Department of Energy

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JAN 29 2007

Mr. James A. Saric, Remedial Project Manager
United States Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

EMCBC-00230-07

Mr. Thomas Schneider, Project Manager
Ohio Environmental Protection Agency
Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF LEACHABILITY STUDY FOR LOW LEVEL URANIUM IN SOIL WEST OF FORMER WASTE PIT 3

Enclosed for your information is the Leachability Study For Low Level Uranium In Soil West Of Former Waste Pit 3. This study is designed to investigate the leachability of the residual uranium present in the surface soils in the area west of the former waste pits to gain a better understanding of the reason for persistently elevated concentrations of uranium in the ponded surface waters.

During the course of routine sampling of several surface water locations, Ohio EPA produced a result of approximately 714 ppb from a sample collected from a puddle on 11/22/2006 located west of former waste pit 3. Subsequent sampling by DOE and analysis of this water showed the majority of the concentrations between 650ppb and 880ppb U.

The location in question is a series of small puddles and drainage ditches due west of the center of former waste pit 3, which drain generally south to a depression near the former cement pond. The size of this area is roughly ½ acre in overall aerial extent and the actual surface water area is much less. Uranium concentrations observed to date indicate the highest concentrations at the northern end of the swale adjacent to the northern brush pile and diminishing to the south. It

should be noted that the area of investigation underwent the rigorous certification procedures that are presented in the Sitewide Excavation Plan with the soil in this entire area passing the certification criteria.

We anticipate conducting this evaluation in the near future. If you have any questions or require additional information, please contact me at (513) 648-3139.

Sincerely,

Johnny Reising

Johnny Reising
Director

Enclosures: As stated

cc w/enclosures:
J. Desormeau, OH/FCP
T. Schneider, OEPA-Dayton (three copies of enclosure)
G. Jablonowski, USEPA-V, SR-6J
M. Cullerton, Tetra Tech
M. Shupe, HSI GeoTrans
S. Helmer, ODH
AR Coordinator, Fluor Fernald, Inc./MS12

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F. Johnston, Stoller, /MS12
F. Miller, Fluor Fernald, Inc./MS90
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T. Terry, Fluor Fernald, Inc./MS1

LEACHABILITY STUDY FOR LOW LEVEL URANIUM IN SOIL WEST OF FORMER WASTE PIT 3

FERNALD CLOSURE PROJECT
FERNALD, OHIO

January 2007

U.S. DEPARTMENT OF ENERGY

REVISION 0

A. Project Summary

1. **Background & Purpose:** This study defines the locations and requirements for collecting a minimum of 5 surface soil samples as well as the analytical protocols to determine the leachability of uranium in the surface soil west of former waste pit 3 (Figure 1). This will be accomplished first by the analysis of a sub-sample of the soil for total uranium via complete dissolution of the matrix. Subsequently, a leaching procedure will be performed on the original soil utilizing rainwater as the leaching agent with analysis of the liquid matrix for the "leachable" uranium content

   The driver for this study is the elevated uranium level found in ponded water that lies in the flood plain west of the former pit 3 area and east of Paddys Run. During the course of routine sampling of several surface water locations, Ohio EPA produced a result of approximately 714 ppb from a sample collected from a puddle on 11/22/2006 located west of former waste pit 3. Subsequent sampling and analysis of this water showed the majority of the concentrations between 650ppb and 880ppb U with two OEPA water sample results at roughly 3000 ppb. Subsequent analysis of the water from the highest location did not reproduce the OEPA results of 3000ppb as the newly collected samples showed only 639 ppb (see Table 1), whereas the surface water final remediation level (FRL) is 530ppb. This more-restrictive FRL was developed based upon many exposure scenarios that included the "meat and milk pathway" with a receptor being exposed to the meat and milk obtained from cattle raised in this area that fed on the grasses and drank the water, which is a prohibited activity for this area. The most likely scenario involves dermal contact by the receptor either swimming or accidental submersion in these waters. This scenario carries a surface water preliminary remediation goal of 6000ppb. All results obtained to date are well below the dermal contact scenario.

