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**PROPOSED RESPONSES TO THE USEPA COMMENTS ON FINAL
REPORT FOR REMOVAL ACTION 14**

02/02/95

DOE-0513-95
DOE-FN EPAS
35
RESPONSES

6592



Department of Energy
Fernald Environmental Management Project
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FEB 2 1995

DOE-0513-95

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

- Reference:
1. James A. Saric to Jack R. Craig, "Removal Action 14 Contaminated Soils Adjacent to the Sewage Treatment Plant Incinerator Final Report," dated January 3, 1995
 2. DOE-0212-95, Jack R. Craig to James A. Saric and Tom Schneider, "Removal Action No. 14 Contaminated Soils Adjacent to the Sewage Treatment Plant Incinerator Final Report," dated November 18, 1994

This letter transmits the proposed responses to the United States Environmental Protection Agency (U.S. EPA) comments on the final report for Removal Action No. 14 (RA14) - Contaminated Soils Adjacent to the Sewage Treatment Plant Incinerator (Reference 1). The specific comments, related document sections and pages, and proposed comment dispositions are summarized in the enclosed Comment Disposition Record. The replacement pages, figures, and tables are provided for inclusion into the final report (Reference 2).

If you have any questions, please contact Mr. Arthur Murphy at (513) 648-3132.

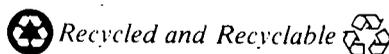
Sincerely,

for

Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Murphy

Enclosure: As Stated



000001

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ATTACHMENT 1
Comment Disposition Record
Contaminated Soils Adjacent to the Sewage Treatment Plant Incinerator
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Original Specific Comment No.: 1
Commenting Organization: U.S. EPA
Section No.: ES.2

Commentor: Saric
Line No.: 20

Page No.: ES-3

Comment:

The reference for Removal Action No. 17 management guidelines is not provided. This omission should be corrected by adding the appropriate reference.

Response:

References are provided in Section 4.0 of the *Final Report*. The sentence in Section ES.2, page ES-3, has been revised as follows:

"Soil excavated during the initial (on-property) stages of Removal Action No. 14 was placed directly into white metal boxes (WMBs) to ensure its controlled management pending characterization relative to Removal Action No. 17 (Improved Storage of Soil and Debris) management guidelines (SECTION 4.0 OF THIS DOCUMENT)."

Original Specific Comment No.: 2
Commenting Organization: U.S. EPA
Section No.: ES.2

Commentor: Saric
Line No.: 23

Page No.: ES-3

Comment:

The text states that "single" soil samples were collected from 10 percent of the white metal boxes (WMB). The term "single" should be replaced in this section and also appropriately throughout the report by the word "grab" or "composite" depending on the type of field sampling collection procedures used.

Response:

The term "single" has been replaced with the correct sample collection terminology, "composite," in Section ES-2, page ES-3 and in Section 2.1.3, page 2-7, as follows:

"~~Single~~ COMPOSITE soil samples were collected from ten percent of the WMBs and analyzed for the radiological and hazardous constituents listed in Table 2-2, (including Toxicity Characteristic Leaching Procedure [TCLP] analysis)."

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Original Specific Comment No.: 3

Commenting Organization: U.S. EPA

Section No.: 2.1.2

Page No.: 2-6

Commentor: Saric

Line No.: 16

Comment:

The text states that the survey instrument correlation curve is presented in Figure A-1. According to the note on Figure A-1, the four data points, No. 1, 3, 15, and 18, were excluded from the correlation. The rationale for the exclusion should be provided and the discrepancy between the text and Figure A-1 should be resolved.

Response:

The text in Section 2.1.2, page 2-6, has been changed to explain the rationale for excluding data points, No. 1, 3, 15, and 18, as follows:

"A correlation curve was calculated for the data and is presented in Attachment A, Figure A-1. AS NOTED ON THIS FIGURE AND IN TABLE A-1, SAMPLE POINTS 1, 3, 15, AND 18 WERE EXCLUDED FROM THE CORRELATION DUE TO INTERFERENCE FROM HIGH RADIUM-226 LEVELS WHICH CAUSED FALSE READINGS IN THE NAI DETECTOR."

Table A-1 in Attachment A has also been revised. In addition, the discrepancy between the text and Figure A-1 in Attachment A has been resolved to include reference to all four data points. Omission of the data points is due to interference from high radium levels.

Original Specific Comment No.: 4

Commenting Organization: U.S. EPA

Section No.: 2.1.2

Page No.: 2-6

Commentor: Saric

Line No.: 29

Comment:

The rationale for excluding eight data points from the correlation is not clearly presented and should be justified by additional discussion. Also, similar to specific comment 3, the discrepancy between the text in this paragraph and Figure A-2 should be corrected. The note explaining which points were excluded from the revised correlation curve should be added to Figure A-2.

Response:

The text in Section 2.1.2, page 2-7, and Table A-1 in Attachment A have been changed to explain the rationale for excluding data points, No. 1, 2, 3, 6, 7, 10, 15, and 18.

"The NaI instrument correlation data presented in Attachment A, Table A-1 was subsequently reviewed and it was determined that ~~certain~~ ADDITIONAL data points used in the correlation were influenced by the presence of gamma-emitting radium-226 in the soil and/or the very high background count rate associated with the STPI. THE ELEVATED LEVELS OF RADIUM-226

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CAUSED FALSE READINGS IN THE NAI DETECTOR. Based on examination of these data, it was determined that points 1, 2, 3, 6, 7, 10, 15, and 18 should be excluded from the correlation. The revised correlation, with these 8 points excluded, is presented in Attachment A, Figure A-2."

In addition, the discrepancy between the text and Figure A-2 in Attachment A has been resolved to include reference to all eight data points.

Original Specific Comment No.: 5

Commenting Organization: U.S. EPA

Commentor: Saric

Section No.: 2.2.2

Page No.: 2-15 to 2-18

Line No.: NA

Comment:

The information regarding the maximum depth of excavation and aerial distribution of deep and shallow zones of excavation is not presented in this section (on-property actions) or in Section 2.3.2 (off-property actions). This information should be included in the text. Information regarding the volume and vertical distribution of the clean fill at the site should also be included. The vertical profiles should be constructed to supplement the information presented in Figure 2-5, which shows the final excavation areas with verification sample point locations.

Response:

Section 2.2.2 (On-Property Excavation), page 2-18, has been revised as follows to include specific depths and volumes of excavated soil from Areas A through J, Zone I, and Zone II:

SUMMARY OF ON-PROPERTY EXCAVATIONS

Area	Depth	Volume of Soil Excavated
A	18"	102 cubic yards (cy)
B	18"	60 cy
C	6"	3 cy
D	12"	39 cy
E	24"	21 cy
F	24"	132 cy
G	6"	39 cy
H	12"	21 cy
I	12"	45 cy
J	6"	3 cy
Zone I	6"	386 cy
Zone II	6"-18"	400 cy

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Section 2.3.2 (Off-Property Excavation), pages 2-26 and 2-28, has been revised as follows to include specific depths and volumes of excavated (and backfilled) soil from Zone III, Zone IV, and the Area South of Zone IV:

"ZONE III WAS EXCAVATED FROM 9" TO 48" IN DEPTH (FIGURE 2-4). A total of 700 yd³ of contaminated soil was excavated from Zone III and stockpiled."

"A total of 850 yd³ of contaminated soil was excavated TO A DEPTH OF 6" from Zone IV and stockpiled."

"An additional 150 yd³ of contaminated SURFACE soil (TOP SIX INCHES) was excavated from Zone IV and stockpiled. The top six inches of soil was also excavated from the area surrounding sample location SP-1 (FIGURE 2-4). A total of 30 yd³ of soil was excavated from this area."

In addition, Figure 2-4 has been revised to include the depths and volumes of soil excavated from both on-property and off-property areas. Figure 2-5 was not used because of the dense configuration of the verification sample points.

Original Specific Comment No.: 6

Commenting Organization: U.S. EPA

Commentor: Saric

Section No.: 2.2.3

Page No.: 2-18

Line No.: 10

Comment:

The text states that the verification samples were collected from depths of 0 to 6 inches, but the text does not specify that the samples were collected from below the excavation bottom, which varies from one area to another. The text should be revised to confirm the vertical position of the verification samples relative to the excavation bottom.

Response:

The text has been revised in Section 2.2.3, page 2-18, as follows:

"Figure 2-5 shows the post-excavation verification sample locations within Areas A through J. These samples were collected from THE BASE OF THE EXCAVATION ~~zero~~ TO A DEPTH OF six inches and submitted to the on-site FEMP laboratory for total uranium analysis."

