, contains four ILLW pits, three ILLW trenches, a hydrofracture experiment spill site, a decontamination facility, homogeneous reactor experiment (HRE) fuel wells, and LLLW pipelines and associated leak sites. Radiological contaminants are primarily fission products with some tritium, uranium, and transuranics. Metals are also contaminants of concern.

The RI work plan has been submitted to regulators, and work is anticipated to start in Fiscal Year (FY) 93. Prior corrective actions have included filling and asphalt capping of the pits, asphalt capping of the trenches, grouting of the fractured shale surrounding Trench 7, removing contaminated soil and/or asphalt capping two LLLW line leaks, and removing soil at the hydrofracture experiment spill site. Operable units established for WAG 7 are the
primary contamination sources (subsurface disposal areas), pipeline and spill leaks sites, and secondary sources (soil, groundwater, and vegetation).

3.7.2 Operable Unit 7A: Primary Sources (Subsurface Disposal Areas)

The primary sources include the pits, trenches, and HRE fuel wells. Three remedial actions were considered in the workshop for the primary sources: containment with caps and surface storm flow controls, in situ grouting, and in situ vitrification. A primary data need for the containment option is to determine the stability of the pits and trenches. Technical demonstrations will be needed for the in situ grouting and vitrification. Defining the source term (i.e., how much of the waste material remains in the primary sources versus how much has migrated to the secondary sources) is critical in determining the relative effectiveness of the remedial actions for the primary and secondary sources. Potential early actions include cap extension, runoff diversion, and a slope buttress.

3.7.3 Operable Unit 7B: Pipeline and Associated Spills and Surface Contamination

Three remedial actions were considered for this pipeline OU: removal and consolidation of the pipe and contaminated soil, removal of the pipe but in situ stabilization of the trench zone, and containment of the pipe and soil by grouting the pipe and capping. In each case, the location of the pipelines and the extent of the contamination need to be known. A treatability study on in situ stabilization of the pipeline trenches is assumed to be required for purposes of the life cycle baseline.

3.7.4 Operable Unit 7C: Secondary Sources (Soils, Surface Water, Groundwater, Vegetation)

The two proposed remedial actions are containment, and removal and consolidation. The containment option consists of a cap with surface water controls and intercepts/drains for the shallow groundwater. The removal and consolidation option consists of soil excavation, groundwater/surface water collection, and composting of vegetation. Typical RI field activities will provide the data necessary for implementing these options. Potential early actions include seep and surface water collection, and selective removal of trees.

3.7.5 Special Considerations

Interface issues to be addressed for this WAG include assigning responsibility for pipelines outside of the WAG 7 boundary, assigning responsibility for post-implementation monitoring, coordinating with Waste Management on disposal or treatment of collected water, and scheduling with the D&D Program for work on for Building 7819.
3.8 WAG 8—Research and Development Facilities and Waste Treatment Facilities Supporting ORNL Activities

3.8.1 General

WAG 8 has been in operation since 1951. Located within its boundaries are various research and development (R&D) facilities that include the Molten Salt Reactor Experiment (MSRE), the High Flux Isotope Reactor, the Transuranic Processing Plant, and the Transuranic Research Facility. Waste types produced by these research and development facilities and stored at WAG 8 in ancillary waste treatment facilities include radioactive process water; solutions containing silver; solutions containing residual organics, acids, and hydroxides; LLW; sanitary wastes; waste oils; and possibly PCBs. A prior corrective action at WAG 8 was the removal of contaminated soils at ILLW transfer pipeline leak sites. Interim actions for the WAG 8 impoundments are being considered for the near future. An R1 work plan has been issued.

Six OUs have been identified for this WAG: impoundments/basins, tanks, pipelines and leak sites, HF2 injection well facilities, the spoil area and miscellaneous surface contamination, and groundwater.

3.8.2 Operable Unit 8A: Impoundments/Basins

The remedial action proposed for the impoundments is containment. This action includes in situ solidification with capping and surface water and shallow storm flow controls to divert water from the cap. Data needs include historical research into the MSRE operations and a treatability study on in situ solidification. To expedite remedial action at the impoundments, an IROD may be issued by 1993.

3.8.3 Operable Unit 8B: Tanks

The remedial action considered for the WAG 8 tanks is contents removal and in situ grouting. Data needs are similar to those discussed for WAG 1 tanks. No further action was assumed for the septic tank.

3.8.4 Operable Unit 8C: Pipelines and Leak Spill Sites

The principal remedial action for the buried pipes is the removal, compaction, and disposal of pipelines in a potential new storage facility. Alternatives considered for the pipes are decontamination and reuse, or disposal under a cap rather than a new storage facility. If the number of spill sites and extent of contaminated soil from spills is relatively small, the soil will be excavated and consolidated if possible. Otherwise, containment may be more feasible.
3.8.5 Operable Unit 8D: HF2

Assuming no surface soil contamination exists outside of the wellhead, the wellhead will be plugged as part of the WAG 10 remedial action. No other action is anticipated unless the field investigation discovers additional contamination in surface soils.

3.8.6 Operable Unit 8E: Contractor Spoil Area and Miscellaneous Surface Contamination

The remedial action for this OU is containment consisting of a cap and surface water/storm flow diversion. This action assumes that the trenches are structurally stable and do not require stabilization, and that the collected water is not contaminated. The RI will supply the data needs for the assessment.

3.8.7 Operable Unit 8F: Groundwater

It is assumed that the groundwater will be monitored by existing monitoring wells at the impoundments. It is also assumed that groundwater remedial actions (if required) would be part of the WAG 2 remediation.

3.8.8 Special Considerations

It was recommended during the workshop that an overall strategy for pipelines be instituted that would include all WAGs. This will make the approach for the pipelines similar to that for the Well P&A Program. Interface issues for WAG 8 include ERP conflicts with ongoing operations; coordination with WAG 10 and Well P&A; efforts on the HF2 well; coordination with WAG 2 on groundwater issues; status checks with Waste Management on LLLW tanks; schedule and location coordination with Facility Planning on the new WAG 1-to-Melton-Valley transfer pipeline; and a status check on the RCRA closure of the 7507 Hazardous Waste Management Area.

3.9 WAG 9—HOMOGENEOUS REACTOR EXPERIMENT (HRE) AREA

3.9.1 General

WAG 9 consists of an unlined earthen pond used for the storage of LLLW from the HRE, two underground tank systems used to store contaminated liquid wastes, an active septic tank used to process domestic sewage, and a parking lot that was originally used for materials storage during the HRE operation. The surface impoundment, containing radiological and chemical liquid waste, was closed by backfilling with soil and shale fragments. The RI plan has been completed.

The four OUs identified for this WAG are the surface impoundment, the tanks, miscellaneous contaminated areas, and the groundwater.
3.9.2 Operable Unit 9A: Surface Impoundment

Containment is the proposed remedial action for this OU. As with other WAGs, the action consists of in situ solidification, capping, and surface water/storm flow controls. Some field investigative data have been gathered for the impoundment, and PCB contamination has been noted that exceeds the limits established by the Tennessee Hazardous Substance Guidance for soil. This action assumes that the TSCA applicable or relevant and appropriate requirements for PCBs will not interfere with implementation, and that solidification is shown to be feasible based on the RI/FS and treatability study.

3.9.3 Operable Unit 9B: Tanks

The two underground tank systems have 1,000-gal and 12,000-gal capacities. Containment, consisting of liquids removal, grouting in place, and piping isolation, is the recommended final remedial action. The data needs and suggested studies are similar to those suggested for WAG 1 tanks.

3.9.4 Operable Unit 9C: Miscellaneous Contaminated Areas

This OU focuses on the septic tank, parking lot, soils, waste evaporator, and the trash area. Based on the planned site investigation, it is assumed that NFA alternative for this OU will be recommended.

3.9.5 Operable Unit 9D: Groundwater

Groundwater will be considered under the area-wide groundwater OU.

3.9.6 Special Considerations

Interface will be required with the D&D Program regarding scheduling of activities for structures and tanks; with K-25 incinerator activities regarding availability and capacity for potential treatment of PCB-contaminated soils; and with WAG 9 and Well P&A Program on overlapping responsibilities.

3.10 WAG 10—UNDERGROUND COMPONENT OF THE VARIOUS HYDROFRACTURE WASTE FACILITIES

3.10.1 General

Between 1959 and 1984, 46 slurry injections were made into shale formations to form thin grout sheets along fractures and bedding planes. The slurry was composed of liquid radioactive waste mixed with cement and other additives. Some of the contaminants are fission products, miscellaneous TRU, and various heavy metals. WAG 10 consists of the underground component (i.e., wells and grout) of the various hydrofracture waste facilities. The surface hydrofracture facilities are covered by other WAGs. An RI work plan and an RI
implementation plan have been reviewed by the regulators. An IROD for well P&A is slated for 1993.

Three OUs were identified in the workshop: the grout sheets, the deep groundwater, and the injection wells and deep boreholes.

3.10.2 Operable Unit 10A: Grout Sheet

The RI work plan identified continual monitoring as a remedial action. Monitoring the deep groundwater (see OU 10B) serves as an indicator of possible migration. The monitoring will be long term. However, the well logging and sampling will be started as an early action to support the P&A of rock cover wells.

3.10.3 Operable Unit 10B: Deep Groundwater

The remedial action consists of fault monitoring to determine if migration from the grout sheets has occurred.

3.10.4 Operable Unit 10C: Wells and Boreholes (Experimental and Production)

It is assumed that the injection wells and 90 percent of the monitoring wells will be plugged and abandoned to lessen the risk of contaminant migration along the wells and boreholes. Ten percent of the monitoring wells will be recompleted to perform selected monitoring for other OUs/WAGs. As part of the Wells P&A, program studies will be performed on the special procedures and tools needed for P&A, and for the compatibility of the grouting mix.

3.10.5 Special Considerations

Interface will be required with those WAGs and programs (e.g., WAGs 2, 5, 7, 8, and D&D) responsible for the surface hydrofracture facilities. Similar coordination will be needed for the area groundwater individual, WAG groundwater, and saline groundwater OUs. Waste Management interface is needed to determine acceptability (capacity and waste acceptance criteria) of the contaminated groundwater and RI purge water at the PWTP/NRWTP. Pretreatment of the purge water and special handling of the filtrate may also be needed. Interface is needed to determine if a new reactor facility, Advanced Neutron Source (ANS), will be located at a background well location.

3.11 WAG 11—WHITE WING SCRAP YARD

3.11.1 General

WAG 11 is a 30.4-acre site known as the White Wing Scrap Yard. This area was used for above-ground storage of scrap metal for K-25, Y-12, and ORNL facilities. Wastes reportedly stored at the site include steel tanks, earth-moving equipment, and several reprocessing reactor vessel components. Identified radionuclides include uranium, thorium, and fission products. Plutonium-239 has not been detected but may also be present according to
historical reports. Site cleanup efforts, consisting of removal of a majority of large pieces of equipment and some contaminated soil, occurred from 1966 to 1970. An RI work plan has been prepared.

The OUs for WAG 11 are the surface water/sediments, groundwater, and the scrap yard soil, both surface and subsurface. Prior OU decisions include removal of debris (FY92-93), containment of mobile contaminants (FY92-93), and restricted site access.

3.11.2 Operable Unit 11A: Surface Water and Sediments

The proposed remedial action for the sediments is removal of the hot spots. This action assumes that the contamination is confined to isolated areas and is not widespread. A radiological survey will be used to confirm that the hot spots have been removed.

3.11.3 Operable Unit 11B: Groundwater

It is assumed that groundwater treatment will not be required. Periodic groundwater sampling and analysis will be used to monitor water quality. The existing monitoring well system will be evaluated and upgraded if needed.

3.11.4 Operable Unit 11C: Surface and Subsurface Soil

As mentioned in Sect. 3.11.1, potential early actions include debris and contaminated soil removal in September 1992. Subsurface geophysics will be used to identify burial areas. It is assumed that debris would be segregated, perhaps compacted in the SEG Super Compactor, and then disposed of in a new facility designed and built to receive the debris. The contaminated soil removed from the site will be decontaminated by soil washing and ion exchange, and then disposed of at SWSA 6. A small volume of TSCA (PCB-contaminated) soil will also need to be stored or treated.

3.11.5 Special Considerations

In performing remedial actions at WAG 11, coordination with the following plans/programs will be required: Environmental Monitoring Plan, K-25 Groundwater Area, East Fork Poplar Creek Remedial Plan, and the Waste Management Facility Plan. Since PCBs have been detected, interface will be needed with K-25 incinerator staff regarding TSCA/PCB waste acceptance criteria.

3.12 WAG 12—CLOSED CONTRACTOR'S LANDFILL

WAG 12 is a 2.9-acre inactive landfill that was in operation from 1950 to 1975. No disposal records exist. The landfill contains construction and demolition debris. It may also contain paints and solvents. Identified contaminants include nickel and near-background levels of cobalt-60, strontium-90, and cesium-137. The RI plan for WAG 12 is not yet developed.
The final remedial action proposed during the workshop is containment in the form of a Tennessee Department of Environmental Conservation municipal landfill cap. The action also includes groundwater/surface water interception and diversion. It is assumed that media sampling during the PA/SI will be sufficient to characterize the landfill and support an ROD without the added cost of an RI. For the purposes of the life cycle baseline no further action after capping is assumed.

3.13 WAG 13—ENVIRONMENTAL RESEARCH AREAS

3.13.1 General

WAG 13 consists of two sites, approximately 5 acres in size, on the north bank of the Clinch River, that were used for environmental research. One site was used for research on the effects of nuclear fallout on the environment; the other was used to study cesium-137 runoff, erosion, and infiltration on silt loam soil. An RI plan has been issued. No corrective actions have yet been taken at WAG 13. However, removal of cesium-137 contaminated silica beads is a priority IROD.

During RI field activities, samples will be collected from the biota, groundwater, and the spray/exposure areas. It is assumed that the sample analysis will show that the levels of contamination in the biota and groundwater are insignificant and require no further action. The expected depth of contamination in the spray/exposure areas is 1.5 ft. It is assumed that the contaminated soil will be removed and disposed of at the Interim Waste Management Facility located at SWSA 6.

3.14 WAG 14—TOWER SHIELDING FACILITY

It was decided there were no remedial actions required at WAG 14 other than D&D activities, which will be performed as part of the D&D Program.

3.15 WAG 15—ORNL FACILITIES AT Y-12

WAG 15 consists of ORNL storage facilities at Y-12. Two SWMUs have been identified: the Cyclotron Pit 9204-1 and the East End Basement 9204-1. The principal waste is PCB-contaminated oil. The oil is currently stored in transformers and capacitors. The RI plan has not yet been developed, and no remedial actions were identified for this WAG. For the purposes of the life cycle baseline, it is assumed that the potential for environmental contamination is limited, and that an NFA decision will be made.

3.16 WAG 16—HEALTH PHYSICS RESEARCH AREA

3.16.1 General

WAG 16 is composed of two OUs: a cesium forest and a buried scrap metal area. The cesium forest consists of 30 trees inoculated 28 years ago with 467 mCi cesium-137. In addition to cesium, other radionuclides have been identified at the two OUs: tritium, cobalt-
60, and strontium-90. No RI plan has yet been developed, and no corrective actions have been implemented.

3.16.2 Operable Unit 16A: Cesium Forest

Most of the cesium should be retained in the trees with only small fractional losses through leaf dissemination. The remedial action proposed for the cesium forest is containment consisting of groundwater/surface water interception and diversion. The sediments will be trapped, and after an appropriate time to allow for decay, will be collected and treated.

3.16.3 Operable Unit 16B: Buried Scrap Metal Area

No remedial actions were proposed for the buried scrap metal area. For life cycle baseline purposes, it is assumed that a PA/SI would be completed and that an NFA decision will be made.

3.17 WAG 17—Storage and Support Facilities for Routine and Experimental ORNL Operations

WAG 17 is still active. It consists of services and support shops and material storage facilities for routine and experimental ORNL operations. The shops provide a range of services including printing, painting, welding, lead burning, and vehicle service and maintenance. The storage facilities include a septic tank, four waste oil storage tanks, one waste oil storage truck, and two photographic reproduction waste storage tanks. Cleanup of a small release of gasoline from one storage tank has been performed.

Four SWMUs have been identified, and all have been classified as requiring NFA. Although an RI plan and RI implementation plan have been reviewed by the regulators, an NFA judgement will be assumed for purposes of the life cycle baseline.

3.18 WAG 18—CONSOLIDATED FUEL REPROCESSING AREA

3.18.1 General

WAG 18 is an area once used for the Experimental Gas Cooled Reactor (EGCR) and for reprocessing experiments. The EGCR never went critical due to funding limitations. Wastes handled include process water, sanitary sewage, and organic solvents. An RI plan has not yet been developed. Three OUs have been identified for this WAG: the two EGCR ponds, a paint solvent storage tank, and a waste acid storage tank.

3.18.2 Operable Units 18A: EGCR Ponds A and B

These ponds were never used for their intended purpose; they were used instead for collection of surface water runoff. It is assumed that a PA/SI will be performed with an NFA conclusion.
3.18.3 Operable Unit 18B: Paint Solvent Storage Tank

This 280-gal tank has been removed from service. During the PA/SI, the tank contents will be sampled. If necessary, the tank contents will then be removed and treated at the TSCA incinerator. For purposes of the life cycle baseline it is assumed that an NFA decision will be made.

3.18.4 Operable Unit 18C: Waste Acid Storage Tank

This tank contains slightly acidic waste contents. It is assumed that a PA/SI will be performed on the tank; that the tank contents will be removed, neutralized, and treated at ORNL; and that a subsequent NFA decision will be rendered.

3.18.5 Special Considerations

The tanks fall under the auspices of the Underground Storage Tank (UST) program. If the contents of the paint solvent storage tank require treatment, interface with the Waste Management Program will be required.

3.19 WAG 19

It was agreed not to address WAG 19 for purposes of the life cycle baseline.

3.20 WAG 20—OAK RIDGE LAND FARM

WAG 20 is a 65-acre municipal sewage, sludge application site that was in operation from 1983 to about 1986. Approximately 6 million gallons of sewage sludge were disposed of in this land farm. Although surface water/groundwater sampling does not indicate a threat, cesium-137 and cobalt-60 have been found in soil samples. For life cycle baseline purposes, it is assumed that a PA/SAI will be performed and a NFA decision will be made.

3.21 AREA GROUNDWATER

3.21.1 General

This OU includes groundwater deeper than 60 feet throughout the ORNL. Groundwater in each valley is considered separately.

Based on the assumption that the deep groundwater is not contaminated (or not contaminated above action levels), the general remediation approach is to monitor for contamination. Special data needs include identification of seeps and obtaining a baseline on background groundwater concentrations. To help prepare a full range of alternatives, it will be necessary to perform a study on the practicality of restoration, a study on the impact of competing (CERCLA versus RCRA) regulations on restoration, and a technical demonstration on the pump and treat method. The demonstration should evaluate the importance of matrix diffusion attenuation to the pump and treat method.
3.21.2 Special Considerations

The area groundwater OU crosses all WAG boundaries. It is therefore expedient that any groundwater remediation activities be coordinated with remediation activities of each individual WAG. In addition, clear responsibility for the groundwater at WAG 11 will be assigned to either ORNL or K-25. Other interface requirements include resolution of permit conflicts; coordination with DOE, Radian, and ORNL regarding the East Fork Poplar Creek remediation; and coordination with the ORNL groundwater monitoring program, UST groundwater monitoring, and the U.S. Geological Survey regarding identification of seeps.