   The location in question is a series of small puddles and drainage ditches due west of the center of former waste pit 3, which drain generally south to a depression near the former cement pond. The overall size of this area is roughly ½ acre. Uranium concentrations observed to date indicate the highest concentrations at the northern end of the swale adjacent to the northern brush pile and diminishing to the south. There is no direct outlet of this drainage swale to Paddys Run. Seepage to the underlying groundwater is assumed however, the soils in the area are generally poorly draining based on the 1993 Wetland Delineation.

   The area of investigation underwent the rigorous certification procedures that are presented in the Sitewide Excavation Plan with the soil in this entire area passing the certification criteria. Based on the certification samples from this area having a range of values between roughly 2 ug/g and 70.9 ug/g, all of which are below the soil FRL of 82 ug/g, it is anticipated that the residual uranium concentration of this soil found in these newly collected samples will be between 10 ug/g (ppm) and 80 ug/g. At these levels, a K_l value of 50 L/Kg or lower can produce uranium levels in the surface water that are being detected now. Based on this information, it is also expected that the surface water concentrations should decrease over time as there is no significant uranium mass left in the soil in this area.

   It is possible that any residual uranium levels could be attributed to historical liquid "spills" or "overflows" from the waste pits instead of the typical air deposition scenario that carried non-leachable uranium onto the soil. Therefore, in an effort to determine the source of the uranium in the surface water, the surrounding area will be evaluated under this plan for a more representative Kl in the area. This will be a follow-up to the Leachability Study that was performed in 1994 as a part of the Operability Unit 5 Feasibility Study (Appendix F) and documented in the Operable Unit 5 K_l Sampling And Analysis Results Report in May of 1995. As such, this new study will follow the same analytical protocols and calculations as described in these documents.

The purpose of this study is to confirm this hypothesis per a request from the Ohio Environmental Protection Agency.

Table 1 - Area West of Former Waste Pit 3
Total Uranium (ug/L)

Location	ID(s)	11/09/06	11/22/06	12/19/06	12/29/06	01/03/07	01/05/07	01/09/07	01/10/07	01/11/07	01/16/07	01/17/07	01/18/07	01/22/07
61	W-61-U	5	--	--	--	--	--	--	--	--	--	--	--	--
62	W-62-U	18.2	--	--	--	--	--	--	--	--	--	--	--	--
63	W-63-U	26.4	--	--	--	--	--	--	--	--	--	--	--	--
65	W-65-U	372.9	--	--	--	--	--	--	--	--	166.2	199.2	663	438
66	W-66-U	80	--	--	--	--	--	--	--	--	122.5	--	--	--
193	W-193-U	--	--	650.9	--	--	--	--	--	--	832.3	466.1	762.2	606.6
194	W-194-U	--	--	856.2	--	--	--	--	--	--	771.2	832.2	613.9	752.6
195	W-195-U	--	--	--	--	--	155.1	244.6	790.1/**792.3**	554.7	127.6	134.9	255.5	427.8
196	W-196-U	--	--	--	--	--	--	--	877.1/**849.4**	740.8	837.7	669.3	97.8	395.1
197	W-197-U	--	--	--	--	--	--	--	--	--	454.8	411.5	432.5	300.6
198	W-198-U	--	--	--	--	--	--	--	--	--	460.3	503.1	511.3	470.6
199	W-199-U	--	--	--	--	--	--	--	--	--	379.6	662.5	571.1	--
200	W-200-U	--	--	--	--	--	--	--	--	--	--	639.1	457.8	557.3
OEPA Swale NE	(near 66)	--	236	--	--	--	--	--	--	--	--	--	--	--
OEPA Swale SE	(near 196)	--	714	--	879	821	--	--	--	--	--	--	--	--
OEPA Swale S	(near 65)	--	464	--	--	--	--	--	--	--	--	--	--	--
OEPA Swale Rootwad*	(near 200)	--	--	--	2960	3020	--	--	--	--	--	--	--	--

* samples were preserved upon collection

unfiltered / **filtered result**

2. **Number of Samples and Locations:** To determine the appropriate sample locations, radiological field scanning techniques will be employed (if field conditions permit) in combination with an evaluation of the uranium concentrations present in both the soil based on the certification sample results and various ponds and puddles west of former waste pit 3 based on recent sampling.

   If the field conditions are conducive to surface scanning, a surface radiological scan will be performed using either field portable Sodium Iodide (NaI) instrumentation or High Purity Germanium Detectors to determine (if possible) the most elevated patterns of residual uranium present at the surface.

