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# AREA 1, PHASE II
# SUPPLEMENTAL CHARACTERIZATION PACKAGE

**FERNALD ENVIRONMENTAL MANAGEMENT PROJECT**
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| | |
|---|---|
| A1PII | Area 1 Phase II |
| ALARA | as low as reasonably achievable |
| ASL | analytical support level |
| CDL | Certification Design Letter |
| CG&E | Cincinnati Gas & Electric Company |
| CU | certification unit |
| D&D | decontamination and demolition |
| DCN | Design Change Notice |
| EIS | East Impacted Stockpile |
| FDF | Fluor Daniel Fernald |
| FRL | final remediation level |
| HPGe | high purity germanium |
| HWMU | Hazardous Waste Management Unit |
| IRDP | Integrated Remedial Design Package |
| LCS | leachate conveyance system |
| LLRW | low-level radioactive waste |
| mg/kg | milligrams/kilogram |
| OSDF | On-Site Disposal Facility |
| PCB | polychlorinated biphenyl |
| pCi/g | picocuries per gram |
| pCi/l | picocuries per liter |
| ppm | parts per million |
| PSP | Project Specific Plan |
| RBA | radiological buffer area |
| RCRA | Resource Conservation and Recovery Act |
| RCT | radiological control technician |
| RI/FS | Remedial Investigation/Feasibility Study |

## LIST OF ACRONYMS AND ABBREVIATIONS
**(continued)**

| | |
|---|---|
| RMA | radioactive material area |
| ROD | Record of Decision |
| RTRAK | Radiation Tracking System |
| SCP | Supplemental Characterization Package |
| SMTA | Special Materials Transfer Area |
| SP | soil pile |
| STP | Sewage Treatment Plant |
| TCLP | toxicity characteristic leachate procedure |
| VOC | volatile organic compound |
| WAC | waste acceptance criteria |
| WAO | waste acceptance organization |
| WIS | West Impacted Stockpile |
| WMB | white metal box |
| $yd^3$ | cubic yards |

## EXECUTIVE SUMMARY

This Area 1 Phase II (A1PII) Supplemental Characterization Package (SCP) summarizes and presents information that was used to develop the A1PII Sewage Treatment Plant (STP) Excavation design documents (construction drawings and technical specifications). Information presented herein that was not in the original design documents has been incorporated into the design by design change notice (DCN). The overall certification strategy for A1PII is also presented in this report.

Analytical data and models were used to determine the limits of material that exceeds the final remediation levels (FRLs), and exceeds Waste Acceptance Criteria (WAC) for the On-Site Disposal Facility (OSDF). These limits were then used to establish the limits of excavation (from FRLs) and to identify limits to segregate material (from limits of above-WAC material). The following are specifically addressed in this SCP:

- Limits of above-FRL uranium outside the STP area
- Limits of above-FRL radium outside the STP area
- Limits of above-WAC technetium-99 in the STP area
- Limits of above-WAC uranium in the STP area
- Limits of deep excavation within the STP area.

Through the use of figures, this SCP succinctly presents the process that was used to develop the limits shown on the construction drawings.

This SCP also addresses:

- Disposition of digester sludge and associated debris (Section 2)
- Disposition of sludge cake and associated debris (Section 3)
- Utility excavation, sampling and material disposition (Section 4)
- General Excavation and Monitoring Approach (Section 5)
- Sampling and Analysis results in STP Incinerator Area (Section 6)
- Overall A1PII Certification Strategy and Schedule (Section 7)

This SCP and the Characterization Summary of the A1PII Trap Range are considered part of the A1PII Implementation Plan; these documents combined with the A1PII design documents make up the A1PII IRDP. The figures presented in this SCP will be posted on the Fernald Soils Characterization and Excavation Project (SCEP) web site (http://www.ead.anl.gov/~femp/srp/prodocs/html/a1p2irdp.html).

# 1.0 CHARACTERIZATION AND EXCAVATION LIMIT SUMMARY

This section summarizes and presents the analytical data and modeling information that was used to establish the limits for the different types of excavations and the limits of segregation for different types of materials in Sector 3 of A1PII. Sectors 1 and 2 are described in Section 7 of this report, which presents the overall excavation and certification strategy for all three sectors of A1PII.

The limits presented in this section will be used to control and guide the remedial action work that will be performed in Area 1, Phase II (A1PII) by the Sewage Treatment Plant (STP) Excavation Contractor in Sector 3.

The excavation limits in this Supplemental Characterization Package (SCP) that differ from those in the original construction documents (Revision 0) were incorporated into the design via design change notices (DCNs) and are presented in Revision 1 of the construction documents. The following types of contaminants and excavations are addressed herein:

- Total uranium contamination in surface soil outside the STP
- Radium contamination in surface soil
- Above-waste acceptance criteria (WAC) technetium-99 contamination in the STP
- Above-WAC uranium contamination in the STP
- Total uranium contamination in the STP (STP deep excavation)

Figures referenced in this section are included as Attachment 2 to this SCP.

## 1.1 GENERAL EXCAVATION BASED ON ABOVE FRL CONTAMINATION

Generally, the excavation limits within the project area are driven by total uranium contamination. Total uranium concentration data in the project area soil is presented on Figure 1-1. The final remediation level (FRL) for uranium in most of the project area is 82 mg/kg except for the west side of the STP, where the FRL is 20 mg/kg (see Section 1.5). However, in accordance with the Operable Unit 5 Record of Decision (ROD), if remedial action occurs in an area where the total uranium contamination exceeds the 82 mg/kg FRL limit, additional excavation will be performed to the extent practical to attain an as low as reasonably achievable (ALARA) level of 50 mg/kg. In order to establish the area excavation limits, a model was used to estimate the areas with total uranium concentrations above 82 mg/kg and to estimate the 50 mg/kg line. Areas with uranium concentrations above 82 mg/kg were delineated for excavation. Additional areas with uranium concentrations above 50 mg/kg that were contiguous with other excavation areas, practical to excavate, and outside well stabilized areas were added to the proposed excavation area as shown on Figure 1-1.

Figure 1-1 shows the estimated limits of above-FRL contamination (both 82 mg/kg and 50 mg/kg limits) and the proposed excavation limits within the entire STP Project Area. Areas will be excavated to a minimum depth of 6 inches, including the STP. Most of the STP will be excavated to a deeper depth; the design depth of excavation in the STP is shown on Figures 1-6 and more detail regarding the STP is presented on Figures 1-7 through 1-9. Figure 1-1 was developed primarily based on total uranium analysis. It illustrates the proposed excavation limit and the process that was used to develop those limits, and includes the following key information:

- Physical Sample Locations and Results: Locations of surface soil samples collected at a depth of 0 to 6 inches (physical samples) and total uranium analytical results are presented on Figure 1-1. Samples with levels above the total uranium FRL (82 mg/kg) are shown as a red circle, results between 50 mg/kg - 82 mg/kg are shown with a green triangle, and below 50 mg/kg are shown as an open circle.

- High-Purity Germanium (HPGe) Sampling Results: Total uranium HPGe measurements with results above the total uranium FRL (82 mg/kg) are shown as a red circle and cross, results between 50 mg/kg - 82 mg/kg are shown as a green circle and cross, and below 50 mg/kg are shown as an open circle and cross.

- Total Uranium Levels based on Modeling: Physical sample results for total uranium surface contamination was modeled. The area estimated to exceed the 82 mg/kg level is colored yellow. The area above 50 mg/kg is bounded by a solid green line.

- Excavation Design Limit: The excavation limit based on practical considerations and the 50 mg/kg level is shown as a blue dashed line. This line was established to describe a line that can be surveyed and excavated in the field.

Also shown in Figure 1-1 are the NAR-007 and OSD-007 stockpiles. The STP Excavation Contractor will remove these stockpiles and excavate six inches below the bottom of each stockpile. Figure 1-1 also shows a buffer area around the base of the Cincinnati Gas & Electric (CG&E) tower north of the STP; no heavy equipment will be permitted in this buffer area. Within 25 feet of the CG&E tower, surface soil stripping will be performed using light equipment.

## 1.2 RADIUM-226 CONTAMINATION

Radium-226 contamination in the STP and adjacent areas is shown on Figure 1-2. The FRL for radium-226 is 1.7 pCi/g. As shown on that figure and as described below, there is only one area where the above-FRL radium contamination is not bounded by the above FRL for uranium. The following information is posted in the figure:

- Physical Sample Locations and Results: Radium-226 surface soil sample locations are presented. Locations where the result is greater than 1.7 pCi/g FRL are posted with red points. For results lower than the FRL, the location is shown as a green open circle.

- Excavation Design Limit: The excavation design limit for the material outside the above-FRL uranium and southwest of the STP area is shown as a blue cross hatch, and the 6-inch excavation limit is shown as a blue dashed line. All materials with above-FRL levels for radium are included in the excavation limit.

## 1.3 ABOVE-WAC TECHNETIUM-99 CONTAMINATION IN STP AREA

Figure 1-3 shows the estimated limits of above-WAC technetium-99 contamination in the STP area. Except for one sample location, above-WAC technetium-99 contamination is limited to the top 6 inches of soil. Five areas with above-WAC technetium-99 concentrations are shown on Figure 1-3. This figure also provides the following information:

- Physical Sample Locations and Results: All technetium-99 sampling locations are shown. Results greater than the WAC limit of 29.1 pCi/g are shown as red dots and posted in pCi/g. All other locations where the result is less than the WAC limit are posted as an open circle. Additional samples were taken at locations #36, #37, and #39 at depth (6" - 12") to confirm that technetium-99 was bounded in these areas. These results confirm that the above-WAC technetium-99 excavations will be 0" - 6". The results of these additional samples are presented in Figure 1-3.

- Above-WAC Limit in Surface Soil: The solid red line denotes the estimated limits of surface soil contamination based on the existing data.

- Above-WAC Digester Sludge: The location of the above-WAC digester sludge in the east sludge drying bed, the digester, and the west chamber of the primary settling basin is shown as a blue hatch area. More information about this material is presented in Section 2.0.

- Excavation Design Limit: The dashed black line denotes the excavation limit. This excavation limit includes areas where sampling indicates the surface soil exceeds the above WAC limit, areas potentially contaminated by previous sludge moving operations, and areas that may be contaminated by future stabilization activities.

As described in Section 2, some above-WAC material (approximately 325 $yd^3$) will be used to stabilize digester sludge. Stabilized digester sludge and remaining excavated above-WAC technetium-99 material will be temporarily stockpiled in SP-7.

As described in Section 6, there are two additional areas in the vicinity of the former STP Incinerator Area that have technetium-99 concentrations above the On-Site Disposal Facility (OSDF) WAC. One is a surface stripping area (below) the pavement that is 6" deep. The other is a deeper contaminated area that is 4 ft deep and also located below the pavement. Material from both of these areas will be excavated and hauled to SP-7. Section 6 provides additional details.

## 1.4 ABOVE-WAC URANIUM CONTAMINATION IN STP AREA

Figure 1-4 shows the estimated limits of above-WAC uranium contamination in the STP area, including the following information:

- Physical Sample Locations and Results: All total uranium sampling locations are shown. Results where the result is greater than the WAC limit of 1,030 mg/kg are shown as red dots and the results posted in mg/kg. All other locations where the result is less than the WAC limit is posted as an open circle.

- HPGe Sampling Results: Total uranium HPGe measurements with results above the 400 mg/kg are shown as a red circle and cross, results below 400 mg/kg are shown as an open circle and cross.

- Above-WAC Limit in Surface Soil: The solid red line denotes the estimated limits of surface soil contamination based on the existing data. As shown on the figure, there are two above-WAC uranium locations in the STP area: 1) are northeast of the digester, and 2) east sludge drying bed.

- Excavation Design Limit: The solid red line and black hatching denotes the excavation limit for above-WAC uranium material. As shown on that figure, the above-WAC soil northeast of the digester will be removed with above-WAC technetium-99 soil. The material in the east sludge drying bed is the sludge cake that will be excavated as described in Section 3.

## 1.5 STP DEEP EXCAVATION

Sampling locations, analytical data, modeling results and design excavation lines for the STP deep excavation are shown on Figures 1-6 through 1-9. STP deep excavation is driven by two factors:

1) below-grade structures, and 2) FRLs. Most of the design excavation grades are driven by excavation required to remove below-grade structures.

All below-grade structures (including buildings, foundations utilities, manholes, etc.) in the STP require removal. The foundations and walls will be excavated in a manner to produce stable slopes so work can be performed in a safe manner. The approximate location of the bottom of structures and underlying drainage layers were determined from previous design and as-built drawings. Stable slopes to excavate these surfaces were then developed.

