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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

POST-REMEDIAL ACTION REPORT FOR THE BAKER BROTHERS VICINITY PROPERTY IN OTTAWA LAKE

Ottawa Lake, Michigan

July 1996

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Bechtel National, Inc.

POST-REMEDIAL ACTION REPORT

FOR THE

BAKER BROTHERS VICINITY PROPERTY

IN OTTAWA LAKE

OTTAWA LAKE, MICHIGAN

JULY 1996

Prepared for

United States Department of Energy

Oak Ridge Operations Office

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

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ACRONYMS

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
BNI	Bechtel National, Inc.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCG	derived concentration guide
DOE	U.S. Department of Energy
FIDLER	field instrument for detecting low-energy radiation
FUSRAP	Formerly Utilized Sites Remedial Action Program
IVC	independent verification contractor
MDA	minimum detectable activity
MED	Manhattan Engineer District
ORNL	Oak Ridge National Laboratory
PPE	personal protective equipment

UNITS OF MEASURE

cm	centimeter
cpm	counts per minute
dpm	disintegrations per minute
ft	foot
g	gram
h	hour
ha	hectare
in.	inch
L	liter
lb	pound
m	meter
μCi	microcurie
ml	milliliter
μR	microroentgen
mrad	millirad
mrem	millirem
pCi	picocurie
yd	yard
yr	year

1.0 INTRODUCTION

1.1 BACKGROUND

This report documents the remedial action conducted from October 1994 to January 1995 at the former Baker Brothers, Inc. vicinity property located at 4400 Piehl Road, Ottawa Lake, Michigan (Figure 1-1). This cleanup was conducted as a time-critical removal action in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This is an efficient, cost-effective approach that allows rapid cleanup of small sites.

Remedial activities at the site were performed under CERCLA and its implementing regulations, the National Contingency Plan, 40 Code of Federal Regulations (CFR) 300, Occupational Safety and Health Administration (OSHA) 1910.120, by the U.S. Department of Energy's (DOE's) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP was established to identify and clean up or otherwise control sites where residual radioactive contamination (exceeding current federal guidelines) remains from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

The objectives of FUSRAP are to

- identify and evaluate sites used to support former Manhattan Engineer District (MED) and U.S. Atomic Energy Commission (AEC) nuclear development activities;
- remove or otherwise control contamination at sites identified as contaminated above current DOE guidelines;
- achieve and maintain compliance with applicable criteria for the protection of human health and the environment; and
- certify each site, to the extent possible, for appropriate future use without radiological restrictions.

The primary legislation authorizing FUSRAP is the Atomic Energy Act of 1954. FUSRAP was established in 1974, and major remedial actions began at FUSRAP sites in 1981. Administered by the Former Sites Restoration Division of the DOE Office of Environmental Management, FUSRAP currently includes 46 sites in 14 states.

Bechtel National, Inc. (BNI) was the project management contractor for the FUSRAP work at the Ottawa Lake site. Oak Ridge National Laboratory (ORNL), the FUSRAP independent verification contractor (IVC), performed independent designation and verification surveys and will issue a report of post-remedial action verification survey results.

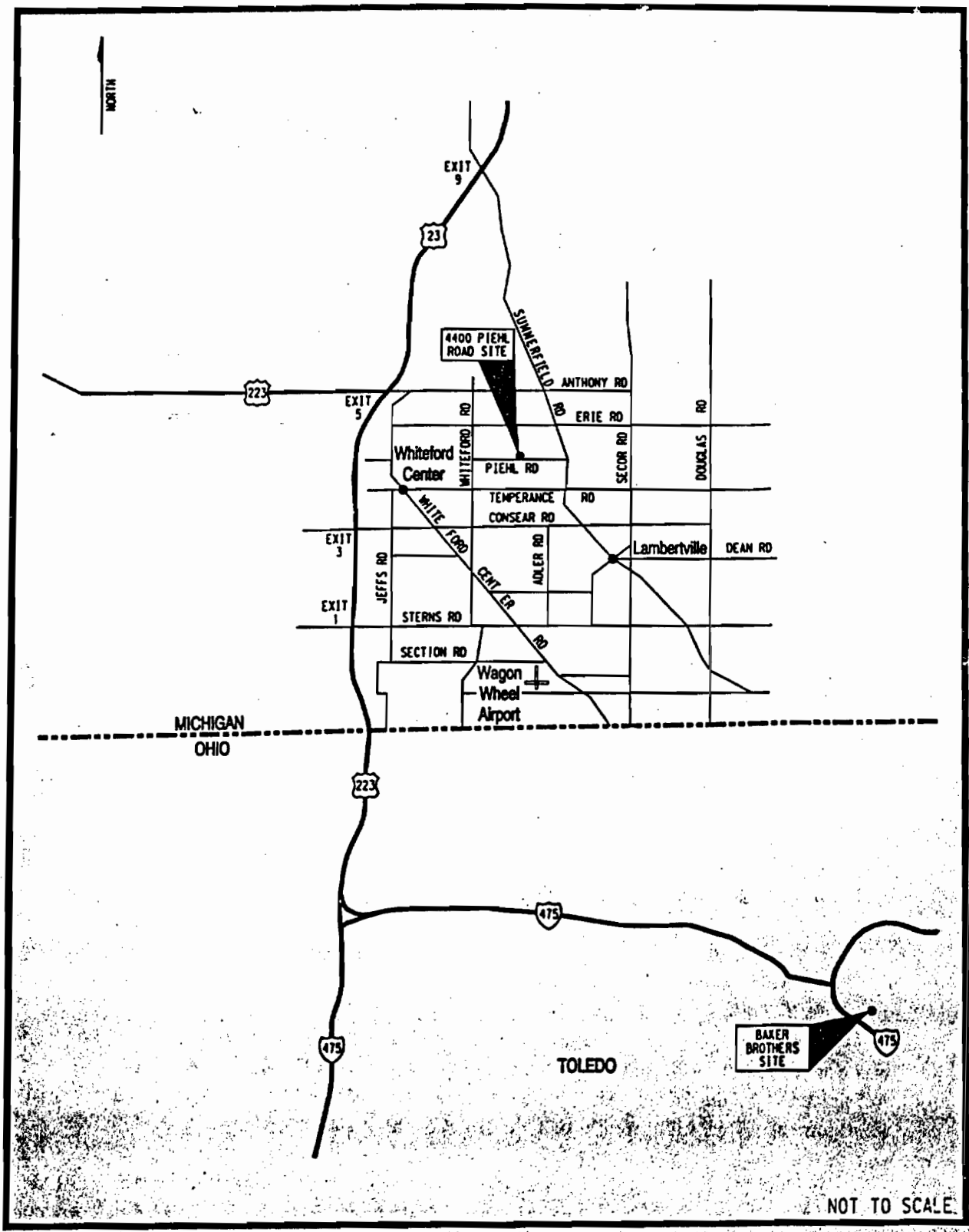

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Figure 1-1
Baker Brothers and Ottawa Lake Locations