The text has been revised in Section 2.3.3, page 2-28, as follows:

"Figure 2-5 shows the post-excavation verification sample locations, 301 to 310 (collected in Zone III) and 401 to 440 (collected in Zone IV). These samples were collected from THE BASE OF THE EXCAVATION ~~zero~~ TO A DEPTH OF six inches and submitted to the on-site FEMP laboratory for total uranium analysis."

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Original Specific Comment No.: 7

Commenting Organization: U.S. EPA

Commentor: Saric

Section No.: 2.3.1

Page No.: 2-20

Line No.: 20

Comment:

The text states that off-property characterization was initiated by collecting soil samples from eight "hot spot" locations. The text should discuss the methods used to determine the "hot spot" sampling locations or a reference to the section of text where this information was presented should be provided.

Response:

Section 2.3.1, page 2-21, has been revised to include a detailed discussion on the methods used to determine the "hot spot" sampling locations, as follows:

~~"Off property characterization was initiated by collecting soil samples from eight "hot spot" locations east of the FEMP property line.~~ THE CORRELATED NAI SURVEY INSTRUMENT, DESCRIBED IN SECTION 2.1.2, WAS USED DURING THE OFF-PROPERTY RADIOLOGICAL WALKOVER SURVEY TO ESTIMATE THE EXTENT OF TOTAL URANIUM CONTAMINATION IN THE SOIL. THE GOAL OF THAT SURVEY WAS TO IDENTIFY LOCALIZED AREAS IN WHICH THE SOIL EXHIBITED COUNT RATES WITH A TOTAL URANIUM CONCENTRATION GREATER THAN 35 pCi/g. THE RADIOLOGICAL WALKOVER SURVEY WAS PERFORMED ON A 25- BY 100-FOOT GRID ESTABLISHED OVER THE ENTIRE OFF-PROPERTY STUDY AREA. ONCE THE LOCATIONS WERE IDENTIFIED, SURFACE RADIATION MEASUREMENTS WERE MADE, AS DESCRIBED IN SECTION 2.2.1. THE ENTIRE STUDY AREA WAS SURVEYED BY WALKING AT A STEADY RATE IN A SERPENTINE MANNER. WHEN A "HOT SPOT" WAS DETECTED, ITS BOUNDARY WAS MARKED WITH STAKES FOR SUBSEQUENT SURFACE SOIL SAMPLING (WEMCO 1992). SUBSEQUENT OFF-PROPERTY CHARACTERIZATION WAS PERFORMED BY COLLECTING SOIL SAMPLES FROM THE EIGHT "HOT SPOTS" THAT WERE IDENTIFIED EAST OF THE FEMP PROPERTY LINE."

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Original Specific Comment No.: 8		
Commenting Organization: U.S. EPA		Commentor: Saric
Section No.: A-2	Page No.: NA	Line No.: NA

Comment:

The definition for Y should be added to the figure legend.

Response:

In Attachment A, Figure A-2, the term "Y" has been omitted. The legend has been revised to provide definitions for the "asterisk" as the **Measured** Counts Per Minute (CPM) and the "diamond" as the **Predicted** CPM.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

**Removal Action No. 14
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to the Sewage Treatment Plant
Incinerator**

FINAL REPORT

**February 1995
Revision 1**

U.S. DEPARTMENT OF ENERGY

000009

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Incinerator**

FINAL REPORT

Fernald Environmental Management Project

February 1995
Revision 1

U.S. DEPARTMENT OF ENERGY

000010

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through the collection and analysis of soil samples. These three steps were repeated during the course of the removal action as a better understanding of the extent of contamination was developed.

Areas of contaminated soil requiring excavation were identified through a series of walkover radiation surveys and soil sampling and analyses. Based on the initial excavation action level for Removal Action No. 14 of 100 pCi of total uranium per gram of soil, the first round of walkover radiation surveys revealed that uranium contamination was more wide spread than originally known. As a result, area-specific excavation criteria were established as follows:

Area	Uranium Action Levels
On-property areas within the STP compound	300 pCi/g
On-property areas outside the STP compound	100 pCi/g
Off-property areas	35 pCi/g

Based on these criteria, approximately 3,020 cubic yards (yd³) of soil were excavated during the course of Removal Action No. 14; 1,320 yd³ from twelve on-property areas (designated as Areas A through J, and Zones I and II), and 1,700 yd³ from two off-property areas (designated as Zones III and IV). Soil excavated during the initial (on-property) stages of Removal Action No. 14 was placed directly into white metal boxes (WMBs) to ensure its controlled management pending characterization relative to Removal Action No. 17 (Improved Storage of Soil and Debris) management guidelines (Section 4.0 of this document). A total of 920 yd³ of soil from on-property excavations was placed into WMBs and filled to their 3 yd³ capacity, pending sampling and analysis.

Composite soil samples were collected from ten percent of the WMBs and analyzed for the radiological and hazardous constituents listed in Table 2-2, (including Toxicity Characteristic Leaching Procedure [TCLP] analysis). Based on results of these analyses (Attachment B.1), it was determined that the excavated soils were not hazardous and, in accordance with the Removal Action No. 17 management guidelines, did not require segregated controlled storage as Resource Conservation and Recovery Act (RCRA) wastes. However, based on the concentrations of radiological contaminants, the soil remained in the WMBs pending final disposition. Soil from ongoing excavation

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2.1.2 Development of Survey Instrument Correlation

Direct radiation measurements using portable radiation detectors were used to screen for uranium concentrations in surface soil. A correlation was developed between the detector count rate, as measured using a sodium iodide (NaI) scintillation detector, and the concentration of total uranium (pCi/g), as measured by laboratory analysis of soil samples. The correlation was established by measuring the in situ count rate at 21 locations from which soil samples were subsequently collected and analyzed for radionuclides. The locations were selected to encompass a range of count rates that could then be plotted as a function of uranium/total soil concentration. Gross count rates were established for each location by averaging the results from three 2-minute stationary counts. A 2- by 2-inch NaI detector was used, with side and top shielding, held 5 inches from the grade. The counting electronics did not include energy discrimination, and the count rates reflected contributions from all gamma radiation emitting sources.

Following completion of the direct radiation measurements, soil samples were collected and analyzed for isotopic and total uranium, isotopic thorium, and radium-226. The results from these measurements and laboratory analyses are presented in Attachment A, Table A-1. A correlation curve was calculated for the data and is presented in Attachment A, Figure A-1. As noted on this figure and in Table A-1, sample points 1, 3, 15, and 18 were excluded from the correlation due to interference from high radium-226 levels and elevated background radiation which caused false readings in the nai detector. Based on this correlation curve, the total uranium removal criteria for 35 pCi/g, 100 pCi/g, and 300 pCi/g were determined to correlate with 4,000 counts per minute (cpm), 5,000 cpm, and 8,500 cpm, respectively. This correlation was applied during the course of radiological walkover surveys to identify the boundaries of soil areas requiring excavation.

During the course of the removal action, concerns arose regarding the accuracy of the correlation relative to identifying all soil areas with total uranium concentrations greater than 35 pCi/g. The NaI instrument correlation data presented in Attachment A, Table A-1 was subsequently reviewed and it was determined that additional data points used in the correlation were influenced by the presence of gamma-emitting radium-226 in the soil and/or the very high background count rate associated with the STPI. The elevated levels of radium-226 caused false readings in the NaI detector. Based on examination of

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these data, it was determined that points 1, 2, 3, 6, 7, 10, 15, and 18 should be excluded from the correlation. The revised correlation, with these 8 points excluded, is presented in Attachment A, Figure A-2. Based on this revised correlation, it appears that the original correlation overpredicted the uranium concentration at the high end (300 pCi/g). In other words, at 8,500 cpm (old correlation) the soil actually contains less than 300 pCi/g total uranium.

Off-property walkover survey results ranged from 3,400 to 3,800 cpm with some locations 3,900 cpm. Because the survey data are gross count rates, the off-property readings are dominated by the background count rate (approximately 3,000 cpm). The correlation curve actually levels off in the region of 35 pCi/g and below. The count rate changes very little relative to actual changes in uranium concentration, making it difficult to apply the correlation reliably in the 3,400 to 3,800 cpm range. The NaI correlation cannot be applied reliably for total uranium soil concentrations below approximately 50 pCi/g. Therefore, the results of in situ soil sampling were used to verify excavation requirements off-property.