   The results of all water samples collected from the ponds west of former pit 3 will be evaluated in combination with the aforementioned radiological field scan and soil results. Based on the collective information, four sample locations will be chosen that will yield the highest probability of elevated levels of uranium in the soil such that further analysis will produce the meaningful data.

   The sample locations will be initially surveyed and staked using geographical information system coordinates and a hand-held global positioning system (GPS) unit. During or following sample collection, the locations coordinates will be determined using more precise GPS instrumentation or land survey equipment and presented in the final report for this study.

   At the location that is expected to have the highest uranium content in the soil, a duplicate sample must be collected for both a total uranium analysis as described below and a modified TCLP preparation using the rainwater and subsequent uranium analysis of the liquid matrix.

   Additionally, rainwater will be collected as the leaching medium. Sufficient volume of rainwater must be obtained to satisfy the leaching procedure described below.

B. Sample Collection Information

1. **General:** Soil samples will be collected from the 0-6 inch depth interval after removing any surface

vegetation, detritus and/or root mass. Soil samples having a minimum mass of 1.5 kilograms will be collected using a clean plastic or stainless steel tools driven into the ground, which will be wiped clean between sampling events/locations. The first sample location must represent the expected highest uranium level location as the duplicate will be collected from this location for the modified TCLP preparation and analysis.

Rainwater will be collected using clean plastic buckets or stainless steal containers by setting these containers outdoors until sufficient volume has been obtained at a rate of 4 liters per sample analyzed. If substantial precipitation is not expected then the rainwater can be substituted with the collection of snow from recent snowfalls or by obtaining water from an offsite stream or pond. The expected number of samples for this plan is five (5), therefore, 20 liters of rainwater (or appropriate substitute) must be collected for this study. A sub-sample of the rainwater must be analyzed for total uranium to establish background condition of the leaching agent. This sub-sample may be retrieved from any one of the 4 liter containers. The sample containerization, preservation and other information is as follows:

Analyte	Sample Matrix	Sample Type	Preservative	Lab	ASL	Holding Time	Container / Mass
Total Uranium	Solid	Grab	None	TBD	B	6 Months	Plastic / 1500g
Total Uranium	Liquid (rainwater)	Grab	None	TBD	B	6 Months	Plastic / 4 liters
None (leaching agent)	Liquid (rainwater)	Grab	None	TBD	B	NA	Plastic / 16 liters Note: total of 20 liters for the 5 samples

3. **Required QC Samples:** None.

4. **Sampling Equipment Cleaning:** Reusable sampling equipment that comes in contact with the surface of the sample material will be wiped visibly clean between sample locations.

5. **Sample Identification Information:**

Location	Sample ID	
1	FPWP3-KL-01^1-U	NOTE: This must be the expected highest U level
1D	FPWP3-KL-01DT^1-U	
2	FPWP3-KL-02^1-U	
3	FPWP3-KL-03^1-U	
4	FPWP3-KL-04^1-U	
Water	FPWP3-KL-WATER-U	

Note: Sample nomenclature description:
FPWP3 – Flood Plain West of Former Waste Pit 3
Location 01, 02, etc.
1 = 0-6 inch depth interval, etc.
^ = SED notation for database purposes (not used for rinsate)
U = total uranium analysis
DT = duplicate for TCLP type anaysis

C. **Laboratory Sample Preparation Protocols:** For each soil sample collected, weigh out approximately one kilogram of the soil sample and dry the sample at 100°C until the weight of the sample remains constant. Record all masses to the nearest mg and calculate the mass lost on drying (initial mass – final mass). Pass the dried sample through a No. 10 (2-mm) stainless steel sieve into a stainless steel container, taking care to break down clay aggregates that formed during the drying process. Individual mineral and rock particles retained in the No. 10 sieve (i.e., greater than 2 mm) can be discarded (this should be much less than one percent of the initial mass). Homogenize the sieved sample in the container by passing the sample through a sample splitter or a riffle sampler several times. After a minimum of three passes through the sample splitter, obtain random split samples from three of the fractions and submit for complete digestion (or as best possible using a combination of nitric acid, hydrofluoric acid, and/or perchloric acid). Analyze the triplicates for total uranium by ICP/MS to establish the initial uranium concentration in the soil. Table 2 summarizes the preparation and digestion of the soil samples.