1.2 HISTORY

During the early and mid-1940s, Baker Brothers, Inc. machined slugs from processed uranium metals under subcontract to MED. After the subcontract termination in 1944, the Baker Brothers property was decontaminated to meet the guidelines in effect at the time. Because the Baker Brothers uranium metal machining was related to AEC activities, a survey of site conditions was performed in 1989 to determine whether the site met current radiological guidelines. In June 1989, a preliminary radiological survey at the former Baker Brothers site [2551-2555 Harleau Place, Toledo, Ohio (Figure 1-1)] was conducted by members of the Measurement Applications and Development group of ORNL at the request of DOE. Results of that survey revealed localized areas of uranium contamination. Consequently, the Baker Brothers property was resurveyed in September 1992 (ORNL 1994) and recommended for inclusion in FUSRAP.

When the Baker Brothers' assets were liquidated, machinery and equipment were sold at auction, and the property was divided and sold to two independent interests. After the northern part of the property was resold during summer 1992, the new owner contacted ORNL to inquire about the radiological status of the property. Through this conversation, it was learned that soil and debris from the former Baker Brothers site had been moved to 4400 Piehl Road in Ottawa Lake, Michigan, for use as fill (ORNL 1994).

Located in a semirural area approximately 25 km (15 mi) northwest of Toledo, Ohio (Figure 1-1), the Ottawa Lake property is flat and contains a large number of trees. The property is approximately 2.8 ha (7 acres) and includes one owner-occupied house, a barn, and a small pond of approximately 0.16 ha (0.4 acre) (Figure 1-2).

During subsequent conversations, the current owner of the Ottawa Lake property stated that 90 to 100 dump truck loads of soil, concrete debris, and tree stumps had been transported to his property from the former Baker Brothers site and placed in front of his house and in a large pile approximately 30 m (100 ft) northwest of the house (ORNL 1994). The owner also stated that a pit approximately 3 m (10 ft) deep, 4.6 m (15 ft) wide, and 10 m (30 ft) long was dug at the edge of the pile. Tree stumps and concrete debris from the former Baker Brothers site were reportedly dumped into the pit, covered with additional soil, and leveled. The pile and pit area were approximately 25-30 m (75-100 ft) from the pond (Figure 1-2). Surface water drains from this area to the pond.

Surface radiation measurements of the interior of the house and samples of the pond water taken by ORNL during the designation study revealed no residual radioactivity. The pond was further sampled during subsequent characterization and remediation activities, and results continued to show that no residual radioactivity above DOE guidelines was present in the pond water or sediment. Analyses showed a uranium concentration of 0.026 pCi/m^3 (26 pCi/L) in the pond, well below the Nuclear Regulatory Commission standard of 40 pCi/m^3 (10 CFR 20.106 Appendix B, Table II).