2.1.3 Management of Excavated Soil

On-property and off-property soil excavation activities associated with Removal Action No. 14 are discussed in detail in Sections 2.2.2 and 2.3.2, respectively. Approximately 3,020 cubic yards (yd³) of soil were excavated during Removal Action No. 14; 1,320 yd³ from 12 on-property areas (Areas A through J, and Zones I and II), and 1,700 yd³ from two off-property areas (Zones III and IV).

At the outset of Removal Action No. 14 (July 1992), there were no established guidelines for the management and disposition of radiologically contaminated soils. However, in December 1992, the OEPA and USEPA approved Removal Action No. 17, Improved Storage of Soil and Debris (FERMCO 1992), establishing guidelines for the management of contaminated soil and debris at the FEMP. Soil, excavated during the initial (on-property) stages of Removal Action No. 14, was placed directly into white metal boxes (WMBs) to ensure its controlled management pending characterization relative to Removal Action No. 17 management guidelines. A total of 920 yd³ of soil from on-property excavations was placed into WMBs, pending sampling and analysis. Composite soil samples were collected from ten percent of the WMBs from each excavation area and analyzed for the radiological and hazardous constituents listed in

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Table 2-2, including Toxicity Characteristic Leaching Procedure (TCLP) metals. Based on an additional objective to evaluate airborne contamination associated with the STP soils, emphasis was placed on collecting samples from the WMBs that contained surface soils to a depth of six inches (FERMCO 1993a). A total of 50 samples were collected and analyzed, and the characterization results are presented in Attachment B.1, Tables B.1-1 through B.1-3.

Based on the analytical results from the soil samples, and Removal Action No. 17 management guidelines, it was determined that the excavated soils did not contain hazardous waste and did not require segregated controlled storage under the Resource Conservation and Recovery Act (RCRA), and Phase I of Removal Action 17. However, based on the concentrations of radiological contaminants, the soil did require controlled management and remains in the WMBs pending final disposition under the ROD for OU-5.

Soil from subsequent excavation activities was not placed in WMBs but was stockpiled on FEMP property in accordance with Removal Action No. 17 guidelines. Based on these guidelines, controlled stockpiles were created south of the FEMP stormwater retention basin for the 1,700 yd³ of excavated soil from Zones III and IV, with total uranium concentrations less than or equal to 100 pCi/g, 5 pCi/g total radium, or 50 pCi/g total thorium. The remaining 400 yd³ of excavated soil from Zones I and II that had total activity concentrations exceeding 100 pCi/g uranium, 5 pCi/g radium, or 50 pCi/g thorium, is stored under tarpaulins located east of the boiler plant pending final disposition.

2.2 ON-PROPERTY ACTIONS

Section 2.2.1 discusses on-property characterization measurements and sampling; Section 2.2.2 discusses soil excavation; and Section 2.2.3 discusses verification sampling for on-property actions.

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2.2.1 Characterization Measurements

The survey instrument correlation, described in Section 2.1.2, was used during the on-property radiological walkover survey to estimate the extent of total uranium contamination in the soil (RAWP Addendum, Revision No. 2). The goal of that survey was to identify localized areas in which the soil exhibited count rates with a total uranium concentration greater than 100 pCi/g. The radiological walkover survey was performed on a 25- by 100-foot grid established over the entire on-property study area. Once the locations were selected, surface radiation measurements were made using a SPA-3 radiation detector suspended five inches from grade and side and top-shielded with 3/8 inch of lead. The study area was surveyed by walking at a steady rate in a serpentine manner. After three, two-minute readings were recorded and averaged, the result was converted to counts-per-minute and recorded as the gross reading. When a "hot spot" was detected, its boundary was marked with stakes for subsequent excavation (FERMCO 1993a). The raw data collected during the radiological walkover survey are presented in Figure 2-1. These data are contoured in Figure 2-2 and are detailed in Attachment B.2, Table B.2-1. Once the radiological walkover survey was completed, it was apparent that a considerable volume of soil would have to be removed to achieve the 100 pCi/g action level. The distribution of uranium contamination in the soil was found to have a higher, more uniform concentration than originally thought.

The radiological walkover survey defined the horizontal extent of contamination; however, limited data on vertical distribution existed. Because the areal extent of soil requiring excavation was large, additional soil sampling data were needed to 1) define the vertical extent of soil exhibiting a total uranium concentration greater than 100 pCi/g, and 2) provide a basis for estimating waste volumes.

The location of additional soil samples (Figure 2-3), was biased by field logistics. Samples were located within the 100 pCi/g boundary, and the depths were selected based on the premise that the vertical extent of contamination would be greater within the STP fence adjacent to the STPI and associated structures. In addition, within the fenced area, the sample points were located to avoid structures and underground utilities in the area. Figure 2-3 indicates the locations of samples collected previously in conjunction with the FEMP Environmental Monitoring Program, and site-wide remedial investigation/feasibility study (RI/FS) characterization efforts. Removal Action No. 14 soil samples were collected in conjunction with the soil excavation activities. Samples

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were submitted to the on-site FEMP laboratory for total uranium analysis, and duplicate samples were sent to an off-site laboratory for analysis in accordance with the protocols described in the RAWP. The area inside the STP fence was divided into four quadrants, and at least one sample per quadrant was also analyzed for the full Hazardous Substances List (HSL).

Analytical results from these on-property sampling activities (ASI-1 through ASI-32) are presented in Attachment B.2, Tables B.2-2 and B.2-3. Review of the radiological data indicates that in addition to uranium contamination, elevated concentrations (greater than five pCi/g) of radium-226 were found in locations ASI-14, ASI-15, ASI-16, and ASI-17. Also, HSL data shows that one sample, ASI-8, from 4- to 6-inches in depth, exhibited organic concentrations greater than the Required Quantitation Limits (RQL). Samples ASI-8 and ASI-13 also exhibit lead levels greater than 100 mg/kg (FERMCO 1993a). The area surrounding sample location ASI-13 was not excavated and, therefore, no lead-containing waste was produced at that location. Although excavation was performed in the location of sample ASI-8, the level of total lead measured in that sample would not predict exceedance of the TCLP regulatory level. Further, the samples collected adjacent to ASI-8 exhibited significantly lower levels of total lead.

The results from sample points ASI-1 through ASI-32 (Attachment B.2, Tables B.2-2 and B.2-3) confirmed the results of the radiological walkover survey, which indicated that the distribution of uranium contamination in the soil was a higher, more uniform concentration than originally thought. It was also apparent that a considerable volume of soil would have to be removed to achieve the 100 pCi/g action level. The sampling results for these samples showed that only radioactive contamination was present.

2.2.2 Soil Excavation

After the radiological walkover survey was completed, and the areas were marked where concentrations of total uranium were expected to exceed the removal criteria, excavation began and continued until soils containing radioactive contamination in excess of the action levels was removed. Originally, the total uranium action level for all on-property areas was set at 100 pCi/g; however, as discussed in Section 2.1.1, it was discovered that contamination inside the fenced area of the STP was higher than first thought. To attain the removal action goal of 100 pCi/g within the STP compound would have required significant excavation to the extent that structural integrity of many STP

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facilities would be threatened. Therefore, DOE and USEPA agreed that the most prudent course of action (before collecting additional data) was to excavate the areas exhibiting total uranium concentrations greater than 300 pCi/g. Selected areas with total uranium concentrations less than 300 pCi/g, but greater than 100 pCi/g, were also excavated if their location was isolated or they were located in close proximity to the FEMP property line. Seven excavation areas inside the fenced STP area and three outside the fenced STP area were established as Areas A through J (Figure 2-4). Controls were put in place around each excavation area (>100 pCi/g) to limit access/exposure (FERMCO 1993a).

Once the initial excavation boundaries were established, the top six inches of soil were excavated with a smooth blade bucket excavator and placed into WMBs. After the top six inches of soil had been removed, additional readings were taken with the shielded SPA-3 within each excavated area. Any reading that exceeded the field action level was marked, and a boundary established for the next 6-inch excavation. The excavation proceeded in 6-inch lifts until the soil exhibited count rates that correlated to a total uranium concentration less than the field action level (300 pCi/g inside the fenced STP area, 100 pCi/g outside the fenced STP area). A total of 178 WMBs (534 yd³) were filled with the excavated soils from Areas A through J. These WMBs were placed in storage pending radiation characterization (Section 2.1.3).

All excavated areas were bermed using adjacent soil to limit run-off from other areas entering the excavated areas. The excavated areas were dewatered routinely, and the water was discharged into the general sump. The soil was seeded to prevent wind and water erosion. Two fire hydrants within the study area, and one within an excavated area (Area F), were repaired to eliminate the potential contribution for contaminant migration from leakage onto the ground (FERMCO 1993a).