3.22 WELL PLUGGING AND ABANDONMENT

3.22.1 General

An IROD is scheduled for September 1993 that will initiate well and borehole P&A. The duration of the P&A activity is assumed to be 5 years. This activity affects most wells; exceptions are as follows: (1) new wells will be covered by the remedial action for each WAG; (2) existing wells at WAGs 5, 6, and 10 will be covered by the remedial action at their respective WAGs; and (3) existing wells that will be used for monitoring, confirmation, or other long-term RI activities will be left unplugged. An inventory of all wells is maintained in a data base by ORNL as part of the ORNL groundwater monitoring program. (Paul Baxter is the program coordination.) The inventory can be provided to estimators to assist them in preparing life cycle costs for this effort.

Data needs for P&A include a Well P&A Plan to prioritize sites and document the procedures, and a specific study to evaluate waste minimization and cost effectiveness of different P&A methods. A technical demonstration is also appropriate to demonstrate selected methods and verify costs.

3.22.2 Special Considerations

Coordination will be needed among the P&A activity, the individual WAG remedial activities, and the area groundwater OU to identify and schedule the specific wells that need to be plugged. Additional coordination will be needed with the ORNL Groundwater Coordinator and ORNL Operations.
Appendix A

LIFE CYCLE WORKSHOP ATTENDEES AND AGENDA
### Appendix A

**Life Cycle Workshop-Attendees**  
October 14, 1991

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<thead>
<tr>
<th>Name</th>
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## Life Cycle Workshop
**October 17, 1991**

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ORNL ERP
LIFE-CYCLE COSTING WORKSHOP
Energy Systems/BNL Team
October 1991

AGENDA (OVERVIEW)

MONDAY, Oct 14th
8:00am - 2:00pm Introduction & Background
2:00pm - 5:00pm WAG 7

TUESDAY, Oct 15th
8:00am - Noon WAG 1
1:00pm - 3:30pm WAG 10
3:30pm - 5:00pm WAG 4

WEDNESDAY, Oct 16th
8:00am - 10:00am WAG 4 (cont'd)
10:00am - 2:30pm WAG 3
2:30pm - 5:00pm WAG 9

THURSDAY, Oct 17th
8:00am - 11:00am WAG 11
11:00am - 2:00pm WAG 8
2:00pm - 5:00pm WAG 13

FRIDAY, Oct 18th
8:00 am - 10:00am WAG 2
10:00am - 1:30pm Area Groundwater
1:30pm - 3:30pm WAG 17
3:30pm - 4:00pm Well Plugging & Abandonment (P&A)
4:00pm - 5:00pm Summary & Closure
Monday, October 14:

8:00 am  INTRODUCTIONS  Sid Garland/
         Energy Systems
         Review Overall Agenda

8:15 am  OVERVIEW OF LIFE-CYCLE COSTING  Sid Garland/
         Energy Systems
         • DOE Initiatives/Requirements
         • Nov '91 vs Long(er)-term Objectives
         • Flow Diagram of L-C Development Process

9:00 am  OVERVIEW OF ORNL ERP  Sid Garland/
         Energy Systems
         • "Organization Chart"
         Illustrate, using Sid’s diagram: DOE->"Integrating contractor" (Energy Systems)>(Energy Systems(11/AA) - Radian(FS/EA) - EBASCO(RD) - MK-F(RA))
         • Overview of ERP Scope
         Discuss Number of WAGs & WAG Priorities; Interfaces among ER, Engrg, Ops, D&D, etc.
         • Background and Application of the Observational Method for ORNL ERP
            Larry Holm/CH2M HILL
            - Background of the Observational Method
            - Two results (in traditional remedial planning): study forever and/or "surprise" during implementation
            - Technically hamstrung by uncertainty in: conditions, regulations, and/or technology performance.
            - Borrowed from traditional geotechnical engineering (geologic uncertainties)
            - Waste remediation has geologic AND many additional uncertainties
- Elements of the Observational Method:
  + Characterization for general understanding
  + Interpret/predict expected conditions and deviations
  + Base design on expected conditions
  + Contingent design for deviations and design specific monitoring
    to determine if deviations are occurring
  + Implement the basic design and monitoring
  + Implement the contingent design as warranted based on
    monitoring.
- Compendium: Endorsements in Concept; Precedent in Geotechnical
  Engineering; Problem Statement; Case Studies; and, Bibliography
- Appropriate application of the Observational Method demands that the RI-
  >FS->RD->RA be considered as a continuum.

10:00 am BREAK

10:15 am OVERVIEW OF WORKSHOP Larry Holm/CH2M HILL
- Purpose of Workshop
  To review priority of WAGs; formulated approach & assumptions sufficient to
  allow a baseline of the ERP to be developed.
- Review of Typical WAG Agenda
  Review of WAG Situation (Use WAG Fact Sheets)
  Conceptual Model
  Identification of Potential Operable Units, "Early Actions", etc.
  Identification of Potential Overall Remedial Actions
  Discussion of Expected Conditions and Deviations (Observational Approach
  context)
  Identification of Remedial Investigation "Needs" (including Site
  Characterization (Special Studies) and Technology Demonstrations)
  Identification of Special Interface Issues (e.g. Ops->D&D->ER, etc.)
  Document General and Specific Assumptions for Life-Cycle Costing

10:45 am OUTLINE OF WORKSHOP PRODUCTS Larry Holm/CH2M HILL
For Each WAG:
- Identify Potential Operable Units, OUs (if appropriate)
- Potential Overall Remedial Actions
- Remedial Investigation "Needs" (including Site Characterization (Special
  Studies) and Technology Demonstrations)
- Identify Potential "Early" Actions (Interim, Expedited, Initial, etc.)
- Special Interface Issues (e.g. Ops->D&D->ER, etc.)
- Document General and Specific Assumptions for Life-Cycle Costing
OVERVIEW OF RESPONSE ACTIONS/TECHNOLOGIES

Provide overview of remedial action and technologies (by remedial groupings). These will be used to facilitate WAG-specific remedial action discussion.

- Remedial Groupings
  - Subsurface Disposal Sites
  - Impoundments
  - Pipeline Leaks/Spill Sites
  - Tanks
  - Groundwater
  - Surface Water (creeks/lakes)
  - Hydrofracture Injection Sites (wellheads)

- General Response Actions for Remedial Groupings
  - No Action
  - Institutional Controls
  - Containment
  - Treatment
  - Removal (excavation/collection)
  - Disposal

- General Response Actions/Remediation Technologies
  - No Action
  - Containment
    - Capping
    - Slurry Walls/Barriers
    - Drains/Trenches
    - Grout Encapsulation
    - Surface Controls
    - Dewatering
    - Structural Stabilization (compaction/grouting)
  - Institutional Controls
    - Active (Guards, Monitoring, Maintenance)
    - Passive (Deed Restrictions, Markers, Barriers)
  - Treatment
    - In Situ
    - Recovery/Recycling
    - Thermal
    - Stabilization/Solidification
    - Bioremediation
    - Physical
    - Chemical
  - Removal
    - Excavation (remote included)
    - Groundwater/Surface Water Collection
    - Gas Collection
  - Disposal
    - Segregation
    - Recoverable Storage
    - Repackaging (remote included)
    - Solids Disposal
    - Onsite (consolidation)
    - Offsite
    - Water Discharge
      - ORNL Treatment Systems
      - Surface Water
11:15 am  WAG 5 (EXAMPLE)  Angie Brill/ERCE

Based on the previous WAG 5 workshop(s), summarize the results for each of the six "Workshop Products" bulleted above.

- Review of WAG 5 Characteristics
- Conceptual Model
- WAG 5 Operable Units
- Identification of Potential Overall Remedial Actions
- WAG 5 "Early Actions"
- Expected Conditions & Deviations (Observational Approach context) at WAG 5
- Identification of Remedial Investigation "Needs" (Including Site Characterization (Special Studies) and Technology Demonstrations)
- Identification of Special Interface Issues (e.g. Ops->D&D->ER, etc.)

12:00 pm  LUNCH

1:00 pm  WAG Priorities for Life-Cycling Costing  Sid Garland/ERCE

- WAGs 1, 5, 7, & 10
- WAGs 3, 4, 9, 11
- WAGs 2, 8, 13, 17
- Others (e.g. area groundwater)
- Life-Cycle Cost Report by 7/92
2:00 pm  WAG 7:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit--Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts

5:00 pm  ADJOURN
Tuesday, October 15:
8:00 am  WAG 1:

WAG Overview and Definition of Operable Units

• WAG Overview
• Conceptual Model
• Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

• Conceptual Model
• Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
• Expected Conditions and Deviations for Selected RA
• Identify Data Requirements
  • Remedial Investigation
  • Site Characterization Program (Special Studies)
  • Technical Demonstrations
• Identify Potential Early Actions for each Operable Unit

Special Issues

• Program Interfaces/Responsibilities
• Facilities Planning
• Operations Impacts
1:00 pm WAG 10:

**WAG Overview and Definition of Operable Units**

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

**Operable Unit—Conceptual Model, Remedial Actions and Data Needs**

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

**Special Issues**

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
3:30 pm  WAG 4:

WAG Overview and Definition of Operable Units

• WAG Overview
• Conceptual Model
• Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

• Conceptual Model
• Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
• Expected Conditions and Deviations for Selected RA
• Identify Data Requirements
  • Remedial Investigation
  • Site Characterization Program (Special Studies)
  • Technical Demonstrations
• Identify Potential Early Actions for each Operable Unit

Special Issues

• Program Interfaces/Responsibilities
• Facilities Planning
• Operations Impacts

5:00 pm  ADJOURN
Wednesday, October 16:

8:00 am WAG 4 (cont'd):

(Note: See Previous Day's Agenda)

10:15 am WAG 3:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit--Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts

5:00 pm   ADJOURN
Thursday, October 17:
8:00 am WAG 11:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
11:00 am  WAG 8:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
2:00 pm WAG 13:

WAG Overview and Definition of Operable Units

• WAG Overview
• Conceptual Model
• Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

• Conceptual Model
• Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
• Expected Conditions and Deviations for Selected RA
• Identify Data Requirements
  • Remedial Investigation
  • Site Characterization Program (Special Studies)
  • Technical Demonstrations
• Identify Potential Early Actions for each Operable Unit

Special Issues

• Program Interfaces/Responsibilities
• Facilities Planning
• Operations Impacts

5:00 pm ADJOURN
Friday, October 18:
8:00 am    WAG 2:

**WAG Overview and Definition of Operable Units**

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

**Operable Unit—Conceptual Model, Remedial Actions and Data Needs**

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

**Special Issues**

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
10:00 am  AREA GROUNDWATER:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts
1:30 pm WAG 17:

WAG Overview and Definition of Operable Units

- WAG Overview
- Conceptual Model
- Identify Potential Operable Units

Operable Unit—Conceptual Model, Remedial Actions and Data Needs

- Conceptual Model
- Identify Potential Final Remedial Actions for each Operable Unit; Select one for Baseline
- Expected Conditions and Deviations for Selected RA
- Identify Data Requirements
  - Remedial Investigation
  - Site Characterization Program (Special Studies)
  - Technical Demonstrations
- Identify Potential Early Actions for each Operable Unit

Special Issues

- Program Interfaces/Responsibilities
- Facilities Planning
- Operations Impacts

3:30 PM WELL PLUGGING & ABANDONMENT (P&A) Sid Garland/ Energy Systems

4:00 pm SUMMARY & CLOSURE Larry Holm/CH2M HILL

5:00 pm ADJOURN
Appendix B

INTRODUCTORY MATERIAL PRESENTED AT WORKSHOP
LIFE-CYCLE COSTING WORKSHOP

4TH Floor
Rm 411, 412, 413
October 14-18, 1991
OAK RIDGE NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM
LONG-RANGE PLAN
WORKSHOP

October 14-18, 1991
Purpose:
The purpose of the ORNL-ERP Long-Range Plan is to document the technical scope, schedule, and costs for all activities necessary to complete environmental restoration activities at ORNL.

Objectives:
1. All assumptions used in developing the scope, schedule and cost will be documented sufficiently to validate the plan, to explain variances, and to justify changes.
2. The Long-Range Plan will include all phases from PA/Sl through verification.
3. The Long-Range Plan will include all WAGs as well as other activities, such as site characterization and program management that are not WAG-specific.
4. The Long-Range Plan will reflect program priorities.
5. The Long-Range Plan will provide a tool to evaluate impacts of changing priorities, funding, etc.
6. The Long-Range Plan will provide a resource-loaded schedule.
7. The Long-Range Plan will include all DOE-OR contractors and subcontractors.
Objectives: (Cont.)

8. The Long-Range Plan will support preparation of other programmatic documents such as ADSs, EOC sheets, CYWPs, and budget submissions.

9. The Long-Range Plan will vary in accuracy but will document the uncertainty accordingly.

10. The Long-Range Plan will use the Observational Approach.

11. The Long-Range Plan will assess impacts on ORNL support services.
Scope:

1. Prepare a Work Breakdown Structure (WBS) for the program lifecycle.

2. Conduct an Observational Approach Workshop.

3. Capture the information from the Workshop and develop into a technical baseline for each WBS element.

4. Utilize the technical baseline established in 3., above, to develop a rough order of magnitude (ROM) cost assessment and schedule for each WBS element.

5. Document all assumptions.

6. Prepare a resource-loaded schedule for each WBS element.

7. Draft reports will be completed for WAGs 1, 5, 7, and 10 by 2/92; WAGs 3, 4, 9, and 11 by 4/92; and WAGs 2, 8, 13, and 17 by 6/92. A final report will be complete by 7/92. Engineering will manage the work; a subcontractor or other DOE prime contractor will assist in preparing schedules and estimates. Bechtel will prepare schedule and estimates for RI work.
LIFE-CYCLE COST DEVELOPMENT PROCESS

PROJECT PLAN

- WAG Prioritization
- Outputs
- Support Activities
- Estimating Protocol
- Schedule Protocol
- Level of Detail
- Roll-up Strategy
- Format

ES Engr.

LIFE-CYCLE COSTING WORKSHOP

BNI Team

REPORT FOR RESULTS

ES Engr.

Scope, Schedule, Estimate for Remainder

ES Engr.

Baseline Design Reports

ES Engr.

Overall Strategy Document

ES Engr.

Scope, Schedule, Estimate for RI Work

ERP

Prepare 1994 ADS

- Use New Scope
- Use Generic Schedules
- Use Life-Cycle Cost Estimates w/ Modifications
- Update as possible
ORR Environmental Restoration

INTEGRATING CONTRACTOR - ENERGY SYSTEMS ER

ENERGY SYSTEMS ER

LEE WANG ASSOCIATES

EBASCO

MK FERGUSON

TBD

CONTRACTORS

SI
Site Assessment

RI
Remedial Investigation

AA
Alternatives Assessment

FS/ROD
NEPA Feasibility Study

RD
Remedial Design

CM
Construction Management

IVC
Independent Verification Contractor

MAINTENANCE AND SURVEILLANCE - ENERGY SYSTEMS

ENERGY SYSTEMS

EBASCO

MK FERGUSON

LEE WANG

DOE

OTHER CONTRACTORS
REGULATIONS

PHASE 1: DOE Orders, CERCLA, and NEPA
10-year program with comprehensive EIS in 1995

PHASE 2: RCRA and NEPA
10 RFIs with comprehensive CMS in 1992

PHASE 3: FFA, CERCLA, and NEPA
Multiple RI/FSs with separate RODs
CATEGORIES OF REMEDIATION SITES

- Solid Waste Storage Areas (SWSA)
- Seepage pits and trenches
- Process ponds
- White Oak Creek
- Low-level radioactive waste (LLW) lines and leak sites
- Environmental research areas
- Hazardous waste sites
- Radioisotope processing facilities
- Experimental reactors
- Liquid LLW tanks
- Research and analytical laboratories
- Inactive hydrofracture injection sites
- Other contaminated sites
DATA PACKAGES

- Records on waste inventories and locations are not complete
- Sites contain low-level, hazardous, mixed, and transuranic wastes
- Wastes are heterogeneous
- Waste form and container type are variable
- Most toxic materials are contained in SWSAs, seepage pits and trenches, LLW lines and tanks, and inactive hydrofracture injection sites
• Radionuclides are primary contaminants of concern

• Tritium, Strontium-90, Cesium-137, and Cobalt-60 represent the greatest potential for environmental and health risk
1 SURVEILLANCE AND MAINTENANCE ACTIVITIES MAY IDENTIFY NEW CONTAMINATION PROBLEMS LEADING TO EITHER NEW PA/SI TASKS OR NEW ICMs.
BACKGROUND
AND APPLICATION
OF THE
OBSERVATIONAL
APPROACH
Observational Approach  
Background & Application

TRADITIONALLY:

STUDY "FOREVER"

"SURPRIZES" DURING IMPLEMENTATION
TECHNICAL UNCERTAINTY:

- Conditions
- Regulatory
- Technology Performance
Observational Approach
Background & Application

"BORROWED" FROM TRADITIONAL GEOTECHNICAL/GEOLOGIC ENGINEERING

- Geologic/Subsurface Uncertainties

APPLIED TO WASTE REMEDIATION

- Geologic/Subsurface Uncertainties

- Numerous Additional Uncertainties
Observational Approach
Background & Application

ELEMENTS OF THE OBSERVATIONAL APPROACH:

- Characterization For General Understanding
- Interpret/Predict Expected Conditions and Deviations
- Base Design on Expected Conditions
- Contingent Design for Deviations; Specific Monitoring for Deviations
- Implement Basic Design & Monitoring
- Implement Contingent Design as Warranted by Monitoring
Observational Approach
Background & Application

ADVANTAGES:

- OPEN RECOGNITION OF UNCERTAINTIES
- PROCEEDS LOGICALLY
- RECOGNIZES VALUE OF INFORMATION OBTAINED DURING IMPLEMENTATION
- CONTINGENT ACTIONS IMPROVE CONFIDENCE
Observational Approach
Background & Application

WHAT IT'S NOT:
- AN EXCUSE FOR LESS-THAN-ADEQUATE ENGINEERING
- "BASH-TO-FIT 'n PAINT-TO-COVER"

WITHOUT:
PREDICTION OF EXPECTED & DEVIATIONS SPECIFIC MONITORING FOR DEVIATION CONTINGENT ACTIONS (Predetermined)

!!! IT'S NOT THE OBSERVATIONAL APPROACH !!!!
COMPENDIUM:

- Observational Approach
- Background & Application
- Endorsements in Concept
- Precedent in Geotechnical Engineering
- Problem Statement in Waste Remediation
- Case Studies (too few!)
- Bibliography
Appendix C