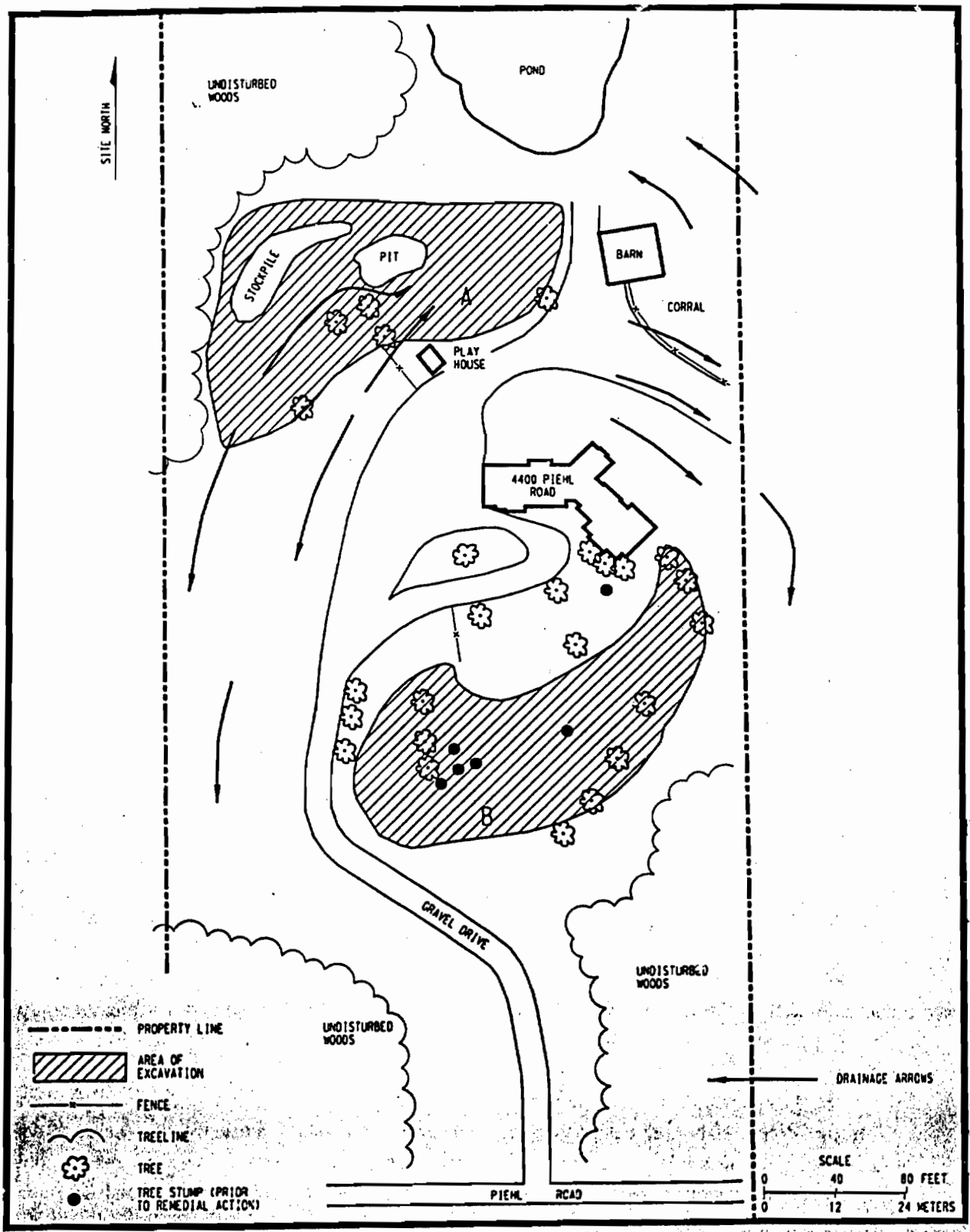

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Figure 1-2
4400 Piehl Road, Ottawa Lake, Michigan

The fill material, which was readily distinguishable from the native soil because of its color and texture, contained a large amount of ash, cinders, and sand. Rusted scrap metal, brick, and other debris indicated that it could have originated at an industrial site. Radiological survey measurements revealed isolated areas of uranium contamination in surface and subsurface soils in two areas where materials from the former Baker Brothers site were reported to have been placed. One contaminated area was a large "U"-shaped region [approximately 1,900 m^2 (2,200 yd^2)] south and east of the house at the edge of the lawn. The soil in this area had been leveled and spread to a depth ranging from a few centimeters to about 60 cm (24 in.). Approximately 10 percent of this area had detectable surface contamination. The second area of fill material [approximately 2,100 m^2 (2,500 yd^2)] was northwest of the house and included an "L"-shaped soil berm approximately 1.5 to 1.8 m (5 to 6 ft) high by 15 m (50 ft) long (Figure 1-2). The pit was located at the end of the eastern length of the "L," and isolated areas of contamination were detected in this area. Based on field measurements, the berm area had the highest concentration of uranium, 1,900 pCi/g and 8 to 120 μR/h (ORNL 1994).

2.0 REMEDIAL ACTION GUIDELINES

The source of contamination at the Ottawa Lake property was residues produced during the machining of slugs from processed uranium metals at Baker Brothers, Inc. in Toledo, Ohio. The residual radioactive contamination guidelines governing the release of properties for future use are included in DOE Order 5400.5, "Radiation Protection of the Public and Environment," and are listed in Table 2-1. The remedial action guidelines for alpha activity (from natural uranium, uranium-235, uranium-238, and associated decay products) on indoor and outdoor structural surfaces are 5,000 disintegrations per 100 square centimeters (dpm/100 cm^2) average over the whole 100-cm^2 surface area; 15,000 dpm/100 cm^2 (maximum); and 1,000 dpm/100 cm^2 (removable). Because only trace concentrations of radium and thorium exist in uranium metal after processing, extremely low concentrations of these two radionuclides were detected in characterization samples; thus, uranium isotopes were the only significant contaminants at the site. The Ottawa Lake site-specific criterion for soil contamination was determined to be 35 pCi/g for total uranium (the sum of the activity contributed by all the uranium isotopes) averaged over any 15-cm (6-in.) layer below the surface of the remediated area. The guideline was determined by applying the as-low-as-reasonably-achievable (ALARA) principle to the two site-specific guidance scenarios derived by Argonne National Laboratory (DOE 1994).

ALARA is a term used to describe an approach to radiation protection to control or manage exposures (both individual and collective to the work force and the general public) and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. As used in DOE Order 5400.5, ALARA is not a dose limit, but rather it is a process for attaining dose levels as far below the applicable limits as practicable.

Direct surface contamination is the total amount of radioactive contamination on a surface; therefore, a survey of direct surface contamination will quantify both the removable and the permanently fixed contamination. Transferable contamination is the removable component that could conceivably be picked up on clothing or skin upon contact.

To quantify direct surface contamination, radiation detection instrumentation is placed directly over the surface to measure the radioactivity emitted from a known surface area. Direct alpha radiation is measured with an alpha scintillation detector connected to a rate meter, an instrument that counts the number of radioactive disintegrations (decays) detected in a specified amount of time. Direct beta/gamma radiation measurements are obtained with a Geiger-Mueller probe attached to a rate meter. The probe is placed 1.3 cm (0.5 in.) above the surface to be surveyed, and pulses are allowed to accumulate for one minute on the rate meter, resulting in a measurement of counts per minute (cpm) for the surface area. These measurements are then converted, with appropriate calibration and conversion factors, to dpm/100 cm^2, a commonly used unit of measurement in health physics.

Table 2-1

Summary of DOE Guidelines for Residual Radioactive Contamination

Base Dose Limits

The basic limit for the annual radiation dose (excluding radon) received by a member of the general public is 100 mrem/yr. In implementing this limit, DOE applies as-low-as-reasonably-achievable principles to set site-specific guidelines.

Site-Specific Soil Guidelines

The site-specific criterion for soil is 35 pCi/g for total uranium (DOE 1994).

Indoor/Outdoor Structure Surface Contamination

The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm^2) (DOE Order 5400.5):

Radionuclide	Average	Maximum	Removable
Natural uranium, uranium-235, uranium-238, and associated decay products	5,000 (alpha)	15,000 (alpha)	1,000 (alpha)
Beta/gamma emitters (radionuclides with decay modes other than alpha emissions)	5,000 (beta/gamma)	15,000 (beta/gamma)	1,000 (beta/gamma)

Transferable contamination is the unattached radioactive material that can be removed from a surface when it is wiped with a soft absorbent paper. The paper is placed in a portable smear counter, and alpha and beta/gamma radiation are each counted for one minute. The resulting measurements in counts per minute are then readily converted to dpm/100 cm^2.