The additional on-property soil sampling, described in Section 2.2.1, identified the presence of two additional areas (Zones I and II) adjacent to the STPI in the northwest corner of the STP compound, with total uranium concentrations which exceeded the 100 pCi/g action level. These two excavation zones are shown on Figure 2-4. Zone I was north of the STPI, bordering the north STP fenceline, and Zone II was west of the STPI on the northwest corner of the fenced STP compound. These two additional areas were excavated as described for Areas A through J above. A total of 386 yd³ of soil was excavated from Zones I and II and deposited in 129 WMBs pending characterization

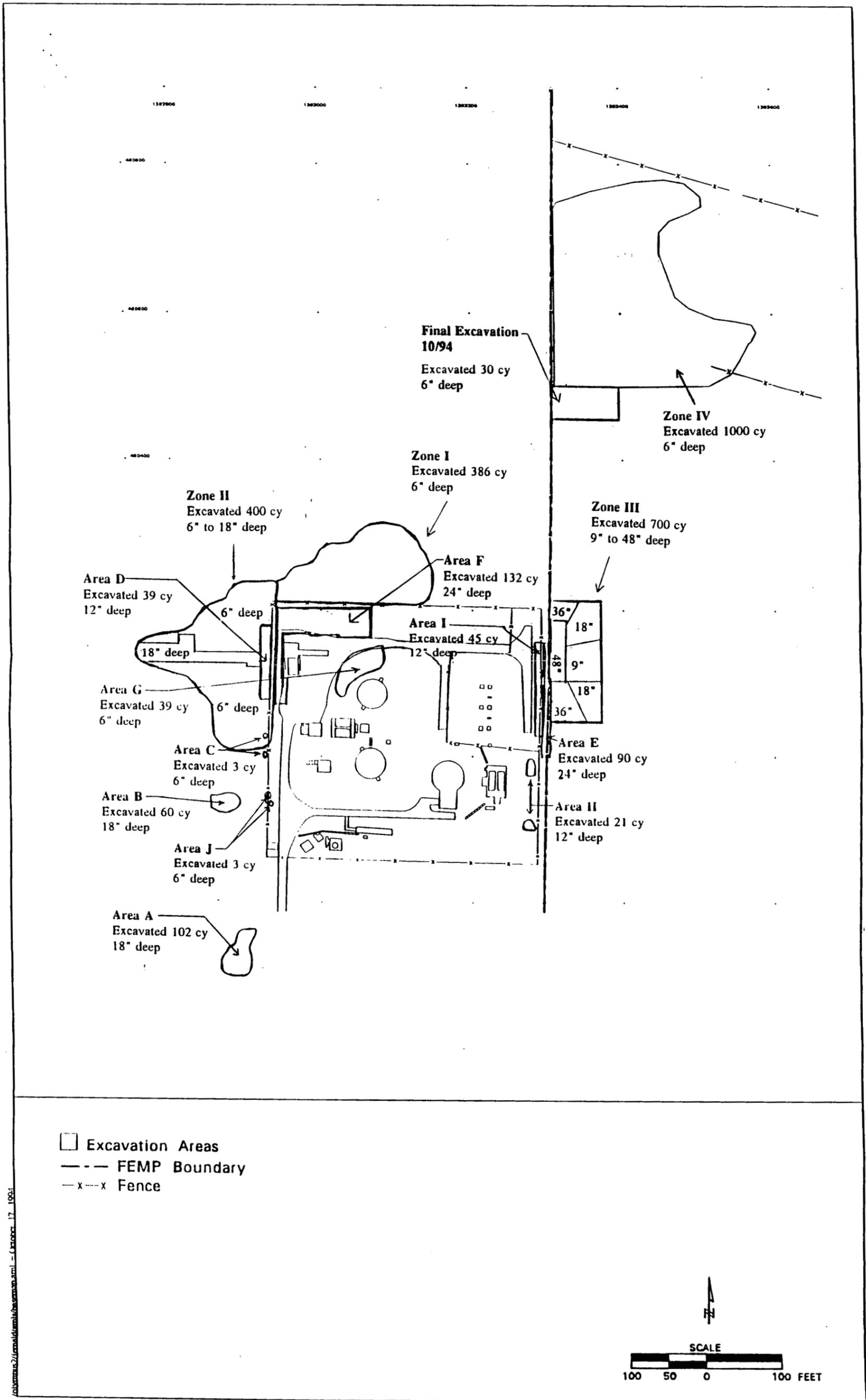


Figure 2-4. On-Property Soil Excavations.

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(Section 2.1.3). Once the soil was determined to be non-hazardous, an additional 400 yd³ of excavated soil was stockpiled in accordance with Removal Action No. 17 management guidelines.

SUMMARY OF ON-PROPERTY EXCAVATIONS

Area	Depth	Volume of Soil Excavated
A	18"	102 cubic yards (cy)
B	18"	60 cy
C	6"	3 cy
D	12"	39 cy
E	24"	21 cy
F	24"	132 cy
G	6"	39 cy
H	12"	21 cy
I	12"	45 cy
J	6"	3 cy
Zone I	6"	386 cy
Zone II	6"-18"	400 cy

2.2.3 Verification Sampling

The effectiveness of soil excavation, within Areas A through J and Zones I and II, was determined by collecting and analyzing post-excavation verification samples from within each of the excavated areas. The selection of sample locations was biased to be representative, and to meet the objective that at least one sample be collected at the maximum excavation depth (FERMCO 1993a). Figure 2-5 shows the post-excavation verification sample locations within Areas A through J. These samples were collected from the base of the excavation to a depth of six inches and submitted to the on-site FEMP laboratory for total uranium analysis. As shown in Attachment B.2, Table B.2-4, the results of the verification samples (ASI-33 through ASI-58) taken in Areas A through J ranged from a total uranium concentration of <7.4 pCi/g to 250 pCi/g. Fourteen of the twenty-six verification samples collected exhibited a total uranium concentration of <7.4 pCi/g. The other twelve sample results ranged from 11.5 pCi/g to 250 pCi/g of total uranium. The three sample results above 100 pCi/g were located inside the fenced STP compound where the 300 pCi/g action level is applied.

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Therefore, these verification sampling results shown in Attachment B.2, Table B.2-4, indicate that the removal action criteria for the soil in areas A through J have been met.

The verification samples, 101 to 140 (taken in Zone I) and 201 to 224 (taken in Zone II), were analyzed for total uranium. The results of these samples are shown in Attachment B.2, Table B.2-5. Two of the samples taken in Zone I contained uranium concentrations greater than the 100 pCi/g action limit. The uranium concentration in these samples was 140.7 pCi/g and 155 pCi/g. Seventeen of the samples contained uranium concentrations greater than the detection limit (<7.4 pCi/g), but less than the action limit of 100 pCi/g. The uranium concentration of these seventeen samples ranged from 8.1 to 90.7 pCi/g. The remaining twenty-one verification samples contained uranium concentrations at or below the detection limit level of 7.4 pCi/g. One of the samples taken in Zone II contained a uranium concentration greater than the 100 pCi/g action limit. However, this sample was actually collected directly on the STP compound fence-line. The uranium concentration in this sample was 278.2 pCi/g. Ten of the samples contained uranium concentrations greater than the detection limit (<7.4 pCi/g), but less than the action limit of 100 pCi/g. The uranium concentration of these ten samples ranged from 11.2 to 81.2 pCi/g. The remaining thirteen verification samples contained uranium concentrations at or below the detection limit level of 7.4 pCi/g.

In summary, these verification sampling results (Attachment B.2, Tables B.2-5 and B.2-6) indicate that the removal action criteria for the soil in Zones I and II have been met, except for the two small areas in Zone I mentioned above. Because these points are within limited access controlled areas (fenced with radiation warning and access restriction signs similar to within the STP compound where the 300 pCi/g limit is applied), the potential health risk to on- and off-property personnel associated with this localized residual contamination was determined to be insufficient to warrant further excavation. Therefore, the removal action objectives are considered to be met.

2.3 OFF-PROPERTY ACTIONS

Off-property actions were identified and expanded during the course of field activities as additional information was obtained regarding the extent of soil contamination adjacent to the STPI. The timing and sequence of these off-property actions is presented in

Table 2-1. Section 2.3.1 discusses characterization measurements and sampling; Section 2.3.2 discusses soil excavation; and 2.3.3 discusses verification sampling for off-property actions.