ORNL ENVIRONMENTAL RESTORATION PROGRAM SUMMARY OF LIFE CYCLE COST OBSERVATIONAL APPROACH WORKSHOP
<table>
<thead>
<tr>
<th>WAG/Operable Unit/Early Action</th>
<th>Start Date</th>
<th>PASI</th>
<th>RI</th>
<th>FS</th>
<th>ROD</th>
<th>RD</th>
<th>Base Action</th>
<th>Contingency Action</th>
<th>Monitoring</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAG 1/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01A, North Tank Farm</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>Remove liquids, treat at evaporator, Use existing piping Control inleakage</td>
<td>Build new treatment &amp; storage capacity Install new piping Control inleakage</td>
<td>Characterization of liquid Monitor inleakage</td>
<td>Decision needed on tank remedy</td>
</tr>
<tr>
<td>01B, South Tank Farm</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>Remove sludge</td>
<td>Remove to extent possible, then grout in situ</td>
<td>Video monitoring Health physics monitoring</td>
<td></td>
</tr>
<tr>
<td>01C, TH-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Remove gunite tanks to disposal site, leave soils, sludge/liquid removed</td>
<td>In situ treatment or new capacity</td>
<td>Monitor radiation levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Remove empty steel tanks to disposal site</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Numbers indicate relative magnitude of effort for each activity: 0, Minor; 1, Low; 2, Moderate; 3, High.
<table>
<thead>
<tr>
<th>WAG/Operable Unit/Early Action</th>
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</thead>
<tbody>
<tr>
<td>In situ actions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grout/cement sludge in place</td>
<td>Modify mix to improve mixing and setting</td>
<td>Process controls</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grout/cement tanks in place</td>
<td>None</td>
<td>Test grout while solidifying</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ISV, tank contents left &quot;as-is&quot;, isolate from inleakage</td>
<td>Temporary break in ops Shutdown of process, evacuation of area Build containment to control environment</td>
<td>Long-term ground-water monitoring</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ISV without contents</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ISV, consolidate contents into one tank</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
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</tr>
</thead>
<tbody>
<tr>
<td>Tank management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No action</td>
<td>Stabilize in place</td>
<td>Monitor groundwater</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Containment bldg over tanks, demolish at end</td>
<td>Build confinement structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fill tanks with sand</td>
<td>None</td>
<td>Radiation levels inside building during remediation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stop leakage</td>
<td>Install/line storm drains</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–plug old lines, install new lines –cap –maintain drywell collection system –shut off off–gas system –divert surface water storm flow</td>
<td>Install cutoff walls Suppress GW table using pumping Install intercept/collection trenches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-site disposal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Off-site disposal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>01D, Surface Impoundments</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>?</td>
<td></td>
<td></td>
<td>Treat water at PWTP; stabilize sludge; backfill; cap</td>
<td>Pretreat water: evaporation, etc</td>
<td>Sample water, monitor WAC</td>
<td></td>
</tr>
</tbody>
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<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>01E, Groundwater</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>Sustain existing collection system; treat at PWTP</td>
<td>Additional collection/ controls</td>
<td>groundwater monitoring</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>One localized pump &amp; treat operation</td>
<td>Pretreatment or new treatment system</td>
<td>Phase II RI</td>
<td>Sample influent</td>
</tr>
<tr>
<td>01F, Pipeline and Storm Drains</td>
<td></td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Boundary containment: see OU 01E;</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Outside other OUs-removal</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;Wet&quot; trenches: see OU 01E</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&quot;Dry&quot; trenches: plugs &amp; cutoff collars</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>01G, WOC Flood Plain Soils</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>Solidify hot spots, cap remainder</td>
<td>see OU 02B</td>
<td>see OU 02B</td>
<td></td>
</tr>
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</tr>
</thead>
<tbody>
<tr>
<td>01H, SWSA 1, 2, and Waste Pile</td>
<td>1 2 2 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SWSA 2: Sample &amp; remove anomalies</td>
<td>Leave in place</td>
<td>Sample anomalies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Waste Pile: limited removal</td>
<td>Contain in place</td>
<td>Sample</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SWSA 1: Groundwater intercept &amp; cap</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>01I, Contaminated Soils</td>
<td>2 2 3 3 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hg soils: Excavate dispose off-site in RCRA landfill</td>
<td>Mixed waste disposal</td>
<td>Monitor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tanks, pipes, etc.: contain, cap, slurry wall</td>
<td>Use unconventional rad handling techniques</td>
<td>monitoring</td>
<td></td>
</tr>
<tr>
<td>01J, Empty Steel Tanks</td>
<td>1 2 2 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50%: leave in place &amp; immobilize sludges</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50%: remove &amp; decon</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

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Appendix C: ORNL Environmental Restoration Program summary of Life Cycle Cost Observational Approach Workshop (continued)

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<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAG 2/</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>Divert WOC, fill &amp; cap WOL</td>
<td>Removal &amp; disposal by entombment</td>
<td>Surface water monitoring</td>
<td></td>
</tr>
<tr>
<td>02A, Sediment (reaches 1 &amp; 2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>Cap on floodplain soil, concrete channel</td>
<td>Removal and disposal by entombment</td>
<td>Surface water monitoring</td>
<td></td>
</tr>
<tr>
<td>02B, Sediment and Soil (reaches 3, 4, &amp; part of 2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early Action</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Remove sediment from weirs (annual), place WAG 6 cap or store on flood plain</td>
<td>Place in &quot;new bldg&quot; or push over weir</td>
<td>Sampling/Inspection</td>
<td></td>
</tr>
<tr>
<td>02EA1, OUs 02A &amp; 02B</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Bank stability action</td>
<td>None</td>
<td>Inspection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vegetation removal</td>
<td>See WAG 7</td>
<td>See WAG 7</td>
<td></td>
</tr>
</tbody>
</table>

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Appendix C: ORNL Environmental Restoration Program Summary of Life Cycle Cost Observational Approach Workshop (continued)

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<th>WAG/Operable Unit/Early Action</th>
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<th>Monitoring</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAG 3/</td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03A, SWSA 3 (Trenches/Tanks)</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>Cap and storm flow controls</td>
<td>Repair cap</td>
<td>Visual</td>
<td>Water quality monitoring</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>NFA @ East Landfill Cap (RCRA Landfill)</td>
<td>Further investigation</td>
<td>Sanitary LF cap</td>
<td>Media sampling</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>Excavate residual contamination at scrap metal yard</td>
<td>Disposal under SWSA 3 cap</td>
<td>See OU 03A</td>
<td>See OU 03A</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>Surface Water diversion</td>
<td>Collect at drains and treat</td>
<td>Collect at seeps or geologic contact</td>
<td>Sample seeps</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Dredge, dry, &amp; place sediments under cap</td>
<td>Make NW Trib. part of WAG 2 Make Raccoon Ck a separate OU</td>
<td></td>
<td>Sediment sampling</td>
</tr>
</tbody>
</table>

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## Appendix C: ORNL Environmental Restoration Program Summary of Life Cycle Cost - National Approach Workshop (continued)

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<th>Monitoring</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Divert culvert</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>03EA1, OU 03D</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Sediment trap on</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Raccoon Ck</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAG 4/</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>New French drain on</td>
<td>Treatment of water</td>
<td>Water quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>north boundary with</td>
<td></td>
<td>sampling</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>no treatment</td>
<td>Other stabilization</td>
<td>None .</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>methods (geogrida)</td>
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<tr>
<td>04A, SWSA-4 (Trenches/Auger Holes)</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>Stabilize trenches with dynamic compac.</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>and cap</td>
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<tr>
<td>04B, Groundwater/Seeps</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>Downgradient drains along eastern boundry</td>
<td>Collection also at seeps</td>
<td>Sample seeps</td>
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<td></td>
<td>Treatment at PWTP</td>
<td>Treatment not needed</td>
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<td>04C, Pipeline</td>
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<td>0</td>
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<td>1</td>
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<td>Plug and abandon assuming no leaks</td>
<td>Remove pipe</td>
<td>Pressure test</td>
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<td>Remove and place under cap</td>
<td>Consolidate contaminated soil</td>
<td>Rad soil survey</td>
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<tr>
<th>WAG/Operable Unit/Early Action</th>
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<th>Monitoring</th>
<th>Comment</th>
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<tbody>
<tr>
<td>04D, Experimental Pilot Pit Area (EPPA)</td>
<td>0 1 1 2</td>
<td>Collect waste, demolish structures, &amp; consolidate under WAG 4 cap</td>
<td>Remove soil &amp; consolidate under cap</td>
<td>Walk over survey</td>
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<td></td>
<td>0 1 1 2</td>
<td>Place municipal waste on plastic liner under WAG 4 cap</td>
<td>None</td>
<td>None</td>
<td>None</td>
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<td>04E, Explosives Trench</td>
<td>1 1 1 2</td>
<td>Cap</td>
<td>Special in-situ method to desensitize</td>
<td>None</td>
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<td>Early Action</td>
<td>1 1 1 1</td>
<td>Collect surface water and storm flow</td>
<td>Treat water</td>
<td>Water quality monitoring</td>
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<td>04EA1, OU 04B</td>
<td>See OU 04B, Groundwater/ seep collection</td>
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<td>05A, Impoundments</td>
<td>2 2 2</td>
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<td>Pump and treat liquid</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td></td>
<td>1 2 2 2</td>
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<td>In-situ solidification/stabilization</td>
<td>Remove sediments, solidify &amp; replace in impoundment</td>
<td>Test sediments during &amp; after treatment</td>
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<tr>
<td>05B, Tanks</td>
<td>0 3 3 3</td>
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<td></td>
<td></td>
<td></td>
<td>In-situ vitrification</td>
<td>Modify off-gas system</td>
<td>Monitor off-gas</td>
<td>Decide on remedy</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>In-situ stabilization</td>
<td>Remove tank contents and stabilize ex-situ remediate tank at later date</td>
<td>Test contents during/after stabilization</td>
<td>ORNL WAC</td>
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<td></td>
<td>Pump/treat tank contents at PWTP</td>
<td>In-situ treatments or off-site treatment</td>
<td>Monitor water table</td>
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<tr>
<td>05C, Subsurface Disposal</td>
<td>2 2 3</td>
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<td></td>
<td>Capping and Structural stabilization</td>
<td>Repair cap</td>
<td>Site surveys</td>
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<td>French drains/ no treatment</td>
<td>Deepen the trenches</td>
<td>Monitor water quality</td>
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<td></td>
<td></td>
<td>Treat at PWTP or at onsite treatment</td>
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### Appendix C: ORNL Environmental Restoration Program Summary of Life Cycle Cost Observational Approach Workshop (continued)

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<th>Monitoring</th>
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<tbody>
<tr>
<td><strong>05D, Pipelines &amp; Leak Sites</strong></td>
<td></td>
<td></td>
<td>1 1 2</td>
<td>Leave in place if under WAG 5 cap</td>
<td>Pipe removal/disposal</td>
<td>Determine cap layout</td>
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<td>Excavate and dispose of pipe</td>
<td>Remove contaminated soil</td>
<td>Field soil sampling &amp; CSL screening</td>
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<tr>
<td><strong>05E, Groundwater</strong></td>
<td>0 1 1 1</td>
<td></td>
<td></td>
<td>Collect at seeps and treat at PWTP (upper zone only)</td>
<td>Build french drain On site treat or pre-Area wide collection</td>
<td>Monitor GW at boundary Monitor WAC Monitor GW in lower zone</td>
</tr>
<tr>
<td><strong>Early Action</strong></td>
<td>1 1 1</td>
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<td></td>
<td>Remove tank contents (pumping)</td>
<td>In situ treatment or off site treatment</td>
<td>Monitor ORNL WAC</td>
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<td><strong>05EAI</strong></td>
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<td><strong>WAG 7/</strong></td>
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<td><strong>07A, Primary Sources</strong></td>
<td>0 3 3 3</td>
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<td>Cap w/ surface water controls and treatment at PWTP</td>
<td>Repair cap Onsite or pre-treat of water</td>
<td>Observe cap Analyze water Monitor WAC</td>
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<td>In situ grout (trenches)</td>
<td>Ex situ grouting by remote methods</td>
<td>Monitor tests</td>
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<td>ISV (trenches)</td>
<td>Cap/grout or other</td>
<td>Monitor tests</td>
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<th>Monitoring</th>
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<tbody>
<tr>
<td>07B, Pipelines, Spills, &amp; Surface Contamination</td>
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<td>Remove &amp; consolidate</td>
<td>Special removal/remediation methods</td>
<td>HP survey</td>
<td>Decide on remedy</td>
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<td>Grout pipe &amp; cover</td>
<td>No action</td>
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<td>In situ stabilization of pipe trenches</td>
<td>Ex situ treatment</td>
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<tr>
<td>07C, Secondary Sources</td>
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<td>2</td>
<td>2</td>
<td>Remove soil &amp; consolidate</td>
<td>Containment</td>
<td>Sampling of soils</td>
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<td></td>
<td>Collect and treat groundwater</td>
<td>Area wide GW collection &amp; treatment</td>
<td>Aquifer tests, sample collected water</td>
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<td>Cut, consolidate, &amp; compost vegetation</td>
<td>On site treatment</td>
<td>Sampling &amp; WAC</td>
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<td>Cap and control surface water (no treatment)</td>
<td>No action</td>
<td>Bio monitoring</td>
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<td>Fix cap or extend</td>
<td>Monitor seeps</td>
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<td>Treat surface water</td>
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<td>Early Actions 07EA1</td>
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<td>07EA2</td>
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<td>WAG B/</td>
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<td>08A. Impoundments</td>
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<td>08B. Tanks</td>
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<th>Monitoring</th>
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<tr>
<td>08C, Pipelines &amp; Leak Sites</td>
<td>1 1 1</td>
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<td></td>
<td>Excavate/dispose (consolidate) leak sites</td>
<td>Containment</td>
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<td>Remove, compact &amp; dispose pipelines (storage bldg.)</td>
<td>Dispose under cap</td>
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<td>08D, HF-2 Surface Facilities</td>
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<td>08E, Contractor Spoil Area &amp; Misc.</td>
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<td>Cap w/ surface water &amp; storm flow diversion</td>
<td>Repair cap</td>
<td>Site surveys</td>
<td>Sample water</td>
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<td>08F, Groundwater</td>
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<td>Refer to WAG 2 monitoring (more cost effective to treat in WAG 2)</td>
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<td>Early Action 08EA1, OU 8A</td>
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<td>FY 93 L-ROD for all impoundments</td>
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<td>09A, Impoundments</td>
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<td>In situ solidification</td>
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<td>Surface water/storm flow controls</td>
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<td>09B, Tanks</td>
<td>09B, Tanks</td>
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<td>2</td>
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<td></td>
<td>Remove liquids, grout in place, cut off piping</td>
<td>See WAGs 1 &amp; 5</td>
<td>See WAGs 1 &amp; 5</td>
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<tr>
<td>09C, Misc.</td>
<td>09C, Misc.</td>
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<td>NFA</td>
<td>To RI/FS</td>
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<td>Refer to area groundwater OU 09D</td>
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<td></td>
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<td>Action</td>
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<tr>
<td>WAG 10/</td>
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<td>3 2 2</td>
<td>Monitoring—see OU 10B</td>
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<td>10A, Grout Sheets</td>
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<td>10B, Deep Groundwater</td>
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<td>Well plug &amp; abandon, see OU 10C</td>
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<td>Fault monitoring</td>
<td>Collect &amp; treat deep groundwater</td>
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<td>10C, Wells &amp; Boreholes</td>
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<td>Plug &amp; abandon (4 injection wells, monitoring wells: 135 P&amp;A 15 recomplete)</td>
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<tr>
<td>Early Action</td>
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<td>1 1 1 1</td>
<td>Longterm monitoring of grout sheets</td>
<td>Start well logging to support P&amp;A of rock cover wells</td>
<td>None</td>
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<tr>
<td>10EA1, OU 10A</td>
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<td></td>
<td>Site Investigation for HF 1</td>
<td>See OU 10B</td>
<td>None</td>
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<th>Contingency Action</th>
<th>Monitoring</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAG 11/</td>
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<td>1</td>
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</tr>
<tr>
<td>11A, Surface Water</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Remove sediment hot spots per RI Plan</td>
<td>Remove additional sediments</td>
<td>Confirmation survey</td>
<td></td>
</tr>
<tr>
<td>11B, Groundwater</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Monitoring</td>
<td>Groundwater collection and treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11C, Surface &amp; Subsurface Soil</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Debris removal &amp; soil removal</td>
<td>Remove to WAG 6</td>
<td>Geophysical &amp; visual</td>
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</tr>
<tr>
<td>Early Action</td>
<td></td>
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<tr>
<td>11EA1, OU 11C</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Debris removal (09/92)</td>
<td>Remove to SWSA 6</td>
<td>Geophysics &amp; observation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contaminated soil removal (09/92)</td>
<td>None</td>
<td>None</td>
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</tr>
<tr>
<td>WAG 12/</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>12A, Subsurface Disposal Unit</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>Municipal landfill cap</td>
<td>RCRA cap</td>
<td>Media sampling</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Groundwater/surface water interception</td>
<td>NA</td>
<td>Groundwater &amp; surface water sampling</td>
<td></td>
</tr>
</tbody>
</table>

Numbers indicate relative magnitude of effort for each activity: 0, Minor; 1, Low; 2, Moderate; 3, High.
<table>
<thead>
<tr>
<th>WAG/Operable Unit/Early Action</th>
<th>Start</th>
<th>PASI</th>
<th>RI</th>
<th>FS</th>
<th>ROD</th>
<th>RD</th>
<th>Base Action</th>
<th>Contingency Action</th>
<th>Monitoring</th>
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<td>WAG 13/</td>
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<td>1</td>
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<td></td>
<td></td>
<td></td>
<td>Monitor surface water, NFA</td>
<td>None</td>
<td>None</td>
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<td></td>
<td></td>
<td></td>
<td>Monitor groundwater, NFA</td>
<td>None</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Monitor vegetation, NFA</td>
<td>None</td>
<td>None</td>
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<tr>
<td>Early Action</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Remove Cs plot source &amp; backfill with membrane and soil</td>
<td>Concrete shield cap</td>
<td>Rad survey</td>
<td></td>
</tr>
<tr>
<td>13EA1, OU 13A</td>
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<td>WAG 15/ NFA</td>
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<td>WAG 16/</td>
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<tr>
<td>16A, Cesium Forest</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Surface water controls i.e., sediment trap (may need to collect &amp; treat sediment after Cs-137 decay is adequate)</td>
<td>Collect and treat surface water</td>
<td>Sample surface water</td>
<td></td>
</tr>
</tbody>
</table>

Numbers indicate relative magnitude of effort for each activity: 0, Minor; 1, Low; 2, Moderate; 3, High.
<table>
<thead>
<tr>
<th>WAG/Operable Unit/Early Action</th>
<th>Start Date</th>
<th>PASI</th>
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<th>FS</th>
<th>ROD</th>
<th>RD</th>
<th>Base Action</th>
<th>Contingency Action</th>
<th>Monitoring</th>
<th>Comment</th>
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<td>0</td>
<td>0</td>
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<td>Document NFA process</td>
<td>None</td>
<td>None</td>
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<td>(see BNI team work plan)</td>
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<tr>
<td>WAG 18/ NFA</td>
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<td>0</td>
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<td>NFA</td>
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<td>WAG 20/ NFA</td>
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<td>0</td>
<td>0</td>
<td>0</td>
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<td>NFA</td>
<td>None</td>
<td>None</td>
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<tr>
<td>AREA GROUNDWATER/</td>
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<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td>Monitoring</td>
<td>Assess on WAG by WAG basis</td>
<td>Install 4 multi-port monitoring wells to 1000' per year for 5 years Monitor East Bethel Valley (Bearden Ck) Whiteoak Dam deep wells monitoring WAG 3, Unit F Well WAG 11</td>
<td></td>
</tr>
<tr>
<td>WELL AND BOREHOLE P &amp; A</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>Perform over 5 years for all wells not used in RI, research, etc.</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>(except WAGs 5, 6, &amp; 10)/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All wells to P&amp;A eventually</td>
<td>None</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Numbers indicate relative magnitude of effort for each activity: 0, Minor; 1, Low; 2, Moderate; 3, High.
Appendix D

WAG 1
ORNL WAGs

WAG: WAG 1 - ORNL Main Plant

FUNCTION: Research/Process Development

YEARS OF OPERATION: 1943 to present

CURRENT RI/FS STATUS: Phase 1 remedial investigation in progress

SWMUs:
- Total Number: 167 (63 by FFA count)
- Type:
  - Tanks
  - Leak/Spill sites
  - Ponds/Impoundments
  - Waste treatment facilities
  - Solid waste storage areas
  - Misc. facilities

WASTES HANDLED:
- Innumerable Rad and chemical process wastes
  - Purex
  - Isotope separation
  - Enrichment
- Sanitary wastes
- Solid wastes

CONTAMINANTS:
- Identified: Radionuclides: Cs-137, Sr-90, Co-60, TRU
  - Metalls: Hg, Os (?)