3.0 REMEDIAL ACTION

3.1 CLEANUP/DECONTAMINATION ACTIVITIES

Before remedial action began, the site was surveyed and additional samples were collected to more accurately define the boundaries of radioactive contamination. Analyses provided the information necessary to classify the waste that would be generated during remediation so that it would be accepted at the low-level radioactive waste disposal facility, Envirocare, in Clive, Utah. As remediation was completed, exposure rate measurements were taken, and composite soil samples (which give the average concentration for a 100-cm^2 area) were collected in the excavations. A pressurized ionization chamber was used to confirm that the external radiation contribution to the total dose from all pathways, excluding radon, was below the basic dose limit of 100 mrem/yr above background. The post-remedial action data confirmed that all soil contaminated above DOE guidelines had been removed.

At the request of the property owner, the number of trees removed was minimized. When the soil and outlying portions of a tree root system or trunk were contaminated above DOE guidelines, the contaminated soil or tree sections were removed instead of the entire tree. Direct measurements of the remaining root system and the tree base were taken to ensure that all portions exceeding DOE guidelines for surface contamination had been removed.

Contaminated materials were excavated with earth-moving equipment; hand tools were used where access was limited and around utility lines to reach the appropriate depth. Excavation included all materials found in the contaminated zones, such as soils, gravel, asphalt, concrete debris, and organic matter (including grass, roots, stumps, and shrubbery). Approximately 1,756 m^3 (1,920 yd^3) of radioactively contaminated material was removed during the excavation and transported to Envirocare of Utah for disposal. A summary of waste disposition is provided in Appendix A.

3.2 CONTAMINATION CONTROL

During the remedial action, engineering controls, administrative controls, and continuous monitoring were used to protect workers and the public from potential exposure to radiation in excess of applicable standards. Workers wore personal protective equipment (PPE) to further limit exposure and to prevent the spreading of contamination. These controls are outlined in the site-specific health and safety instructions.

To eliminate the potential for recontaminating remediated areas by tracking, the excavation began in the "L-shaped," backyard area (A) and proceeded to the "U-shaped" front yard area (B) (Figure 1-2). To further limit inadvertent spread of residual radioactive material, vehicles and equipment were decontaminated and surveyed to verify that they were clean.

All personnel working in contaminated areas were required to wear disposable coveralls, safety glasses, disposable booties, gloves, and hard hats. If conditions warranted, additional protective clothing and equipment such as hoods and respirators were required, as specified in the health and safety instructions. Workers exiting radioactively contaminated work areas were subjected to a whole-body scan (frisked) at the control point by a health physics technician with a hand-held radiation detection instrument to ensure that their protective clothing was not contaminated and to eliminate the potential for spreading contamination to clean areas. A frisk is simply a search for radioactive material that may have rubbed off onto the clothing of individuals inside the work area. The hand-held radiation detection instrument is held approximately 1.3 cm (0.5 in.) away from the surface to be frisked and moved slowly (about 2 inches per second) to scan the portion of the body or clothing being checked.

Workers' boots and hands were resurveyed after they removed their PPE to ensure that their hands and feet had not become contaminated while removing their PPE. Contaminated PPE was disposed of properly at a licensed disposal site. The uncontaminated PPE was cleaned and recycled or reused.

The primary potential pathways for exposure to radioactive material for members of the public were inhalation and ingestion of radioactively contaminated airborne dust generated during the excavation of contaminated soils. During excavation, the potential for dust migration was minimized by

- spraying a fine mist of water during soil removal and soil transport;
- placing contaminated soils in intermodal containers with attached lids to prevent loss of contents;
- placing sediment barriers (silt fences) around contaminated work areas; and
- placing large sheets of plastic around contaminated work areas (loading area, access control point, etc.) where practicable.

Perimeter air particulate sampling was performed to ensure that no member of the public was exposed to airborne radioactivity above DOE basic guidelines (DOE Order 5400.5). The limits in DOE Order 5400.5 are derived concentration guides (DCG); a DCG is the concentration of a particular radionuclide that would yield a committed effective dose equivalent of 100 mrem/yr, the DOE basic dose limit, to an individual continuously exposed to the radionuclide by one pathway for an entire year. This guideline was established to protect members of the general public and the environment against undue risk from radiation. High-volume air samplers were used to collect samples and monitor the air particulate concentration. The filters were accumulated daily and counted after sufficient time was allowed for radon progeny decay. Concentrations of uranium-238 measured by area particulate air samplers ranged from background to 2.0×10^{-14} μCi/ml (0.00002 pCi/L), 100 times less than the DCG of 2.0×10^{-12} μCi/ml (0.002 pCi/L) for uranium-238.

4.0 POST-REMEDIAL ACTION MEASUREMENTS

Before post-remedial action data were collected, measurements and soil samples were obtained from background locations near the Ottawa Lake vicinity property. External gamma radiation exposure rates were measured, and soil samples were collected and analyzed for uranium. Background sampling locations are listed and analytical results are presented in Table 4-1.

After each portion of the site was remediated, an external gamma radiation survey was conducted to confirm that no residual radioactive contamination above DOE guidelines remained. Initial post-remediation surveys were conducted by ThermoAnalytical (now Thermo NUtech), the radiological support subcontractor, on behalf of BNI. Survey techniques used during the post-remediation and verification surveys included walkover gamma scans, external gamma exposure rate measurements, direct and transferable surface contamination measurements where appropriate, and soil sampling. The Ottawa Lake Post-Remedial Action Survey Plan (Appendix B) describes the methods for each of the survey techniques.

ORNL, functioning as the IVC, performed independent verification surveys of the remediated areas using similar survey techniques. After BNI and ORNL concluded that the site was remediated, ORNL demobilized on November 26, 1994. BNI then restored the site to the condition agreed to by the property owner and BNI; this work was completed on December 8, 1994. The IVC survey results will be issued as a separate report by ORNL and included in the certification docket for the former Baker Brothers, Inc. site, Toledo, Ohio.