2.3.1 Characterization Measurements

The correlated NaI survey instrument, described in Section 2.1.2, was used during the off-property radiological walkover survey to estimate the extent of total uranium contamination in the soil. The goal of that survey was to identify localized areas in which the soil exhibited count rates with a total uranium concentration greater than 35 pCi/g. The radiological walkover survey was performed on a 25- by 100-foot grid established over the entire off-property study area. Once the locations were identified, surface radiation measurements were made, as described in Section 2.2.1. The entire study area was surveyed by walking at a steady rate in a serpentine manner. When a "hot spot" was detected, its boundary was marked with stakes for subsequent surface soil sampling (WEMCO 1992). Subsequent off-property characterization was performed by collecting soil samples from the eight "hot spots" that were identified east of the FEMP property line.

All sampling was performed in accordance with the Removal Action Work Plan Sampling and Analysis Plan (Section 3.0 of the RAWP) (WEMCO 1992). These sample locations were identified as STP30 to STP37 and are shown in Figure 2-3. Two of the eight locations, STP34 and STP35, were sampled for the HSL, dioxin, and radionuclides, as listed in Table 2-2, while the other six locations were sampled only for the radionuclides listed in Table 2-2 and total uranium. All analytical results are presented in Attachment B.3, Tables B.3-1 and B.3-2. Only the northernmost sample location (STP30) exceeded the off-property action level of 35 pCi/g with a total uranium concentration of 58.47 pCi/g. All HSL results were found to be below either the required laboratory quantitation limits or the upper 95 percent tolerance limits for FEMP background soil. No dioxin was found in any sample (FERMCO 1993a). The sampling results also confirmed only radioactive contamination was present. The sampling results from sample locations STP30 to STP37 (Attachment B.3, Tables B.3-1 and B.3-2) indicated that further sampling was required to more accurately define off-property contamination, and provided an indication as to the location of future sampling sites.

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Based on the results of the initial soil sampling described above, additional off-property sampling was performed that focused on two areas. The first area was the wooded section northeast of the STPI surrounding sample point STP30 (see Figure 2-3), which exhibited a total uranium concentration exceeding 35 pCi/g. Samples were collected to more clearly define the horizontal and vertical extent of contamination in this area. A 250- by 250-foot grid was established with STP30 as the center. Along this grid, ten sample locations, C1 to C10, were chosen using a random number generator and analyzed for radionuclides listed in Table 2-2 as well as total uranium (FERMCO 1993a).

The other off-property area requiring additional soil sampling was an area immediately adjacent to the FEMP property line, directly east of the STPI. When the on-property 100 pCi/g boundaries were marked, there was an area immediately adjacent to the FEMP property line, on-property, which exceeded 100 pCi/g. Because of the proximity of this 100 pCi/g area, it was deemed appropriate to initiate additional sampling off-property, immediately adjacent to this area. A 50-foot (east to west) by 200-foot (north to south) section was marked into 25-foot grid increments. Ten sample locations, D1 to D10, were selected along this grid and analyzed for radionuclides as well as total uranium. Figure 2-3 shows the locations of these additional off-property soil samples (FERMCO 1993a).

Attachment B.3, Table B.3-3 provides the results of the additional off-property sampling activities. Review of the radiological data for the C-series samples shows several samples within the wooded area that have uranium concentrations greater than the 35 pCi/g action level. Two locations (C-9 and C-10 (outside the wooded area) also exhibited uranium concentrations greater than 35 pCi/g. Only one location in the D area, D2, had a uranium concentration greater than 35 pCi/g. Also, locations D2 and D3 were found to have elevated (greater than 5 pCi/g) radium-226 and thorium-230 results (FERMCO 1993a). The sampling results from locations C1 to C10 and D1 to D10 (Attachment B.3, Table B.3-3) were considered in determining the excavation boundaries for Zones III and IV.

An additional walkover survey and follow-up soil sampling was performed for the off-property areas north and east of the STP prior to excavation. The purpose of this additional sampling was to further define the extent and boundaries of potential radiological contamination above the action level, beyond the discrete areas of identified

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contamination. These additional surveys and samples were conducted to follow-up radiological characterizations previously performed in this area. Survey transects were established northward and eastward from the STPI, in areas which were downwind (prevailing winds) from the STPI (see Figure 2-6). Each of the transects extended eastward from the property boundary with a 100-foot spacing between transects. Transects were not established in the wooded area located just off-property, since radiological contamination had been confirmed in this area, and because of the difficulty in traversing this area with dense understory vegetation (FERMCO 1993a).

The walkover survey was performed by taking 2-minute readings, from five inches above-grade, at 50-foot intervals along each transect, using the top and side-shielded SPA-3 detector. The SPA-3 readings were taken in areas that were free of standing water and that were cleared of vegetation. The results of these survey measurements are presented in Attachment B.3, Table B.3-4. The second consecutive reading that indicated less than 35 pCi/g determined the boundary for a more detailed 25- by 25-foot survey grid as shown in Figure 2-7. After the detailed grid was established, walkover survey measurements were taken at each grid line intersection, again using the shielded SPA-3 detector (as per the initial radiological walkover survey) (FERMCO 1993a). The results of these measurements are presented in Table B.3-4, along with the 50-foot grid results.

Soil samples were collected at the location of the second consecutive survey reading from the FEMP property line that correlated to less than 35 pCi/g to confirm the uranium contamination levels as shown in Figure 2-8. As discussed in Section 2.1.2, it was determined that the NaI survey instrument was not able to provide a reliable correlation to total uranium concentration at the 35 pCi/g level. These samples (A1, B1, C1, D1, E1, F1, G2, H2, I4, J4, L3, L2, L1, and L0) were analyzed for the radionuclides specified in Table 2-2. Additionally, samples from two randomly selected locations within the westernmost wooded area and from two locations outside the wooded area were analyzed for TCLP constituents. Samples were collected from the top six inches of soil, the 6- to 12-inch layer, the 12- to 18-inch layer, the 18- to 24-inch layer, the 24- to 36-inch layer, and the 36- to 48-inch layer. The last two layers were archived for possible future analysis, depending on results from overlying layers (FERMCO 1993a). Sampling results (Attachment B.3, Table B.3-5) indicated soil uranium concentrations near or below the detection limit of 3.7 pCi/g and no contamination outside of the off-property excavated areas (Zones III and IV).