The FRL throughout most of the STP area is 82 mg/kg of uranium. However, as described in Section 1.1, when excavation is performed, it will continue to the 50 mg/kg level if practical. In addition, a lower cleanup level of 20 mg/kg was established on the west side of the STP area in the vicinity of the Trickling Filters because of potential high leachability. The rationale and basis for this lower FRL is presented in the "Operable Unit 5 $K_1$ Sampling and Analysis Results." As described in that report and illustrated on Figure 2-3 of the Sitewide Excavation Plan (SEP), an area of the west side of the STP area should be excavated to an FRL of 20 mg/kg. The limit of the area that will be excavated to the 20 mg/kg level is shown on Figure 1-6.

The STP deep excavation design surface was developed through a logical process. The first step was to incorporate data into a three-dimensional model; an FRL of 20 mg/kg was used in the original model. The results of this model were then used to establish the original FRL surface that required excavation. This original model excavation surface is presented on Figure 1-5.

The original FRL model surface and foundation excavation surface were then combined and an STP excavation plan was developed. This excavation plan was developed by establishing a surface below all of the above surfaces and then squaring off the excavation so that it can be staked and excavated in the field. The STP excavation plan was then checked against existing data. Three sampling locations in the vicinity of the former STP Incinerator (with total uranium concentrations of 214 mg/kg, 22.9 mg/kg, and 20.7 mg/kg) were outside the original excavation plan. The design excavation plan was modified in these areas. The results of this modification are presented on Figure 1-6.

The STP deep excavation is presented in cross-sections on Figures 1-7 through 1-9. These figures present:

- Physical Sample Locations and Results: Borings and sample locations from those borings are illustrated on the cross-sections. Sample locations where the result is greater than 20 mg/kg are shown as red and the results posted in mg/kg. Other sample locations where the result is less than 20 mg/kg are shown in green.

- Original FRL Model Surface: The original FRL model surface is shown in blue on the cross-sections.

- STP Underground Structures: The approximate locations of the underground components of the structures in the STP are shown as shaded areas. These limits are approximate. Actual limits will be determined in the field and include backfill material.

- STP Deep Excavation Design Surface: The design surface for STP excavation is a solid red line. This is the surface that will be presented on the construction drawings for the STP Contractor.

The actual excavation depth will be determined in the field based on sampling and analysis results.

## 1.6 EXCAVATION SEQUENCE AND SUMMARY

Figure 1-10 presents the general sequence that will be used to excavate the project area. This is a general overview schedule only; schedule details will be developed and presented by the STP Excavation contractor. The actual schedule will be affected by weather, field conditions and other factors. As show on Figure 1-10 the general excavation sequence for the A1PII area will consist of the following major phases:

- Pre-STP Excavation: Areas that will be excavated prior to initiation of construction work on the STP Excavation contract are shown in blue. These areas include the northern section of the conveyance channel, and some road surface material in the project area.

- Initial STP Excavation: Initial STP Excavation areas are shown in red and consist of the above-WAC and RCRA waste within the STP area. The materials consist of the digester sludge, material that is above WAC for technetium-99, uranium, and the sludge cake. This material is located in the areas surrounding the incinerator, the sludge drying beds, trickling filters, digester, and primary settling basins.

- Utility Excavation: Utilities outside the STP Deep Excavation are shown as solid green. These utilities will be excavated separate from the STP Deep Excavation in accordance with the methods presented in Section 4. As described in Section 4, surface stripping will be performed in areas where utilities will be excavated prior to utility removal. Details regarding the specific utility lines are presented on the construction drawings. This figure is for general sequencing information and will not be used for construction or utility removal.

- Final STP Excavation: Final STP Excavation is shown as green hatch. This area includes the remaining STP Deep Excavation, surrounding areas to be excavated to a depth of 6 inches , stockpiles NAR-007 and OSD-007 and adjacent areas.

- Post STP Excavation: The Post STP Excavation areas are shown in yellow. These areas include the surface material from the remaining roads and support areas, the OSDF borrow area haul road, and STP haul road.

# 2.0 DISPOSITION OF DIGESTER SLUDGE AND ASSOCIATED DEBRIS

During decontamination and demolition (D&D) of the digester building in the former STP, approximately 650 $yd^3$ of sludge was encountered in the STP digester tank. This digester sludge material was subsequently determined to have technetium-99 concentrations above the OSDF WAC. Although there is still some digester sludge in the bottom of the remaining below-grade component of the digester tank, most of the sludge was removed from the digester tank and placed on the east sludge drying bed (within an area established by an earth berm and lined with filter fabric) and in the west chamber of the primary settling basins. The existing locations of the digester sludge are illustrated on Figure 1-5. The above-grade concrete sidewalls of the digester tank were demolished. The debris from this demolition was size-reduced in accordance with OSDF WAC and placed in containers. A white paper that is provided as Attachment 1 presents the following:

- Background information about the digester sludge and technetium-99 at the FEMP
- Analytical data from the digester sludge and associated debris
- Summary of STP debris disposition approach in Operable Unit 3 and updated comparison
- Proposed material dispositions and the basis for those dispositions.

As described in Attachment 1, the digester sludge will be stabilized in the STP area and subsequently sent off site for disposal. The associated debris will be visually inspected to determine its disposition; based on this visual inspection, the debris will either be disposed in the OSDF or off site. The visual inspection for waste disposition will be performed to determine the presence of stains and/or digester sludge residue mass. Pipes and other components in the STP used to handle digester sludge will be handled the same way as the concrete debris. The planned disposition of the various materials is summarized below; additional details are provided in Attachment 1.

- Digester Sludge: This material will be stabilized in the STP area by combining it with above-WAC technetium-99 contaminated soil on a two to one ratio (two parts digester sludge to one part soil). This material will then be hauled and temporarily stockpiled in SP-7 prior to off-site disposal.
- Stained Debris with No Visible Residue Mass: This material will be disposed in the OSDF in accordance with the Operable Unit 3 ROD. This approach is consistent with

the analytical data which indicates stained debris does not contain technetium-99 concentrations above the OSDF WAC.

- Debris with Sludge Residue Mass: This material will be either sent offsite for disposal, or cleaned by removing all sludge residue mass; the clean debris will then be disposed in the OSDF and sludge residue mass will be sent offsite for disposal.

# 3.0 DISPOSITION OF SLUDGE CAKE AND ASSOCIATED DEBRIS

The sludge drying beds are located north of the sludge digester and primary sedimentation basin within the A1PII STP area. The facility consisted of an east bed and a west bed, which were constructed in the early to mid-1950s. The sludge drying beds covered an area approximately 90 feet x 80 feet, and contained a distribution system made of concrete distribution boxes and pipes. A sand drainage layer, gravel drainage layer, and system of collection pipes were located below the surface of the sludge drying beds. The sludge drying beds were used to air dry sludge from the sewage treatment process. Drying was an ongoing operation; dried sludge was continually removed from the beds after it was dried and stabilized.

The west sludge drying bed was taken out of service in 1976, and covered with two to three feet of earth between 1985 to 1988. Soil borings of the west sludge drying bed taken [for the Remedial Investigation/Feasibility Study (RI/FS)] in November 1989 and (for the pre-design investigation) in September 1997 verified the construction and lithologic composition ( two to three feet of soil cover, one foot sand layer, and one foot gravel layer) of the west sludge drying bed. The exact procedures that were used to close the west sludge drying bed are unknown. However, borings through the bed did not detect elevated levels of radiological contamination or evidence of remaining sludge.

In addition to STP sewage sludge, sludge from the FEMP Services Building sump was also placed in the sludge drying beds. The Services Building sump serviced the site laundry unit, which included dry cleaning operations using tetrachloroethene. Tetrachloroethene is a Resource Conservation and Recovery Act (RCRA)-listed spent solvent (F002); therefore, the sludge drying beds were classified as a Hazardous Waste Management Unit (HWMU 41). As described in the analytical summary below, the classification of this material as a hazardous waste under RCRA was based on process knowledge, not analytical data.

## 3.1 ANALYTICAL SUMMARY

Historical data indicate that some sludge cake on the east sludge drying bed had a total uranium mean concentration of 1910 ppm; this exceeds the OSDF WAC for uranium. Recent measurements using a high-purity germanium detector (HPGe) confirm this result. During the recent pre-design investigation, physical samples were collected with boring equipment from two locations (12327 and 12328) in the east sludge drying bed and analyzed for total uranium and volatiles. Samples were collected from: 1) the remaining surface sludge, 2) the underlying sand drainage layer, and 3) underlying soil to a depth of 10.5 feet. Analytical results show the highest total uranium concentrations were at the surface and decreased significantly with depth in both locations. All uranium concentrations were below WAC, and only the surface sample (top 6 inches) in each location exceeded the conservative cleanup level of 20 ppm. At location 12327, the uranium concentration ranged from 69.3 ppm at the surface to 1.3 ppm at a depth of 10.5 feet. At location 12328, the total uranium concentrations ranged from 32.1 ppm at the surface to 1.2 ppm at a depth of 10.5 feet. This sampling indicated that all of the material in the sludge drying bed area was WAC compliant for uranium. Furthermore, the volatile analyses form the borings (12327 and 12328) indicated no volatile contamination. The analytical results are presented in Appendix B-6 of the A1PII Implementation Plan.

Historical analytical results from the sludge cake reported detection of acetone, methylene chloride, toluene xylenes, tetrachloroethene, and 1,1,1-trichloroethane. Tetrachloroethene was the only RCRA toxicity characteristic (TC) constituent detected. It was detected at a concentration that was one order of magnitude below the TC regulatory limit when the total result was converted to the toxicity characteristic leachate procedure (TCLP) equivalent concentration using the 20-fold method dilution factor.

Process knowledge indicates that the sludge from the Services Building sump contained a F002 spent solvent, tetrachloroethene. Based on this process knowledge, historical data, and recent real time data, the sludge cake is characterized as low level radioactive waste (LLRW) that is RCRA hazardous and above OSDF WAC.

## 3.2 EXISTING CONDITIONS

The sludge drying beds and associated piping system remained intact until August 1998, and 35 $yd^3$ of sludge cake was estimated to be contained on the top of the east bed. In August 1998, the east bed was cleared of vegetation (grass, weeds, trees, bushes, and poison ivy), most of the sludge cake, approximately ten inches of the sand layer, upper two inches of the gravel layer, surface infrastructure (above-ground piping, concrete distribution boxes,.and concrete support piers), and debris (woven wire fence, steel fence posts, empty gallon cans, and crumpled barn tin). Some of this material was used to construct a berm on the western side of the east sludge drying bed. Remaining material from the east sludge drying bed was placed behind the west berm on the west sludge drying bed and covered with geotextile. Poison ivy is interspersed throughout the entire western part of the berm's contents.

The north and south berms were constructed of soil from the OSDF borrow area. The east berm was constructed of soil from the OSDF borrow area, 24 inch PVC pipe, and concrete support piers from the east sludge drying bed. The entire bermed area was covered with a semi-permeable geotextile liner. Digester sludge was then removed from the digester via a track hoe, dumped into a front end loader bucket and transported to east sludge drying bed. The digester sludge was placed approximately 3 feet thick within the bermed area onto the east sludge drying bed. The digester sludge was then covered with 6 mil polyethelene sheeting and weighted down with soil and sand bags.

## 3.3 MATERIAL DISPOSITION SAMPLING PLAN

Some of the sludge cake is now commingled with sand, pea gravel, debris, and vegetation in the western part of the berm. Before the western berm and sludge cake are addressed, the digester sludge will be removed, stabilized and hauled to SP-7. The filter fabric that separates the digester sludge from the sludge cake will be dispositioned based on whether it was in contact with the sludge cake. Filter fabric that was in contact with the sludge cake will be treated in the same manner as the sludge cake and placed in containers prior to offsite disposal. Filter fabric that was not in contact with the sludge cake will be treated in the same manner as the digester sludge and hauled to SP-7. All filter fabric associated with the sludge will be dispositioned offsite. The western berm, sludge cake and associated debris will be removed and the area sampled as described below.

- Sludge Cake Removal and Disposal: After removal of the digester sludge and filter fabric, the sludge cake and material with visible evidence of sludge cake will be excavated and placed in containers and placed in the SMTA. Sludge cake will be excavated based on visual observation and in accordance with the sampling and analysis results as described below.

- Berm Removal: The remaining berm will be removed after sludge cake, digester sludge and filter fabric are removed from the area (see Section 2.0 of this SCP). Debris in the berm will be visually inspected and dispositioned in accordance with the debris process described below. Remaining berm soil that may have been exposed to leachate from the digester sludge will be sampled in accordance with the Excavation Monitoring PSP.

