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AREA 1, PHASE II
SUPPLEMENTAL CHARACTERIZATION PACKAGE

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LIST OF ACRONYMS AND ABBREVIATIONS

A1PII	Area 1 Phase II
ALARA	as low as reasonably achievable
ASL	analytical support level
CDL	Certification Design Letter
D&D	decontamination and demolition
DCN	Design Change Notice
HPGe	high purity germanium
HWMU	Hazardous Waste Management Unit
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
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SMTA	Special Materials Transfer Area
STP	Sewage Treatment Plant
TCLP	toxicity characteristic leachate procedure
WAC	waste acceptance criteria
WAO	waste acceptance organization
WMB	white metal box
yd^3	cubic yards

EXECUTIVE SUMMARY

This Area 1 Phase II (A1PII) Supplemental Characterization Package 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 is not currently part of the design documents will be incorporated into the design by design change notice (DCN).

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 Package:

- 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 A1PII Supplemental Characterization Package succinctly presents the process that was used to develop the limits shown on the construction drawings.

This Package 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 Monitoring Approach (Section 5)
- Recent Sampling and Analysis results in STP Incinerator Area (Section 6).

This Supplemental Package was prepared in response to regulatory agency comments on Draft D of the A1PII Implementation Plan. This Supplemental Characterization Package and the Characterization Summary of the A1PII Trap Range are considered part of the A1PII Implementation Plan.

The figures presented in this Package will be posted on the Fernald Soils Characterization and Excavation Project (SCEP) web site (http://www.fernald.gov/Key Projects/soils.htm).

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. These limits 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.

The excavation limits that are different in this package compared to the construction documents (Revision 0) will be incorporated into the design via design change notices (DCNs). The following type 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 area
- Above-WAC uranium contamination in the STP area
- Total uranium contamination in the STP area (STP Deep Excavation)

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

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 most of in the project area is 82 mg/kg (see Section 1.5 for area with FRL of 20 mg/kg). 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 excavation limits in the area, 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 area. Most of the STP area will be excavated to a deeper depth; the design depth of excavation in the STP area is shown on Figures 1-6 and more detail regarding the STP area 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 the 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 a minimum of six inches below the bottom of each stockpile. Figure 1-1 also shows the 25 ft buffer area around the CG&E tower north of the STP; no excavation will occur in this buffer area.

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: Locations of Radium-226 surface soil sample locations are presented. Locations where the result is greater than 1.7 pCi/g FRL is posted with a red point and the result is included. 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. As shown on that figure, all material 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 where the result is greater than the WAC limit of 29.1 pCi/g are shown as red dots and the results posted in pCi/g. All other locations where the result is less than the WAC limit is posted as an open circle.

- 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 of this Supplemental Package.

- Excavation Design Limit: The solid 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 2.0, some above-WAC material (approximately 325 yd^3) will be used to stabilize digester sludge. Stabilized digester sludge will be temporarily stockpiled in SP-7. Remaining excavated above-WAC technetium-99 material will also 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. Material from one location will be sent to SP-7, and material from the other location will be placed in a white metal boxes (WMBs) and placed in the Special Material Transfer Area (SMTA).

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 82 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 South Trickling Filter, and 2) east sludge drying bed.

- Excavation Design Limit: The solid red line 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 3.0 of this Package.

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) final remediation levels (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 as 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 3-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 1-6.

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. Two sampling locations in the vicinity of the former STP Incinerator (with total uranium concentrations of 214 mg/kg and 22.9 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 1-7.

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.

- 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 to this Supplemental Package 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 disposed off site. 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 (2 parts soil to one part digester sludge). 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 within the A1PII STP area. The original design of the facility consisted of an east bed and a west bed. Construction of the west bed was not completed, and it was never placed into operation. The east sludge drying bed covered an area approximately 90 feet x 40 feet, and contained a distribution system made of concrete distribution boxes and pipes. A sand drainage layer and system of collection pipes was located below the surface of the east sludge drying bed. The east bed was used to air dry sludge from the sewage treatment process. Drying was an ongoing operation; dried sludge was continually removed from the bed after it was dried and stabilized.