TABLE 2
Preparation and Digestion of Soil Samples

Dry the sample	Weigh approximately one kilogram of sample and place it in an oven to dry at 100°C. Record the initial mass of the sample. Continue to dry the sample and measure the sample mass daily until the sample mass is constant. Calculate and record the mass lost during the drying (initial mass – final mass).
Screen the sample	Pass the dry sample through a No. 10 (2 mm) stainless steel sieve and collect the screened fraction in a stainless steel container. Care should be taken to ensure that clay aggregates are gently disaggregated and pushed through the screen. Individual mineral and rock grains that do not pass through the screen may be discarded.
Homogenize the sample	Pass the screened sample through a sample splitter or riffle sampler a minimum of three times.
Obtain split samples	After the final pass through the sample splitter, collect three split samples of 1 to 2 grams each.
Digest the split samples	Place the triplicate split samples into three digestion vessels and completely digest the sediment (or as best possible using a combination of nitric acid, hydrofluoric acid, and/or perchloric acid) **Note: The contract laboratory must submit their digestion procedure to DOE prior to beginning sample prep to ensure consistency with OU5 Feasibility Study, Appendix F.**

D. Leach Test

Prepare the leach test for each sample by placing 400-grams of dried soil (+/- one mg) and 3.5 L of rainwater (+/- one mL) into an acid-washed (i.e., nitric acid rinse followed by three rinses with deionized water) glass reaction vessel. A liquid to solid mass ratio of 8.75 is used to simulate the same batch test conditions used in Attachment F.2.1 of the OU5 FS report.

Using a glass stir rod (each container should have a dedicated stir rod to avoid cross contamination), carefully mix the contents of the container thoroughly and allow the soil particles to settle before recording the pH of the solution and capping the vessel. On a daily basis, open the vessel, take a pH measurement, thoroughly mix the contents of the vessel and then recap the vessel. Table 3 summarizes daily activities for the leach tests.

On day 10 of the leach test, open the vessel, measure the pH, collect a 20-mL liquid sample using a 0.45

micron filtered syringe, mix the contents of the vessel after the sample is collected, and recap the vessel. Acidify the liquid sample to a pH of less than 2 with nitric acid and ship to the onsite lab for analysis of total uranium. Repeat the daily pH and mixing activities on Days 11, 12 and 13. On Day 14, repeat the Day 10 activities and obtain another liquid sample. If the measured uranium concentration for the Day 10 and Day 14 liquid samples agree within the analytical uncertainty (i.e., +/- 10 percent), the uranium concentration is at steady state and the test can be terminated; otherwise, repeat the daily pH and mixing activities on Days 15 and 16 and obtain a third liquid sample on Day 17. Compare the second and third samples in the same manner as the first and second and determine if the test can be terminated. If sampling must continue, continue the sampling every third day (i.e, 20, 23 etc) until two consecutive results agree within 10 percent.

For comparability, the duplicate sample collected from the location with the highest expected total uranium (i.e. sample FPWP3-KL-01DT^1-U) will be analyzed according to the Toxicity Characteristic Leaching Procedure (TCLP) with one minor modification. The leaching agent typically used for the TCLP extraction (i.e. acetic acid) will be replaced with the provided rainwater. All other aspects of the TCLP procedure will remain constant. This will produce a result in approximately 3 days.

TABLE 3
Daily Activities for Leach Tests

Day 1	Prepare each test by placing approximately 400 g of soil and 3.5 L of rain water in an acid washed reaction vessel. Gently stir the contents of the vessel for one minute and allow the sediment to settle before obtaining a pH measurement. After recording the pH measurement, cap the vessel.
Days 2 through 9 Days 11 through 13	Open the vessel and measure and record pH. Gently stir the contents of the vessel for one minute and recap the vessel.
Day 10 Day 14	Open the vessel and measure and record pH. Using a 0.45 micron filtered syringe, extract 20 mL of fluid and place the fluid in an acid washed 50 mL container. Acidify the sample to a pH of less than 2 using nitric acid. Gently stir the contents of the vessel for one minute and recap the vessel.
Days 15 and 16 (If needed) Days 18 and 19 (If needed)	Open the vessel and measure and record pH. Gently stir the contents of the vessel for one minute and recap the vessel.
Day 17 (If needed) Day 20 (If needed)	Open the vessel and measure and record pH. Using a 0.45 micron filtered syringe, extract 20 mL of fluid and place the fluid in an acid washed 50 mL container. Acidify the sample to a pH of less than 2 using nitric acid. Gently stir the contents of the vessel for one minute and recap the vessel.