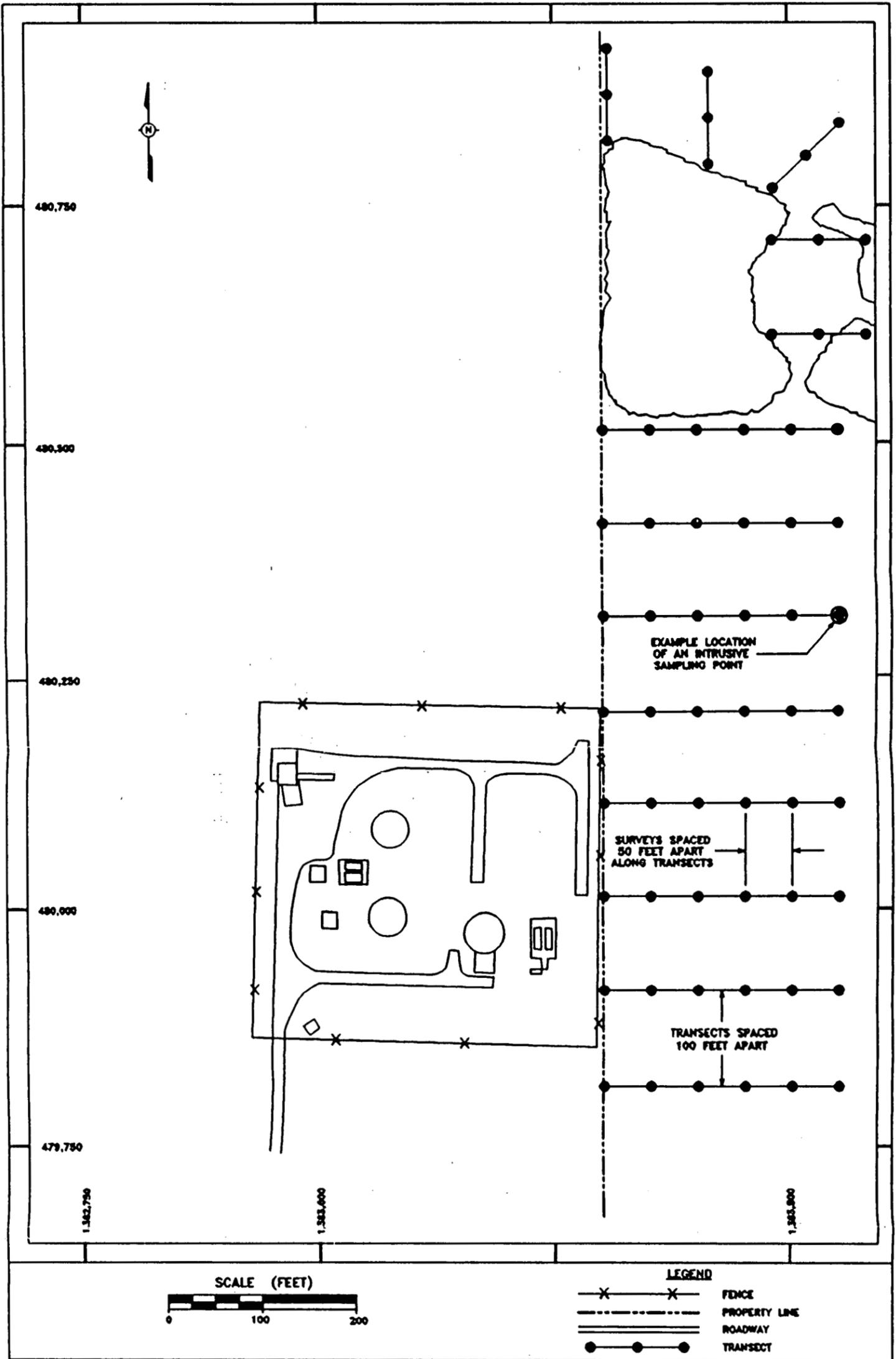


Figure 2-6. Transect Survey Locations to Determine Areal Extent.

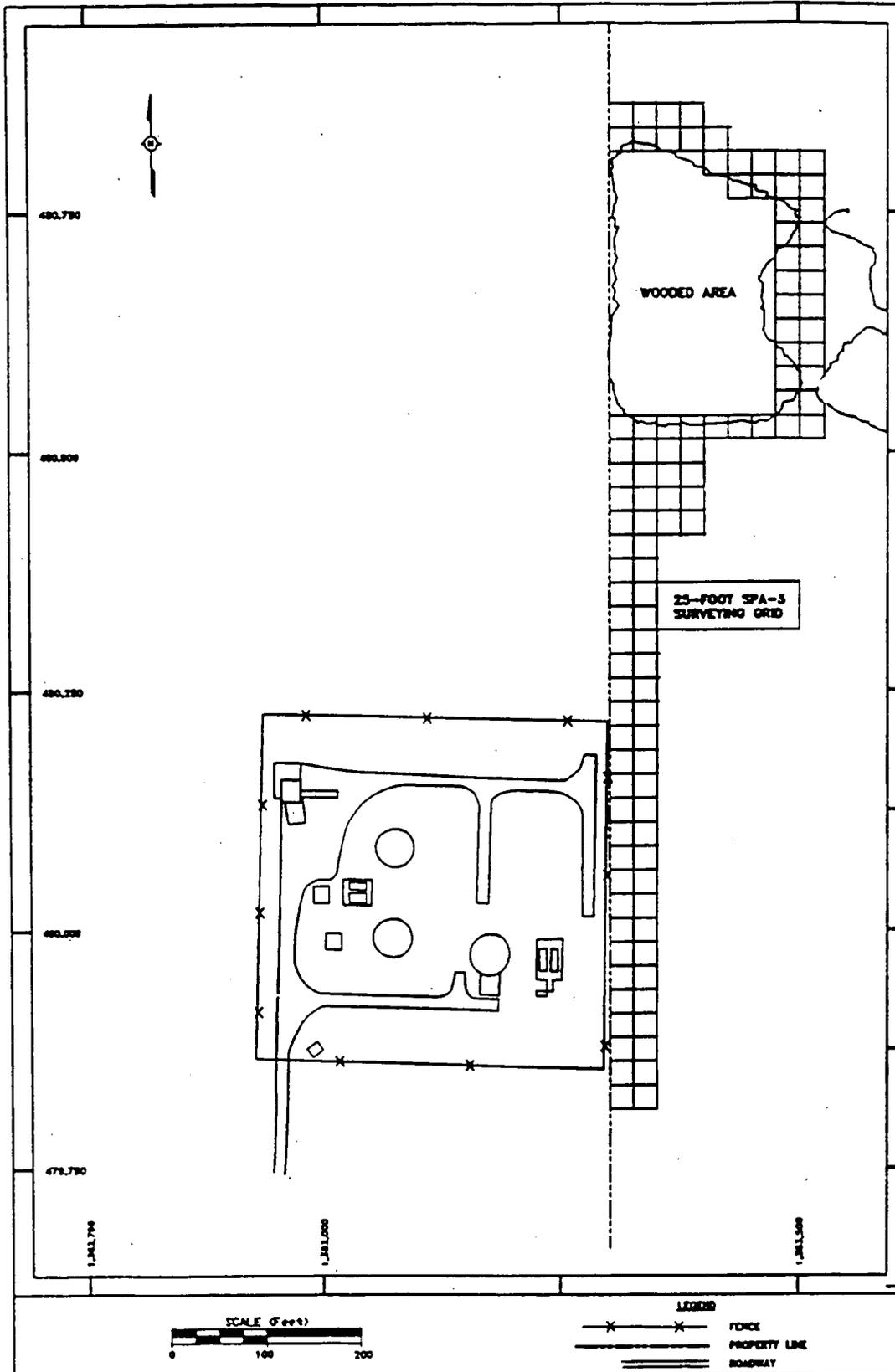


Figure 2-7. Detailed 25- by 25-foot Transect Survey Locations.

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A final set of soil samples was collected immediately south of Zone IV excavation area. Because this area had been plowed by a private individual following the original sampling, five additional samples were collected in this area (SP-1 through SP-5). Samples SP-1 and -2 were collected from the same locations as previous samples C-9 and C-10. Samples were collected from the top six inches of soil, the 6- to 12-inch layer, and the 12- to 18-inch layer. Analysis of these samples revealed uranium concentrations that were less than 35 pCi/g in all cases, with the exception of location SP-1 in the top six inches which indicated a total uranium concentration of 55 pCi/g. The results of these analyses are detailed in Attachment B.3, Table B.3-8.

2.3.2 Soil Excavation

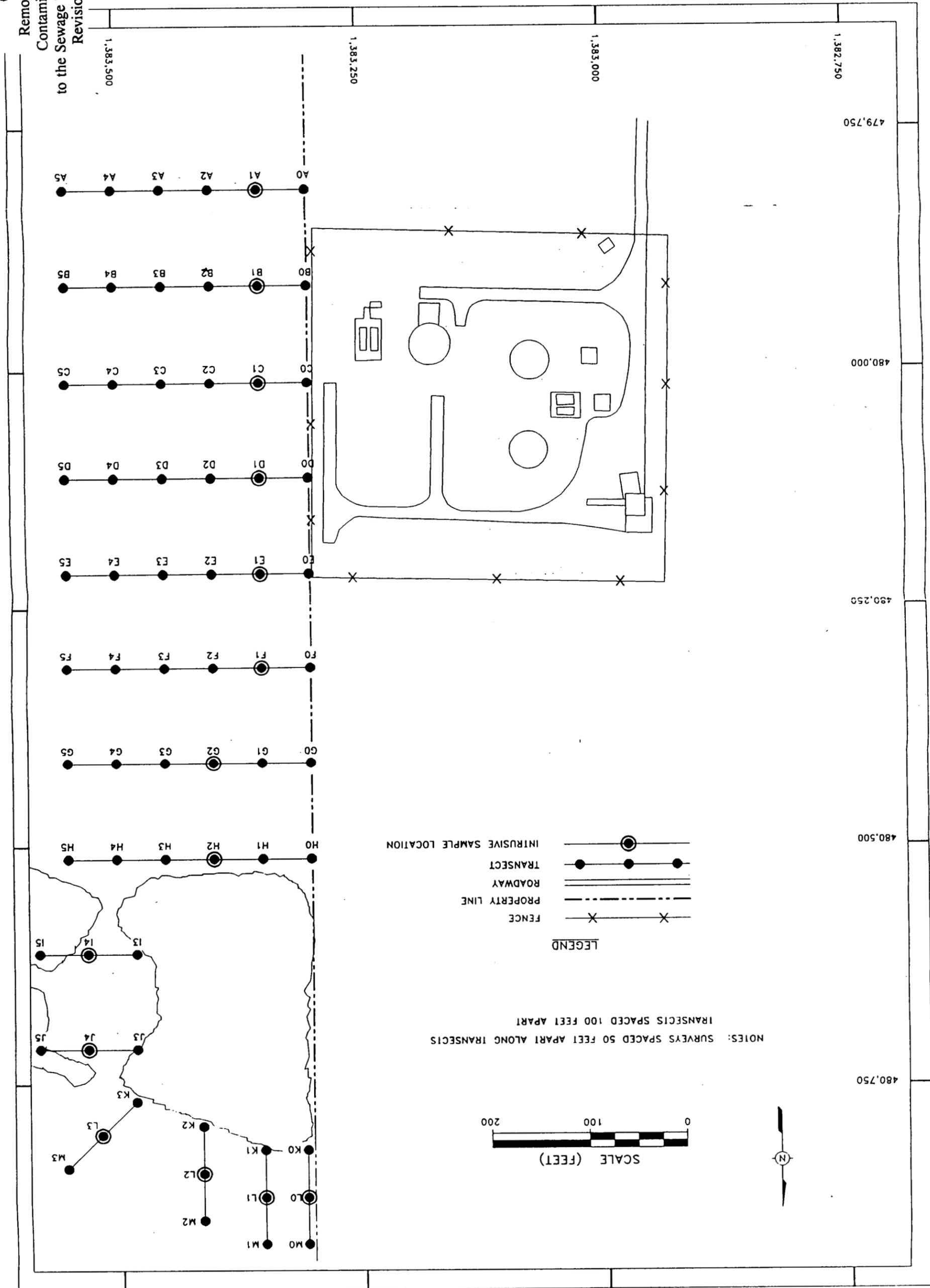
The off-property soil sampling discussed in Section 2.3.1 identified areas of elevated uranium concentrations in the soil along the east fenceline of the STP compound (Zone III) and in the wooded area (Zone IV) northeast of the STP compound. These two off-property excavation areas are shown on Figure 2-4.