In addition to STP sewage sludge, sludge from the FEMP Service Building sump was also placed in the east sludge drying bed. The Service 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 east sludge drying bed was 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 had a total uranium mean concentration of 1910 ppm; this exceeds the OSDF WAC for uranium. Recent HPGe measurements 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 bed 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 bed. In August 1998, the bed was cleared of vegetation and surface infrastructure (above-ground piping, concrete distribution boxes, etc.). A small (approximately 3 feet high) berm, built with soil from the OSDF borrow area, debris from the sludge drying bed area, and 24-inch diameter PVC pipe, was installed around the perimeter. Part of the berm was reinforced with the distribution boxes from the east sludge drying bed. The bermed area (which primarily consists of the east sludge drying bed) was then lined with filter fabric. Digester sludge was then removed from the digester via a track hoe, dumped into a front end loader bucket and transported to the bermed area. The material was placed approximately 3 feet thick onto the east sludge drying bed. The digester sludge was then covered with plastic.

During berm construction, the existing sludge cake was not excavated and graded. To the extent possible, the material was left intact and covered with filter fabric. Care was taken to minimize and/or prevent contamination of the west sludge drying bed.

3.3 MATERIAL DISPOSITION SAMPLING PLAN

The sludge cake is now buried below approximately 450 yd^3 of digester sludge. Therefore, the digester sludge will be removed, stabilized and hauled to SP-7 before the berm and sludge cake will be addressed. 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 packaged in a WMB. 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. The berm, sludge cake and associated debris will be removed and the area sampled as described below.

- Berm Removal: The berm will be removed after the digester sludge and filter fabric are removed from the area (see Section 2.0 of this Package). Debris in the berm will be visually inspected and dispositioned in accordance with the debris process described below. Soil in the berm that may have been exposed to leachate from the digester sludge will be sampled in accordance with a PSP. A minimum of one soil sample will be collected from each side of the berm that is constructed with soil.

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

- Associated Debris Removal and Disposal: Debris from the east sludge drying bed, including the vegetation, piping, and concrete distribution boxes, 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 in WMBs 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 east sludge drying bed 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 sand drainage layer and two borings through the entire depth of the east sludge drying bed 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.

4.0 UNDERGROUND UTILITIES OUTSIDE STP DEEP EXCAVATIONS

This section presents and summarizes excavation methods for underground utilities within A1PII, outside of STP deep excavation, and area certification. These methods generally conform to Approach F of the SEP. The proposed methods and their application are summarized in Table 4-1 and illustrated in Figures 4-1 through 4-4. 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 AND GENERAL EXCAVATION CONCEPTS

As mentioned above, this section addresses utilities outside the STP deep excavation. Utilities within the deep excavation will be excavated and certified as described in Section 5 of this Package. Table 4-1 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. However, common principles which pertain to all utility excavations include the definitions of pipe backfill and pipe bedding.

- Pipe Backfill: Pipe backfill is defined as native material that was excavated and backfilled during installation of the utility; it extends from 6 inches below the surface to just above the pipe bedding. Pipe backfill 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 actual utility during installation. All pipe bedding is considered impacted; it will be evaluated for WAC determination based on observations and the specific type of material that was handled as described below. During utility excavation, the area around the pipe bedding will be over excavated to ensure that all bedding is removed.

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:

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

Process piping and the 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. Because utility excavations are to be performed prior to surface stripping, utility excavations in areas where surface stripping is not proposed requires greater attention to avoid contamination of surrounding surface soil through contact with excavated trench materials.