- Associated Debris Removal and Disposal: Debris from the east sludge drying bed, including the vegetation, piping, concrete distribution boxes (which are currently in the western berm), and concrete support piers (which are currently in the eastern berm) will be visually inspected to determine waste disposition. This will include material and debris located on the west bed. Generally, debris from the sludge drying beds will be disposed in the OSDF unless it has "residue mass" attached to it. If "residue mass" is attached to the debris, then it will be either be cleaned to remove the mass or containerized and disposed off site as RCRA-listed LLRW.

Berm soil will be sampled to verify that it was not contaminated with digester sludge. After removal of all sludge cake based on visual observation, a minimum of four representative samples in the location of the sludge drying beds will be collected. The details for this sampling and analysis will be provided in a PSP. The sampling will include a minimum of four samples of the underlying drainage layers and two borings through the entire depth of the sludge drying beds underlying drainage layers to the original clay below. The bottom of the concrete support piers footing is at approximate elevation 595.0 and the top of the sand layer is at approximate elevation 598.0. A sample depth of 4 feet should extend approximately 1 foot below the concrete support piers footing, into the original clay below the sand drainage layer.

## 3.4 HWMU CLOSURE PROCESS

The sludge drying beds (HWMU 41) will be closed in accordance with the HWMU closure requirements presented in Section 2.2.5 of the SEP. The sludge cake excavation limits have been tentatively established and will be confirmed in the field. All sludge cake in the area will be removed during excavation. Sampling will be performed in accordance with a CDL, which will be prepared for this area after remediation is completed. The results will be presented in a separate section of the Certification Report.

# 4.0 UNDERGROUND UTILITIES

This section presents and summarizes analytical data on pipe bedding (both inside and outside the STP deep excavation), excavation methods for underground utilities outside of the STP deep excavation, and the backfilling and certification process. Analytical data from pipe bed sampling indicate that it does not exceed the OSDF WAC. Sampling locations and analytical results for the pipe bedding are presented on Figure 4-1and Table 4-1, respectively. The proposed utility removal methods generally conform to Approach F of the SEP. The proposed methods and their application are summarized in Table 4-2 and illustrated in Figures 4-2 through 4-5. Additional details on sampling and analysis for precertification and certification will be presented in a Project Specific Plan (PSP) and Certification Design Letter (CDL) before excavation begins.

## 4.1 BACKGROUND INFORMATION AND ANALYTICAL DATA

Removal of utilities both inside and outside the STP deep excavation of the following types of material:

- Pipe Backfill: Pipe backfill is defined as native material that was excavated and backfilled during original installation of the utilities; it extends from 6 inches below the surface to just above the pipe bedding. Pipe backfill within the STP deep excavation is considered impacted material. Pipe backfill outside of the STP deep excavation is considered non-impacted material unless visual observation indicates otherwise. It will be visually monitored during excavation.

- Pipe Bedding: Pipe bedding is sand and/or other aggregate material that was placed around the utilities during installation. All pipe bedding is considered impacted material. As described in the analytical summary below, pipe bedding will be considered to be compliant with the OSDF WAC unless otherwise indicated.

Pipe bedding material was sampled for WAC determination at six locations outside the STP area, and at five locations within the STP as shown on Figure 4-1. The results from this sampling event (Table 4-1) demonstrate that the bedding material is below WAC and the FRLs for total uranium and technetium-99. However, since the pipe bedding is non-native material, it will be treated as impacted and disposed in the OSDF. During excavation, the area around the pipe bedding will be over excavated to ensure that all bedding is removed. Furthermore, additional samples may be taken based on visual observations.

Utilities within the deep excavation will be excavated and certified as described in Section 5 of this Package. Utilities outside the STP deep excavation will be excavated as described herein. Table 4-2 identifies all underground utilities outside the STP deep excavation to be removed by the STP excavation contractor. As discussed in Section 4.2, the excavation method selected for utilities depends on various utility characteristics.

## 4.2 EXCAVATION METHODS

Underground utility excavations outside of STP deep excavations are driven by the type of utility and the certification status of surrounding surface soil. A utility is excavated and the excavation is certified depends on whether or not a utility is considered process piping, and whether or not 6 inch stripping of surface soil is proposed for the area from which the utility is to be excavated. Based on these two variables, there are four different methods for excavating underground utilities outside of STP deep excavations. These methods and the corresponding figures are:

| | | |
|---|---|---|
| Method 1: | Process piping within proposed 6" stripping areas | Figure 4-2 |
| Method 2: | Process piping outside of proposed 6" stripping areas | Figure 4-3 |
| Method 3: | Non-process piping within proposed 6" stripping areas | Figure 4-4 |
| Method 4: | Non-process piping outside of proposed 6" stripping areas | Figure 4-5 |

The process piping and surrounding pipe bedding will be monitored in the field with greater scrutiny since, by definition, process piping presents a significantly greater risk of contamination in the pipe and associated pipe bedding than does non-process piping. For example, excavation and certification of the force main sanitary effluent line entering the STP from the Former Production Area requires greater scrutiny than a drinking water line.

Whether or not surface soil stripping is proposed for the area from which the utility is to be excavated governs how excavated materials are handled in relation to surrounding surface soil, as well as excavation and certification sequencing. Where required, soil stripping will be performed prior to utility excavation and removal.

## 4.3 BACKFILLING

Within the OSDF footprint, backfilling of underground utility trenches will be done in accordance with the requirements for structural fill under the OSDF. Backfill material will include native material and material from the OSDF Borrow Area. Trenches located outside of the OSDF cell liner footprint will be backfilled using suitable structural material from the OSDF Borrow Area. OSDF backfill requirements have been incorporated into STP excavation specification 02206 via a DCN. Figure 1-10 shows the OSDF cell liner footprint.

## 4.4 SUMMARY

Table 4-2 presents a summary of all utilities outside of STP deep excavations to be excavated under the STP Excavation contract, pertinent information in considering an excavation method, and the proposed excavation/certification method(s). As shown in Table 4-2, some utilities cross between areas where surface stripping is proposed and areas where stripping is not proposed, and therefore require excavation by different methods depending on location. Also, a special case is presented by excavation of the fuel gas line west of the STP (FG-14-4"V) and adjacent drinking water line (DW-3"-W). Due to their proximity to the effluent line (FT-4-12"W), which has been designated as process piping, all three lines will be excavated in a common trench under the general guidance of Method 1. Any signs of leakage from the effluent line will be monitored for potential leaching into the adjacent bedding of the fuel gas and drinking water lines.

**TABLE 4-1**
**PIPE BEDDING MATERIAL SAMPLING RESULTS**

| Boring ID | Boring ID on Figure 4-1 | Total Uranium (mg/kg) | Technetium-99 (pCi/g) |
|---|---|---|---|
| 12418 | 1 | 1.18 | 0.40U |
| 12418-D | 1 | 1.41 | 0.52U |
| 12419 | 2 | 1.28 | 0.98U |
| 12420 | 3 | 2.36 | 0.82U |
| 12421 | 4 | 1.31 | 0.29U |
| 12422 | 5 | 1.33 | 0.74U |
| 12423 | 6 | 0.98 | 0.36U |
| 12324 | 7 | 2.19 | 0.88U |
| 12425 | 8 | 1.05 | 0.78U |
| 12426 | 9 | 2.79 | 10 |
| 12427 | 10 | 5.05 | 1.6 |
| 12428 | 11 | 1.25 | 0.89U |

U - not detected. Number presented is detection limit.

**TABLE 4-2**
**SUMMARY OF UNDERGROUND UTILITIES OUTSIDE OF STP DEEP EXCAVATIONS**

| UTILITY I.D. | UTILITY TYPE | UTILITY DESCRIPTION | PROCESS PIPING | 6" STRIPPING | EXCA. METHOD |
|---|---|---|---|---|---|
| SN-8"-L1 | Sanitary | Force main from the Former Production Area to the STP. | YES | YES/NO | **METHOD 1 & 2** |
| FT-4-12"W | Effluent | Effluent line from Former Production Area to the STP. | YES | YES/NO | **METHOD 1** |
| FG-14-4"V (1) | Fuel Gas | Section from Former Production Area to the STP. | NO | YES/NO | **METHOD 1** |
| DW-3"-W | Drinking Water | From Former Production Area to STP, to be excavated in common trench with FT-4-12"W. | NO | YES/NO | **METHOD 1** |
| DW-4"-L3 | Drinking Water | From Former Production Area to STP. | NO | YES | **METHOD 3** |
| SN-16" CI | Sanitary | STP discharge line tö the river from STP to property line. | NO | NO | **METHOD 4** |
| FG-14-4"V (2) | Fuel Gas | Section south of STP to property line. | NO | NO | **METHOD 4** |
| 21"Wx20"D conc. duct | Electrical | From DO Substation to Former Production Area. | NO | YES/NO | **METHOD 3 & 4** |
| 17"Wx16"D conc. duct | Electrical | Immediately north of DO Substation. | NO | NO | **METHOD 4** |
| 19" Sq. conc. duct | Electrical | Immediately north of DO Substation. | NO | NO | **METHOD 4** |
| 20"Wx12"D conc. duct | Electrical | Northwest of DO Substation. | NO | NO | **METHOD 4** |
| ST-20" | Storm | Link between manhole 176C and 176B. | NO | NO | **METHOD 4** |

Shaded rows represent those utilities to be excavated in a common trench.

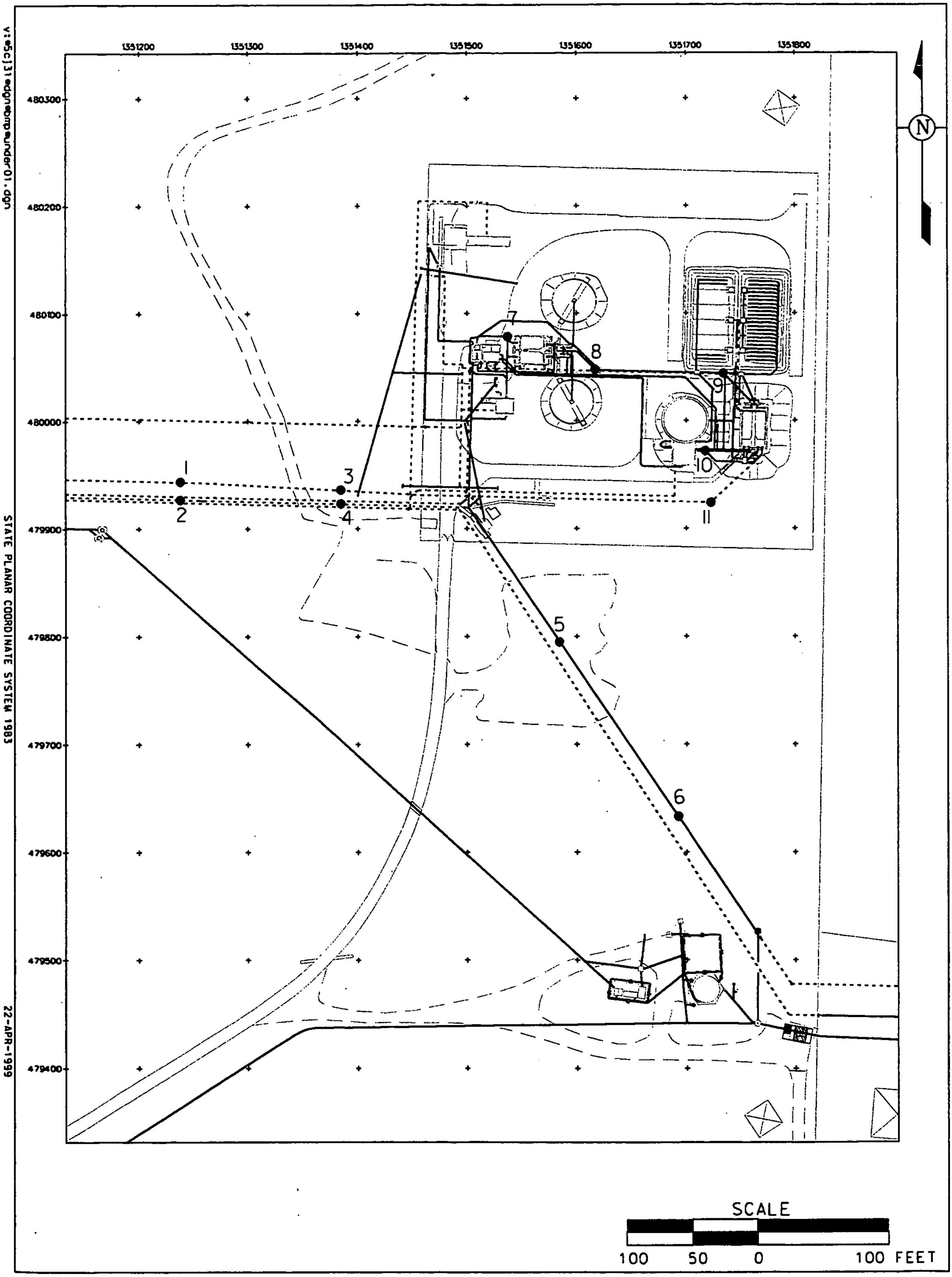
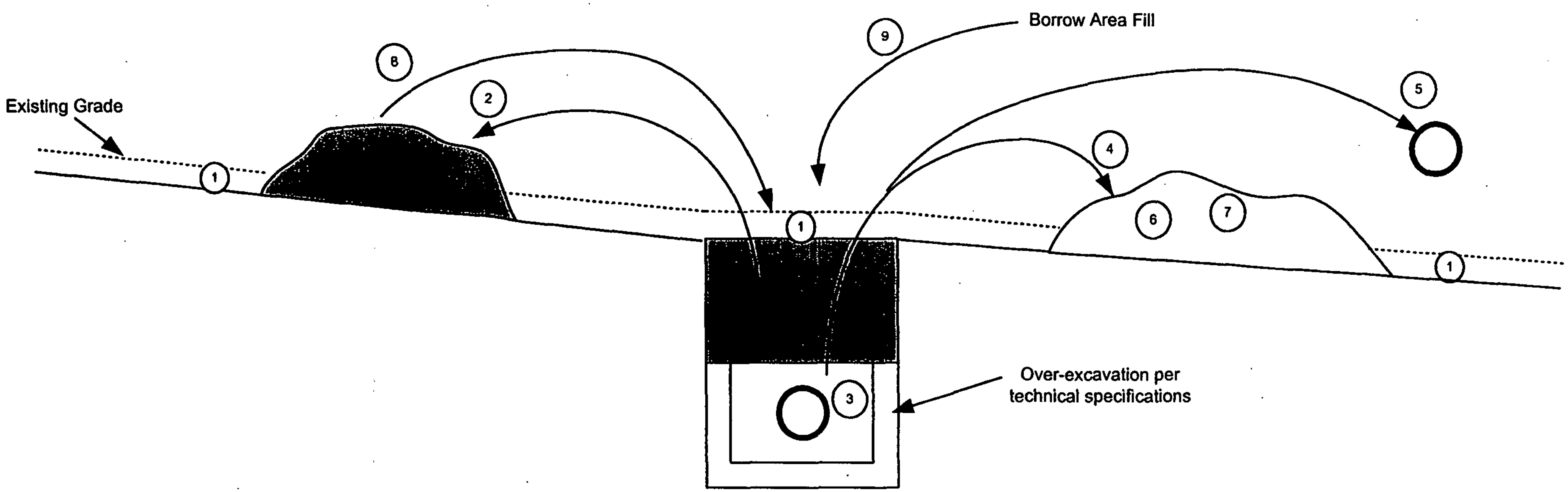