Once excavation boundaries were established, the top six inches of soil in Zone III were excavated with a smooth blade bucket excavator and stockpiled in the northeast corner of the production area of the FEMP, in accordance with Removal Action No. 17 management guidelines. After the top six inches had been removed, additional readings were taken with the shielded SPA-3 within the excavated area. Any reading which exceeded the field action level was marked, and a boundary established for the next six-inch excavation. This excavation proceeded in 6-inch lifts until the soil exhibited count rates that correlated to a total uranium concentration less than the field action level (35 pCi/g). Zone III was excavated from 9" to 48" in depth (Figure 2-4). A total of 700 yd³ of contaminated soil was excavated from Zone III and stockpiled.

After the Zone IV area was cleared of trees, the uranium contaminated soil was excavated as described for Zone III above. A total of 850 yd³ of contaminated soil was excavated to a depth of 6" from Zone IV and stockpiled.

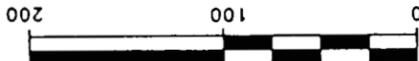
The first round of post-excavation verification soil samples collected within Zone IV indicated residual concentrations of uranium in five locations. The soil in each of the five areas was subsequently excavated as described above. An additional 150 yd³ of contaminated surface soil (top six inches) was excavated from Zone IV and stockpiled.

Figure 2-8. Additional Off-Property Soil Sampling Locations.



NOTES: SURVEYS SPACED 50 FEET APART ALONG TRANSECTS
TRANSECTS SPACED 100 FEET APART

SCALE (FEET)



LEGEND

- FENCE (line with 'X' markers)
- PROPERTY LINE (dashed line)
- ROADWAY (double lines)
- TRANSECT (line with dots)
- INTRUSIVE SAMPLE LOCATION (circle with dot)

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The top six inches of soil was also excavated from the area surrounding sample location SP-1 (Figure 2-4). A total of 30 yd³ of soil was excavated from this area.

2.3.3 Verification Sampling

The effectiveness of the excavation within Zones III and IV in achieving the action level of 35 pCi/g was determined by collecting and analyzing post-excavation verification samples from within each of the excavated areas. The selection of sample locations was biased to provide representativeness, and to meet the objective that at least one sample was collected at maximum depth. Figure 2-5 shows the post-excavation verification sample locations, 301 to 310 (collected in Zone III) and 401 to 440 (collected in Zone IV). These samples were collected from the base of the excavation to a depth of six inches and submitted to the on-site FEMP laboratory for total uranium analysis.

The results of these samples are shown in Attachment B.3, Table B.3-6. All ten verification samples taken in Zone III were below the detection limit for uranium as discussed in Section 2.3.2. Five of the samples taken in Zone IV contained uranium concentrations greater than the 35 pCi/g action limit. The uranium concentration in these samples ranged from 37 pCi/g to 79 pCi/g. Five more samples contained uranium concentrations greater than background (<7.4 pCi/g), but less than the action limit of 35 pCi/g. The uranium concentration of these five samples ranged from 11 pCi/g to 35 pCi/g. The remaining thirty verification samples contained uranium concentrations at or below the detection limit of 7.4 pCi/g.

Within Zone IV, an additional set of verification samples was collected to determine the effectiveness of the additional Zone IV excavations described in Section 2.3.2. Figure 2-5 shows the off-property post-excavation verification sample locations, 402, 421, 422, 432, and 435 taken in Zone IV. These five verification samples indicated uranium concentrations less than 7.4 pCi/g (detection limit) as shown in Attachment B.3, Table B.3-6. The verification sampling results shown in Attachment B.3, Tables B.3-6 and B.3-7 indicate that the removal action criteria for the soil in Zones III and IV have been met.

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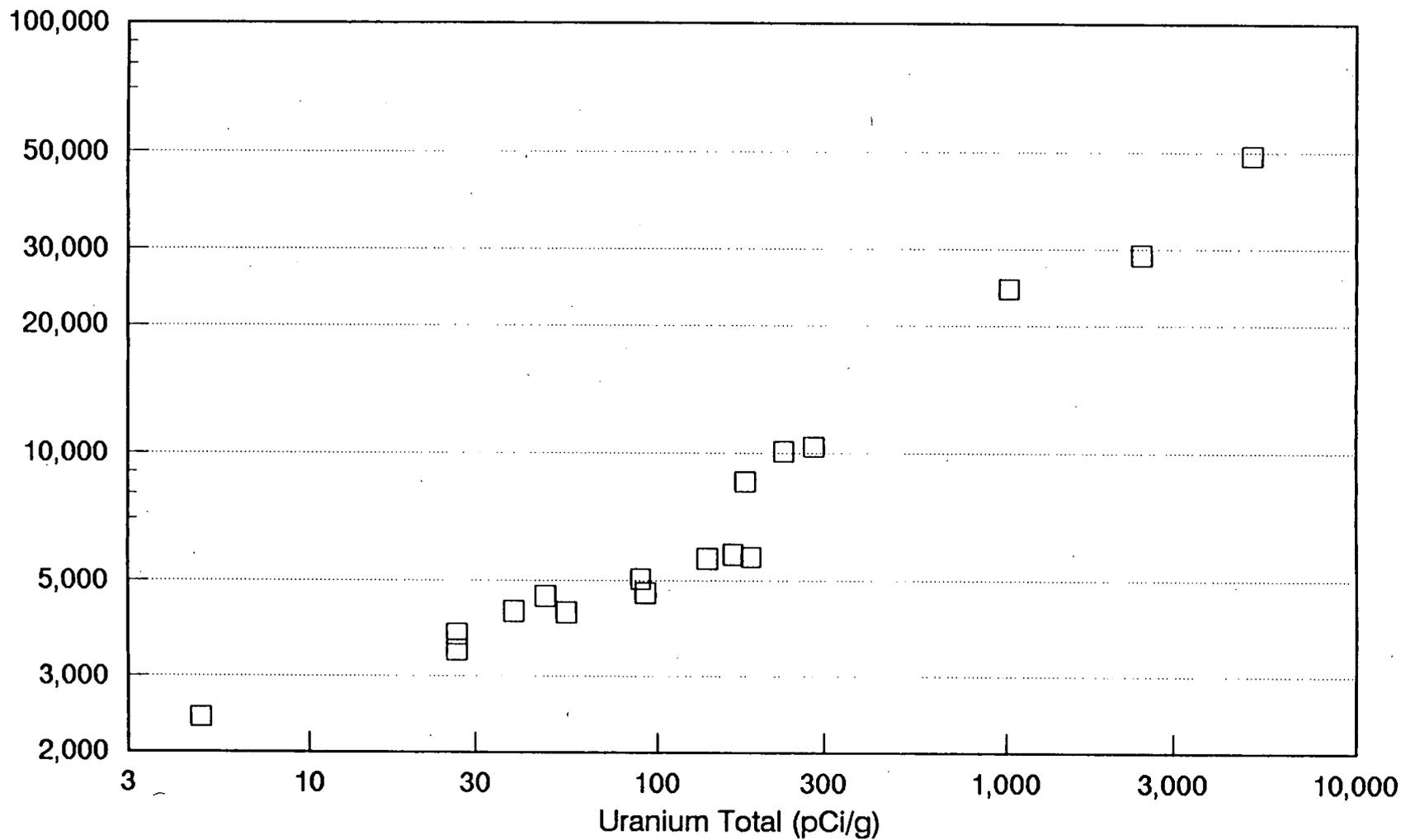
6598