4.3 SUMMARY

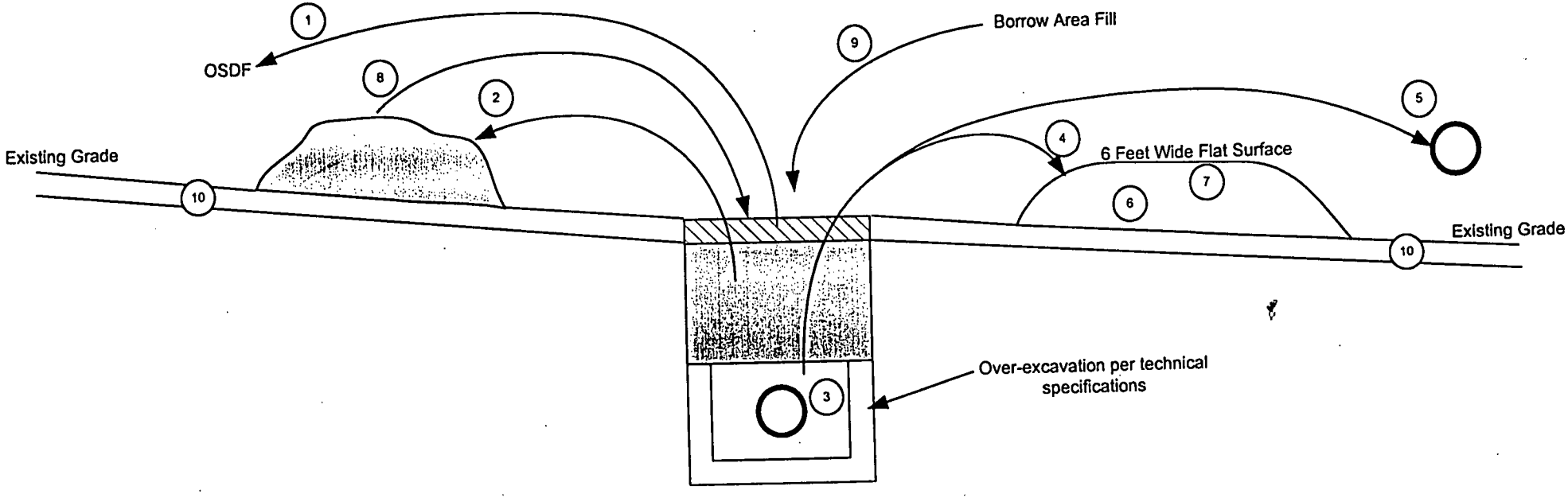
Table 4-1 presents a summary of all utilities outside of STP deep excavations to be excavated under the STP Excavation contract, pertinent information in considering an excavation method, and the proposed excavation/certification method(s). As shown in Table 4-1, some utilities cross between areas where 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
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 to 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

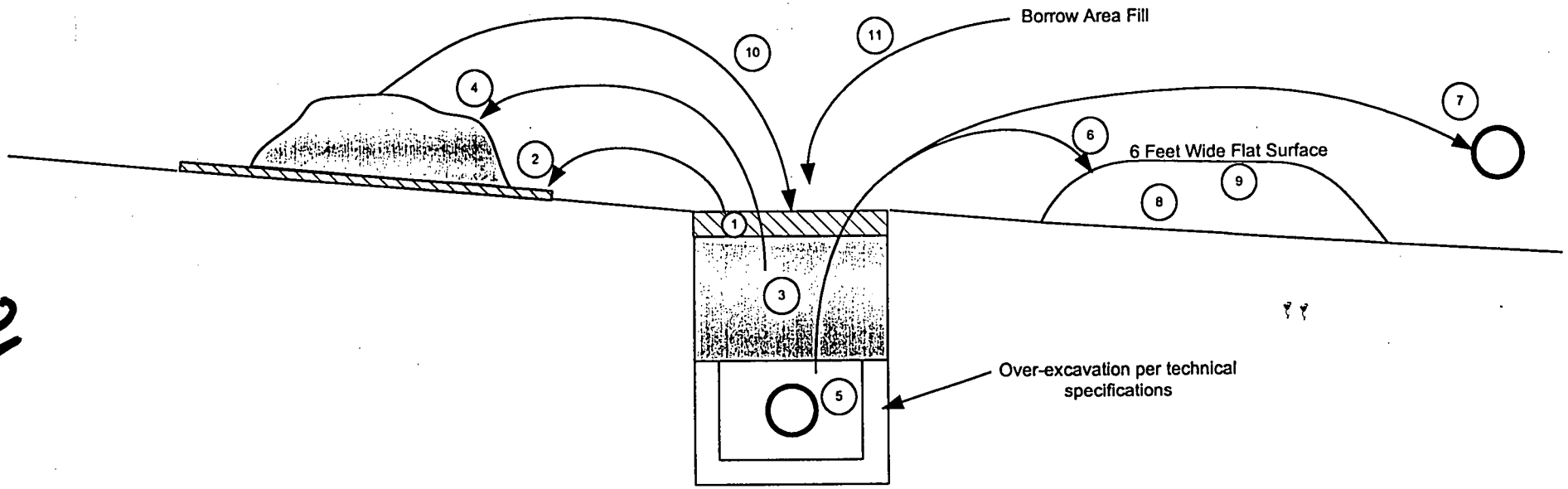
Shaded rows represent those utilities to be excavated in a common trench.