FIGURE 4-1. PIPE BEDDING SAMPLE LOCATION

# FIGURE 4-2
# METHOD 1: PROCESS PIPING WITHIN PROPOSED 6" STRIPPING AREAS




(1) Contractor strips six (6) inches of surface soil to limits shown on construction drawings and dispositions in the OSDF.

(2) Contractor excavates subsurface soil (backfill) from above the pipe bedding and stockpiles it upgradient of the utility trench.

(3) Contractor excavates the pipe bedding material and pipe, plus over-excavates per technical specifications.

(4) Contractor stockpiles pipe bedding as impacted material along side of and downgradient of the excavation.

(5) Pipe is visually inspected. Pipe with visible process residue mass is managed as contaminated debris, size reduced and hauled to SP-7 for off-site disposal. Pipe with no visible residue mass is size reduced and sent to OSDF.

(6) If pipe bedding shows signs of pipe leakage, FDF samples pipe bedding material for WAC attainment and directs the contractor to disposition the material in either the OSDF or SP-7 stockpile, pending sample results. Otherwise, the contractor dispositions the material in the OSDF upon completion of FRL sampling.

(7) FDF samples the last bucket removed from the trench bottom for FRL with the assistance of contractor equipment.

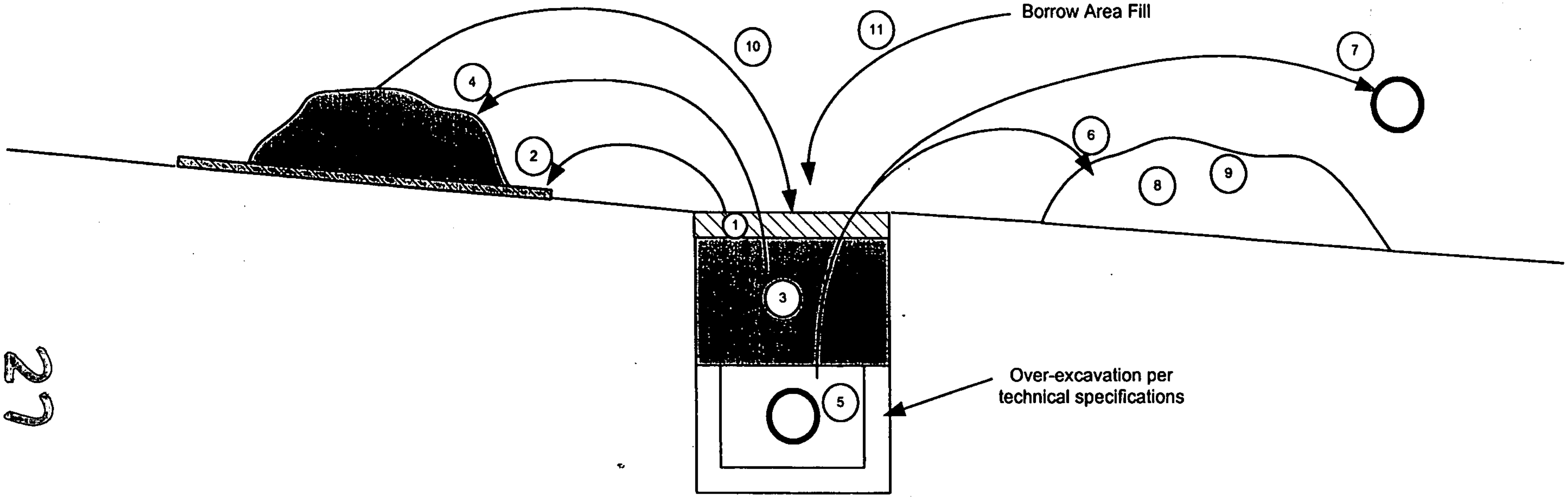
(8) Prior to obtaining FRL results, the contractor backfills the trench with subsurface soil excavated from above the pipe bedding. If FRL results indicate that an area of the trench is above FRL, the contractor shall re-excavate that location to remove the appropriate material.

(9) Material from the OSDF Borrow Area is used to backfill the trench to grade.



2210

# FIGURE 4-3
# METHOD 2: PROCESS PIPING OUTSIDE OF 6" STRIPPING AREAS




(1) Contractor excavates six (6) inches of surface soil above utility line(s).

(2) Contractor spreads excavated surface soil adjacent to, and upgradient of, the utility excavation. The spread material serves as a pad for stockpiling subsurface soil (backfill) excavated from above the pipe bedding.

(3) Contractor excavates subsurface soil (backfill) from above the pipe bedding and manages as non-impacted material.

(4) Contractor temporarily stockpiles the subsurface soil (backfill) onto the surface soil pad.

(5) Contractor excavates the pipe bedding material and pipe, plus over-excavates per technical specifications.

(6) Contractor stockpiles pipe bedding as impacted material along side of and downgradient of the excavation.

(7) Pipe is visually inspected. Pipe with visible process residue mass is managed as contaminated debris, size reduced and hauled to SP-7 for off-site disposal. Pipe with no visible residue mass is size reduced and sent to OSDF.

(8) If pipe bedding shows signs of pipe leakage, FDF samples pipe bedding material for WAC attainment and directs the contractor to disposition the material in either the OSDF or SP-7 stockpile, pending sample results. Otherwise, the contractor dispositions the material in the OSDF upon completion of FRL sampling.

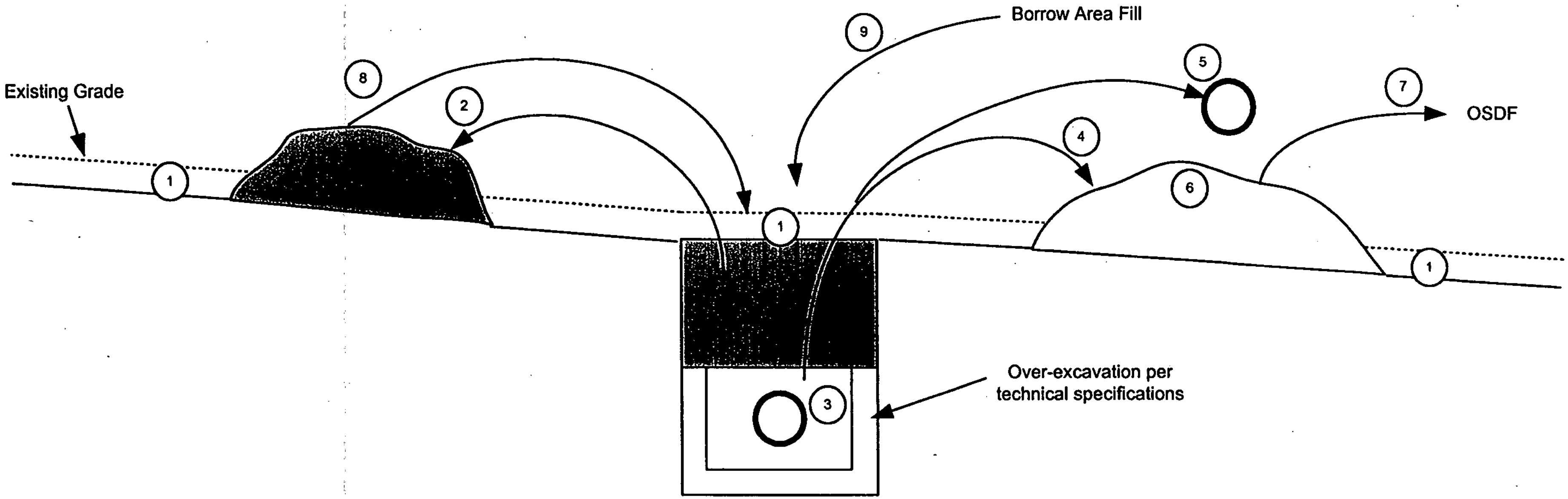
(9) FDF samples the last bucket removed from the trench bottom for FRL with the assistance of contractor equipment.

(10) Prior to obtaining FRL results, the contractor backfills the trench with subsurface soil excavated from above the pipe bedding. The contractor leaves the surface soil pad that this material was stockpiled on in place. If FRL results indicate that an area of the trench is above FRL, the contractor shall re-excavate that location to remove the appropriate material.

(11) Material from the OSDF Borrow Area is used to backfill the trench to grade.

(12) Surrounding surface soil and remaining surface soil pad (step 2) are certified in place.