Walkover gamma radiation surveys using a field instrument for detecting low-energy radiation (FIDLER) were conducted over the excavated areas and grounds to verify that all gamma-emitting contamination above DOE guidelines had been removed. Following the FIDLER survey, 25 equispaced soil samples were collected at depths of 0-15 cm (0-6 in.) from each 10- by 10-m (33- by 33-ft) excavated area. These samples were composited and analyzed for uranium-238 by gamma spectroscopy. More than 5 percent of the samples were also analyzed for uranium-238, uranium-235, and uranium-234 by alpha spectroscopy as a quality check on the gamma spectroscopy results and to confirm that isotopic ratios were indicative of natural uranium. Analytical results for samples from the excavated areas indicated that no contamination above the current DOE guidelines and the site-specific total uranium concentration of 35 pCi/g remained (Table 4-2). Figure 4-1 shows the grid used to perform sampling activities and shows post-remedial action soil analysis results.

The concentrations of direct and transferable surface contamination measured on the decontaminated tree root systems and trunks to ensure that residual radioactivity had been removed are presented in Table 4-3.

Table 4-1

Uranium Concentrations and External Gamma Exposure Rates at Background Locations

Location	Gamma Radiation Exposure Rate (μR/h)	Total Uranium Concentration (pCi/g)
Corner of 8330 Whiteford Center Road and Temperance Street	7.8	2.00
Playground at St. Anthony School off St. Anthony Road	6.4	0.90
Parmelee Park off Summer Field Road	6.7	1.5
Average Background Readings	7.0	1.5
DOE Guidelines	— [a]	35.0

[a] Less than 100 mrem/yr above background

Table 4-2

Post-Remedial Action Soil Sample Results
for the Ottawa Lake Vicinity Property

Grid Number	Grid Coordinates	Total Uranium[a] (pCi/g)	Gamma Exposure Rate[a] (μR/h)
1	N175, E55	10.4	6.9
2	N175, E65	6.0	6.6
3	N175, E75	7.2	6.9
4	N165, E25	10.6	6.9
5	N165, E35	14.0	6.8
6	N165, E45	14.0	6.5
7	N165, E55	15.0	7.3
8	N165, E65	14.8	6.8
9	N165, E75	13.8	6.9
10	N155, E25	10.4	6.9
11	N155, E35	14.8	6.6
12	N155, E45	15.8	6.6
13	N155, E55	20.0	7.0
14	N155, E65	33.8	7.5
15	N145, E25	5.2	6.5
16	N145, E35	9.4	6.8
17	N145, E45	9.2	7.2
18	N135, E25	7.2	6.8
19	N135, E35	7.8	6.6
20	N105, E85	8.4	7.1
21	N105, E95	9.2	7.2
22	N95, E35	5.2	6.8
23	N95, E45	3.2	6.6
24	N95, E55	2.4	6.5
25	N95, E65	7.0	7.4
26	N95, E75	10.4	7.3
27	N95, E85	6.4	7.1
28	N95, E95	11.2	7.2
29	N85, E35	5.0	6.8
30	N85, E45	3.0	6.6
31	N85, E55	14.0	6.6
32	N85, E65	15.6	6.8
33	N85, E75	17.0	7.4
34	N85, E85	9.2	7.2
35	N85, E95	9.4	6.7
36	N75, E35	9.8	6.7
37	N75, E45	8.4	6.6
38	N75, E55	9.0	6.8
39	N75, E65	2.8	7.1
40	N75, E75	6.0	7.5
41	N75, E85	8.8	7.0
DOE Guidelines		35	—[b]

[a] All results include background readings for the Ottawa Lake region.
[b] Less than 100 mrem/yr.