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



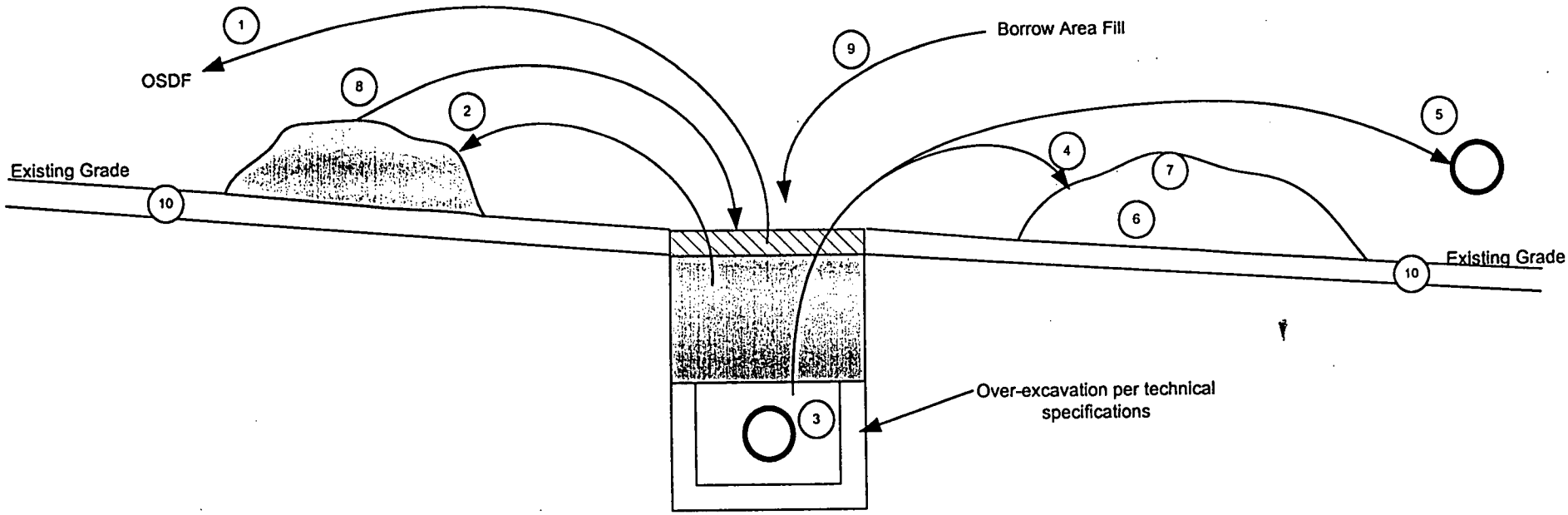
1. Contractor excavates six (6) inches of surface soil above utility line(s) and dispositions in the OSDF.
2. Contractor excavates subsurface soil (backfill) from above the pipe bedding and stockpiles it upgradient of the utility trench.
3. Contractor excavates the pipe bedding material and pipe, plus over-excavates per construction drawings.
4. Contractor stockpiles pipe bedding as impacted material along side of and downgradient of the excavation. Contractor maintains a 6' minimum flat surface on the impacted material stockpile to facilitate HPGe monitoring.
5. Pipe is visually inspected. Pipe with visible process residue mass is managed as contaminated debris and placed in containers for off-site disposal. Pipe with no visible residue mass is size reduced and sent to OSDF.
6. 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.
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. Contractor is careful not to over-excavate into existing surface soil. 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 or STP Backfill Borrow Area is used to backfill the trench to grade.
10. Surrounding surface soil is stripped to 6" below original grade per construction drawings.