## FIGURE 4-4
## METHOD 3: NON-PROCESS PIPING WITHIN PROPOSED 6" STRIPPING AREAS

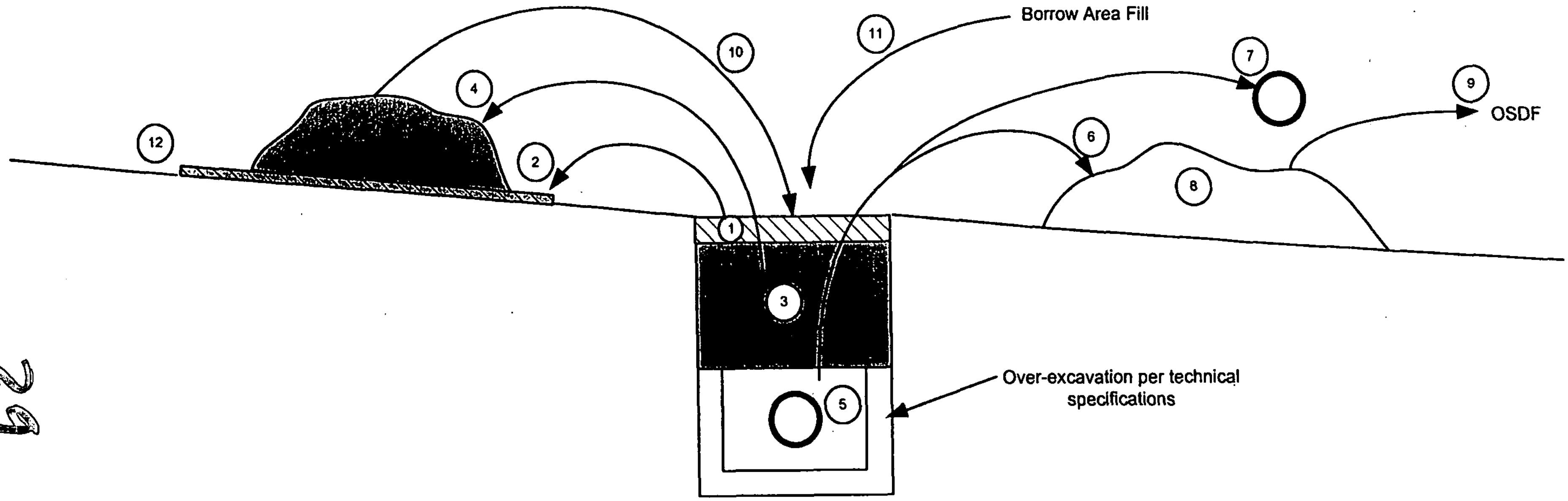



1. Contractor strips six (6) inches of surface soil to limits shown on construction drawings and dispositions in the OSDF.
2. Contractor excavates subsurface soil (backfill) from above the pipe bedding and stockpiles it upgradient of the utility trench.
3. Contractor excavates the pipe bedding material and pipe, plus over-excavates per technical specifications.
4. Contractor stockpiles pipe bedding as impacted material adjacent to the excavation.
5. Pipe is visually inspected. Non-process pipe should have no visible residue mass. Size reduce and send to OSDF.
6. FDF samples the last bucket removed from the trench bottom for FRL with the assistance of contractor equipment.
7. Contractor dispositions pipe bedding material in the OSDF.
8. Prior to obtaining FRL results, the contractor backfills the trench with subsurface soil excavated from above the pipe bedding. If FRL results indicate that an area of the trench is above FRL, the contractor shall re-excavate that location to remove the appropriate material.
9. Material from the OSDF Borrow Area is used to backfill the trench to grade.



2210

# FIGURE 4-5
# METHOD 4: NON-PROCESS PIPING OUTSIDE OF PROPOSED 6" STRIPPING AREAS




1. Contractor excavates six (6) inches of surface soil above utility line(s).
2. Contractor spreads excavated surface soil adjacent to, and upgradient of, the utility excavation. The spread material serves as a pad for stockpiling subsurface soil (backfill) excavated from above the pipe bedding.
3. Contractor excavates subsurface soil (backfill) from above the pipe bedding and manages as non-impacted material.
4. Contractor temporarily stockpiles the subsurface soil (backfill) onto the surface soil pad.
5. Contractor excavates the pipe bedding material and pipe, plus over-excavates per construction drawings.
6. Contractor stockpiles pipe bedding as impacted material adjacent to the excavation.
7. Pipe is visually inspected. Non-process pipe should have no visible residue mass. Pipe is size reduced and sent to OSDF.
8. FDF samples the last bucket removed from the trench bottom for FRL with the assistance of contractor equipment. Contractor dispositions pipe bedding material in the OSDF.
9. Contractor dispositions pipe bedding material in the OSDF .
10. Prior to obtaining FRL results, the contractor backfills the trench with subsurface soil excavated from above the pipe bedding. The contractor leaves the surface soil pad that this material was stockpiled on in place. If FRL results indicate that an area of the trench is above FRL, the contractor shall re-excavate that location to remove the appropriate material.
11. Material from the OSDF Borrow Area is used to backfill the trench to grade.
12. Surrounding surface soil and remaining surface soil pad (step 2) are certified in place.

# 5.0 EXCAVATION

The STP excavation will be in accordance with Approach D in the SEP; implementation details will be modified for site-specific conditions. The section presents the overall excavation and monitoring approach. Construction requirements that affect the STP Excavation contractor are described in the technical specifications. Specific sampling and analysis procedures will be developed and presented in future PSPs.

## 5.1 EXCAVATION AND MONITORING

Fluor Daniel Fernald (FDF) and the STP Excavation contractor personnel will perform continuous visual monitoring of all excavation activities. FDF monitoring personnel will include construction, waste acceptance organization (WAO), characterization and other personnel. Actual monitoring and analytical requirements vary depending on the location, type of excavation, expected contaminants, and other factors. These requirements are summarized as follows:

- Underground Utilities Outside STP Area: Underground utilities will be excavated and monitored as described in Section 4 of this SCP and in accordance with Approach F of the SEP. Surface soil (top 6 inches) over the utilities outside the STP area will be excavated and disposition in accordance with existing data. Pipe trench backfill (original soil that was dug out of the trench and used for backfill over the pipe bedding) outside the STP area is considered non-impacted unless otherwise indicated during excavation. Pipe bedding and the utility lines are impacted material. The pipe bedding and utility lines in the vicinity of utilities that may have conveyed above-WAC material will be monitored or sampled as appropriate for WAC compliance. After removal of all pipe bedding material, FDF will perform real time monitoring of the trench and collect certification samples.

- Underground Utilities Within STP Area: Within the STP area, all surface soil, trench backfill, pipe bedding, and pipes are considered impacted and will be treated appropriately; they will be monitored for WAC compliance. After the bedding is removed in the STP area, deep excavation will be performed in accordance with the STP deep excavation requirements to the limits shown on the construction drawings.

- Above-WAC Technetium-99 Areas: The above-WAC technetium-99 surface soil stripping areas and the deeper area in the former incinerator area have been delineated by pre-design sampling and analysis; the locations are shown on the construction drawings. Upon removal of the digester sludge and sludge cake, and excavation of above-WAC soil to a depth of six inches, the bottom of the excavation where the technetium-99 has not been vertically bound will be sampled for technetium-99 and scanned for uranium contamination. If results indicate the presence of above-WAC contamination, spot excavations will be performed to remove that material. When monitoring and sampling results do not indicate the presence of above-WAC contamination, excavation will proceed in 4 foot lifts, as described in Section 1.5. The STP Excavation contractor will provide survey data to ensure that the required depth has been removed. (Spec section 2205, 3.2.A and 3.2.D).

- STP Deep Excavation: After the digester sludge, above-WAC soil, underground utilities, and at- and below-grade structures are removed, the STP deep excavation will be performed. Initially, the contractor will excavate two 4-foot lifts, scanning the excavated surface each time for uranium WAC compliance. The contractor will then proceed to the deep excavation lines and grades shown on the construction drawings. The surface of the deep excavation limit is sampled for certification, and if possible, scanned for precertification. The STP Excavation contractor will provide survey data to ensure that the required depth has been excavated. Precertification monitoring will then be performed and, if necessary, there will be additional spot excavations to meet FRLs. FDF will then have ten calender days for pre-certification analysis. (Spec. Section 02205, 3.10.A). This will be a combination of real time monitoring and physical sampling.

- Sand and Other Material below the Above-WAC Digester Sludge: As described in Section 3, RI/FS and pre-design data were collected to characterize the sludge cake in the east sludge drying bed and the drainage layers and material below the bed. These data indicated that the material below the sludge cake meets the OSDF WAC. However, this was before the above-WAC digester sludge was temporarily stockpiled in the area. The above-WAC digester sludge, filter fabric beneath the digester sludge, and sludge cake will first be removed. Additional sampling and analysis will then be performed to verify that the drainage layers, soil berms, and other material below digester sludge has not been contaminated. Because this material will be removed as part of STP deep excavation, this sampling will be performed to determine the WAC compliance of the material.

Additional details for the above monitoring, sampling and analytical programs will be described in PSPs.

## 5.2 LOADING AND HAULING

Trucks will be loaded in the clean STP Radiological Buffer Area (RBA) using controlled loading to prevent and/or minimize spillage. The 50 ft. dumping/loading (potential dust generating activities) requirements will remain in effect for these activities. Trucks will then be surveyed using large area masslin smears and direct frisk as necessary. If there is no spread of contamination, the truck will be released from the STP RBA. If there is indication of contamination spread or visible material on outside of truck, the truck will be cleaned and re-surveyed prior to release. If the equipment surface is wet, proper time shall be allowed for the smear medium to dry.

Trucks will exit the STP RBA and go directly to the OSDF RBA via the STP Haul Road and the OSDF Haul Road. Haul truck bed covers will be in place at all times except during loading and dumping. Trucks will not be permitted to stray from the designated route shown on the traffic plan. FDF Radiological Control Technicians (RCTs) at each RBA will maintain radio communication and visual contact with the truck. Information concerning truck identification will be relayed between RCTs as necessary.

Trucks will dump from the clean unloading ramp in the OSDF RBA. If no material is visible on the truck after dumping, the truck will proceed back to the STP without cleaning or surveying. If material is visible on the truck after dumping, support at the unloading point will assist the contractor with any cleaning and surveying.

Routine radiological surveys will be performed in all affected project areas including the clean haul path, to permit evaluation of radiological controls. Haul trucks will be considered internally contaminated and will only be permitted to work between loading and unloading areas. The truck will be permitted for other use only after it receives an unrestricted release; otherwise, it will be parked in the Radioactive Material Areas (RMAs) when not in use and labeled appropriately. If a truck breaks down during hauling, it will be towed to either the STP or OSDF RMA for maintenance. If there is any indication of the spread of contamination outside of a radiological area, the appropriate RCT will be contacted to evaluate the situation. Radiological protocols dictate recording and notification of contamination events. Spills will be immediately cleaned up in accordance with the contractor's spill prevention and cleanup plan, and will be re-surveyed to verify removal of contamination. Any occurrence of the spread of impacted material outside of a radiological or radiologically posted area will be considered unsatisfactory performance of contract requirements and will be rectified by the contractor, under the direction of FDF Construction Management, prior to allowing re-start of STP hauling activities.

## 5.3 BACKFILL

STP excavations will be backfilled in two phases under two different contracts. Underground utility trenches outside of the STP deep excavations will be backfilled by the STP Excavation contractor. STP deep excavations will be backfilled at a later date by the Phase II Rerouted North Entrance Road contractor. Backfilling will be governed by whether or not the trench is within the proposed OSDF cell liner footprint. Excavations located within the OSDF cell liner footprint will be backfilled per OSDF technical specifications using CL material from the OSDF Borrow Area. Excavations outside of the OSDF cell liner footprint will be backfilled using suitable structural material from the OSDF Borrow Area. Figure 1-10 illustrates the OSDF cell liner footprint. In addition, the appropriate design drawing(s) and technical specifications will be revised by DCN to communicate this information to the STP excavation contractor.

# 6.0 SEWAGE TREATMENT PLANT INCINERATOR INVESTIGATION

## 6.1 INITIAL SAMPLING

In early September 1998, the above-grade demolition of the STP area, including the Incinerator area, was completed. Six borings were taken within the STP Incinerator Area for characterization purposes. The boring locations are shown in Figure 6-1, and are labeled 12384, 12385, 12386, 12387, 12388, and 12389. Samples were collected from the 0-6 inch, 6-12 inch, and 12-18 inch intervals below the concrete pad and analyzed for total uranium and technetium-99. While some total uranium results exceed the FRL, none approached the WAC levels; these results are also shown on Figure 6-1. For technetium-99, two results exceed the WAC level of 29.1 pCi/g: the 0-6 inch interval from location 12387 (34 pCi/g), and the 6-12 inch interval from location 12388 (43 pCi/g). Furthermore, at location 12388, an oily liquid was encountered in some perched groundwater at a depth of approximately 12 inches.

## 6.2 ADDITIONAL SAMPLING

In order to further determine the vertical and lateral extent of this oil mixture, additional sampling was performed. A Geoprobe™ Screen Point 15 sampling well was installed at Boring 12388. Soil samples were collected at Boring 12404 (6 inches from Boring 12388). Samples were collected at 6-inch intervals above the perched water zone, then from the next two 6-inch intervals below the perched water zone. Samples were analyzed for total uranium, technetium-99, volatiles and total PCBs at Analytical Support Level (ASL) B.

Four additional borings were placed approximately 7.5 feet due north, south, east and west from Boring 12404 to help determine horizontal extent of contamination. Borings were labeled 12400, 12402, 12403, and 12401, respectively, as shown in Figure 6-1. Each boring was advanced to a depth of 5 feet from the bottom of the pavement. Samples were collected for total uranium and technetium-99 at the following intervals: 1.5 - 2.0 feet, 2.0 -2.5 feet and 2.5 - 3.0 feet. The top 0 - 1.5 feet was asphalt and fill material and was not sampled.