MEDIA OF CONCERN:
- Soil (surface and subsurface)
- Surface water
- Biota
- Groundwater
PRIOR CORRECTIVE ACTIONS:

- Replace or modify LLW lines, some soil removal
- Soil removal in limited areas
- Many tanks taken out of service

PRIOR OPERABLE UNIT DECISIONS:

- New operable unit strategy being developed by ERP team

- May 1991 operable unit decisions:
  - Current boundary defines OU
  - Only small scale interim actions until facility shutdown
  - Interim ROD for WAG 1 ponds (3524, 3513, 3539 and 3540) 1993
I. Prevent near term release risk

(A-C) Tanks:
   - North Tank Farm
   - South Tank Farm
   - TH-4

II. Characterization and Control of Off-WAG Migration Surface Impoundments:

(D) Surface Impoundments:
   - Control of discharge to Whiteoak Creek
   - Eliminate habitat for frogs

(E) Further groundwater characterization

(F) Pipeline and Storm Drain Network

(G) Whiteoak Creek flood plain soils (Osmium Soils)

III. Characterization and Control of ON-WAG contamination

(H) SWSA 1, 2, Waste pile

(I) Contaminated soils

(J) Empty steel tanks (active; inactive)
Interface Issues—WAG 1

1. Active and Inactive Tanks Program (Tom Monk and Tom Ethridge)

2. Planning and Site Re-development Program

3. Interface with D&D
   - 5 ft zone
   - schedule/sequence of D and D and ERP involvement
   - steel tanks in buildings

4. WAG boundary definition (NE)

5. DOE policy regarding buried TRU waste

6. Coordinate with waste management regarding waste volume/waste acceptance criteria

7. New LLLW pipelines and other pipeline systems/interconnections

8. WAG 1 and WAG 2 interface

9. Interface with regulators regarding definitions for land disposal ban

10. Interface with FFA driven upgrade work (WMD Ops)
    (Jack Stelleren & Bob Mason)

11. Hg soil/building D&D interface

12. Hg "roasting" at Y-12

13. Interface with operating facilities for soil remediation

14. WAG 1 material to K-25 decontamination facility (2000-2020)

15. Transfer of responsibility for sewage ponds to ERP
INTERFACE ISSUES

North and South Tank Farms

1. New Melton Valley Storage Tank (MSVT) capacity increase

2. Operations of the PWTP and Evaporator

3. DOE TRU Waste Policy

4. Use of WIPP

5. DOE building requirements

6. Integrated Technology Demonstration Program--DOE HQ

7. Funding and construction contracting approach (e.g., lump sum vs unit price)

8. Transport
Fig. D.2. WAG 1 conceptual model–tanks.
Fig. D.3. WAG 1 conceptual model—subsurface disposal.
Fig. D.5. WAG 1 conceptual model—pipelines.
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove liquids</td>
<td>Tank-level trend data Sample and analyze for evaporator acceptance Determine integrity of existing piping system (planned tests in 1-2 yrs will only look at active system) Identify/control inleakage sources</td>
<td>The liquid meets the acceptance criteria of the existing evaporator Storage volume for the bottoms is available The liquids can be transferred to the evaporator through existing pipes or by trucking</td>
<td>Liquid is not acceptable to the evaporator No storage/disposal capacity</td>
<td>Characterization of liquid as removed</td>
<td>Build new treatment and storage capacity Install new piping system (e.g., temporary two-walled pipe system to connect with active system) Prevent/control inleakage</td>
</tr>
<tr>
<td>Remove sludge</td>
<td>Sludge physical characterization Radionuclide characterization for shielding design Treatability studies (e.g., size reduction, vacuum technology, sluicing) Research on remote removal techniques</td>
<td>Sludge treatment has been selected and a storage site identified Liquid has been removed via sluicing, mechanical, or chemical techniques (e.g., high pressure jets, grinding, or acid mobilization) Sludge is expected to be heterogeneous and difficult to pump</td>
<td>No sludge storage site is identified Sludge (some or all) cannot be removed without significant damage to tank</td>
<td>Video monitoring of operations Health physics monitoring Waste acceptance criteria and storage site</td>
<td>Remove sludge to extent possible; then grout in situ Tank removal</td>
</tr>
<tr>
<td>Remove gunite tanks</td>
<td>Structural analysis of tank to determine removal method (concern with dome or sidewall failure) Radiation levels in tanks using core samples Full radiological characterization of surrounding soil Shell contamination Note: this information could be collected during the FS process</td>
<td>The liquid and most of the sludge has been removed An enclosure with radiation shielding is provided. This enclosure is temporary and is not governed by the DOE general design criteria (6430.1A). The surrounding soils are not removed A disposal site is identified</td>
<td>Contents were not removed because there is insufficient disposal/storage capacity DOE 6430.1A applies Total removal of tank and contaminated soil is required</td>
<td>Radiation levels</td>
<td>In situ treatment or new capacity</td>
</tr>
<tr>
<td>Remove steel tanks</td>
<td>Radiological characterization of shell and surrounding soil</td>
<td>Tanks are empty Decontamination facility and disposal site are identified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
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</tr>
<tr>
<td>Grout/cement sludge in place</td>
<td>Risk assessment and ALARA to show that in situ stabilization is preferable to removal. Characterization of sludges and liquids (e.g., aluminum and sulfates: solubility vs pH; inventory of TRU wastes: determine if curium-244 is TRU)</td>
<td>Permits are obtained. Too risky to transport to WIPP and in situ closure approved.</td>
<td>Permit status changes.</td>
<td>Process controls.</td>
<td>Modify the mix or technology to improve mixing and setting.</td>
</tr>
<tr>
<td></td>
<td>Treatability tests with actual sludge samples to develop mix. Research hydrofracture performance data for the sludged material. Durability of grouted mixtures (Leach Index: 10 CFR 61: Leaching tests: ANS 16.1</td>
<td>Sludge is non-homogeneous, but mixable (sludge can be mobilized via breakup and suspension). A temporary secondary containment building may be required during operations.</td>
<td>Sludge cannot be mixed. Sludge samples were not representative and the mix does not set (e.g., noncompatibility due to salt content, pH, solids density, acid and water solubility, inert solids in suspension, rheological properties).</td>
<td>Test grout mix while solidifying.</td>
<td>Modify the mix or technology to improve mixing and setting.</td>
</tr>
<tr>
<td></td>
<td>Roger Gilchrist (Hanford) is collecting data for all USTs—all DOE inst.</td>
<td></td>
<td>The leaching characteristics of the set mix are not acceptable.</td>
<td>Take core samples to test solid for leach rate.</td>
<td>Modify the mix or technology to improve mixing and setting.</td>
</tr>
<tr>
<td>Grout/cement tanks in place</td>
<td>Geotechnical survey. Mapping of utilities in area. Structural analysis for tank removal and placement.</td>
<td>Permits are obtained. Action is applicable whether sludge has been removed or is included in the tank grouting. Perhaps reduce volume of grouted area by removing smaller tanks and placing them in large tanks before grouting.</td>
<td>Permit status changes. Voids or fissures in area open to tank.</td>
<td>Long-term groundwater monitoring.</td>
<td>Modify the mix or technology to improve mixing and setting.</td>
</tr>
<tr>
<td>In situ vitrification: tank contents left “as-is”</td>
<td>Predict/prepare for ISV “products” (e.g. off-gases, volatiles). Treatability study</td>
<td>Recognize hazard during melt cycles. Tanks are dry (e.g., requirement to dry the tanks by evaporation) Isolate tanks from inleakage Fill tanks with cullet</td>
<td>Loss of control of off gases. Air handling system may break down. Process control.</td>
<td>Monitor air emissions and pressure and temperature in tank. Shutdown of process; evacuations of area. Build containment to control environment</td>
<td>Modify the mix or technology to improve mixing and setting.</td>
</tr>
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<tr>
<td>In situ vitrification: without contents</td>
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</tr>
<tr>
<td>In situ vitrification: Consolidate contents into one tank</td>
<td>Pump contents into new LLLW line to Melton Valley Clean walls and fill Leave “as-is” and fill</td>
<td></td>
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</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
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</tr>
<tr>
<td>No action</td>
<td>Risk assessment</td>
<td>Approval obtained</td>
<td>Tank failure</td>
<td>Groundwater</td>
<td>Stabilize in place.</td>
</tr>
<tr>
<td></td>
<td>Containment building over tanks: a near-term action to stop rain water infiltration and mitigate the effects of a tank failure.</td>
<td>Determination of the design criteria (requirements will effect size and cost)</td>
<td>Groundwater</td>
<td>Radiation levels inside building during remediation</td>
<td>Build confinement structure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Location of all utilities in the building area.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Soil investigations to determine suitability for building construction.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Radiological characterization for shielding and remote operations design.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Fill tanks with sand to mitigate tank collapse and prepare for future in situ vitrification</td>
<td>Structural assessment of tanks to determine if sand can be added and if it improves integrity.</td>
<td>Groundwater enters tanks.</td>
<td></td>
<td>Improve (e.g., make continuous) liquid-level monitoring in tanks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The tank liquids have already been removed and inleakages has been stopped.</td>
<td>Lateral stormflow supplies inleakage.</td>
<td></td>
<td>Conduct shallow zone monitoring of soil-water pressure (e.g., tensiometers).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groundwater table elevation is below level of concern for inleakage.</td>
<td>Lateral inflow of stormwater and perch GW is not significant.</td>
<td></td>
<td>Use multi-level GW head monitors above bedrock.</td>
</tr>
<tr>
<td></td>
<td>Stop inleakage by</td>
<td>Determine the sources of inleakage, and perform a water balance study by:</td>
<td>Groundwater enters tanks.</td>
<td></td>
<td>Monitor water level in dry wells.</td>
</tr>
<tr>
<td></td>
<td>-plugging old lines and using new lines for transfers</td>
<td>-measuring vertical distribution of head (w/ multi-port wells) incl unsaturated zone</td>
<td>Lateral stormflow supplies inleakage.</td>
<td></td>
<td>Estimate potential volumes of infiltration using plastic sheeting over tanks.</td>
</tr>
<tr>
<td></td>
<td>-capping to exclude rain infiltration</td>
<td>-exact location of pipes entering tanks</td>
<td></td>
<td></td>
<td>Install/line storm drains.</td>
</tr>
<tr>
<td></td>
<td>-continuing to maintain dry-well collection system</td>
<td>-obtaining continuous record of precipitation</td>
<td></td>
<td></td>
<td>Install cutoff/low-permeability walls to slow or divert lateral flow.</td>
</tr>
<tr>
<td></td>
<td>-shutting off off-gas system to eliminate the negative pressure produced by the off-gas system</td>
<td>-measuring pumping withdrawal from dry wells (perhaps dye tracer tests to determine flow percentages from given dry wells</td>
<td></td>
<td></td>
<td>Use GW pumping to suppress water table near tanks.</td>
</tr>
<tr>
<td></td>
<td>-diverting surface water flow from storms</td>
<td>-mapping storm surface water using topographical surveys and field investigations</td>
<td></td>
<td></td>
<td>Install intercept/collection trenches.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-measuring water table during storms</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>-studying storm inleakage using video monitors</td>
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<tr>
<td>Remedial Action</td>
<td>Immediate Data Needs</td>
<td>Long-Term Data Needs</td>
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</tr>
<tr>
<td>Off-site disposal</td>
<td>Interface with ORNL WMD to evaluate adequacy of current liquid/sludge data against current waste acceptance criteria (WAC)  Interface with ORNL WMD to evaluate current liquid/sludge capacity and schedule for future capacity expansion  Evaluate currently available solid waste volume projections for adequacy and validity of assumptions (look at 1986 PEER study first--are assumptions still valid?)</td>
<td>Evaluate criticality aspects of sludges (may be an immediate, albeit proforma issue)  Additional sludge characterization (perhaps better done once removal or mixing operations have begun):  - Improve statistical validity  - TCLP  Assuming tanks and soil removal:  - Radiological and TCLP analyses on tank shells (especially concrete)  - Radiological and TCLP characterization on soils  Volume of contaminated soils surrounding tanks that would have to be handled and disposed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech. Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------</td>
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<td>------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Treatment of water</td>
<td>Characterize water</td>
<td>Can be treated at PWTP</td>
<td>Can not use PWTP</td>
<td>Sample water</td>
<td>Pretreat waste: evaporation, etc.</td>
</tr>
<tr>
<td>Containment: dewater sludge and stabilize: backfill impoundment and cap</td>
<td>Collect sludge samples for vendor demo: remove sludge</td>
<td>Sludge can be stabilized</td>
<td>Sludge cannot be stabilized</td>
<td>Monitoring WAC</td>
<td></td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech. Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-----------------------------------------</td>
<td>-------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Containment/collection:</td>
<td>Identify discrete discharge points during Phase 2 RI</td>
<td>Existing network is adequate</td>
<td>Contamination is more extensive than expected</td>
<td>Groundwater monitoring</td>
<td>Add new controls</td>
</tr>
<tr>
<td>Maintain existing</td>
<td></td>
<td>Treatment at PWTP; contaminants are primarily radioisotopes.</td>
<td>Wastes cannot be treated at PWTP</td>
<td>Sample influent</td>
<td>Pretreatment or design/build a new treatment system</td>
</tr>
<tr>
<td>collection system</td>
<td></td>
<td>One pump and treat operation will be sufficient.</td>
<td>More than one pump and treat operation needed</td>
<td>Phase 2 RI</td>
<td>Add additional collection and treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment at PWTP</td>
<td>Cannot treat at PWTP</td>
<td>Sample influent</td>
<td>Pre-treatment or design a new treatment system</td>
</tr>
<tr>
<td>Pump and treat</td>
<td>Evaluate depth of bedrock, pipe trenches, etc. during Phase 2 RI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table D.7
Summary of Data Needs for WAG 1
Operable Unit 1F: Pipelines and Storm Drains

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary containment on West, South, East perimeters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside other OUs &quot;orphans&quot;</td>
<td>Collect data so can classify as in water table or out</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prioritize pipe segments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Wet&quot; trenches, south of Central Ave.</td>
<td>Determine locations using as-built drawings and geophysics</td>
<td>See groundwater OU for WAG 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Dry&quot; trenches, north of Central Ave.: plugs and cutoff collars</td>
<td>Tech Demo: location, collars</td>
<td>Inventory of subsurface facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table D.8
Summary of Data Needs for WAG 1
Operable Unit 1G: White Oak Creek Flood Plain Soils

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: solidify &quot;hot spots&quot; and cap remaining wastes</td>
<td>Identify &quot;hot spots&quot;</td>
<td>Note: assume same as WAG 2 Reach 4 remedial action</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

File: TANKFACE
### Table D.9.
Summary of Data Needs for WAG 1
Operable Unit III: SWSA 1, 2, and Waste Pile

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWSA 2--no further action</td>
<td>Sample/remove anomalies</td>
<td>Sub-surface anomalies should be removed</td>
<td>No need to remove sub-surface anomalies</td>
<td>Sample and analyze anomalies</td>
<td>Contain in place</td>
</tr>
<tr>
<td>Waste Pile: limited remediation</td>
<td>Sampling of waste pile contents</td>
<td>Hazardous waste only</td>
<td>Mixed waste present</td>
<td>Sample and analyze</td>
<td>Contain in place</td>
</tr>
<tr>
<td>SWSA 1--containment: groundwater intercept and cap</td>
<td>Use geophysics and test pits to better delineate SWSA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table D.10.
Summary of Data Needs for WAG 1
Operable Unit I: Contaminated Soils

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavate: Hg contaminated soils, Y-12 Hg roasting, bioremediation, soil washing</td>
<td>Assessment of mobility; fate and transport study Technical development of remediation technologies</td>
<td>Mercury, no radionuclides; offsite RCRA landfill disposal</td>
<td>Radionuclides present, makes it a mixed waste</td>
<td>Sampling and analysis for radionuclides</td>
<td>Mixed waste disposal</td>
</tr>
<tr>
<td>Tanks, pipes and other</td>
<td>Delineate areas</td>
<td>Can use conventional radioactive material handling techniques</td>
<td>Can not use conventional radioactive handling techniques</td>
<td>Monitoring</td>
<td>Special materials handling techniques</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
</tbody>
</table>
| If contains grout: perform decontamination technical demo  
  • Leave in place, immobilize sludges | Sludge immobilization  
  Vendor demo of surface etching  
  Grouting demo  
  Interval dose reading | 50% of tanks, leave residual sludges | | | |
| If does not contain grout:  
  • Remove and decontamination | Inventory of tanks  
  Decontamination  
  Tech Demo  
  - Sludge immobilization  
  - Grouting  
  Vendor demo of surface etching  
  Internal dose reading  
  Inventory of tanks | 50% of tanks remove and decon residual sludges | | Cannot remove | |

Note: There are now 65 tanks (1 concrete, 12 gunite, and 52 steel).
EXECUTIVE SUMMARY

The workshop was held to determine what additional data are required to support a Feasibility Study of Remedial Action Alternatives under the CERCLA program for the North and South Tank Farms in WAG 1 of ORNL. It was concluded that sufficient data are available to proceed with the first phase of a Remedial Action Alternatives Assessment, although there is a need to identify the sources of inleakage to the tanks.

Additional technology specific data and analyses will likely be required to support the second phase of Alternatives Analysis. Specific data on the sludge contained in the tanks will be obtained during treatability studies as required for the detailed analysis of tank content removal and treatment alternatives. A risk assessment will be required to determine the effect of leaving the tank contents, particularly the TRU sludges, in place. A tank structural analysis will be required to determine means to improve the tank integrity or to plan for their removal.

The need for closer administrative coordination and the systematic compilation of a central data base was identified to ensure that all existing information is available to the Alternative Analysis. A complete characterization of the underground piping system and other utilities in the tank area will be required. Close interaction with waste management operations is needed to plan for future actions. Finally, the major policy interfaces for issues such as TRU waste and overall site plans are required.

1. ORGANIZATION OF THE WORKSHOP

The workshop was held on October 29-30, 1991. The agenda and list of participants are attached.

The purpose of the workshop was to identify data needs for remediation of the North and South Tank Farms to guide the remedial investigation. The data needs were developed by working groups instructed to address remediation of the sites using the Observational Approach. Following introductory presentations on the workshop organization and the technical understanding of the sites, the participants met in small groups.