E. Analytical Results and Calculations

The contract laboratory shall report the total uranium results for the soil samples within 3 days.

Use the triplicate results (U_1, U_2, and U_3) on each soil sample to calculate the initial uranium concentration in soil (Ui) as follows:

$$U_i \text{ (ug/g)} = \frac{U_1 + U_2 + U_3}{3}$$

When two consecutive liquid samples are shown to have uranium concentrations within 10 percent of each other, the uranium concentration in the fluid will be used to calculate the following parameters: average steady-state uranium concentration in the fluid; mass of uranium removed from the sediment by the leaching; final uranium concentration in the sediment and the apparent uranium leaching coefficient.

The final two liquid uranium concentrations that establish steady-state conditions ($[U]_1$ and $[U]_2$) will be used to calculate the average uranium concentration ($[U]_{avg}$) as follows:

$$[U]_{avg} \text{ (ug/L)} = \frac{[U]_1 + [U]_2}{2}$$

The mass of uranium removed from the sediment (U_r) during the leach test is calculated using $[U]_{avg}$ and the volume of fluid in the leach test:

$$U_r \text{ (ug)} = [U]_{avg} \text{ (ug/L)} * 3.5 \text{ L}$$

The final uranium concentration in the sediment (U_f) is calculated using the initial uranium concentration in the sediment (U_i), the mass of sediment placed in the leach vessel and U_r:

$$U_f \text{ (ug/g)} = \frac{\{U_i \text{ (ug/g)} * 400 \text{ g}\} - U_r \text{ (ug)}}{400 \text{ g} - U_r \text{ (g)}}$$

The apparent leaching coefficient (K_L) is calculated with U_f, the background uranium concentration in soil (U_b) and $[U]_{avg}$:

$$K_L \text{ (L/kg)} = \frac{\{U_f \text{ (ug/g)} - U_b \text{ (ug/g)}\} * 1000 \text{ g/kg}}{[U]_{avg} \text{ (ug/L)}}$$

The background concentration of uranium in surface soil (U_b):

$$U_b = 3.94 \text{ ug/g}$$

F. Safety Concerns

Site-specific safety concerns and measures are as follows:

- Wear boots which meet ANSI Z-41 with adequate traction for walking on potentially wet, slippery slopes at all times.
- Walk down the work area before the start of an activity and identify possible hazards and correct the concern or avoid the hazard location.
- Use caution on uneven terrain to avoid slips, trips and falls.
- Wear safety glasses with rigid side shields that meet or exceed ANSI-Z87.1 when not in vehicles or other enclosures.
- Wear long sleeved clothing when walking through tall vegetation and wooded areas to avoid scratches/cuts from briars, etc.
- Utilize the "buddy system" with acceptable communication at all times.

All emergencies shall be reported immediately by calling "911" by phone. Any unplanned event, injury or accident shall be reported to the contractor site safety representative as soon as time permits after the event.

G. Implementation of Field Changes

Any necessary changes to this sampling plan will be documented and presented in the final report for this study.

H. Data and Records Management

As specified in Section 5.1 of the SCQ and procedure SMPL-01, sampling teams will describe sampling activities on Sample Collection Logs, the Field Activity Logs, and the Chain of Custody/Request for Analysis Form, as required. The PSP number will be on all documentation associated with these sampling activities. Standard required information will be entered into the Sitewide Envionmental Database (SED). The original field data packages will be filed and controlled by the FCP Sample and Data Management group.

Laboratory analytical data packages will be filed and distributed in accordance with existing data management procedures. The analytical data package will be forwarded to the FCP Data Validation group for validation at VSL B. All analytical data and data validation qualifiers will be transferred (from FACTS) or entered into the SED per existing procedures.

I. Waste Disposition

Sampling and investigation-derived waste such as diposable gloves, towels, etc. will be disposed as clean material in a FCP dumpster/waste container. Excess soil samples remaining after analysis will be disposed by the contract laboratory under its respective waste management plan.