Perched groundwater was sampled from three Geoprobe™ Screen Point 15 sampling wells. These wells were located at Borings 12401, 12403, and 12404. In order to achieve the required volumes, the samples from these wells were composited into one sample. Perched groundwater samples were described as black, oily water. Samples from the oily water mixture were analyzed for total uranium and technetium-99. The results were 131 mg/l and 98 pCi/l, respectively. Furthermore, volatiles, PCBs and diesel range organics analyses were performed on this mixture. Preliminary results from these analyses showed Aroclor 1248 present at 8200 $\mu$g/l, with no other PCBs present. Only 2-butanone was reported present in the volatile analysis at a level of .026 mg/l. However, the detection limit for the other volatile analytes was 0.05 mg/l. The diesel range organic result was reported as Diesel Oil #2 at 49 mg/l.

Results of laboratory analyses of the soil samples are as follows:

- Tetrachloroethene (PCE) was detected in Boring 12404 at 0.078 mg/kg at 1-1.5 feet; 0.44 mg/kg at 2.5 to 3.0 feet and 12 mg/kg at 3.0 to 3.5 feet Trichloroethene was also found at Boring 12404 at the same depths. Results were 2.0 - 2.5 feet, 0.16 mg/kg; 2.5 - 3.0 feet, 0.029 mg/kg; and 3.0 - 3.5 feet, 0.63 mg/kg. Arochlor-1248 was detected in Boring 12404 at 1.8 mg/kg at 1.0 to 1.5 feet and at 46 mg/kg at 0.5 to 1.0 feet.

- Technetium-99 was the only radiological constituent found at elevated levels. At Boring 12403 at 2.5 - 3.0 feet, 33 pCi/g of technetium-99 was found, and at Boring 12388 at 0.5 - 1.0 feet, 43 pCi/g of technetium-99 was found.

- Other VOCs discovered in Boring 12403 are 1,2-dichloroethene (0.021 mg/kg at 2.0 ft. - 2.5 ft.) and 1,1-dichloroethane (.007 mg/kg at 2.0 ft. - 2.5 ft.). Carbon disulfide was also found at 2.0 ft - 2.5 ft. at a concentration of 0.006 mg/kg.

## 6.3 EXCAVATION APPROACH

Initial excavation in the area will consist of removing the surface concrete and pavement. This material will be handled as debris; it will be cleaned of residue and disposed of in the OSDF. Material below the paved surface will then be excavated.

In order to remove the above-WAC contamination for technetium-99, a 10 feet x 10 feet x 6 inch excavation will be performed around Boring 12387 as shown on Figure 6-1. This material will be sent to SP-7.

Based on the existing data, the contaminated perched water, oily material, and above-WAC technetium-99 contaminated material is limited to an area underneath the incinerator pad. The excavation will be visually monitored by the contractor, FDF, WAO and FDF construction personnel to ensure that all oil-saturated soil beyond the design limits is excavated. The excavation strategy is to remove a 10 feet x 20 feet x 4 feet volume of material around the incinerator pad area, as shown on Figure 6-1. This material will be excavated, loaded into haul vehicles and transported to SP-7 for temporary storage prior to offsite disposal.

Once these excavations are complete, the STP deep excavation as shown in Figure 1-6 will be performed.

**TABLE 6-1**
**OILY LAYER LOCATIONS**

| BORING LABEL | DEPTH | DESCRIPTION |
|---|---|---|
| 12401 | 2.7' - 4' | Oily sand and gravel |
| 12402 | 0 - 6" | Oily sand and gravel |
| 12403 | 2.5' - 3' | Oily sand and gravel |

# 7.0 CERTIFICATION STRATEGY

As discussed in the IRDP, A1PII is divided into three sectors; Figure 7-1 shows the three sectors and the major features located within each sector. The strategy and schedule for certification within each sector varies depending on remedial actions, availability of the area, and the OSDF construction schedule. Since the certification will be performed in an iterative manner, areas within sectors will be certified in phases. In order to track the certification progress, three CDLs will be submitted to the regulatory agencies. The CDL scope and schedule for each sector are summarized below.

| Sectors | Phase | Submit CDL | Submit Certification Report |
|---|---|---|---|
| Sector 1, Sector 2A, Conveyance Ditch | A | COMPLETE | COMPLETE |
| Sector 2B | B | COMPLETE | 5/14/99 |
| Sector 1B, Sector 2C and 2D, and Sector 3 | C, D | 10/31/99 | 12/31/99 |

The remainder of this section discusses the certification of Sectors 1, 2, and 3.

## 7.1 SECTOR 1 CERTIFICATION

Sector 1 is located in the southern portion of A1PII and consists primarily of the OSDF Borrow Area and the Trap Range. Most of this area was certified in Spring 1998, as discussed in the Certification Report for A1PII Sector 1, 2A, and the Conveyance Ditch. The OSDF Borrow Area was certified, as were several areas characterized for reuse during site prep activities, including the outfall area, the sediment basin, and the storm water control ditches around the Trap Range. The outfall and sediment basin will be certified in place once the areas which drain into these structures are certified. The Trap Range and Trap Range Ditches will be certified after the stabilization and excavation of the Trap Range is complete. The planned certification sequence in Sector 1 is shown in Table 7-1.

## 7.2 SECTOR 2 CERTIFICATION

Sector 2 is located north of the relocated North Entrance Road, south of the A1PI certified area. A portion of this area was certified in Spring 1998, including the OSDF Cell 3 footprint and the haul road tie-in. In order to meet the OSDF construction schedule, remedial actions and certification in the remainder of Sector 2 will be performed in three additional phases (B, C, and D).

Phase B will consist of certifying the East Impacted Stockpile (EIS) and the former North Access Road, and will be divided into four certification units (CUs). Two CUs will be the paved areas of the old North Access Road, where certification samples will be taken through the pavement into the native material. One CU will cover the ditches (east and west) on the north end of the old North Access Road, and one will cover the footprint of the EIS. The EIS was removed in January 1999, followed by a Radiation Tracking System (RTRAK) scan at original grade. The scan showed the area was below WAC, and an additional six inches of soil was removed. A precertification scan of the post-excavation area was then performed. This general sequence (removal of pile, RTRAK scan of the original grade for WAC, removal of six inches, then real time scan for precertification) will be followed for most remedial actions in Sector 2.

Phase C will involve certifying the West Impacted Stockpile (WIS), WIS Sediment Basin, the remainder of the EIS Stockpile/Debris Pile, the Old Sediment Basin south of the EIS, and adjacent areas. Phase D will consist of the Clean Sediment Basin, OSDF Contractor Laydown Area, Stockpile OSD-007, the OSDF Haul Road, and adjacent areas.

Three different corridors for the OSDF Leachate Conveyance System (LCS) line also cross through both Phase C and Phase D areas. These three corridors include:

- Original temporary line
- Interim line
- Permanent line.

The original temporary line was installed underground. It was taken out of service when leaks were detected in the line; this line will be excavated and removed from the area. An interim line will be installed above ground to replace the original temporary line until the permanent line can be installed. The permanent line will be installed underground and will remain in place to convey leachate from the OSDF on a permanent basis.

Sector 2 certification specifically excludes the Debris Haul Road, which clips the northwest corner of Sector 2, and the OSDF Decontamination Facility in the northern portion of Sector 2. These areas will be certified part of Area 6.

Proposed remedial actions and precertification for the various components in Phases 2C and 2D include the following:

- WIS - Remove pile, RTRAK scan for WAC, remove 6 inches, then perform a precertification scan.
- WIS Sediment Basin - Remove sediment and berm, then perform a precertification scan.
- Adjacent area to WIS and WIS Sediment Basin - Excavate 6 inches, then perform a precertification scan.
- Remainder of East Pile/Debris Pile - Remove pile, RTRAK scan for WAC, remove 6 inches, then perform a precertification scan.
- Old Sediment Basin South of EIS - Perform a precertification scan.
- Clean Sediment Basin - Remove sediment, then perform a precertification scan.
- Adjacent area to Clean Sediment Basin - Perform a precertification scan.
- Stockpile OSD-007 - Remove pile, RTRAK scan for WAC, remove 6 inches, then perform a precertification scan.
- OSDF Contractor Laydown Area and Adjacent Areas - Remove aggregate surface. Historical data show above-FRL contamination in the area; once this area is bounded, necessary excavations will be performed, followed by a precertification scan.
- OSDF Haul Road - Collect certification samples through soil surface.
- Original Temporary LCS Line – The original temporary LCS line was installed before the area was certified. This area will be treated as a separate CU and will be certified at depth; this is expected to take place after the temporary line is removed.
- Interim LCS Line - The revised temporary LCS line will be installed above ground on the western edge of Area 1, Phase II. No separate percertification and certification of this area is proposed.
- Permanent LCS Line - The exact timing for final design, certification and installation of the permanent LCS line is not established. Sections of permanent LCS line installed through uncertified areas will be placed and backfilled with certified material.

Once remedial actions in these areas are complete, the certification schedule is as follows:

| | |
|---|---|
| Complete remedial action | 9/30/99 |
| Certification Design Letter | 10/31/99 |
| Sample | 11/15/99 |
| Validation/Analysis | 12/15/99 |
| Certification Report | 12/31/99 |

Table 7-2 summarizes the planned certification sequence in Sector 2.

## 7.3 SECTOR 3 CERTIFICATION

Sector 3 consists of the STP and the adjacent areas south of the relocated North Access Road and north of the STP Access Road. The conveyance channel was characterized for reuse as part of A1PII site preparation activities. Sector 3 certification will be performed after STP area remedial actions are complete (9/30/99). Sector 3 certification areas are summarized in Table 7-3. A1PII certification specifically excludes the Dissolved Oxygen Facility, which will be certified as part of Area 10.

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**TABLE 7-1**
**SECTOR 1 CERTIFICATION SEQUENCE**

| Sector | Phase | CU/Structure | Remedial Action | Current Status/Proposed Schedule | Submit CDL | Submit Certification Report |
|---|---|---|---|---|---|---|
| 1 | A | Borrow Area | N/A | Certified | Complete | Complete |
| 1 | D | Outfall Area | None | Characterized for Reuse | 10/31/99 | 12/31/99 |
| 1 | D | Sediment Basin | None | Characterized for Reuse | 10/31/99 | 12/31/99 |
| 1 | D | Trap Range | Stabilize and Excavate | Excavate by 9/30/99 | 10/3199 | 12/31/99 |
| 1 | D | Trap Range Ditches | None | Characterized for Reuse | 10/31/99 | 12/31/99 |

## TABLE 7-2
## SECTOR 2 CERTIFICATION SEQUENCE

| Sector | Phase | CU / Structure | Proposed Remedial Action | Current Status/Proposed Schedule | Submit CDL | Submit Certification Report |
|---|---|---|---|---|---|---|
| 2 | A | Cell 3 Footprint | N/A | Certified | Complete | Complete |
| 2 | A | Haul Road Tie-in | N/A | Certified | Complete | Complete |
| 2 | B | NAR and Ditches | None | Certification Report in Preparation | Complete | 5/14/99 |
| 2 | B | East Stockpile | Remove Pile + 6" Complete | Certification Report in Preparation | Complete | 5/14/99 |
| 2 | C | West Impacted Stockpile (WIS) | Remove Pile + 6" | Remove Pile by 7/30/99 | 10/31/99 | 12/31/99 |
| 2 | C | WIS Sed Basin | Remove Sed. + Berm | Remove by 7/30/99 | 10/31/99 | 12/31/99 |
| 2 | C | Other WIS Areas | Remove 6" | Remove by 7/30/99 | 10/31/99 | 12/31/99 |
| 2 | C | East Pile / Debris | Remove Pile + 6" | Remove by 7/30/99 | 10/31/99 | 12/31/99 |
| 2 | C | Old Sed Basin S of Pile | None Planned | Ready for Pre-Cert | 10/31/99 | 12/31/99 |
| 2 | C | Adjacent Areas | None Planned | Ready for Pre-Cert | 10/31/99 | 12/31/99 |
| 2 | D | Clean Sed Basin | Remove Sediment | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 2 | D | OSD-007 | Remove Pile + 6" | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 2 | D | OSDF Haul Road | None - Cert in place | Ready for Cert | 10/31/99 | 12/31/99 |
| 2 | D | Adjacent Areas | None Planned | Ready for Pre-Cert | 10/31/99 | 12/31/99 |
| 2 | D | Original Temporary LCS | Excavate line and bedding | Certify trench and backfill | 10/31/99 | 12/31/99 |
| 2 | D | Interim LCS | None Planned | Install at west side of A1PII | NA | NA |
| 2 | D | Permanent LCS | Certify route or backfill with certified soil | NA | 10/31/99 | 12/31/99 |