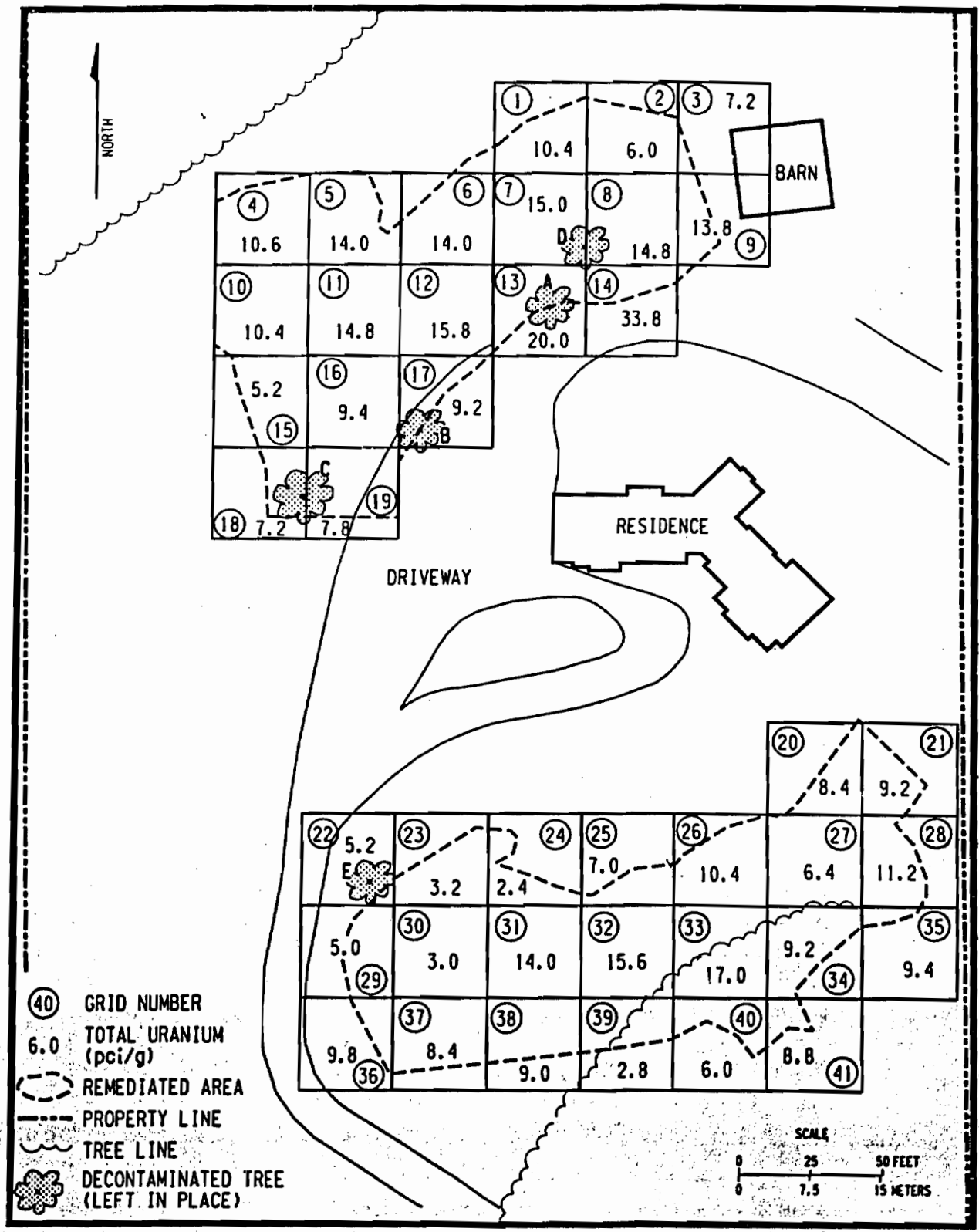

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Figure 4-1
Post-Remedial Action Soil Analysis Results
For 4400 Piehl Road, Ottawa Lake, Michigan

Table 4-3

Summary of Post-Remedial Action Radiological Results for the Root Systems and Tree Bases at the Ottawa Lake Vicinity Property

Tree ID[b]	General Location	Direct Surface Contamination[a]				Transferable Surface Contamination[a]			
		Alpha		Beta/Gamma		Alpha		Beta/Gamma	
		Sample Activity Range (dpm/100 cm²)	Number of Measurements/ Number Below Criteria	Sample Activity Range (dpm/100 cm²)	Number of Measurements/ Number Below Criteria	Sample Activity Range (dpm/100 cm²)	Number of Measurements/ Number Below Criteria	Sample Activity Range (dpm/100 cm²)	Number of Measurements/ Number Below Criteria
A	Tree in Backyard at N155, E56	0-19	3/3	1,500-2,001	3/3	<1-<2	3/3	<51-<-10[c]	3/3
B	Tree in Backyard at N144, E41	10-19	4/4	<300-650	4/4	<1-5	4/4	<61-<20	4/4
C	Tree in Backyard at N122-123, E24-25	10-19	3/3	<375-1,125	3/3	<1-5	3/3	<57-<-27[c]	3/3
D	Tree in Backyard at N159-161, E61-63	0-76	5/5	1,000-2,501	5/5	<1-14	5/5	<44-84	5/5
E	Roots on NW side of SCA	0-57	5/5	<375-2,626	5/5	<1-5	5/5	<34-<24	5/5
DOE Guideline:		5,000		5,000		1,000		1,000	

[a] All results include background readings for the Ottawa Lake region.

[b] Trees are identified in Figure 4-1.

[c] "<-" sign indicates that the measurement was less than the minimum detectable activity (MDA) and that after background was subtracted, the numerical value was negative (e.g., <MDA result minus >MDA background = negative result indicated by "<-").

5.0 POST-REMEDIAL ACTION STATUS

The post-remedial action survey data indicated that all areas of the Ottawa Lake vicinity property at 4400 Piehl Road determined to be contaminated during characterization surveys now meet applicable DOE guidelines for cleanup of residual radioactive contamination. After review of post-remedial action measurements, survey procedures, and quality assurance data, the IVC confirmed that the property was decontaminated to the radiological guidelines established for the site.

After verification activities were completed, the IVC notified DOE-Headquarters, Division of Facility and Site Decommissioning, and DOE-Oak Ridge Operations Office, Former Sites Restoration Division, of its findings and recommendations. DOE reviewed the data to determine whether the remedial action was successful. Based on this review, radiological conditions at the site were determined to be in compliance with DOE decontamination criteria and standards to protect health, safety, and the environment. A certification docket will be prepared to officially certify that the Baker Brothers site and the Ottawa Lake vicinity property were remediated to established criteria. The issuance of the certification docket will be documented through publication of a notice in the *Federal Register*.

REFERENCES

U.S. Department of Energy (DOE), Letter from D. Adler (Oak Ridge Office) to A. Williams (DOE-Headquarters), "Uranium Residual Radioactive Material Guidelines," BNI CCN 122335, October 24, 1994.

Oak Ridge National Laboratory (ORNL), *Results of the Radiological Survey at 4400 Piehl Road, Ottawa Lake, Michigan*, BNI CCN 103603, April 4, 1994.

GLOSSARY

Alpha-emitting - See **Radiation.**

Ambient Background Radiation - Ambient background radiation refers to naturally occurring radiation emitted from either cosmic (e.g., from the sun) or terrestrial (i.e., from the earth) sources. Exposure to this type of radiation is unavoidable, and its level varies greatly depending on geographic location. For example, New Jersey typically receives 100 millirem per year (mrem/yr), Colorado receives about 115 mrem/yr, and some areas in South America receive up to 7000 mrem/yr. Naturally occurring terrestrial radionuclides include uranium, radium, potassium, and thorium (see **Radionuclide**). The dose levels do not include the concentrations of naturally occurring radon inside buildings.

Beta/gamma-emitting - See **Radiation.**

Centimeter - A centimeter (cm) is a metric unit of measurement for length; 1 inch is equal to 2.54 cm; 1 foot is equal to approximately 30 cm.

Contamination - The term "contamination" is used generally to mean a concentration of one or more radioactive materials that exceeds naturally occurring levels. Contamination may or may not exceed the DOE cleanup guidelines.

Disintegrations per minute - Disintegrations per minute (dpm) is the measurement indicating the amount of radiation being released from a substance per minute.

Dose - As used in this report, dose is actually dose equivalent and is used to relate absorbed dose (mrad) to an effect on the body. Dose is measured in mrem. For comparison, a dose of 500,000 mrem to the whole body within a short time causes death in 50 percent of the people who receive it; a dose of 5,000,000 mrem may be delivered to a cancerous tumor during radiation treatment; normal background radiation at or near sea level results in an annual dose of about 100 mrem; DOE radiation protection standards limit the dose that may be received by members of the general public to 100 mrem/yr above background levels; living in a brick house typically results in a dose of about 75 mrem/yr above the background level.