On the first day, the participants were divided into five groups, with each given the charter to address data needs for all potential actions. The groups...
were asked to record their discussions on worksheets using the Observational Approach format as follows:

1. Potential actions, with emphasis on early actions.
2. Expected conditions.
3. Deviations from the expected conditions.
4. Monitoring during the action.
5. Contingent actions to respond to deviations.
6. Data needs or required special studies or demonstrations.

The results were discussed in a joint session at the end of the first day. On the second day, task groups were formed to consider specific actions identified during the first day's discussions in greater detail, again using the Observational Approach format. The task group topics were:

1. In-situ actions and TRU waste policies.
2. Removal actions.
3. Off-site disposal actions.

The discussions were summarized at a joint session. During the course of the group discussions, the need to characterize and control tank inleakage was identified as a major issue; Dale Huff presented an outline of potential actions using the Observational Approach format during the joint session.

2. SUMMARIES OF DISCUSSIONS

The results of the discussions are summarized in this section, based on the worksheets developed during the individual group and joint sessions. These worksheets are retained in the project file. The summaries are compilations of material from several sessions on each topic, and are organized by the type of action considered. Since these are direct results from multiple open discussions of many possibilities, the presentations are not necessarily complete or consistent with each other. Interim actions are covered in Section 2.1, in-situ actions in 2.2, removal actions in 2.3, and no action in 2.4. Section 2.5 is a summary of the overall discussions on the potential remedial actions that were regarded as the best candidates for the North and South Tank Farms.

2.1 Interim Actions

Two potential interim actions were identified. These actions are not considered to be final remedies. Rather, they are viewed as possible first steps needed to support both in-situ closure and content removal remedies.

Action 1: Control Inleakage
Expected conditions:

The inleakage sources could be rainfall seepage, groundwater inflow through cracks or ports, or discharges from leaking pipelines. It is expected that direct rainfall leakage can be prevented by capping, and that surface water flow in storms can be diverted. The groundwater level can be controlled by pumping, and the present dry well pumping is expected to be maintained. Discharges from pipes can be controlled by plugging the pipes, which presumes that they will not be required in future actions. The inleakage may be enhanced by the negative pressure maintained in the tanks by the off-gas system.

Deviations:

Inleakage may be occurring from groundwater discharging into the bottom or on the lower side walls of the tanks, and there may be significant lateral storm flow to the tanks.

Monitoring:

Better level monitoring in the tanks, and installation of piezometers within the tank farm to define groundwater head.

Contingent actions:

Installation of storm drains to divert surface water; cut off slurry or freeze walls to divert groundwater; groundwater pumping to control level.

Data needs:

The immediate data needs are to determine the sources of inleakage, and to perform a water balance study. This includes better level monitoring, coupled with precipitation data; the location of pipes, their condition, and video monitoring of their entrance to the tank during storms; the groundwater head distribution and water table during storms; the withdrawal rate from the existing dry wells; topographical surveys and field investigations to map storm surface water flow patterns; dye tests; and tests to determine the effect of the off-gas vacuum system.

**Action 2: Containment Building Over Tanks**

Expected conditions:
The building is a near term action that will stop rain water infiltration and mitigate the effects of a potential tank failure. Such a failure, if the tanks were not contained, could result in direct radiation and airborne exposure to plant personnel. The building could also be designed to contain future investigation and remediation actions, so that plant personnel would be protected during such activities.

Deviations:

If this structure were classified as a permanent installation, DOE design criteria could lead to an expensive structure with substantial foundations.

Monitoring:

Radiation levels inside building during remediation.

Contingent Actions:

Data needs:

Determination of the design requirements; location of all utilities in the building area; soil investigations to determine suitability for building construction; radiological characterization for definition of shielding and remote operations in building.

2.2 In-Situ Actions

Four in-situ closure actions were considered. Three of these assume that the tank contents are left in place, while the fourth considers only in-situ closure of the tank shell and surrounding soils. All actions in which the sludges are left in the tanks assume that approval for TRU burial at the site is obtained under DOE Order 5820.2A.

Action 3: Fill Tanks With Sand

Expected conditions:

The tank liquids have been removed and inleakage controlled; the sand can be added through existing ports. This action prevents tank collapse and prepares for future in-situ vitrification. Approval is obtained to leave TRU wastes in place.

Deviations:

Tank liquids and inleakage cannot be controlled.
Monitoring:

Long-term groundwater monitoring required.

Contingent actions:

Solidify contents.

Data needs:

Structural assessment of tanks to determine if sand can be added and if it improves integrity.

Action 4: Grout/Cement Sludge in Place

Expected conditions:

Approval is obtained to leave TRU waste in place and the sludge is mixable.

Deviations:

Approval to leave TRU waste in place is not obtained; the sludge cannot be mixed with the grout due to its heterogeneous form and presence of hard crystals; the sludge samples were not representative and the mix does not set; the leaching characteristics of the set mix are not acceptable.

Monitoring:

Test grout mix while solidifying; take core samples to test solid for leach rate, long term groundwater monitoring.

Contingent actions:

Modify the mix or technologies to improve mixing and setting; if leach rate not acceptable, build containment walls around area.

Data needs:

Risk assessment and ALARA study to show that in-situ stabilization is preferable to removal; treatability tests with actual sludge samples to develop mix.

Action 5: Grout/Cement Tanks in Place
Expected conditions:

This action is applicable whether sludge has been removed or is included in the tank grouting. Approval under DOE Order 5820.2A is assumed to be required in either case, because it is expected that the tank structure has absorbed sufficient TRU to be considered as TRU waste. It may be possible to reduce the volume of grout needed by removing the smaller tanks and placing them in the large tanks before grouting.

Deviations:

Approval may not be obtained to leave TRU contaminated shells and soils in place, or it may be determined that the shells are not classified as TRU waste. The content removal may have opened the tanks to voids or fissures in the area which would require closing.

Monitoring:

Long term ground water monitoring.

Contingent actions:

Data needs:

Geotechnical survey; mapping of utilities in area; structural analysis for removal and placement of small tanks within large tanks. Assessment of risks associated with removal and placement of small tanks.

Action 6: In-Situ Vitrification

Expected conditions:

The tanks are dry and groundwater inleakage is controlled. Approval is obtained under DOE Order 5820.2A.

Deviations:

Loss of off-gas control during vitrification.

Monitoring:

Monitor air emissions and pressure and temperature in tank.

Contingent actions:
Shutdown, evacuate, and build containment around area.

Data needs:

Treatability studies for melt gaseous products.

2.3 Removal Actions

Four potential removal actions were considered, ranging from removal of the tank liquids to removal of the shells. Liquid removal was considered separately, since it will be required to support any other remedial actions.

**Action 7: Remove Liquids**

**Expected conditions:**

- The liquid meets the acceptance criteria of the existing evaporator; storage volume for the evaporator bottoms is available; the liquids can be transferred to the evaporator through existing pipes or by trucking.

**Deviations:**

- The liquid is not acceptable to the evaporator; inleakage is not controlled.

**Monitoring:**

- Characterization of liquid as removed; determine leak sources.

**Contingent actions:**

- Build new treatment and storage capacity; install new piping system; prevent inleakage.

**Data needs:**

- Tank level trend data; review of existing liquid sample data for evaporator acceptance; determine the integrity of the existing piping systems used to remove and transfer liquids.

**Action 8: Remove Sludge**

**Expected conditions:**
Liquid has been removed; sludge treatment has been selected and a storage site identified. Removal could include sluicing with high pressure jets, grinding, and acid mobilization. The sludge is expected to be heterogeneous and difficult to pump.

Deviations:

No sludge storage site is identified; sludge cannot be removed without significant damage to tank.

Monitoring:

Video monitoring of operations; health physics monitoring.

Contingent actions:

Remove sludge as possible; then grout in-situ.

Data needs:

Sludge physical characterization and treatability studies; research on remote removal techniques; waste acceptance criteria and storage site.

Action 9: Remove Gunite Tanks

Expected conditions:

The liquid and most of the sludge has been removed; an enclosure with radiation shielding is provided; this enclosure is temporary and is not governed by the DOE general design criteria (6430); a disposal site is identified; the surrounding soils are not removed in this action.

Deviations:

There is insufficient storage capacity; DOE 6430 applies; total removal of tank and contaminated soil is required.

Monitoring:

Radiation levels.

Contingent actions:

Data needs:
Structural analysis of tank to determine removal method; radiation levels in tanks using core samples; full radiological characterization of surrounding soil.

**Action 10: Remove Steel Tanks**

**Expected conditions:**

- Tanks are empty; decontamination facility and disposal site are identified.

**Deviations:**

**Monitoring:**

**Contingent actions:**

**Data needs:**

- Radiological characterization of shell.

**2.4 No Action**

The no action alternative was briefly considered to be consistent with standard CERCLA regulatory policy for Remedial Action Alternatives Assessment.

**Action 11: No Action**

**Expected conditions:**

- Approval obtained under DOE Order 5820.2A and from the EPA and the State of Tennessee under the requirements of the Federal Facilities Agreement.

**Deviations:**

- Tank failure.

**Monitoring:**

- Groundwater.

**Contingent actions:**

- Stabilize in place; build confinement structure.
Data needs:

Risk assessment.

2.5 Potential Remedial Actions

From the discussions of possible actions, three candidates emerged. One of these is an interim action and two are final actions.

2.5.1 Interim Action

There was a consensus that early action is needed on understanding and controlling the inleakage to the tanks. The ability to control the inleakage will be required for any future action.

2.5.2 Final Actions

One potential final action is to stabilize the tanks and close them in-situ. This requires stopping the inleakage and determining methods to enhance structural integrity, such as by filling the tanks with soil. This also requires resolution of the policy and risk assessment issues related to in-situ closure.

The second potential action is to remove the tank contents. The sludge in-situ stabilization methods discussed required mobilization of the contents. It was felt that if the sludges must be mobilized, it was preferable to remove them. The final action on the tanks themselves was left open, since the risk and policy issues relating to empty but contaminated tanks are unknown until analysis of the content removal action is complete.

3. SUMMARY OF DATA NEEDS

3.1 Technical Data

A review of the workshop discussions shows four areas where more technical information will be required. First, the sources of inleakage must be identified. Next, the site area must be better characterized to understand limits on major actions, such as installing a building or containment walls. The tank structure must be further analyzed to determine methods to improve the integrity, limits on operations inside the tanks, and methods for tank removal. Finally, the physical characteristics of the sludge, as they relate to removal methods or fixation methods, must be better understood. This characterization is expected to occur during treatability studies conducted in the detailed evaluation phase of the Alternatives Assessment.
A risk assessment and fate and transport analysis are needed to show the effect of leaving the sludge in place. This, combined with an ALARA analysis of removing the sludge, and a better understanding of TRU policies, will determine the acceptability of in-situ actions.

3.2 Coordination

Much of the data needed to begin the Alternatives Assessment is known or suspected to be available, but has not been compiled in a form specific to this task. A systematic approach to identifying and documenting such data is recommended. One possible mechanism is to form a task group with representatives from all related organizations and programs. Future workshops should include more technical expert participation; the need for involvement by operations personnel and health physics staff was noted.

The off-site (i.e. off-WAG 1) disposal group noted three interface data needs pertaining to waste management. The capacity, both existing and planned, for liquid and solid waste treatment and storage facilities is needed. The statistical validity of the waste characterization for the tank contents, the tanks, and the soils must be reviewed; further characterization during removal may be required to meet waste acceptance criteria. The volumes to be removed, including potential soil removals, must be estimated.

Interfaces with the management of the LLLW system are needed to obtain a complete characterization of the system to determine potential future use, possible inleakage paths, and to design for remedial actions.

3.3 Policy Issues

Several issues were identified during the workshop that can be resolved by the appropriate administrative organization. An organized approach to documenting the policies as they apply to this task is recommended. One of the key issues is the TRU policy. Many actions considered in the workshop assumed that there are conditions under which some or all of the TRU could be left in place. Another issue is the use of the disposal route through the Melton Valley Storage Tanks, to the Waste Handling and Packaging Plant, and finally to the Waste Isolation Pilot Plant. One participant stated that this route is programmed and available.

Further administrative interfaces are required to determine the applicable DOE design criteria for treatment or confinement structures on site. Coordination with the DOE technology demonstration program should be developed to identify the best treatment technologies. Finally, detailed analysis of the implementation of actions will require more information on funding and contracting methods, and on requirements for transportation of wastes, both on and off site.
The workshop concluded with discussions of future plans for the RI-AA-FS-ROD sequence. A two-step alternatives assessment was discussed. The first phase would be a preliminary analysis to identify alternatives to be carried forward into detailed analysis. A six month to one year hiatus between the preliminary and detailed analysis phases would allow time for policy resolution, and for planning the collection of additional data or samples for treatability studies.
Appendix E

WAG 2
ORNL WAGs

WAG: 2 - Covers White Oak Creek (WOC) drainage and associated floodplain and groundwater.

FUNCTION: Transports contaminants originating from operations at ORNL. The floodplain sediments have sorbed contaminants. The WOC drainage system acts as a conduit for contamination from upgradient WAGs.

YEARS OF OPERATION: 1943 - present

CURRENT RI/FS STATUS: Draft R1 Plan has been completed and is being reviewed at this time.

SWMUs: Two SWMUs;
- WOC (south of 7500 bridge)/Melton Branch
- White Oak Lake/Dam/Embankment

WASTES HANDLED:
- liquid waste released from WAGs 1, 3 through 10, 13, and 17
- releases from NPDES permitted sources
- non-point discharges
- estimated volumes and inventories are not available

CONTAMINANTS:
- Co-60, Sr-90, Cs-137, Eu-152, Eu-154, H-3, Pu-239, Pu-240 Ru, As, Am-241, U-235, TRU
- Cu, Zn, Ni, Mo, Pb, Hg, PCBs, VOCs

PRIOR CORRECTIVE ACTIONS: CERCLA removal action on WOC embayment area (i.e., sediment retention structure) to control the release of contaminated sediments

PRIOR OPERABLE UNIT DECISIONS:
- Current boundary of WAG 2 will define OU.
Operable Units - WAG 2

A. Sediment (Reaches 1 and 2)
B. Sediment and Soil (Reaches 3, 4, and part of 2)

WAG 2 Interfaces

1. USGS weirs and monitoring
2. SWSA 7 waste disposal development
3. (Internal) Reprioritization of WAGs
4. DOE TRU policy
5. Community relations
6. Waste Management interface for cleaning weirs
7. Hydrologic impacts of other WAGs
8. Planned bank erosion study/bank stability
9. Add new stream reaches to WAG 2
10. Additional special studies
### Table E.1.
**Summary of Data Needs for WAG 2**
**Operable Unit 2A: Sediment (Reaches 1 and 2)**

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: divert creek and fill and cap Whiteoak Lake</td>
<td>Assess risk from long lived radionuclides</td>
<td>No TRU or long lived radionuclides problem</td>
<td>TRU or long lived radionuclides are a problem</td>
<td>Sampling and analysis for radionuclides and other contaminants</td>
<td>Greater containment disposal; e.g., removal and disposal by entombment</td>
</tr>
<tr>
<td></td>
<td>Develop better understanding of hydrology including hydrologic model for future WAG-specific actions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluate treatment technologies to remove radionuclides from sediment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical demonstration of channel armor and filtration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assess risk from sediment transport during an extreme event</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table E.2.
**Summary of Data Needs for WAG 2**
**Operable Unit 2B: Sediment and Soil (Reaches 3, 4, and upper portion of Reach 2)**

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: concrete channel and cap on floodplain soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Early Actions</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Remove sediment from weirs. (Note: needs to be done annually)</td>
<td>Technical demonstration of new flow measurement device which does not silt up</td>
<td>Place sediment under WAG 6 cap&lt;br&gt;Place in floodplain</td>
<td>Cannot place sediment under WAG 6 cap&lt;br&gt;Cannot place in floodplain</td>
<td>Sampling/inspection&lt;br&gt;Cannot place in floodplain</td>
<td>Place sediment in new storage facility&lt;br&gt;Push sediment over weir</td>
</tr>
<tr>
<td>Bank Stability Action: Intermediate Pond Below WAG 5 Below HIFR</td>
<td>Technical demonstration for evaluation of effectiveness of Goby mats</td>
<td>Goby mats can be used</td>
<td>Mat cannot be used</td>
<td>Inspection</td>
<td>Other stabilization removal or capping</td>
</tr>
<tr>
<td>Vegetation removal</td>
<td>Survey vegetation</td>
<td>See WAG 7</td>
<td>See WAG 7</td>
<td>See WAG 7</td>
<td>See WAG 7</td>
</tr>
</tbody>
</table>
Appendix F

WAG 3
ORNL WAGs

WAG: 3

- Solid waste disposal facility, closed scrap metal area and contractor’s landfill.
- Covers an area of approximately 17.1 acres.

FUNCTION:
- Solid waste storage area (SWSA) 3
- disposal of solid wastes in trenches excavated to bedrock (approximately 15 ft deep).
- Storage of slightly contaminated equipment above ground.
- Closed scrap metal area. Initially used as contractors’ landfill, between 1950 and 1960, and later used for storage of scrap metal.
- Contractors’ landfill.
  - Started in 1975 and continuing today as disposal area for solid waste such as concrete masonry block, flash, plaster, paper, wood, etc.
  - Operating under TDEC permit.
  - TDEC permitted disposal of stabilized sludge from coal yard in 1986.

YEARS OF OPERATION:
- SWSA 3
  - 1946 to 1951
  - above ground storage facility until 1979

Closed scrap metal area
- 1950 to 1960

Contractors’ landfill
- 1975 to present

CURRENT RI/FS STATUS: RI plan has been completed. Awaits prioritization.

SWMUs:
- Total of 3
  - SWSA 3 (SWMU 3.1)
  - Closed scrap metal area (SWMU 3.2)
  - Contractor’s Landfill (SWMU 3.3)

WASTES HANDLED:

SWSA 3
- 600,000 to 725,000 ft³ of solid waste
- 44,000 to 56,000 Ci of radioactivity
Closed scrap metal area
- Volume of deposited waste is not known

Contractors Landfill
- Volume of deposited or accumulated waste is not known. Two acres of soil is known to be radiologically contaminated.

CONTAMINANTS:

SWSA 3
- Typically appears to contain Sr-90, Cs-137, H-3, TRE and TRU. The 1978 soil survey indicated presence of Pu-238, Pu-239, Am, and Cm-244.

Closed scrap metal area
- No information is available.

Contractors' landfill
- Estimated 2 acres of radiologically contaminated soil appears to contain strontium-90, cesium-137, and cobalt-60.

PRIOR CORRECTIVE ACTIONS:

SWSA 3
- Burial of radioactive contaminated wastes in trenches was discontinued in 1951.
- In 1978-1979 the SWSA 3 area was cleaned up by removing the contaminated items stored above ground.
- A ditch was installed inside the fenced area to divert the surface water runoff to White Oak Creek (WOC).