## TABLE 7-3
## SECTOR 3 CERTIFICATION SEQUENCE

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| Sector | Phase | CU / Structure | Proposed Remedial Action | Current Status/Proposed Schedule | Submit CDL | Submit Certification Report |
|---|---|---|---|---|---|---|
| 3 | D | Conveyance Channel | None | Characterized For Reuse | 10/31/99 | 12/31/99 |
| 3 | D | STP Deep | Excavate to Design Limits | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 3 | D | Utility Trenches | Excavate to Design Limits | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 3 | D | Sludge Drying Beds | Excavate to Design Limits | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 3 | D | Surface Strip | Excavate to Design Limits | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 3 | D | NAR-007 | Remove Pile + 6" | Remove by 9/30 | 10/31/99 | 12/31/99 |
| 3 | D | Relocated NAR | None | Remove by 2002 | 10/31/99 | 12/31/99 |

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Attachment 1

# Characterization and Disposition of Digester Sludge and Associated Debris in the Sewage Treatment Plant Area

April 1999

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# 1.0 INTRODUCTION

During decontamination and demolition of the digester building in the former Fernald Environmental Management Project (FEMP) Sewage Treatment Plant (STP), approximately 650 $yd^3$ of sludge was encountered in the STP digester. This digester sludge material was subsequently determined to have technetium-99 concentrations above the waste acceptance criteria (WAC) established for the On-Site Disposal Facility (OSDF). Most of this material was removed from the digester, and the majority of the concrete sidewalls of the digester were decontaminated of visible sludge residue mass and demolished. The debris from demolition of the concrete sidewalls was size-reduced in accordance with OSDF size reduction requirements. Although sludge residue mass was removed from most of the concrete sidewalls, some of this debris is stained with digester sludge (i.e., discolored but absent of visible sludge residue mass); digester sludge residue mass is attached to some other concrete debris. Piping in the STP that was used to handle digester sludge and associated material is expected to be similar to the digester wall debris; some will be stained and some will have visible residue mass attached. The digester sludge and the debris (with stains and residue mass attached ) will be dispositioned as described in this paper.

The objective of this paper is to describe the plan for disposition of the digester sludge and the associated debris:

- Digester sludge will be sent offsite for disposal.
- Stained debris (with no visible residue mass), as determined by Waste Acceptance Organization (WAO) inspections, will be dispositioned in the OSDF.
- Debris with sludge residue mass will be sent offsite for disposal, or the sludge residue mass will be removed to achieve WAO inspection criteria for "visible process residues" (the definition of "visible process residues" specifically includes "stains'); debris will be sent to the OSDF and the residue mass will be sent offsite for disposal.

This paper presents the following:

- Background information about the digester sludge and technetium-99 at the FEMP,
- Analytical data from the digester sludge and associated debris,
- Summary of STP debris disposition approach in the Operable Unit 3 Remedial, Investigation/Feasibility Study and updated comparison,
- Proposed material dispositions and the basis for them.

## 2.0 TECHNETIUM-99 AT THE FEMP

The former STP is located in the soil remediation area of the FEMP designated Area 1, Phase II (A1PII). During decontamination and demolition (D&D) of the digester and digester control building in the former STP, approximately 650 $yd^3$ of digester sludge was encountered. Originally, the digester sludge was to be removed from the area prior to D&D and managed in the new FEMP slurry dewatering facility at the Advanced Wastewater Treatment Facility (AWWT). However, the sludge was not readily processed by the AWWT system and was in the digester when D&D activities began. A decision was made to store the sludge in the STP area and handle it during the remediation of soil and at- and below-grade structures in the area. Subsequent analysis has shown that the digester sludge contains technetium-99 and total uranium at concentrations that exceed OSDF WAC for soil-like materials. Because both the Operable Unit 3 and Operable Unit 5 Records of Decision specify WAC attainment requirements regarding technetium-99, these elevated levels of technetium-99 in the digester sludge are of special concern and are addressed herein.

**Sources of Technetium-99**

Technetium-99 is known to exist in past FEMP waste streams resulting from processing slightly enriched uranium material which contained technetium-99 as an impurity. The movement of technetium-99 in the process and treatment systems of past FEMP operations is well understood from a chemical perspective, and is summarized as follows.

Technetium-99 existed as an impurity in slightly enriched uranium material (0.72 - 0.88% uranium-235) that was received as uranium trioxide ($UO_3$) from Hanford and as a partial inventory of scrap residues from Paducah. Most enriched uranium processing took place between 1965 and 1973 and between 1981 and 1984. The $UO_3$ material was introduced into Plant 4 for reduction and hydrofluorination to produce uranium tetrafluoride ($UF_4$), which was subsequently used in Plant 5 to produce uranium metal via reaction between $UF_4$ and magnesium metal (Mg). Historical records indicate that technetium-99 was partitioned into magnesium fluoride ($MgF_2$) slag, produced as a byproduct of the $UF_4$ and Mg reaction, and a small fraction of the uranium metal was associated with this $MgF_2$ slag. The uranium metal



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associated with the slag and the $MgF_2$ slag were recycled in Plant 2/3 via digestion in nitric acid to recover the uranium. Scrap residues from Paducah were sent to Plant 2/3 and processed in the same manner as the recycled slag.

Another potential source of technetium-99 at the FEMP was uranium hexafluoride ($UF_6$) depleted in uranium-235 (i.e., about 0.2%). $UF_6$ was produced at the gaseous diffusion plants in Portsmouth and Paducah and contained technetium-99 as the volatile $TcF_6$ compound. The gaseous $UF_6$ was reduced with hydrogen gas in the Pilot Plant to form the $UF_4$ solid, which was then used to produce uranium metal in Plant 5.

The nitric acid digestion in Plant 2/3 oxidized and mobilized technetium-99 as the pertechnetate ion ($TcO_4^-$). Once oxidized to $TcO_4^-$, technetium-99 remained in the aqueous phase and passed through the aqueous waste treatment systems. Aqueous waste streams produced at Plant 2/3 were first treated with MgO at the refinery sump to raise the pH (~10) and precipitate residual dissolved uranium as $MgU_2O_7$ prior to discharging the clarified solution to the general sump. Solutions received in the general sump were treated further with lime (CaO), and the filtrate cakes and resulting solutions (pH ~ 12) were placed directly in the waste pits until the early 1980s. Both of the treatment steps increased the pH of the solution, which enhanced the stability field, and hence the mobility, of the aqueous $TcO_4^-$ ion.
In the 1980s, the biodenitrification treatment facility (BTF) was constructed to receive Plant 2/3 aqueous waste containing high nitrate and technetium concentrations, and the waste was accumulated in a 500,000-gallon tank prior to treatment in the BTF. Historical records do not indicate a change in the flow of the treated aqueous waste from the general sump to the waste pits until the BTF was constructed. Several individuals familiar with the FEMP operations noted that effluent from the BTF was sent to the STP for a short period of time (approximately 1988 to 1990). The basis for the change to the standard operating procedure, which was to discharge the effluent to Manhole 175 from the BTF, was to further lower the nitrate levels of the aqueous waste stream coming from the BTF by running the waste stream through the STP. This practice continued for approximately two years until the final denitrification system was constructed for the BTF.

**Technetium-99 in the STP Area**

During the A1PII pre-design investigation, performed from Fall 1997 to Summer 1998, technetium-99 was detected in the surface soil in the STP Area. Sampling and analysis performed in Summer 1998 detected technetium-99 in the digester sludge.

Technetium-99 in the surface soil is limited to the top 6 inches of material in the vicinity of the trickling filters and other water treatment facilities. Analytical results indicated that this surface soil contains technetium-99 at concentrations that exceed the OSDF WAC for soil.

The STP digester was used to anaerobically digest wastewater sludge generated at the FEMP. When D&D activities began at the STP, the digester contained approximately 650 $yd^3$ of digester sludge. This sludge is currently located in the east sludge drying bed, the bottom (below-grade portion) of the digester tank, and the west chamber of the primary sedimentation tank (STP Complex D&D Project Closeout/Turnover Documentation).

## 3.0 ANALYTICAL SUMMARY

Sampling and analysis was performed on the digester sludge and concrete from the inside of the digester (to represent debris) to characterize this material for waste disposition. The results of this sampling and analysis, summary of the digestion process, and conclusions regarding the leachability of the material based on the data and digestion process is presented in this section.

### Digester Sludge Analysis

Sampling and analysis activities were performed to characterize the digester sludge and to develop a proposed management approach for the material. Analysis included:

- Total Uranium and Technetium-99
- Toxicity Characteristic Leachate Procedure (TCLP) for Metals
- Liquid/Solid phase analysis for Uranium and Technetium-99.
- Fecal coliform and Paint Filter Liquid Test (PFLT)

**Total Uranium and Technetium-99.** The first round of sampling was performed on sludge removed from the digester tank to the sludge drying beds and the primary settling basin. Samples were collected as the sludge was removed from the digester. Generally, one sample of sludge was taken per vertical foot of sludge removed from the digester tank. These samples were analyzed by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) for total uranium. Technetium-99 analysis, percent water in the samples, and a screening analysis of selected metals, including lead, was also performed. Analytical results (Table 1) indicate the sludge is above OSDF WAC for uranium and technetium-99 in soil-like materials. The screening analysis for lead indicated that lead concentrations in the sludge were in the range of 120 to 305 mg/kg. Because these concentrations exceeded the TCLP "twenty-times indicator" of 100 mg/kg for lead, TCLP analysis was determined to be appropriate for the digester sludge.

**TABLE 1**
**URANIUM AND TECHNETIUM-99 CONCENTRATIONS IN DIGESTER SLUDGE**

| Sample ID | Total U (mg/kg)[a] | Technetium-99 (pCi/g)[b] | % $H_2O$ |
|---|---|---|---|
| 1 (380) | 2470 | 9970 | 84.4 |
| 1D (380D) | 2510 | Not Analyzed | 84.4 |
| 2 (381) | 4480 | 6690 | 78.9 |
| 3 (382) | 3180 | 11,800 | 77.7 |
| 4 (383) | 5000 | 7740 | 80.7 |
| 5 (384) | 2710 | 6780 | 85.1 |
| 6 (385) | 4280 | 7420 | 83.0 |
| 7 (386) | 4260 | 9110 | 80.1 |
| 8 (387) | 3990 | 5900 | 68.6 |

[a] OSDF WAC is 1030 mg/kg
[b] OSDF WAC is 29.1 pCi/g

__TCLP Analysis for Metals.__ Based on the total lead concentrations in the screening analysis, a second round of samples was collected from the remaining sludge in the digester. TCLP analyses was performed on four samples to determine if the digester sludge should be classified as a hazardous waste under the Resource Conservation and Recovery Act (RCRA). TCLP analysis was performed to determine concentrations of the 8 RCRA metals. As shown in Table 2, the TCLP levels for the all RCRA metals are below the RCRA characteristic level for hazardous waste classification.

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**TABLE 2**
**TCLP ANALYSIS OF DIGESTER SLUDGE**

| Metal | RCRA Regulatory Level (mg/L) | Sample 9 (mg/L) | Sample 10 (mg/L) | Sample 11 (mg/L) | Sample 12 (mg/L) |
|---|---|---|---|---|---|
| Arsenic | 5.0 | 0.195 | 0.194 | 0.194 | 0.194 |
| Barium | 100.0 | 0.627 | 0.486 | 0.672 | 0.764 |
| Cadmium | 1.0 | 0.0023 | 0.001 | 0.0017 | 0.001 |
| Chromium | 5.0 | 0.0145 | 0.0045 | 0.012 | 0.0059 |
| Lead | 5.0 | 0.0275 | 0.0031 | 0.0315 | 0.0043 |
| Mercury | 0.2 | <0.00002 | <0.00002 | <0.00002 | <0.00002 |
| Selenium | 1.0 | 0.0183 | 0.0183 | 0.0183 | 0.0183 |
| Silver | 5.0 | 0.0015 | 0.0015 | 0.0015 | 0.0015 |

**Liquid/Solid Phase Analysis for Uranium and Technetium-99.** Additional analysis was performed on the samples collected in the second round of sampling. This analysis included pH, total uranium and technetium-99 analysis for the solid and liquid phases of the sludge (Table 3). The solid and liquid phases of the sludge were separated by centrifuge in the lab. The liquid phase samples may contain colloids which would bias the results to higher concentrations relative to the true dissolved concentrations. The solid/liquid phase analysis (Table 3) indicates high partition coefficient ($K_l$) values with regard to leaching. High $K_l$ values indicate that technetium-99 has a greater affinity to be partitioned into the solid phase of the sludge relative to the liquid. The OSDF WAC development process for technetium-99 assumed a $K_l$ value of 30 L/kg for technetium-99 in soil and total desorption from concrete debris within 70 years.