J. General Project Information

1. **Project Contacts:** Johnny Reising (DOE-EM Fernald Project Director)
   Jane Powell (DOE-LM Fernald Project Director)
   Michele Miller (Stoller Fernald Project Director)

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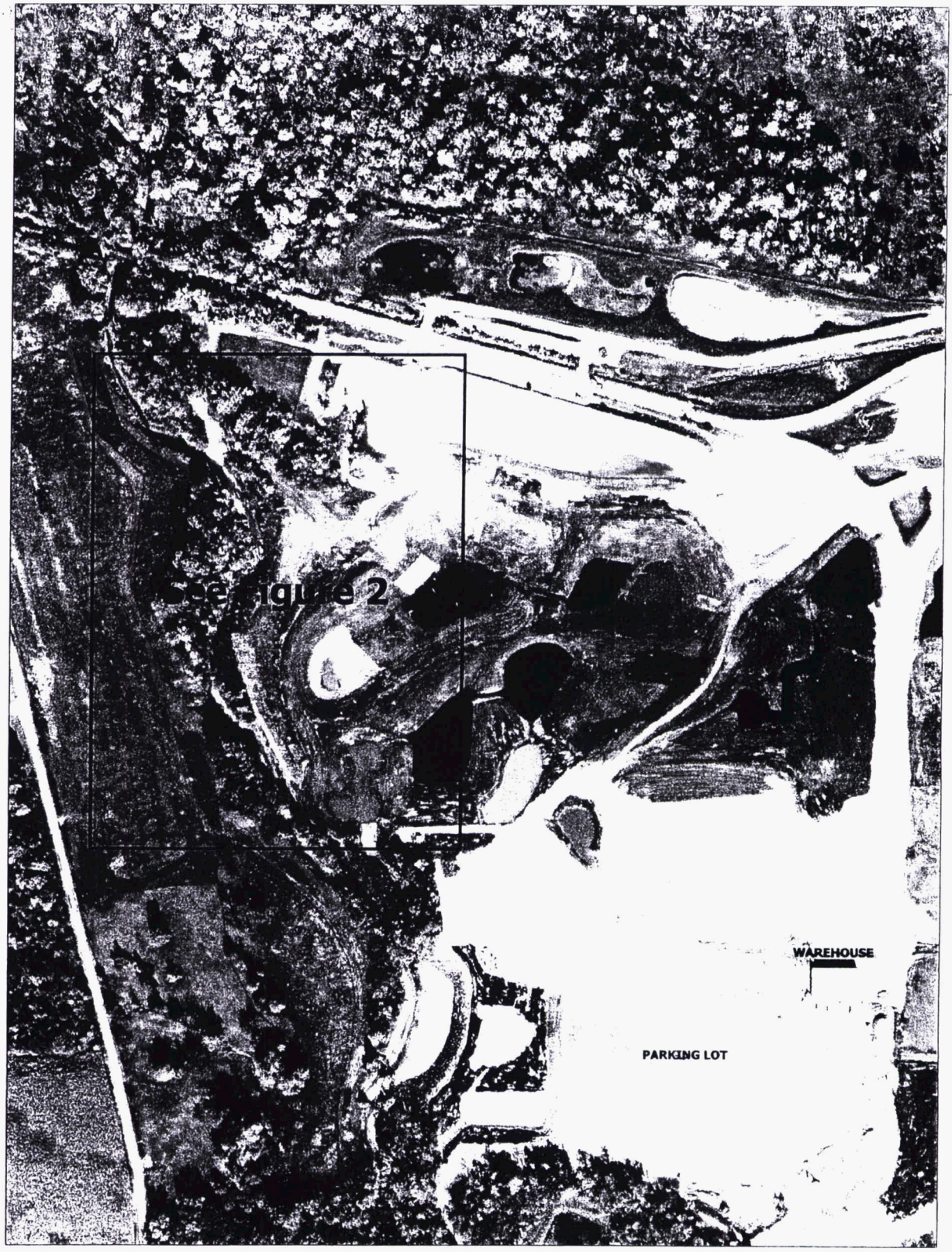
STATE PLANAR COORDINATE SYSTEM 1983