Exposure Rate - Exposure rate is the rate at which radiation imparts energy to the air. Exposure is typically measured in microroentgens (μR), and exposure rate is typically expressed as μR/h. The dose to the whole body can be approximated by multiplying the exposure rate by the number of hours of exposure. For example, if an individual were exposed to gamma radiation at a rate of 20 μR/h for 168 h/week (continuous exposure) for 52 weeks/yr, the whole-body dose would be approximately 175 mrem/yr.

Gamma Radiation - See **Radiation.**

Meter - A meter (m) is a metric unit of length; 1 m is equal to approximately 39 inches.

Microroentgen - A microroentgen (μR) is a unit used to measure radiation exposure. For further information, see **Exposure Rate.**

Millirem - The millirem (mrem) is the unit used to measure radiation dose to man. The DOE dose limit is 100 mrem above background radiation levels within any one-year period for members of the general public. Naturally occurring radioactive substances in the ground result in a yearly exposure of about 100 mrem to each member of the population. To date, no difference can be detected between the health of population groups exposed to 100 mrem/yr above background and the health of groups who are not exposed.

Natural Background Radiation - Natural background radiation refers to radiation emitted from the naturally occurring radionuclides found in manmade materials. The concentrations of the radionuclide, and thus the radiation, will vary widely because of variations in the composition of the materials.

Radiation - There are three primary types of radiation: alpha, beta, and gamma. Alpha radiation travels less than an inch in air before it stops, and it cannot penetrate the outer layers of human skin. Beta radiation can penetrate the outer layers of skin but cannot reach the internal organs. Gamma radiation, the most penetrating type, can usually reach the internal organs.

Radionuclide - Radioactive elements are also referred to as radionuclides. For example, uranium-235 is a radionuclide, uranium-238 is another, thorium-232 is another, and so on.

Remedial Action - Remedial action is a general term used to mean "cleanup of contamination that exceeds DOE guidelines." It refers to any action required so that a property may be certified as being in compliance with guidelines and may therefore be released for future use. Remedial action also includes restoring remediated properties to their original conditions as far as possible.

Uranium - Uranium is a naturally occurring radioactive element. The principal use of refined uranium is for the production of fuel for nuclear reactors. Uranium in its natural form is not suitable for use as a fuel source.

APPENDIX A

WASTE MINIMIZATION SUMMARY

FOR THE OTTAWA LAKE VICINITY PROPERTY

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The decontamination of the Ottawa Lake site was conducted in a manner designed to control expenses while expediting the remedial action. The volume and waste streams requiring disposal are listed in Table A-1. This table shows that the total volume shipped for disposal and the total volume excavated are the same. None of the excavated material was used as fill material; all of it was disposed of as low-level radioactive waste. The time and expense that would have been required for separating the uncontaminated debris and the clean material from the contaminated waste were determined not to be justified.

Table A-1

Remedial Action Summary

WBS 120

SITE 4400 Piehl Road

OWNER Mr. Frank Vitale

SITE ADDRESS 4400 Piehl Road

CITY, STATE Ottawa Lake, Michigan

REMEDIATION AUTHORITY

- ☒ NEPA/CERCLA
- ☐ SUPERFUND
- ☐ RCRA

Action	Date	Responsible Entity	Document
Designation	10-08-92	DOE	Designation/Authorization Report
Characterization	04-04-93	ORNL	Results of Radiological Survey at 4400 Piehl Road, Ottawa Lake, Michigan
Final RA	01-31-96	DOE/ORNL/BNI	Post-Remedial Action Report for the Former Baker Brothers, Inc. Vicinity Property at 4400 Piehl Road, Ottawa Lake, Michigan

TOTAL VOLUME 1,920 yd^3
To Remain In Situ 0
Volume Reduction 0
Net Disposal 1,920 yd^3

Documentation Used: N/A

TYPE OF WASTE FOR NET DISPOSAL:

REGULATORY	VOLUME	DISPOSAL SITE
☒ LLRW	1,920 yd^3	Clive, Utah
☐ 11(E)2		
☐ MIXED		
☐ CHEMICAL		
PHYSICAL		
☐ BUILDING RUBBLE		
☐ SOIL		
☐ LIQUID		
☐ OTHER		

TREATMENT TECHNOLOGIES APPLIED AT THE SITE:
None

APPENDIX B

OTTAWA LAKE

POST-REMEDIAL ACTION SURVEY PLAN

OTTAWA LAKE POST-REMEDIAL ACTION SURVEY PLAN

PURPOSE

The purpose of this plan is to describe the methodologies that the Formerly Utilized Sites Remedial Action Program (FUSRAP) will use for radiological surveys, sampling, and analysis to document the final condition of the Ottawa Lake property as radioactively clean according to the release standards of Department of Energy (DOE) Order 5400.5 (Reference 1). This plan addresses the DOE protocol for verification and certification of sites under FUSRAP (Reference 2).

Bechtel National, Inc. (BNI) will be the FUSRAP remedial action contractor, and the Oak Ridge National Laboratory (ORNL) will act as the Independent Verification Contractor.

REFERENCES

(1) DOE Order 5400.5, Radiation Protection of the Public and Environment, Washington, D.C.

(2) DOE, 1990, Verification and Certification Protocol for the Office of Environmental Restoration FUSRAP and D&D Program, Revision 3, November.

(3) ORNL, 1993. Radiological Survey Results at 4400 Piehl Road, Ottawa Lake, Michigan (BTO002), BNI CCN 103603, April.

(4) ThermoAnalytical (TMA), Health Physics Operational Procedures Manual

A) 3C.2 "Determination of Background"
B) 3B.1 "Delineation of Survey Areas in Open Land"
C) 3B.3 "Gamma Ray Exposure Rate Surveys at 1-Meter in Open and Enclosed Areas"
D) 3A.2 "Direct Surface Contamination Survey"
E) 3A.3 "Transferable Surface Contamination Survey"
F) 4A.1 "Systematic and Bias Surface Soil Sampling (Radiological)"

(5) BNI, 1993, Instruction Guide for Post-Remediation Survey of Soil, 191-IG-032, Revision 0.