As shown on Table 3, the leaching coefficient for technetium-99 in the digester sludge samples ranges from 259 L/kg to 1150 L/kg. This is an order of magnitude higher than the level used for development of the OSDF WAC and it indicates that technetium-99 is significantly more likely to be found in the solid residue of the sludge than in the associated liquid.

**TABLE 3**
**pH AND SOLID/LIQUID PHASE DIGESTER SLUDGE ANALYSIS**

| | | Solid Phase | | Liquid Phase | | Leaching Coefficient ($K_l$) | |
|---|---|---|---|---|---|---|---|
| Sample | pH | Tc-99 (pCi/kg) | Total U (mg/kg) | Tc-99 (pCi/L) | Total U (mg/L) | Total U (L/kg) | Tc-99 (L/kg) |
| 9 | 8.11 | 230,000 | 2150 | 200 | 3.50 | 614 | 1150 |
| 10 | 8.11 | 4,400,000 | 1040 | 17,000 | 0.921 | 1129 | 259 |
| 11 | 8.01 | 2,600,000 | 1870 | 3500 | 2.15 | 870 | 743 |
| 12 | 8.15 | 2,500,000 | 1130 | 8800 | 4.42 | 256 | 284 |

**Fecal Coliform and PFLT Analysis.** A third round of sampling involved collecting three individual samples of the digester sludge in 1) the digester, 2) the primary settling basin, and 3) the east sludge drying bed for biohazard and PFLT analysis.

These samples were proposed to be analyzed for fecal coliform to determine if the sludge required treatment as a biohazard. Since fecal coliform analysis is performed on aqueous samples, each of the three samples was centrifuged to separate the two phases. The digester bed sample yielded 25 ml, and only a few milliliters separated in the other two samples. The fecal coliform analysis was performed on the one sample and the result was 243 colonies/100 ml, which is below the limit established in the National Pollutant Discharge Elimination System (NPDES) permit. Therefore, the sludge is not considered a biohazard. The PFLT analysis indicates that the sludge from the primary sedimentation tank and sludge drying bed passed the PFLT. Sludge from the digester failed the PFLT; however, based on laboratory observations, a 10:1 (sludge: soil) mixture will probably pass the PFLT.

**Analytical Summary of Digester Sludge.** In summary, analysis of the digester sludge indicates:

- It is above WAC for total uranium and technetium-99.
- It is not a RCRA characteristic hazardous waste.
- It is not considered a biohazard

- The sludge in the sludge drying bed and primary settling basin pass the PFLT in their present state.
- The sludge in the digester is likely to pass the PFLT if it is stabilized by adding 10% more soil (a ratio of 10 parts sludge to 1 part soil).

**Digester Wall Sampling (Concrete Debris)**

Because of the elevated levels of technetium-99 in the digester sludge, samples of the stained concrete walls on the inside of the digester wall were collected. Samples were collected from the stained concrete to determine the technetium-99 concentrations in the concrete surface for WAC determination. The purpose of this sampling was to determine the chemical WAC status of the stained concrete and to confirm the disposition determinations made during the Operable Unit 3 RI/FS. These samples were collected and analyzed in the same manner that was used by Operable Unit 3 during the RI/FS phase.

Four samples were taken from the inside wall of the digester. The sampling locations were field-located at the north, south, east and west locations of the inside wall. The area was cleaned before sampling using a brush and soapy water to simulate concrete wall cleaning during remediation. After the sampling area was cleaned, 300 grams of concrete material was collected, penetrating no further than ½ inch into the wall. The entire sample was dried and ground, then subjected to total dissolution and analyzed for technetium-99. The results are presented in Table 4.

**TABLE 4**
**TECHNETIUM-99 CONCENTRATIONS IN DIGESTER WALL BUILDING**

| Sampling Location | Technetium-99 (pCi/g) |
|---|---|
| North | 1.5 |
| South | 2.0 |
| South - Duplicate | 0.40 |
| East | 0.95 |
| West | 7.3 |

The average concentration (using the higher 2.0 pCi/g level from the south) is 2.9 pCi/g; as described in section 4.0; this level is lower, but consistent with the data in the Operable Unit 3

RI/FS and supports the waste disposition decision process contained therein. These data indicate that the debris (without visible residue mass) is suitable for placement in the OSDF.

**Leachability of Technetium-99 in Digester Sludge.**

The STP used anaerobic digestion as part of the treatment process. Anaerobic digesters operate under strongly reducing conditions, and sulfide concentrations are generally on the order of 200 to 600 mg/L. Therefore, oxidation-reduction reactions occurred when the aqueous waste stream entered the anaerobic digester.

Technetium-99 precipitates in the reduction reactions when technetium (VII) in the aqueous $TcO_4^-$ specie is reduced to technetium (IV), (III) or (II), with the lower oxidation states coordinated by oxygen or sulfide atoms to form solid phases. The solid phases formed during the reduction reactions may include $TcO_2$ and $TcS_2$, and the solids may be finely divided as colloids in the sludge suspension. Given that elevated levels of sulfide are generally maintained in the anaerobic digestion process, most of the technetium could probably be removed from solution by precipitation of the sulfide phase. Other metal-sulfide phases (e.g., FeS, PbS, ZnS, CdS, etc) will precipitate with the technetium, and the nearly insoluble nature of these sulfide phases is demonstrated by TCLP results on sludge samples, which show the sludge is not a RCRA characteristic waste, even though the "twenty-times indicator" is exceeded.

In conclusion, the oxidation-reduction environment in the anaerobic digester acted like a sink to capture the majority of technetium-99 and other metals, most likely as sulfide solids in the stratified zones of the digester. Metal-sulfide solids are quite insoluble under ambient conditions, and hazardous metals and technetium-99 present in the sludge were not likely to reenter the aqueous environment unless the sludge was reacted with a strong oxidizing agent (e.g., nitric acid). TCLP results for the sludge (Table 2) support this hypothesis, as all hazardous metal concentrations are well below TCLP limits. Therefore, it is unlikely that any significant amount of technetium-99 has absorbed into the subsurface of the concrete walls which were in contact with the sludge in the STP. This conclusion is supported by the data presented in Table 4.

## 4.0 DISPOSITION OF DEBRIS

As previously described, debris from the STP area with no visible signs of residue was proposed to be dispositioned in the OSDF. This was based on Operable Unit 3 data, scientific assumptions and process knowledge. As described below, the recently obtained data are consistent with, and support, this approach.

**Operable Unit 3 Summary**

During the Operable Unit 3 RI/FS, samples from the STP were collected and analyzed, and the approximate amount of technetium-99 that will be sent to the OSDF from the STP was determined. This was done by estimating the concentration of technetium-99 in the different buildings, estimating the mass of those buildings, and then calculating the estimated mass of technetium-99. The Operable Unit 3 RI/FS estimated that approximately 59 grams of technetium-99 will be placed in the OSDF from all FEMP sources; this estimate included 0.056 grams of technetium-99 from the STP area. Debris from the digester was estimated to generate approximately 0.016 grams technetium-99; this estimate included all concrete structural components of the digester and digester control building and consisted of 693 tons of material. This digester estimate was based on a technetium-99 level of 4.40 pCi/g in the outer 0.5" of concrete. The total contribution of the material represented by this 4.40 pCi/g was 0.004 grams (or 25% of the technetium-99 contribution from the digester).

**Comparison of Recent data with Operable Unit 3 Data**

As presented in Section 3, the average technetium-99 concentrations in the outer 0.5 inches of concrete is 2.9 pCi/g; this is in the same range but less than the 4.4 pCi/g used for the Operable Unit 3 calculation. If this actual average is used in the calculation, it will actually reduce the estimated quantity of technetium-99 going to the OSDF from the STP area.

However, if the maximum value of 7.3 pCi/g is used (instead of 4.4 pCi/g) in the calculations, the total mass contribution from the outer 0.5 inches of concrete will increase 0.0027 grams (from 0.004 to 0.0067) and the total contribution of technetium-99 from the STP area to the OSDF will increase from 0.05649 mg to 0.05919 mg (or 4.7%).

The data collected during this recent investigation are consistent with the approach presented in the Operable Unit 3 RI/FS and indicates that sending debris that is free of sludge residue mass to the OSDF will not increase estimated quantity of technetium-99 in the OSDF.

## 5.0 CONCLUSIONS AND PROPOSED DISPOSITION OF TECHNETIUM-99 MATERIAL

The analytical data indicate that technetium-99 levels in the digester sludge (Table 1) and the solid component of the digester sludge (Table 3) exceed the OSDF WAC. The data also indicate that hazardous metals and technetium-99 metals are bound within the solid component of the sludge and are not likely to leach out of the material (Table 2); the technetium-99 levels are 259 to 1150 times higher in the solid phase than in the water phase of the digester sludge. Based on these data, concrete that was exposed to the sludge (and saturated by the associated water) will not reach the same levels of technetium-99 concentrations that are found in the sludge; this conclusion is supported by the analytical data of the concrete (Table 4). The data in Table 4 is also consistent with, and supports the data in the Operable Unit 3 RI/FS.

The proposed waste disposition plan presented in this section is based on the data presented in this paper.

### Digester Sludge

The digester sludge exceeds the OSDF WAC and will be dispositioned offsite. There are approximately 650 $yd^3$ of digester sludge in the STP Area. This material exceeds the OSDF WAC for both technetium-99 and uranium. The material will be stabilized by mixing the sludge with soil. It will then be temporarily stockpiled in the SP-7 stockpile area and ultimately disposed off site. The digester sludge will be stabilized with above-WAC technetium-99 soil in the STP Area at a 2:1 ratio (i.e., two parts digester sludge to one part soil). Additional soil will be added to the stabilized sludge, if needed, to pass the PFLT prior to loading and hauling the material to SP-7. This stabilization will ensure that the relatively high water concentrations (see the first round of analysis) does not present a future handling problem. This stabilization will be done prior to hauling.

### Soil

Soil with technetium-99 concentrations above the OSDF WAC will be disposed off site. There are approximately 700 $yd^3$ of soil with technetium-99 contamination above the OSDF WAC. Generally, technetium-99 contamination is contained in the top six inches of the surface soil.

This will be used to stabilize the digester sludge (as previously described) or hauled directly to SP-7 for temporary storage prior to off-site disposal.

**Debris with Stains from Digester Sludge**

Debris with stains from digester sludge but no visible signs of residue mass, i.e., meeting WAO visual WAC, will be dispositioned in the OSDF. This is based on the data presented in this report indicating that technetium-99 has low leachability in the sludge and that technetium-99 levels in the concrete are below the OSDF WAC. These data are consistent with the levels approach presented in the Operable Unit 3 RI/FS. The total quantity of technetium-99 stained debris is unknown. Stained debris from D&D activities is contained in seven roll-off boxes and is estimated at 169.6 tons (Table 3-2, STP Complex D&D Project Completion Report). During the handling of this material construction and WAO personnel will monitor the work to ensure that only stained debris (no residue mass) is sent to the OSDF.

**Debris with Visible Digester Sludge Residue Mass Attached**

Debris from the digester building and other STP structures (such as concrete debris and pipe) with visible digester sludge residue mass attached will be considered technetium-99 contaminated material. The classification determination (i.e., residue mass that is more than stains) will be made by WAO personnel in accordance with FEMP procedures. Visible digester sludge residue mass will either be removed from the debris and the debris placed in the OSDF or, if the residue mass cannot be removed it will be treated as above-WAC technetium-99 contaminated debris and sent off-site for disposal. Debris with residue mass will be temporarily stored at the FEMP in boxes or in bulk at SP-7 pending off-site disposal. The total quantity of this material is unknown, but it will include all piping and debris from the STP area that carried the sludge and can not be visibly cleaned and inspected. It is estimated to include up to 70 white metal boxes of piping.

## REFERENCES

Fernald Environmental Management Project, "Sewage Treatment Plant Complex Project Closeout/Turnover Documentation," 55210-RP-0001, September 1998.

Fernald Environmental Management Project, "Sewage Treatment Plant Complex Decontamination and Decommissioning Project Completion Report," 55210-RP-0002, October 1998.

U.S. Department of Energy, "Remedial Investigation and Feasibility Study for Operable Unit 3," September 1993.

U.S. Department of Energy, "Record of Decision for Remedial Actions at Operable Unit 5," January 1996.

U.S. Department of Energy, "Record of Decision for Final Remedial Action at Operable Unit 3," August 1996.

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Attachment 2

## Section 1, 6 and 7 Figures

April 1999

Soils Characterization and **FLUOR DANIEL FERNALD** Excavation Project

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Section 1, 6 and 7 Figure are located on the SCEP Website