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



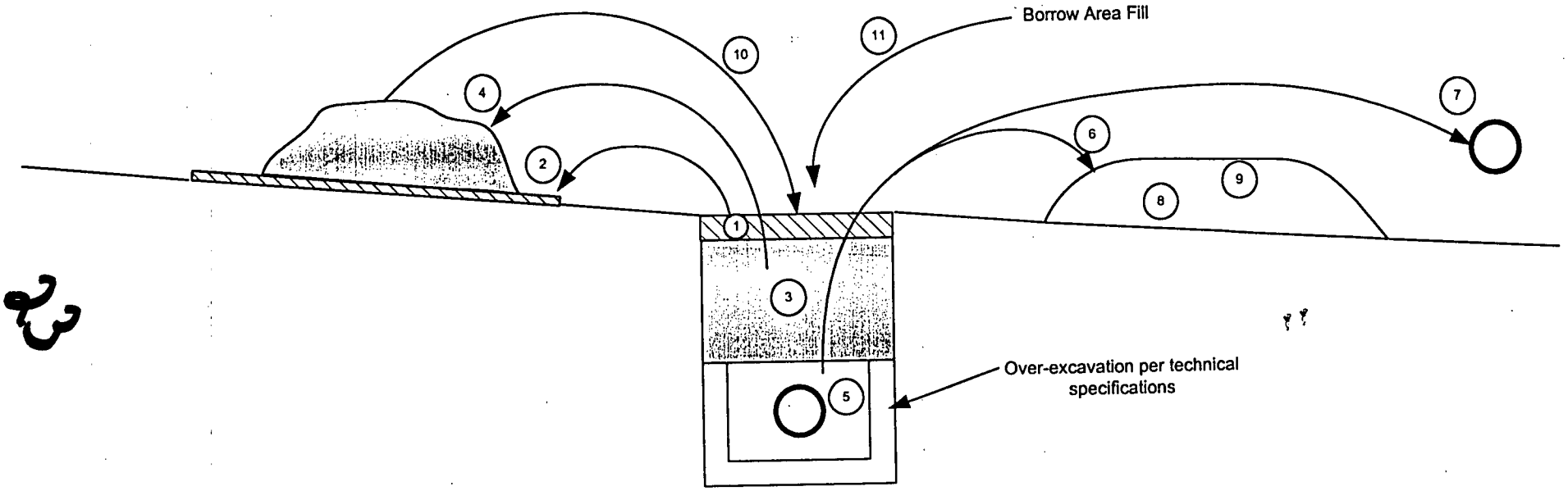
1. Contractor excavates six (6) inches of surface soil above utility line(s).
2. Contractor spreads excavated surface soil adjacent to, and upgradient of, the utility excavation. The spread material serves as a pad for stockpiling subsurface soil (backfill) excavated from above the pipe bedding.
3. Contractor 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 construction drawings.
6. Contractor stockpiles pipe bedding as impacted material along side of and downgradient of the excavation. Contractor maintains a 6' minimum flat surface on the stockpile to facilitate HPGe monitoring.
7. Pipe is visually inspected. Pipe with visible process residue mass is managed as contaminated debris and placed in containers for off-site disposal. Pipe with no visible residue mass is size reduced and sent to OSDF.
8. 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. The contractor over-excavates 6 inches when removing the stockpile.
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 or STP Backfill 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 4-3
METHOD 3: NON-PROCESS PIPING WITHIN PROPOSED 6" STRIPPING AREAS