17-JAN-2007

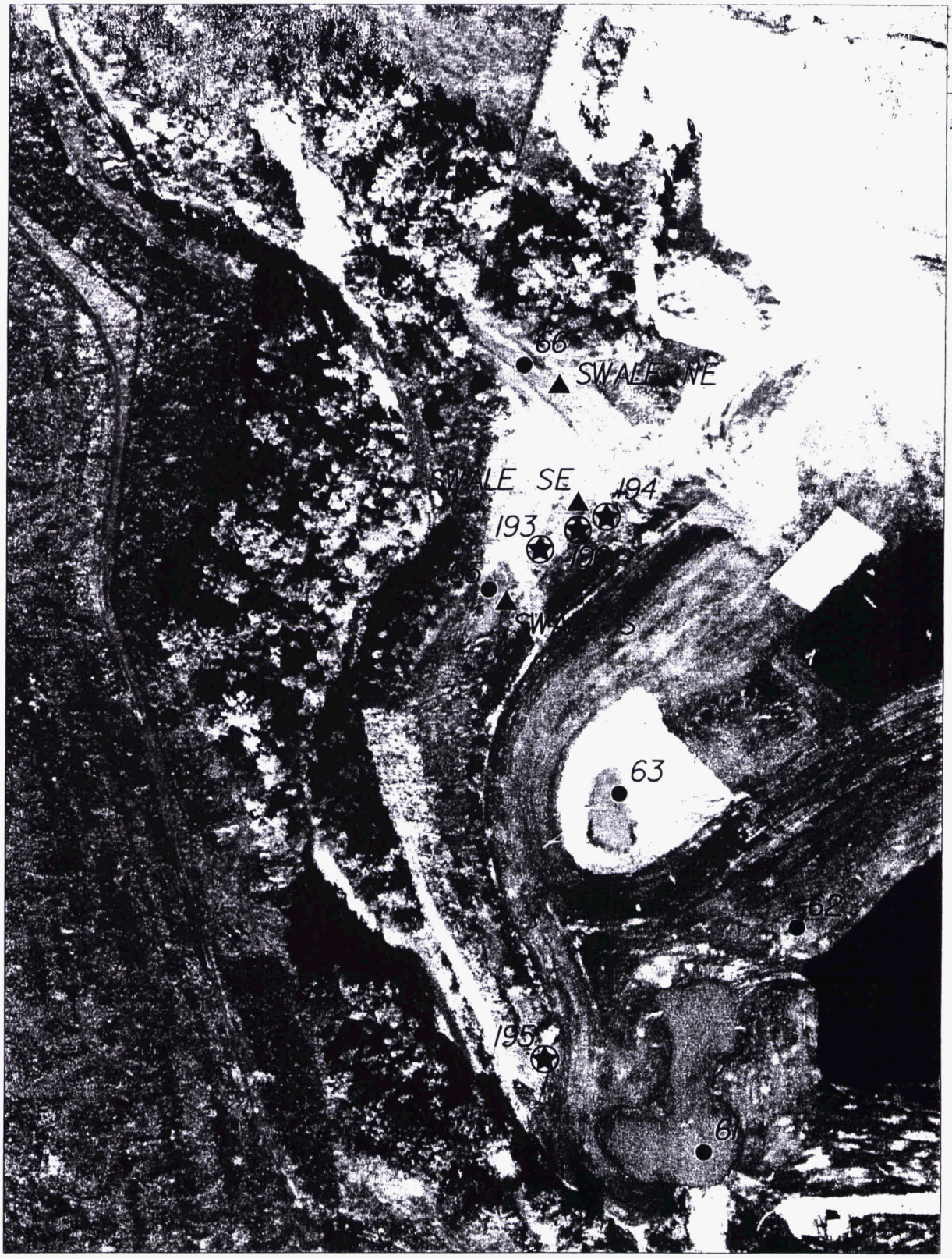


LEGEND:

SCALE

400 200 0 400 FEET

FIGURE 1. INDEX MAP – WATER SAMPLE LOCATIONS



LEGEND:

(ALL LOCATIONS ESTIMATED)

- ● DOE CONTRACTOR SAMPLE
- ★ ELEVAIED U LEVELS (DOE CONTRACTOR SAMPLE)
- ▲ OEPA WATER SAMPLE

SCALE

150 75 0 150 FEET

FIGURE 2. WATER SAMPLE LOCATIONS

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