PRIOR OPERABLE UNIT DECISIONS:

- The current boundary of WAG 3 will define OU.
Operable Units - WAG 3

A. SWSA 3 (trenches and tank)
B. Contractor's land fill/surface soil
C. Groundwater
D. Surface Water/sediments (Raccoon, North West Tributary/Whiteoak Creek)

Interface Issues - WAG 3

1. Maintenance/nature of existing cap/Is area closed in regulatory sense
2. "Solvent tank" burial? (where, when, did it really happen?)
3. Maintenance - Tom Burwinkle on historic subsidence
4. Well plug and abandonment
5. Borrow needs for cap construction
6. Interface with TDE at east "new" landfill
7. Interface with Waste Management regarding groundwater treatment capacity and waste acceptance criteria
8. Does WAG 2 include Northwest Tributary
9. Question Red Williams on where culvert discharges
Fig. F.2: WAG 3 conceptual model—subsurface disposal
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: cap</td>
<td>Geophysics to determine</td>
<td>No subsidence</td>
<td>Subsidence occurs</td>
<td>Visual inspection</td>
<td>Repair cap</td>
</tr>
<tr>
<td></td>
<td>- trench boundaries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- tank location, and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- concrete caps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containment</td>
<td>Diverted water is &quot;clean&quot;</td>
<td>Diverted water is &quot;dirty&quot;</td>
<td>Sample and analyze for water quality</td>
<td>Treat at PWTP</td>
<td></td>
</tr>
<tr>
<td>storm flow control (french drain)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and surface water control (includes culvert)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Table F.2. Summary of Data Needs for WAG 3 Operable Unit 3C: Groundwater

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: collection drains</td>
<td>Perform seismic survey (depth to bedrock) Evaluate groundwater quality and properties Perform pump and dye tests Define areas of recharge (water balance study)</td>
<td>Collection at WAG boundary</td>
<td>Collection not adequate</td>
<td>Sample seeps</td>
<td>Collect at seeps or at geologic contact (i.e., Chickamauga Unit E/F/G contact)</td>
</tr>
<tr>
<td>Treatment</td>
<td>Determine groundwater flows, volume, quality</td>
<td>Groundwater is contaminated and requires treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** This table outlines the data needs and expected conditions for the groundwater remediation efforts in Operable Unit 3C, including the actions taken to address deviations and the monitoring strategies employed.
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment:</td>
<td>Groundwater sampling</td>
<td>&quot;New&quot; closed landfill needs no further remediation (eastern portion); confirm with RI groundwater sampling</td>
<td>Connection between old and new</td>
<td>Groundwater monitoring</td>
<td>Further investigation</td>
</tr>
<tr>
<td>• No further action at East Landfill</td>
<td>No conveyance between old and new landfills</td>
<td>RCRA cap not required</td>
<td>Media sampling and analysis</td>
<td>Sanitary landfill cap</td>
<td></td>
</tr>
<tr>
<td>• Cap RCRA landfill</td>
<td>RCRA cap required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal: excavate residual contamination at scrap metal yard</td>
<td>Perform sampling; conduct walkover survey</td>
<td>Disposal within cap for west Contractor's Landfill</td>
<td>Cannot dispose in contractors landfill (non-RCRA)</td>
<td>Soil sampling</td>
<td>Disposal Under SWSA 3 Cap</td>
</tr>
<tr>
<td></td>
<td>Sampling/survey</td>
<td>Discrete contamination</td>
<td>Extensive contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Water Diversion (SWSA)</td>
<td>Same as SWSA 3 Cap</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table F.3. Summary of Data Needs for WAG 3 Operable Unit 3B: Contractor’s Landfill/Surface Soils
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface water</td>
<td>Refer to groundwater for WAG 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of sediments:</td>
<td>Sediment sampling (Raccoon Creek &amp;</td>
<td>Discrete sediment</td>
<td>Extensive sediment</td>
<td>Sediment sampling</td>
<td>Make NW Tributary part of WAG 2</td>
</tr>
<tr>
<td>dredge, dry, place under cap</td>
<td>Northwest Tributary)</td>
<td>contamination</td>
<td>contamination</td>
<td>and analysis</td>
<td>Make Raccoon Creek a separate OU</td>
</tr>
</tbody>
</table>

Note: May need to consider making NW tributary part of WAG 2. Assume remediate SWSA 3 and stop seeps; no further action for Raccoon Creek, NW tributary part of WAG 2.
<table>
<thead>
<tr>
<th>Potential Early Actions</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divert culvert</td>
<td>Study to locate, characterize, and quantify discharge areas.</td>
<td>Geophysics, dye studies</td>
<td>Monitoring</td>
</tr>
<tr>
<td>Sediment trap on Raccoon Creek</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table F.5: Summary of Early Action for WAG 3
Appendix G

WAG 4
ORNL WAGs

WAG: 4 - SWSA 4

Includes abandoned ILLW transfer lines, experimental pilot pit and trench/auger hole for disposal of radioactive solid wastes.

FUNCTIONS:

SWSA 4: Disposal of low and high level radioactive wastes in trenches and auger holes.

The ILLW transfer lines were used to transport liquid waste from ORNL Main Plant Area to the pits in Bethel Valley, trenches in WAG 7 and old hydrofracture facility (OHF) in Melton Valley.

The Experimental Pilot Pit Area (EPPA) was used as a site to conduct experiments on fixation of high level waste into a stable solid.

YEARS OF OPERATION:

SWSA 4
- SWSA 4 1951-1959 rad waste burial
- 1959-1973 construction and demolition debris and storage

Abandoned ILLW transfer lines
- 1952-1975

EPPA
- 1955-1957
- 1977-1978
- 1982-1983

CURRENT RI/FS STATUS:

RI plan is complete for WAG 4

SWMUs:

- Total of 3 SWMUs
  (1) Abandoned ILLW transfer line—SWMU 4.1
  (2) EPPA—SWMU 4.2
  (3) SWSA 4—SWMU 4.3
WASTES HANDLED:

- The volume of waste buried in SWSA 4 is estimated to be approximately 187,143,000 ft³ and contains approximately $1.1 \times 10^5$ Ci of radioactivity. SWSA 4 used as Southern Regional Burial Ground by the AEC.

- Some equipment used in the experiments remain in the pits and the details are not known.
  
  • Coal gasification experiments were terminated and the concrete bunkers (6 ft diameter x 12 ft high) constructed during 1977-78 are left in place. Also, some coal remains on site.
  
  • Equipment associated with solid waste leaching experiment remains on site.
  
  • A number of 200 gal plastic tanks used in the TRU waste leaching experiment remain on site. It is also not known whether or not any 55 gallon drums are still left in place.
  
  • Other equipment from unknown origin remains on site. Four 200 gal plastic tanks with approximately 6 inches water labeled as contaminated are left on site.

CONTAMINANTS:

- Information on chemical contaminants and actual quantity and types of radionuclides are not available; however, there are known releases of strontium and tritium.

PRIOR CORRECTIVE ACTIONS:

- Surface runoff diversion project using asphalt lined channels was completed in 1975.
  
  - Paved interceptor channel and catch basins were constructed in 1983 as part of second surface water diversion project.

PRIOR OPERABLE UNIT DECISIONS:

- The current boundary of WAG 4 will define OU.
Operable Units - WAG 4

A. SWSA 4 (Primary Sources)
   - Trenches
   - Auger holes
   - Surface water/sediments
   - Soil

B. Groundwater/seeps (bathtubbing trench)

C. Pipeline leaks

D. EPPA soil, facilities, trash

E. Explosives Trench

Interface Issues - WAG 4

1. Responsibility for balance of pipeline outside WAGs
2. D&D and ERP scheduling and sequencing for EPPA and pipelines
3. WAG 2 and WAG 4 for contaminated floodplain
4. Waste Management regarding French drain water treatment and waste acceptance criteria
5. TRU policy regarding waste
6. Safety Committee (DOE/ORNL) regarding explosive trench
7. Borrow area size/location for cap construction
8. Use of K-25 D&D Facility by ORNL
9. Russian grouting demonstration at bathtubbing trench (Mike Gilliam)
Fig. G.3. WAG 4 conceptual model—pipelines.
### Table G.1.
**Summary of Data Needs for WAG 4**  
*Operable Unit 4A: SWSA-4 (Trenches/Holes)*

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: surface water/storm flow controls (2/3 of north boundary new french drain)</td>
<td>Evaluate water flow data (new and existing) and water quality in subsurface drains</td>
<td>Collected water does not need treatment</td>
<td>Collected water does need treatment</td>
<td>Water quality sampling and analysis.</td>
<td>Water treatment</td>
</tr>
<tr>
<td>Containment: caps with stabilization</td>
<td>Delineate trenches; examine records and perform geophysical surveys</td>
<td>Sources can be stabilized by dynamic compaction. Auger holes are included under cap</td>
<td>Cannot use dynamic compaction. Different treatment required for auger holes.</td>
<td></td>
<td>Other stabilization methods (e.g., geogrids)</td>
</tr>
</tbody>
</table>

**NOTE:** Surface water/sediment and floodplain soils should be considered at the same time when capping; assume no action for sediments except for "hot spot" remediation.
### Table G.2.
**Summary of Data Needs for WAG 4 Operable Unit 4B: Groundwater/Seeps**

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: install downgradient drains</td>
<td>Evaluate location, volume and characteristics of discharges</td>
<td>Treatment needed at PWTP Cap in place Drain along length of eastern boundary</td>
<td>Treatment not needed Need additional collection at seeps</td>
<td>Water quality sampling Sample seeps</td>
<td>Add collection at trench</td>
</tr>
</tbody>
</table>

### Table G.3.
**Summary of Data Needs for WAG 4 Operable Unit 4C: Pipeline**

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: plug and abandon</td>
<td>No leaks</td>
<td>Leaks exist</td>
<td>Pressure test</td>
<td>Removal</td>
<td></td>
</tr>
<tr>
<td>Removal: consolidate and place under cap</td>
<td>Pipe location survey Contaminated at known locations Unsure of location</td>
<td>Field survey soil in trench</td>
<td></td>
<td>Consolidate contaminated soil</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Check site history to see if any known leak sites exist.*
### Table G.4.
Summary of Data Needs for WAG 4
Operable Unit 4D: Experimental Pilot Pit Area (EPPA)

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect waste, demolish structures, and consolidate under WAG 4 cap</td>
<td>Walk over survey</td>
<td>No soil contamination exists</td>
<td>Soil contamination does exist</td>
<td>Perform radiological walkover survey</td>
<td>Remove soil and consolidate under cap</td>
</tr>
<tr>
<td>Municipal waste on plastic liner</td>
<td>Trash disposal options</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table G.5.
Summary of Data Needs for WAG 4
Operable Unit 4E: Explosives Trench

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: capping (sodium)</td>
<td>Study on in situ desensitization</td>
<td>Conventional methods/blast mats, etc.</td>
<td>Conventional methods cannot be used</td>
<td>Special in situ treatment to desensitize</td>
<td></td>
</tr>
<tr>
<td>Containment: surface water/storm flow controls</td>
<td>Evaluate water quality and flow rates</td>
<td>Collected water does not need treatment</td>
<td>Collected water requires treatment</td>
<td>Water quality sampling and analysis</td>
<td>Water treatment</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Containment: install downgradient drains</td>
<td>Evaluate location of discharge areas; characterize discharge volumes and water quality</td>
<td>Drain along length of eastern boundary</td>
<td>Need additional collection at seeps</td>
<td>Sample seeps</td>
<td>Add collection at trench</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Treatment needed at PWTP</td>
<td>Cap in place</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seep collection and treatment</td>
<td>Characteristics, volume, and quality of the water</td>
<td>Can collect and treat water at PWTP</td>
<td>Cannot treat water at PWTP</td>
<td>Sample collected seep water</td>
<td>Pre-treatment or waste evaporation</td>
</tr>
</tbody>
</table>
Appendix H

WAG 5
ORNL WAGs

WAG: 5 - SWSA5

FUNCTION: Landfill
(33 acres)

YEARS OF OPERATION: 1959 to 1973

CURRENT RI/FS STATUS: Revised RI Plan submitted. Awaiting start of field work.

SWMUs:
- Total Number - 11
- Type
  • LLW line & leak sites
  • SWSA 5
  • Hydrofracture surface facilities (OHF & NHF)—not included in baseline
  • Sludge basin
  • Concentrate storage tanks
  • Waste storage tanks (OHF)
  • TRU waste storage area (10 acres)—not included in baseline

WASTES HANDLED:
- Solid waste (3 X 10⁶ ft³, 200,000 Ci)
- LLW to hydrofracture
- SE Regional AEC burial ground (1959 to 1963) - unknown wastes

CONTAMINANTS
- Identified: Radionuclides: Sr-90, Cs-137, H-3, CO-60
  Metals: Cd, Cr, Ni, Cu, Zn
- Potential: Organics - not analyzed

MEDIA OF CONCERN:
- Surface water/sediment SWSA 5 & OHF pond
- Groundwater

PRIOR CORRECTIVE ACTIONS:
- Isolation of seep 4 source

PRIOR OPERABLE UNIT DECISIONS:
- WAG will define operable unit.
Operable Units—WAG 5

A. Impoundments
B. Tanks
C. Subsurface Disposal
D. Pipelines
E. Groundwater
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment: pump and treat liquids</td>
<td>Perform treatability study</td>
<td>Standing water volume greater than required for stabilizing sediments</td>
<td>Standing water volume less than or equal to required volume for stabilizing sediments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment: Solidification/stabilization (insitu)</td>
<td>Perform treatability study</td>
<td>Sediments can be solidified</td>
<td>Sediments cannot be solidified insitu due to mixing limitations</td>
<td>Testing of sediments during and after treatment</td>
<td>Remove sediments; solidify and replace in impoundment</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------</td>
<td>------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Treatment: In situ vitrification</td>
<td>Tank content characterization, soil sampling (extent of contamination), depth to water and bedrock</td>
<td>Volume and quality of off-gas is predictable</td>
<td>Volume and quality of off-gas is not as expected</td>
<td>Monitor off-gas</td>
<td>Modify off-gas system in field</td>
</tr>
<tr>
<td></td>
<td>Tank content characterization (chemical and physical)</td>
<td>Conditions allow for sufficient melt</td>
<td>Insufficient melt</td>
<td>Monitor melt</td>
<td>Add soil or amendment</td>
</tr>
<tr>
<td>In situ stabilization</td>
<td></td>
<td>Tanks contents can be stabilized in situ</td>
<td>Tank contents cannot be stabilized in situ</td>
<td>Test contents during and after stabilization</td>
<td>Remove tank contents and stabilize ex situ; remediate tank at a later date</td>
</tr>
<tr>
<td>Pump/treat tank contents</td>
<td>Tank content characterization (chemical/physical)</td>
<td>Tank contents can be treated at ORNL</td>
<td>Tank contents can not be treated at ORNL</td>
<td>Monitor ORNL waste acceptance criteria/permits</td>
<td>In situ treatment or off-site treatment</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>------------------</td>
<td>-------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>Containment: Capping and structural stabilization</td>
<td>Geophysical Surveys (delineate trenches)</td>
<td>Trenches can be stabilized</td>
<td>Subsidence</td>
<td>Site Surveys</td>
<td>Repair Cap</td>
</tr>
<tr>
<td></td>
<td>Geotechnical Properties (stability)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perimeter Sampling (extent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containment: Water diversion fench drains (lower the water table)</td>
<td>Determine water table level, recharge parameters, and depth to bedrock; estimate flow rates and contamination</td>
<td>The system will lower the water table</td>
<td>The system does not lower the water table</td>
<td>Monitor groundwater table</td>
<td>Modify the system (add trenches or deepen) to increase collection</td>
</tr>
<tr>
<td></td>
<td>Water is not contaminated (after initial collection)</td>
<td>Water is contaminated</td>
<td></td>
<td>Analyze water for contaminants</td>
<td>Treatment at ORNL PWTP or add a treatment unit onsite</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
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<td>------------------------------------------</td>
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</tr>
<tr>
<td>Treatment; In situ</td>
<td>Geophysical survey to locate pipes</td>
<td>Pipe is located under proposed cap</td>
<td>Pipe is not located under proposed cap</td>
<td>Cap layout</td>
<td>Pipe removal/disposal</td>
</tr>
<tr>
<td>Removal/disposal</td>
<td>Geophysical survey to locate pipes</td>
<td>Pipelines are intact and contaminated</td>
<td>Pipelines leak and backfill is contaminated</td>
<td>Perform soil sampling and CSL analysis</td>
<td>Remove contaminated soil</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
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<td>-------------------------------------------------------------------</td>
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<td>-------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Groundwater collection at boundary;</td>
<td>Determine groundwater flowrates (collect and evaluate hydrogeologic data) and contaminant concentration in upper zone</td>
<td>Groundwater contaminated and can be treated at ORNL</td>
<td>Groundwater cannot be treated at ORNL</td>
<td>Groundwater and waste acceptance criteria/permit will be monitored</td>
<td>Build on-site treatment plan for pretreatment of groundwater</td>
</tr>
<tr>
<td></td>
<td>Determine contaminant concentration (groundwater sampling) in lower zone</td>
<td>Groundwater contaminated in upper zone (regolith)</td>
<td>Groundwater is also contaminated in lower zone</td>
<td>Monitor groundwater in lower zone</td>
<td>Area wide collection system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contaminated groundwater can be collected at surface seeps</td>
<td>Contaminated groundwater bypasses seeps</td>
<td>Monitor groundwater at boundary</td>
<td>Build a french drain collection system</td>
</tr>
<tr>
<td>Potential Early Actions</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
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<td>-------------------</td>
</tr>
<tr>
<td>Removal of tank contents by pumping</td>
<td>Characterize tank contents (physical and chemical properties) Perform treatability tests if needed</td>
<td>Contents can be treated at ORNL</td>
<td>Contents do not meet ORNL waste acceptance criteria</td>
<td>Monitor ORNL waste acceptance criteria/permits</td>
<td>Insitu treatment or offsite treatment of waste material</td>
</tr>
</tbody>
</table>
Appendix I

WAG 7
ORNL WAGs

WAG: 7 - Pits and Trenches

FUNCTION: - LLLW Disposal Through Seepage Pits and Trenches
- Decontamination Facility
- HRE Fuel Disposal

YEARS OF OPERATION: 1951 to 1966

CURRENT RI/FS STATUS: RI plan submitted to regulators. Anticipate starting RI in FY93.

SWMUs:
- Total Number: 9
- Type:
  - ILLW Pits (4)
  - ILLW Trenches (3)
  - Hydrofracture experiment spill site
  - Decontamination Facility
  - HRE fuel wells
  - LLW lines & leaks

WASTES HANDLED: LLW (42x10^6 gal.; 1.2x10^6)
Estimated 2x10^5 Ci Sr-90, 6x10^5 Ci Cs-137 & smaller amounts of U & TRU

CONTAMINANTS:
- Identified: radionuclides - Co-60, Sh-125; H-3; Sr-90; U-238; U-232; U-235; Cs-37; Tc-99; U-233; Pu-238; Pu-239/240; Cm-244; Am-241
  Metals - Pb; Cd; Co; Cu; Ni; V; Zn
- Potential: organics not previously analyzed for

MEDIA OF CONCERN:
- Surface water/sediment
- Groundwater
- Soil (surface and subsurface)
- Flora
PRIOR CORRECTIVE ACTIONS:

- Fill and cap pits
- Cap trenches
- Slurry wall at Trench 7
- Remove soil and cap LLLW line leaks
- Remove soil at HF spill

PRIOR OPERABLE UNIT DECISIONS:

- Current WAG boundary defines OU
- Pits and trenches possible ISV early action
Operable Units - WAG 7

A. Subsurface disposal areas (primary sources)
B. Pipeline and spill leak sites/surface contamination
C. Secondary sources (soil/groundwater/vegetation)

Interface Issues - WAG 7

1. Schedule for Building 7819 transfer to S&M to D&D to ERP
2. Responsibility for balance pipelines between WAGs
3. Waste management regarding quantity/quality of water to ORNL treatment facility
4. Post-implementation monitoring responsibility
Fig. I.2. WAG 7 conceptual model—subsurface disposal.