ATTACHMENT A

INSTRUMENT CORRELATION DATA

000031

SPA-3 #1793 w/ shielding (cpm)



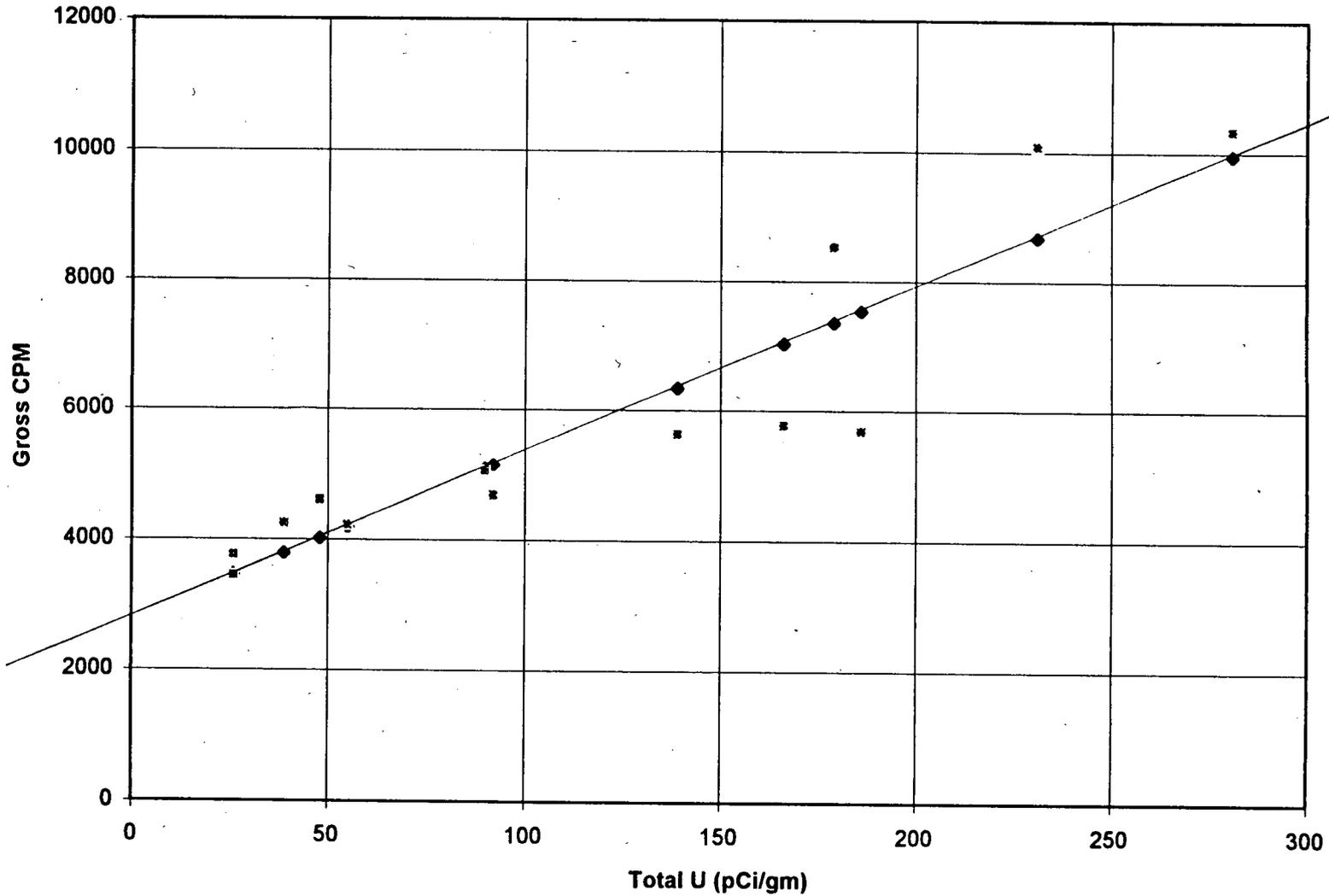
Excludes points 1, 3, 15, and 18 as indicated in Table A-1

Figure A-1. Initial correlation of total uranium to shielded SPA-3 at FEMP Sewage Treatment Plant.

000032

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$$(\text{Gross CPM} = 2802.1 + 25.43 * \text{Total U})$$



Excludes points 1, 2, 3, 6, 7, 10, 15, and 18 as indicated in Table A-1

- - Predicted CPM
- * - Measured CPM

Figure A-2. Total uranium calibration curve for radiation survey instruments at FEMP.

000033

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Table A-1. Instrument correlation sample results.

PT #	LOCATION DESCRIPTION	GROSS CPM	BKG CPM	NET CPM	U TOTAL pCi/g	Th-230 pCi/g	RATIO Th230/UTOT	U-235 pCi/g	RATIO 235/UTOT	Ra-226 pCi/g	RATIO Ra226/UTOT	CORRELATION COMMENTS
1	south outside fence along access road	9567	7900	1667	43	48.9	1.1	1.55	0.04	10.3	2.39E-01	Exclude based on interference from high radium
2	north inside fence close to incinerator	49250	46200	3050	5073	0.0	0.0	145	0.03	4.45	8.77E-04	Exclude based on interference from high background
3	west outside near fence	15433	13000	2433	82	108.0	1.3	3.2	0.04	27.6	3.38E-01	Exclude based on interference from high radium
4	south outside fence	3763	2840	923	26	0.0	0.0	0.56	0.02	0.96	3.63E-02	
5	south outside fence	3450	2540	910	26	0.0	0.0	0.78	0.03	1	3.78E-02	
6	southeast outside fence	2410	1670	740	5	0.0	0.0	0.1	0.02	0.73	1.50E-01	Exclude based on interference from high radium
7	north inside fence close to incinerator	24267	21700	2567	1015	0.0	0.0	27.9	0.03	1.92	1.89E-03	Exclude based on interference from high background
8	nw corner of fence	4250	3140	1110	39	0.0	0.0	1.05	0.03	0.94	2.44E-02	
9	north just inside fence	5683	4430	1253	186	0.0	0.0	4.74	0.03	1.11	5.96E-03	
10	north inside fence close to incinerator	29067	26400	2667	2427	0.0	0.0	67.9	0.03	2.91	1.20E-03	Exclude based on interference from high background
11	northeast outside fence	4680	3710	970	92	0.0	0.0	2.27	0.02	1.11	1.20E-02	
12	north outside fence	5052	3950	1102	90	0.0	0.0	2.65	0.03	1.05	1.17E-02	
13	northwest outside fence	4608	3490	1118	48	0.0	0.0	1.08	0.02	1	2.11E-02	
14	west at fence near incinerator	10083	8000	2083	231	0.0	0.0	5.73	0.02	1.57	6.81E-03	
15	west outside near fence	13717	11600	2117	78	67.6	0.9	3	0.04	18.5	2.36E-01	Exclude based on interference from high radium
16	west outside far from	4227	3200	1027	55	0.0	0.0	1.44	0.03	0.92	1.69E-02	
17	west at fence near incinerator	10333	8460	1873	281	0.0	0.0	7.41	0.03	2	7.11E-03	
18	south outside fence along access road	6933	5330	1603	35	28.0	0.8	1.07	0.03	5.61	1.63E-01	Exclude based on interference from high radium
19	north inside fence further from incinerator	5767	4530	1237	166	0.0	0.0	4.04	0.02	1.23	7.43E-03	
20	northwest at fence near incinerator	5633	4430	1203	139	0.0	0.0	3.6	0.03	1.17	8.39E-03	
21	west near outside fence near incinerator	8517	7020	1497	179	0.0	0.0	4.35	0.02	1.13	6.32E-03	

000634

0502