1. Contractor excavates six (6) inches of surface soil above utility line(s) and dispositions in the OSDF.
2. Contractor excavates subsurface soil (backfill) from above the pipe bedding and stockpile it upgradient of the utility trench.
3. Contractor excavates the pipe bedding material and pipe, plus over-excavates per construction drawings.
4. Contractor stockpiles pipe bedding as non-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 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.
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. Contractor is careful not to over-excavate into existing surface soil. 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 or STP Backfill Borrow Area is used to backfill the trench to grade.
10. Surrounding surface soil is stripped to 6" below original grade per construction drawings.

FIGURE 4-4
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 non-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 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. Contractor over-excavates 6 inches when removing the stockpile.
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 or STP Backfill 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 MONITORING

The STP excavation will be in accordance with Approach D in the SEP. The section presents the overall monitoring concepts. 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.

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 Supplemental Package 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 for WAC compliance. After removal of all pipe bedding material, FDF will perform realtime 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 by bulk excavation 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. No additional monitoring will be performed after the above-WAC technetium-99 contaminated material is removed as shown on the construction drawings. 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 structure are removed, the STP deep excavation will be performed. This will be performed in bulk excavation to the lines and grades shown on

the construction drawings. The STP Excavation Contractor will provide survey data to ensure that the required depth has been excavated. FDF will then have 10 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 Sludge Cake: 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 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 above the sand layer must first be removed. Additional sampling and analysis will then be performed to verify that the drainage layers, soil berms, and other material below sludge cake 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.

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 12399, 12401, and 12403. In order to achieve the required volumes, the samples from these wells were composited into one sample. Perched groundwater sampled was

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 μg/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 was found in Boring 12404, at three different depths; 2.0 - 2.7 feet, 0.78 mg/kg; 2.7 - 3.2 feet, 0.44 mg/kg; and 3.2 - 3.7 feet, 12 mg/kg. Trichloroethene was also found at Boring 12404 at the same depths. Results were 2.0 - 2.7 feet, 0.16 mg/kg; 2.7 - 3.2 feet, 0.029 mg/kg; and 3.2 - 3.7 feet, 0.63 mg/kg. Boring 12404 was also analyzed for Aroclor-1248, which was found at every sample interval. Concentrations ranged from 1.8 mg/kg (2.0 ft.- 2.7 ft.) to 46 mg/kg (0.5 ft. - 1.0 ft.).

- Technetium-99 was the only radiological constituent found at elevated levels. At Boring 12403 at 30-36 inches, 33 pCi/g of technetium-99 was found.

- Other VOCs discovered in Boring 12403 are 1,2 Dichloroethene (.029 mg/kg, 0.021 mg/kg at 2.0 ft. - 3.2 ft.) and 1,1-dichloroethane (.007 mg/kg at 2.0 ft. - 2.7 ft.). Carbon disulfide was also found at 2.0 ft - 2.7 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 strategy is to remove a 10 feet x 20 feet x 4 feet volume of material as shown on Figure 6-1

around the incinerator pad area. This material will be placed in white metal boxes and moved to the SMTA.

Once these excavations are complete, the STP deep excavation as shown in Figures 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

1970

Attachment 1

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

December 18, 1998

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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 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_D)	
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. This data indicates 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 participates 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 is consistent with, and supports, this approach.

Operable Unit 3 Summary

During the Operable Unit 3 RI/FS, samples from 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 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 is 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. This soil is surface soil with a maximum depth of 6 inches. 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 herein that indicates: technetium-99 has low leachability in the sludge and, 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.

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Attachment 2

Section 1 and 6 Figures

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The figures for Sections 1 and 6 are available on the
Fernald website on the Soil Characterization
and Excavation Package page.