SHADING INDICATES OPERABLE UNITS
FIG. 14. WAG 7 conceptual model-pipelines.
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: caps</td>
<td>Evaluate trench/pit stability</td>
<td>Trenches are stable</td>
<td>Trenches need stabilization</td>
<td>Survey and observe</td>
<td>Repair</td>
</tr>
<tr>
<td>Containment: surface storm flow control (e.g., drains, berms, extend cap)</td>
<td>Source term data/coring and logging, gamma logging, modeling, identification of recharge areas, etc.</td>
<td>Source term remains</td>
<td>Source term does not remain</td>
<td>Monitor effectiveness</td>
<td>D.D.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Surface storm flow control required</td>
<td>Surface storm flow control not required</td>
<td>Analyze and monitor WAC/capacity</td>
<td>Onsite treatment or pre-treatment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contaminated water treated at ORNL</td>
<td>Water is not contaminated; not treated at ORNL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment and Containment: in situ grout (trenches)</td>
<td>Study to evaluate grout types, Technical demonstration</td>
<td>Clay grout is effective</td>
<td>Can not demonstrate immobilization</td>
<td>Monitor tests</td>
<td>Ex situ grouting by remote methods</td>
</tr>
<tr>
<td>In situ vitrification</td>
<td>Technical demonstration</td>
<td>Technology is demonstrated and commercially available</td>
<td>Technology not appropriate for full scale application</td>
<td>Monitor tests and status of ongoing technology development</td>
<td>Capping/grouting or other</td>
</tr>
</tbody>
</table>
### Table 1.2
Summary of Data Needs for WAG 7
Operable Unit 7B: Pipeline/Spills/Surface Contamination

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal and consolidation</td>
<td>Determine location of pipelines and extent of contamination</td>
<td>Normal techniques will work</td>
<td>Zones of high levels of contamination exist</td>
<td>Conduct field radiological surveys</td>
<td>Special methods for removal/remediation</td>
</tr>
<tr>
<td>Containment: grout pipe and cover</td>
<td>Determine extent of contamination</td>
<td>Action is required</td>
<td>No action required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment: stabilize trench zone</td>
<td>Determine location of pipelines; perform a treatability study</td>
<td>Can remove pipe and mix soil in situ</td>
<td>Cannot remove pipe and mix soil in situ</td>
<td>Conduct field radiological surveys</td>
<td>Ex situ treatment</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
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<td>--------------------------------------------</td>
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<td>-----------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Removal and consolidation: soil excavation</td>
<td>Identify extent of soil secondary source areas</td>
<td>Extent of contamination can be delineated</td>
<td>Extent of contamination cannot be delineated</td>
<td>Field sampling and analysis of soils</td>
<td>Containment</td>
</tr>
<tr>
<td>Removal and consolidation: groundwater/surface water collection</td>
<td>Characterize hydrogeology and extent of contamination. Perform risk assessment. Perform treatability study.</td>
<td>Collection feasible; collected water meets waste acceptance criteria</td>
<td>Collection not feasible; collected water does not meet waste acceptance criteria</td>
<td>Aquifer testing; sample and analyze collected water</td>
<td>Area-wide groundwater collection and treatment system</td>
</tr>
<tr>
<td>Removal and consolidation: vegetation-cut, consolidate, and compost</td>
<td>Risk assessment</td>
<td>Action is feasible and necessary</td>
<td>Not necessary</td>
<td>Bio monitoring</td>
<td>No action</td>
</tr>
<tr>
<td>Summary of Data Needs for WAG 7 Operable Unit 7C: Secondary Sources</td>
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<tr>
<td><strong>Expected Conditions</strong></td>
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<tr>
<td>Cap is effective in containment</td>
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<tr>
<td>Cap not effective in containment</td>
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<tr>
<td>Deep monitoring</td>
<td></td>
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<tr>
<td>Sample and analyze collected water</td>
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<tr>
<td>Potential area wide collection and treatment system if risk warrants</td>
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</tr>
<tr>
<td><strong>Data Needs: RI/Special Demos</strong></td>
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<td></td>
</tr>
<tr>
<td>Characterize nature and extent of contamination and perform risk assessment</td>
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<tr>
<td>Characterize hydrology</td>
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<tr>
<td>Characterize flow patterns, depth to bedrock, etc.</td>
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<tr>
<td>Feasible to collect groundwater</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Not feasible to collect groundwater; deep groundwater contamination</td>
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</tr>
<tr>
<td><strong>Remedial Action</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Containment: soils-cap</td>
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<tr>
<td>Containment: surface water controls</td>
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</tr>
<tr>
<td>Containment: groundwater—drains and interception</td>
<td></td>
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<td></td>
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<tr>
<td>Containment: groundwater zone monitoring</td>
<td></td>
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</tr>
</tbody>
</table>

<p>| Contingent Action                                             |
| Fix or extend cap                                            |
| Treat, if necessary perform treatability study               |
| Deep groundwater zone monitoring                             |
| Potential area wide collection and treatment system if risk warrants |</p>
<table>
<thead>
<tr>
<th>Potential Early Actions</th>
<th>Contingent Action</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Table 1.5.
Summary of Early Actions for WAG 7

<table>
<thead>
<tr>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cap extension/ runoff diversion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slope buttress</td>
<td>Selective removal of trees</td>
</tr>
</tbody>
</table>
ORNL WAGs

WAG 8: Research and Development Facilities and Waste Treatment Facilities supporting ORNL activities.

FUNCTION: Research and Development Facilities include the Molten Salt Reactor Experiment (MSRE), the High Flux Isotope Reactor (HFIR), the Transuranic Processing Plant (TPP) and the Transuranic Research Facility (TRF).

YEARS OF OPERATION: WAG 8, Since 1951 through present.
- MSRE—1965 to 1969
- HFIR—1965 to present
- TPP—late 1960s to present
- TRF—late 1960s to present

CURRENT RI/FS STATUS: RI Plan has been issued.

SWMUs: There are 14 SWMUs identified, including
- HFIR/TRU waste collection basins
- LLLW lines & leak sites
- active & inactive LLLW storage tanks
- HF-2 site
- septic tank
- misc. impoundments
- contractors spoils area

WASTES HANDLED:

Residual organics, acids, sodium and potassium hydroxides - 13,200 gallons
process water with radioactive - 840,000 gallons
LLW - 2,100 gallons
sanitary wastes - unknown
Silver - 400 gallons
Waste Oil - 60 gallons
PCBs - unknown

CONTAMINANTS:

Radionuclides - Pu-242, Co-60, Cm-244, Cs-137, Sr-90, Ru-106

Others - As, Ba, Cd, Pb, Se, Ag, Endrin, Lindane, Methoxychlor, Toxaphene
PRIOR CORRECTIVE ACTIONS:

Removal of contaminated soils at ILLW transfer pipeline leak sites.

PRIOR OPERABLE UNIT DECISIONS:

- Current WAG 8 boundary will define the OU.
- Decision needed in near future regarding interim action for WAG 8 impoundments.
A. Impoundments/Basins
B. Tanks
C. Pipelines/Leak Sites
D. HF2
E. Spoil Area and miscellaneous surface contamination
F. Groundwater

Interface - WAG 8

1. 7507 Hazardous Waste Management Area
   RCRA Closure FY92?
   (Check with Nancy Daily)

2. ERP conflicts with HFIR operations

3. WAG 10 and D&D on HF2 (injection well) surface and subsurface facilities

4. WAG 2 interface

5. LLLW tanks status with Waste Management

6. Need to look at pipelines as an overall strategy

7. HF2 - Core holes, interface with WAG 10 and/or Well P&A (add the 22 coreholes to WAG 10)

8. Schedule and location of New Melton Valley (to Wag 1) pipeline (Facility Planning)
Fig. J.2. WAG 8 conceptual model—impoundments.
Fig. J.3. WAG 8 conceptual model—subsurface disposal.
Fig. J-5. WAG 8 conceptual model—tanks.
### Table J.1.
Summary of Data Needs for WAG 8
Operable Unit 8A: Impoundments

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: in situ solidification with capping</td>
<td>Study of Molten Salt Reactor Experiment operations</td>
<td>Assume same as WAG 1 actions for impoundments</td>
<td>Not contaminated</td>
<td>Sampling and analysis of impoundment contents</td>
<td>No action</td>
</tr>
<tr>
<td>Containment: surface water and shallow storm flow controls (diversion)</td>
<td>Perform treatability study (same as WAG 5 and WAG 4)</td>
<td>Same as for surface impoundments for WAG 1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table J.2.
Summary of Data Needs for WAG 8
Operable Unit 8B: Tanks

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grout in place (see WAG 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contents removal (see WAG 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septic Tank: no further action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table J.3.
Summary of Data Needs for WAG 8
Operable Unit 8C: Pipelines/Leak Sites

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leak Sites (7): excavate/disposal (consolidate if possible)</td>
<td></td>
<td>Small leak sites</td>
<td>Large leak sites</td>
<td>Sampling and analysis during excavation.</td>
<td>Containment</td>
</tr>
<tr>
<td>Pipelines: removal, compaction, and disposal (e.g., in a storage building)</td>
<td>Study needed on pipeline decontamination and reuse</td>
<td>Dispose in potential new storage facility</td>
<td>No room in potential new storage facility</td>
<td></td>
<td>Dispose under a cap</td>
</tr>
</tbody>
</table>

Note: Look at overall pipeline strategy across all WAGs; maybe a similar approach to well P&A program.

### Table J.4.
Summary of Data Needs for WAG 8;
Operable Unit 8D: HF-2

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellhead WAG 10 (plugged)</td>
<td>Investigate for potential spills and contamination</td>
<td>No further action</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
Assume no surface soil contamination outside of wellhead.
Add the 22 coreholes to WAG 10.
Potential for TRU.
### Table J.5.
Summary of Data Needs for WAG 8
Operable Unit 8E: Contractor Spoil Area and Miscellaneous

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: capping with surface water/storm flow diversion</td>
<td>Characterize/confirm the nature and extent of contamination</td>
<td>Area is stable (i.e., no trench subsidence)</td>
<td>Subsidence has occurred</td>
<td>Site surveys</td>
<td>Repair cap</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water not contaminated after collection</td>
<td>Water is contaminated</td>
<td>Sample and analyze collected water</td>
<td>Treatment at ORNL PWTP or add onsite treatment unit.</td>
</tr>
</tbody>
</table>

### Table J.6.
Summary of Data Needs for WAG 8
Operable unit 8F: Groundwater

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: Refer to WAG 2 monitoring (more cost effective to treat in WAG 2)</td>
<td>Groundwater monitoring at impoundments</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Early Actions</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-------------------------</td>
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<td>------------</td>
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<td>-------------------</td>
</tr>
<tr>
<td>Interim Record of Decision (ROD) planned 93(?) for impoundments (assume all)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix K

WAG 9
ORNL WAGs

WAG: 9 - Homogeneous Results Experiment (HRE) Area. Includes earthen surface impoundment, underground storage tank systems, septic tank and parking lot.

FUNCTION:

a. Surface impoundment, an unlined earthen pond, 315,000 gallons capacity. Used for storage and treatment of LLW from HRE and facilities.

b. Two underground tank systems, 1000 gallon and 12,000 gallons capacity. Used to store contaminated liquid wastes from different sources.

c. 1400 gallon septic tank used to process domestic sewage. No radiological contamination evident.

d. Parking lot was originally used for storage of materials during the operations of HRE.

YEARS OF OPERATION:


b. 1951-1954, 1956-1961 (Note: Tank 7562 is not considered inactive as some contaminated waste is added occasion.)

c. 1951-present.


CURRENT RI/FS STATUS:

- RI Plan complete. Awaiting prioritization to proceed.

SWMUs:

- There are 5 SWMUs identified.
- HRE pond
- LLLW tanks
- waste evaporator and loading pit
- trash area
WASTES HANDLED:

- Approximately 1,136,000 liters of radiological and chemical wastes containing 750 Ci of radioactivity have been handled at surface impoundment.
- Waste volumes and inventories for other SWMUs are not available.

CONTAMINANTS:

- Radionuclides such as Sr-90, Cs-137, U-234, U-235, U-238, Pu-239, Co-60, and Am-241 have been detected in surface impoundment.
- Major chemical constituents in surface impoundment include Al (166,231 kg), Ca (114,383 kg), K (48,776 kg), and Ti (8,809 kg).
- Details on other SWMUs are not available.

PRIOR CORRECTIVE ACTIONS:

The surface impoundment was closed by backfilling with soil and fragments of shale. Some investigative effort to collect data on radioactivity and chemical contamination has been made. PCB contamination has been noted to exceed the limits established by Tennessee Hazardous Substance Guidance for soil.

PRIOR OPERABLE UNIT DECISIONS:

- Current WAG boundary defines OU.
Operable Units - WAG 9

A. Impoundment
B. Tanks
C. Miscellaneous (septic tank, parking lot, soils, waste evaporator, trash area)
D. Groundwater

Interface Issues - WAG 9

1. With D&D regarding - Structures and tanks scheduling
2. K-25 incinerator availability and capacity
3. WAG 9 relation to WAG 2
4. TSCA ARAR for PCBs
5. Interface with well P&A
6. Investigation of area groundwater
Fig. K.3. WAG-9 conceptual model – tanks.
<table>
<thead>
<tr>
<th>Table K.1. Summary of Data Needs for WAG 9 Operable Unit 9A: Impoundments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Needs:</strong> RI/Special Studies/Tech Demos</td>
</tr>
<tr>
<td>Containment: In situ solidification and cap</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Remedial Action</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table K.2. Summary of Data Needs for WAG 9 Operable Unit 9B: Tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Needs:</strong> RI/Special Studies/Tech Demos</td>
</tr>
<tr>
<td>Containment:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Containment:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Remedial Action</strong></td>
</tr>
</tbody>
</table>
### Table K.3.
Summary of Data Needs for WAG 9
Operable Unit 9C: Miscellaneous (septic tank, parking lot, soils, waste evaporator, trash area)

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Investigation</td>
<td></td>
<td>No further action</td>
<td>No further action is not appropriate</td>
<td></td>
<td>To RI/FS</td>
</tr>
</tbody>
</table>

### Table K.4.
Summary of Data Needs for WAG 9
Operable Unit 9D: Groundwater

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to area-wide groundwater action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix L

WAG 10
ORNL WAGs

WAG: 10 - Underground component of the various hydrofracture waste facilities (i.e., wells and grout)

Surface hydrofracture facilities will be covered by other WAGs.

FUNCTION: Unique waste disposal method that consisted of mixing liquid radioactive wastes with cement and other additives to form a slurry. Slurry injected into shale formations 290 to 1069 ft deep at pressures of 2000 psi and higher. The slurry spread along the fractures and bedding planes for hundreds of meters forming thin grout sheets of thicknesses less than a millimeter.

YEARS OF OPERATION: 46 injections between 1959–1984

CURRENT RI/FS STATUS: RI Plan and RI Implementation Plan have been reviewed by the regulators. Waiting for prioritization.

SWMUs: - Total Number: 4
(HF-1 - SWMU 10.1)
(HF-2 - SWMU 10.2)
(HF-3 - SWMU 10.3)
(HF-4 - SWMU 10.4)

WASTES HANDLED:
- Disposal of over 12 million liters of low level radioactive wastes
- Total inventory of $1.4 \times 10^6$ Ci of radioactivity

CONTAMINANTS:
- Identified: strontium-90, cesium-137, curium-244, miscellaneous TRU, and other nonradioactive species such as heavy metals. The analysis was based on sampling the contents from Melton Valley storage tanks, and were not conclusive.

PRIOR CORRECTIVE ACTIONS: None to date

PRIOR OPERABLE UNIT DECISIONS: Interim ROD for well plug and abandonment, 1993
Operable Units - WAG 10

A. Grout Sheets
B. Contaminated Deep Groundwater
C. Injection Wells and Deep Boreholes

WAG 10 Interface Issues

1. Scheduling of WAGs 2, 5, and 7 and D&D/WAG 10
2. Nature of an responsibility for area groundwater, WAG groundwater, and saline groundwater
3. Waste Management interface for groundwater treatment, volume and waste acceptance criteria (for RI purge water and for extraction remedial action)
4. Pretreatment of purge water and handling of filtrate
5. New Reactor Facility Advanced Neutron Source at background well location
Fig. L.3 WAG 10 conceptual model – hydrofracture wells (experimental).
<table>
<thead>
<tr>
<th>Data Needs: RI/Special Studies/Tech Dems</th>
<th>Expected Conditions</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remedial Action</td>
<td>Monitoring - See deep groundwater recovery trial (in-place containment)</td>
<td>Releases form grout sheets do not pose threat to human health and the environment</td>
</tr>
<tr>
<td></td>
<td>Expected conditions do not hold</td>
<td>Monitor concentrations in deep groundwater</td>
</tr>
</tbody>
</table>

Table L.1. Summary of Data Needs for WAG 10 Operable Unit 10A: Grout Sheets
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment: plug and abandon (P&amp;A) (see deep Wells and Boreholes operable unit)</td>
<td>Groundwater sampling and analysis to update information regarding nature and extent of contamination (New well installation). Evaluate potential for ingestion along hypothesized fault.</td>
<td>Deep groundwater contamination does not pose a threat to human health.</td>
<td>Expected conditions do not hold</td>
<td>Monitor deep groundwater for spread of contaminants</td>
<td>No cost effective technology available to remediate. Implement institutional controls</td>
</tr>
<tr>
<td>Fault Monitoring</td>
<td>See existing RI Plan: geophysics, coring, treatability study (paper)</td>
<td>No significant migration along potential fault</td>
<td>Migration occurring along potential fault</td>
<td></td>
<td>Collection and treatment of deep groundwater</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Plug and abandon injection wells</td>
<td>Recomplete selected monitoring wells for monitoring deep groundwater</td>
<td>Special procedures needed</td>
<td>None anticipated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Monitoring Wells (150 total) 90% P & A 10% recreate  | P & A paper study  
- Compatibility  
- Wells under pressure?  
- Well sampling and logging  
- Waste management issues | Wireline tools will be used                  |                     |            |                   |
<table>
<thead>
<tr>
<th>Potential Early Actions</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term monitoring for grout sheets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start well logging to support P&amp;A of rock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cover wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI for HFI</td>
<td>Log wells</td>
<td>NFA</td>
<td></td>
<td></td>
<td>See groundwater OU</td>
</tr>
<tr>
<td></td>
<td>Sample wells</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
WAG 11: This area, known as White Wing Scrap Yard, covers 30.4 acres and is located approximately a mile east of intersection of highways 58 and 95 in the McNew Hollow area. This WAG provided scrap metal storage for K-25, Y-12 and ORNL facilities.

FUNCTION: The area was used for above ground storage of scrap nuclear and chemical components. Apart from steel tanks, dump trucks, earth moving equipment, glass lined tanks, mild and stainless steel frame components, several reprocessing reactor vessel components were reported to have been stored at this site.

YEARS OF OPERATION: 1950 to (unknown)

Storage of contaminated materials reportedly started during early 1950s. However, actual duration of storage and date it was discontinued are not known.

SWMUs: The area has been categorized as one SWMU.

WASTES HANDLED:

The volume of materials stored by ORNL is estimated to be about 500,000 cubic feet. However, the volume of materials stored by the K-25 and Y-12 facilities is not known.

One reactor vessel was estimated to be contaminated with 25 gm. of plutonium-239.

Inventories of various radionuclides are not available.

CONTAMINANTS:

Identified Radionuclides- Co-60, Sr-90, Cs-137, Pa-234, U-235, Th-234.

Identified Metals- Cd, Cr, Cu, Ni, Zn, and Pb.

Identified Organics- Di-n-butylphthalate and soil contaminated with PCBs have been noted.
PRIOR CORRECTIVE ACTIONS:

Site cleanup efforts were initiated during 1966. Majority of large pieces of equipment and other contaminated materials were removed from the site. The cleanup efforts were discontinued during October, 1970.

Following the initial cleanup efforts, an area on the south side of WAG 11 was excavated and the contaminated soil was removed and replaced with uncontaminated soil.

PRIOR OPERABLE UNIT DECISIONS:

- Removal of debris, FY92-93
- Containment of mobile contaminants, FY92-93
- November 1989 site access restricted by roped areas
Operable Units - WAG 11

A. Surface Water
B. Groundwater
C. Scrap Yard soil (surface and shallow subsurface)

Interface Issues - WAG 11

1. Environmental Monitoring Plan and ERP (Tom Early)
2. K-25 Groundwater Area and ERP (Lisa Shipe)
3. East Fork Poplar Creek Remedial Planning and ER (Radian/SAIC, Fred Haywood)
4. Waste Management Facility Plan and ER (Waste Storage Building)
5. TSCA/PCB waste acceptance criteria for K-25 incinerator
6. Examine Elza-Gate experience with PCB contaminated soil
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove contaminated sediments (&quot;hot spots&quot;) from WAG based upon RI Plan</td>
<td>Sediment contamination confined to &quot;hot spots&quot;</td>
<td>Contamination is more widespread; i.e., not confined to isolated &quot;hot spots&quot;</td>
<td>Confirmation survey</td>
<td>Pick up additional sediments</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td>Evaluate existing monitoring system; upgrade existing perimeter wells if necessary</td>
<td>No treatment required</td>
<td>Treatment required</td>
<td>Sampling and analysis</td>
<td>Groundwater collection and treatment</td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
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<td>---------------------</td>
<td>------------</td>
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<td>-------------------</td>
</tr>
<tr>
<td>Refer to Early Actions for WAG 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential Early Actions</td>
<td>Data Needs: RI/Special Studies/Tech Demos</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Debris removal in September '92</td>
<td>Identify optimum methods for material segregation</td>
<td>No existing buried drums</td>
<td>More buried drums than anticipated</td>
<td>Geophysics and observations</td>
<td>Remove to SWSA 6</td>
</tr>
<tr>
<td></td>
<td>Subsurface geophysics to identify burial areas</td>
<td>Build new facility to receive wastes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEG Super Compactor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of contaminated soil in September '92;</td>
<td>Volume of contaminated soil</td>
<td>Excavate with disposal at SWSA 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>decontamination of soil by soil washing and ion</td>
<td></td>
<td>Small volume of TSCA material to store (Elza Gate experience, PCBs &lt; 50 ppm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exchange</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix N

WAG 12
ORNL WAGs

WAG: 12 - Closed Contractors' Landfill

FUNCTION: Landfill
(2.9 acres)

YEARS OF OPERATION: 1950 to 1975

CURRENT RI/FS STATUS: RI plan not yet developed

SWMUs:
- Total Number: 1, landfill

WASTES HANDLED:
- Construction and demolition debris (up to 1.8 X 10^6 ft^3)
- No records but likely contains paints, solvents, etc.

CONTAMINANTS:
- Identified: Radionuclides - Co-60, Sr-90 and Cs-137 near background
  Metals - Ni
  Organics - Di-n-butylphthalate

MEDIA OF CONCERN:
- Soil
- Groundwater

PRIOR CORRECTIVE ACTIONS:

PRIOR OPERABLE UNIT DECISIONS: NFA. Will not be considered an OU for the Action Plan.
OPERABLE UNIT—WAG 12

1. Closed Contractors Landfill
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment:</td>
<td>Medial Sampling (PA/SI) [Assume no RI, straight to ROD.]</td>
<td>Cap is adequate</td>
<td>Cap not adequate</td>
<td>Media Sampling</td>
<td>RCRA Cap</td>
</tr>
<tr>
<td>TDEC Municipal Landfill Cap (i.e., membrane + 2 ft fill cap)</td>
<td>Adequate</td>
<td></td>
<td></td>
<td>Surface water and groundwater sampling</td>
<td></td>
</tr>
<tr>
<td>Groundwater/surface water interception and diversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix O

WAG 13
ORNL WAGs

WAG 13: Environmental Research Areas

FUNCTION:

YEARS OF OPERATION:

CURRENT RI/FS STATUS:

Draft RI Plan has been completed and is being reviewed at this time.

SWMUs: Two SWMUs;
- White Oak Creek (south of 7500 bridge)/Melton Branch
- White Oak Lake/Dam/Embayment

WASTES HANDLED: - Liquid wastes released from WAGs 1, 3 through 10, 13 and 17.
- Releases from NPDES permitted sources
- Non-point discharges
- Estimated volumes and inventories are not available

CONTAMINANTS: - Co-60, Sr-90, Cs-137, H-3, Pu, Ru, Am-241, U-233, TRU
- Cu, Zn, Ni, Mo, Pb, Hg, PCB, VOCs

PRIOR CORRECTIVE ACTIONS: None

PRIOR OPERABLE UNIT DECISIONS: Current boundary of WAG 2 will define OU.
Fig. O.2. WAG 13 conceptual model — surface experiments.
### Table O.1
Summary of Data Needs for WAG 13
Operable Unit 13A: WAG 13

<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: R1/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to &quot;Early&quot; Action for WAG 13</td>
<td>Talk with employees; historical investigation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spray Areas: monitor</td>
<td>Delineate spray areas and other exposure areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater: monitor</td>
<td>Collect/analyze additional groundwater information</td>
<td>No further action</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation: monitor</td>
<td>Collect/analyze biota information</td>
<td>No further action</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table O.2
Summary of Early Action for WAG 13
Operable Unit 13A: Cs Plots/September 1992
Probable Final Remedial Action: No Further Action with Monitoring

<table>
<thead>
<tr>
<th>Potential Early Actions</th>
<th>Data Needs: R1/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of source material; cap with membrane and soil</td>
<td>Accepted at IWMF, SWSA 6</td>
<td>Expected depth of contamination is 1.5 feet</td>
<td>Not accepted at IWMF. SWSA 6</td>
<td>Depth greater than 1.5 feet of depth</td>
<td>Survey</td>
</tr>
</tbody>
</table>
Appendix P

WAG 15
FUNCTION: Storage Facilities

YEARS OF OPERATION: ?

CURRENT RI/FS STATUS: R1 Plan not yet developed

SWMUs:
- Total Number: 2
- Type:
  • Cyclotron Pit 9204-1
  • ORNL at Y-12 Contaminated at East End Basement 9204-1

WASTES HANDLED:
- Oil containing PCB & possibly radionuclides (inventory reduced from 15,000 to 7,000 gals.)
- Transformers & capacitors at 4 locations range in oil capacitor from 2 gals. to 2,200 gals.

CONTAMINANTS:
- Identified: PCB-containing oil

MEDIA OF CONCERN: Limited Concern

PRIOR CORRECTIVE ACTIONS:

PRIOR OPERABLE UNIT DECISIONS: None.
- Assume NFA
Appendix Q

WAG 16
16 - Health Physics Research Area

FUNCTION: Research

YEARS OF OPERATION: ?

CURRENT RI/FS STATUS: RI plan not yet developed

SWMUs:
- Total Number: 2
- Type:
  - Cesium forest
  - Buried scrap metal area

WASTES HANDLED:
- 30 trees inoculated with Cs-137 (467 mCi initially; <370 mCi remaining)
  Loss through 28 years of decay & leaf dissemination

CONTAMINANTS:
- Identified: Radionuclides - Co-60, Sr-90, Cs-137, H-3
  Metals - Cd (background levels)

MEDIA OF CONCERN: Limited Concern
- Vegetation?
- Soil?

EXPOSURE PATHWAY: Minimal
- Plant leaves

PRIOR CORRECTIVE ACTIONS:

PRIOR OPERABLE UNIT DECISIONS: None.
Operable Units—WAG 16

1. Cesium Forrest
   - 20 x 25 meter plot
   - Poplar trees (approximately 30 trees at 100 ft height)
   - 270 Ci Cs-137 (1990)
   - Wind distribution

2. Scrap Metal (burial)
   - Complete PA/SI and assume NFA
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Containment:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water sampling</td>
<td>Adequate retention of sediment</td>
<td>Retention of sediment is inadequate</td>
<td>Surface water sampling</td>
<td>Collect and treat</td>
<td></td>
</tr>
<tr>
<td>surface water controls (ie, sediment trap)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May need to consider collection and treatment of retained sediments at a later date—after Cs 137 decay is adequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater/surface water interception and diversion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix R

WAG 17
ORNL WAGS

WAG: 17 - Storage and support facilities for supporting routine and experimental ORNL operations.

FUNCTION: Support facilities include shops for printing, painting, welding, lead-burning, vehicle service and maintenance and material storage.

YEARS OF OPERATION: WAG 17, since 1940 to present

a. septic tank (7000), 1959 to the early 1970s
b. four waste oil storage tanks, 1975 through 1986
c. one waste oil storage mobile junk truck, 1975 to 1986
d. two photographic reproduction waste storage tanks, 1981 to 1986

CURRENT RI/FS STATUS:

RI Plan and R1 Implementation Plan received and commented on by regulators. Implementation awaiting prioritization.

SWMUs: There are 4 SWMUs identified, all have been classified NFA.

WASTES HANDLED: Sanitary Waste - 39,000 gallons
Oil - 7,580 gallons
Photographic process wastes - presumed empty
Unleaded gasoline - unknown

CONTAMINANTS: Radionuclides: Tritium
Metals: Cr, Zn, Cu
Other: Petroleum, PCBs, 11 SVOCs

PRIOR CORRECTIVE ACTIONS: Cleanup of a small release (<100 gallons) of gasoline from one storage tank (7005a) has been performed.

PRIOR OPERABLE UNIT DECISIONS:

All SWMUs have been classified NFA. WAG will not be considered an OU for the Action Plan.
<table>
<thead>
<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No further action</td>
<td>Document rationale for not further action (e.g., no releases, active, refer to BNI work plan.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remedial Action</td>
<td>Data Needs: RI/Special Studies/Tech Dems</td>
<td>Expected Conditions</td>
<td>Deviations</td>
<td>Monitoring</td>
<td>Contingent Action</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Seeps identification (broad scale, USGS as starting point)</td>
<td>Regulatory: does not violate RCRA/CERCLA</td>
<td>Regulatory: does violate RCRA/CERCLA</td>
<td>Four wells per year; multi-port (install &amp; abandon) 1,000 ft. (for 5 years)</td>
<td>WAG by WAG</td>
</tr>
<tr>
<td></td>
<td>Characterize groundwater background concentrations</td>
<td>Not contaminated</td>
<td>Is contaminated, but &quot;releases&quot; are this discrete points (example: seeps)</td>
<td>East Bethel (Bearden Creek)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perform study on practicality of restoration:</td>
<td></td>
<td></td>
<td>Whiteoak Dam deep(er) wells and monitoring</td>
<td></td>
</tr>
<tr>
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<td>WAG 1</td>
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<td>- aquifer classification (DRASTIC Model)</td>
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<td>- describe conditions</td>
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<td>Pump and treat technical demonstration</td>
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Appendix S

WAG 18
WAG: 18 - Consolidated Fuel Reprocessing Area

FUNCTION: Old High Temperature Gas Cooled Reactor (HTGCR) Experiment (never critical)
Reprocessing experiments with fission products

YEARS OF OPERATION:

CURRENT RI/FS STATUS: RI plan not yet developed

SWMUs:
- Total Number: 3
- Type:
  - EGCR Ponds
  - Solvent storage tank
  - Acidic process waste tanks

WASTES HANDLED:
- Process water from poorly defined process
- Sanitary sewage
- Organic solvents

CONTAMINANTS:
- Identified: None observed in few samples analyzed except possibly Zn
- Potential:
  - Organics from solvent storage tank
  - Metals from acidic process waste

MEDIA OF CONCERN:
- Soil?

PRIOR CORRECTIVE ACTIONS:

PRIOR OPERABLE UNIT DECISIONS: NFA. This WAG will not be considered an OU.
Operable Units—WAG 18

A. EGCR Ponds A & B
   - never used
   - used for collection of surface water runoff
   (perform PA/SI - then NFA)

B. Paint Solvent Storage Tank
   - 280 gallon capacity tank
   - removed from service
   - UST
   [perform PA/SI (tank contents sampled) and remove contents (TSCA incinerator) - then NFA]

C. Waste Acid Storage Tank
   - slightly acidic waste contents
   - UST
   [perform PA/SI, remove tank contents (neutralize and treat at ORNL), then NFA]
Appendix T

WAG 20
WAG: 20 - Oak Ridge Land Farm

FUNCTION: Disposal of Sewage Sludge By Landfarming (65 acres)

YEARS OF OPERATION: 1983 to present

CURRENT RI/FS STATUS: RI plan not yet developed

SWMUs:

- Total Number: 1
- Type:
  - Sewage sludge landfarm

WASTES HANDLED:

- Sewage sludge > 6 X 10^6 gal. applied

CONTAMINANTS:

- Identified: Radionuclides - Cs-137, Co-60
  Metals - Hg and Cd

- Potential: Organics not analyzed

MEDIA OF CONCERN: Limited Concern

- Soil
- Surface water

PRIOR CORRECTIVE ACTIONS:

PRIOR OPERABLE UNIT DECISIONS: PA/SI
Municipal Sewage Sludge Application Site

- land disposal
- no more sludge disposal (after 1986)
- sludge from OR municipal sewage plant
- surface water/groundwater sampling does not indicate threat

(Assume PA/S1; then NFA)
Appendix U

AREA GROUNDWATER
1. Permit conflicts (including definition of "reference levels")
2. Is K-25 groundwater program responsible for WAG 11
3. DOE and Radian with ORNL regarding East Fork Poplar Creek remediation experience
4. UST groundwater monitoring
5. USGS (broad area) regarding seeps identification
6. Each WAG (RI/FS & RD/RA)
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<tr>
<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
<th>Expected Conditions</th>
<th>Deviations</th>
<th>Monitoring</th>
<th>Contingent Action</th>
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<tr>
<td>Monitoring</td>
<td>Seeps identification (broad scale, USGS as starting point)</td>
<td>Regulatory: does not violate RCRA/CERCLA</td>
<td>Regulatory: does violate RCRA/CERCLA</td>
<td>Four wells per year; multi-port (install &amp; abandon) 1,000 ft depth (for 5 years)</td>
<td>WAG by WAG</td>
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<tr>
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<td>Characterize groundwater background concentrations</td>
<td>Not contaminated</td>
<td>Is contaminated, but &quot;releases&quot; are at discrete points (example: seeps)</td>
<td>East Bethel (Bearden Creek)</td>
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<td>Perform study on practicality of restoration: CERCLA vs RCRA - alternatives for restoration - aquifer classification (DRASTIC Model) - describe conditions</td>
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<td>Whiteoak Dam deeper wells and monitoring</td>
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<td>Pump and treat technical demonstration</td>
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<td>WAG 3, Chickamauga Unit F</td>
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Appendix V

WELL PLUGGING AND ABANDONMENT
1. WAG specific number of wells (Paul Baxter)
2. Other RI efforts (long term rescheduling)
3. USGS information
4. Groundwater Coordinator with Operations for execution coordination
5. P&A for new wells installed as part of future individual WAG 6 investigations is covered by Remedial Action for each WAG
6. State requirements for P&A (unknown at this time)
7. Assumptions:
   - 2000 wells total
   - 300 will be used further
   - 4% greater than 100 ft deep
   - 20% greater than 50 ft deep

ORNL compliance and monitoring programs
<table>
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<th>Remedial Action</th>
<th>Data Needs: RI/Special Studies/Tech Demos</th>
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<td>0 to 5 Years: Will be performed over the next five years for wells not used in RI research, etc.</td>
<td>Inventory field effort to gather data: survey, depth, elevation, etc. for &quot;found&quot; wells, Verification of Inventory, Well P&amp;A Plan: - How to evaluate and prioritize - Procedure tied to type of well, Specific Study: - Cost effective P&amp;A methods (minimize waste) and technical demo</td>
<td>Number of wells to be provided by Paul Baxter, Leave any debris on each site in interim cap with surface water controls</td>
<td>+25% contingency on number of wells requiring P&amp;A</td>
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### Well P&A

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<tr>
<th>Type of Well</th>
<th>WAG 1</th>
<th>WAG 6</th>
<th>WAG 5</th>
<th>WAG 10</th>
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<tr>
<td>Standpipe (&lt; 50 ft)</td>
<td>108</td>
<td>684</td>
<td>228</td>
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<td>Shallow (&lt;100 ft)</td>
<td>36</td>
<td>180</td>
<td>60</td>
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<td>Deep (&gt; 100 ft)</td>
<td>6</td>
<td>36</td>
<td>12</td>
<td>150</td>
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<td><strong>Sum</strong></td>
<td><strong>250</strong></td>
<td><strong>900</strong></td>
<td><strong>300</strong></td>
<td><strong>150</strong></td>
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*One-hundred active.

Note: The distribution of well depth at these WAGs was provided for use as a basis for estimating well distribution at other WAGs. P&A of WAG 1, 6, 5, and 10 wells will be performed as part of the remedial action taken at these WAGs.

Note: Paul Baxter to provide breakdown by depth from database. Cost based on WAG 6 estimate.
# DISTRIBUTION

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45-49. T. M. Dravecky, Bechtel National, Inc., P.O. Box 350, Oak Ridge Corporate Center, 151 Lafayette Drive, Oak Ridge, TN 37830-0350

50. L. Holm, CH2M Hill Co., 599 Oak Ridge Turnpike, Oak Ridge, TN 37830

51. G. R. Hudson, DOE Oak Ridge Field Office, P.O. Box 2001, Oak Ridge, TN 37831-8541

52. J. R. Kannard, Program Manager, Bechtel National, Inc., P.O. Box 350, Oak Ridge Corporate Center, 151 Lafayette Drive, Oak Ridge, TN 37831-0350

53-56. R. L. Nace, DOE, Office of Environmental Restoration, Office of Eastern Area Programs, Oak Ridge Program Division, Washington, DC 20585-0002

57-58. R. C. Sleeman, DOE Oak Ridge Field Office, P.O. Box 2001, Oak Ridge, TN 37831-8540

59. J. Smith, Ebasco Services, 111 Union Valley Road, Oak Ridge, TN 37830

60-61. J. T. Sweeney, DOE Oak Ridge Field Office, P.O. Box 2001, Oak Ridge, TN 37831-8541


63. T. Wheeler, Radian Corporation, 120 S. Jefferson Circle, Oak Ridge, TN 37830

64-65. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831
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