(6) BNI, 1992, Instruction Guide for Decontamination of Field Sampling Equipment at FUSRAP Sites, 191-IG-011, Revision 5

(7) BNI, 1993, Instruction Guide for Surface Water and Sediment Sampling Activities, 191-IG-028, Revision 0.

(8) BNI, 1994, How to Ship Samples from a FUSRAP Site, PI R4.7, Revision 2.

(9) BNI, 1994, Health and Safety Work Instruction for Ottawa Lake Remedial Action.

BACKGROUND (from Reference 3)

During the early and mid-1940s, Baker Brothers, Inc., in Toledo, Ohio, fabricated uranium slugs from processed uranium metals under subcontract to the Manhattan Engineer District (MED). The Baker Brothers assets were later liquidated, the machinery and equipment sold at auction, and the property divided and sold to two independent companies. One part of the property was resold in the summer of 1992. Through conversation with the new owner, it was learned that soil from the former Baker Brothers site may have been moved to a site in Michigan.

The property at 4400 Piehl Road in Ottawa Lake, Michigan, is in a semi-rural area approximately 15 miles northwest of Toledo, Ohio. The adjacent properties are similar in size and topography. The general area is flat and has a large number of trees. The site consists of approximately seven acres, one house (occupied by the owner), a barn, and a pond.

During September of 1992, the Measurement Applications Department (MAD) at ORNL conducted a radiological survey of 4400 Piehl Road, Ottawa Lake, Michigan at the request of DOE, since soil had allegedly been hauled to this site from the former Baker property in Toledo, Ohio. Although the majority of the measurements on the property were within DOE guidelines, isolated spots of uranium concentration were found. Based on these findings, the residential property at 4400 Piehl Road in Ottawa Lake, Michigan was recommended for inclusion under FUSRAP.

The owner alleges that several dozen large dump truck loads of soil, concrete, and tree stumps were transported to his property from the former Baker Brothers site and either placed in front of his house or in a large pile behind and approximately 100 feet northwest of the house. The transported soil is readily discernable from the native soil due to its color and texture, and contained a large amount of ash, cinders and sand. It also contained heavily rusted scrap metal, brick, and other debris as might be expected to be found at an industrial site. The owner also alleges that a rather large pit was dug approximately 10 feet deep at the edge of the pile. The tree stumps and the concrete slabs from the former Baker Brothers site were allegedly dumped into the pit, covered with additional soil and leveled. Surface water drains from this area to the pond.

Two general areas are affected by the transported soil. One is the area in front of the house (to the south and to the east). The soil in this area has been leveled and spread, and varies in depth from a few inches to about 1.5 feet. The second area of transported soil is in back of the house (to the north and to the west), west of the barn. This area includes a pile of soil (berm) and the buried pit.

RESIDUAL CONTAMINATION GUIDELINES

The source of contamination of the designated property was from the fabrication of uranium slugs from processed uranium metals at Baker Brothers, Inc. The applicable residual contamination guidelines are as follows (Reference 1):

- The site-specific criterion for soil is 35 pCi/g for total uranium, based on criterion established for similar sites.

- The residual contamination guidelines for fixed and transferable radioactive contamination (dpm/100 cm²) (Reference 1):

radionuclide	average	maximum	removable
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α

DECONTAMINATION ACTIVITIES

A Real Estate Instrument shall be in place for the property remediated. All designated areas of contamination are exterior. At a minimum, remediation of the site will consist of excavation of soil with total uranium concentrations exceeding the 35 pCi/g site-specific guideline.

Consequently, verification surveys and sampling will focus on confirming that soil remaining after remedial action does not contain radioactive contamination at concentrations exceeding the site-specific criterion. To the extent necessary, equipment used during the decontamination activity will be cleaned and surveyed for surface contamination prior to release.

Areas where remediation activities will be conducted will include, but not be limited to, those identified by the designation contractor in the site designation report (Reference 3). Design Drawing 120-DD460-C02 delineates those general areas that will be excavated.

POST-REMEDIATION SURVEYS AND SAMPLING

Following remediation, the FUSRAP Radiological Support Subcontractor (ThermoAnalytical, TMA) will perform post-remedial action surveys and sampling to determine the completeness of the corrective action and to document that the site now complies with the applicable criteria and can be released for use without radiological restrictions.

Survey Equipment

The recommended equipment for use by FUSRAP for release of equipment and materials from the site includes:

- Alpha Scintillation detector (Eberline AC-3 or equivalent)
- Beta/Gamma Pancake GM detector (7 mg/cm² mylar shielded (Eberline HP-210 or equivalent)
- Alpha Scintillation Counter (Eberline SAC-4 or equivalent)

The recommended equipment for use by FUSRAP for Post-RA verification includes:

- Portable Ratemeter/Scaler (Eberline PRS-1 or equivalent)
- Gamma Scintillation Detector (Eberline SPA-3 or equivalent), or low range/high range HP-270 or equivalent
- Reuter-Stokes Pressurized Ion Chamber (PIC)
- Field Instrument for Detection of Low-Energy X-Rays (FIDLER)

The same types of calibration sources and methods for instrument calibration will be used by Bechtel and ORNL to insure compatibility and reproducibility of results.

Background Measurements

Prior to performing post-remedial action surveys, TMA will obtain site-specific background measurements from three remote background locations in the general vicinity of the site (0.5 to 3 miles) according to TMA procedure 3C.2 (Reference 4A). The location for background measurements will be selected by Bechtel and TMA, and background measurements will be made at each location by TMA and ORNL.

Surveys

After completion of excavation of the contaminated soils, TMA shall conduct post-remedial action surveys to verify satisfactory decontamination of the area. A survey grid shall be established at the site, conforming to the specifications in TMA procedure 3B.1 (Reference 4B) and the "Instruction Guide for Post-Remediation Radiological Survey of Soil" (191-IG-032) (Reference 5), and surveys shall be conducted in each square of the 10 m by 10 m grid. ORNL will use the same grid.

TMA will measure external gamma radiation exposure at a height of 1 m in the center of each survey grid block as required by 191-IG-032 (Reference 5) using methods in accordance with TMA procedure 3B.3 (Reference 4C).

Any structures left after remediation, such as pipes or trees, will be surveyed for alpha and beta/gamma direct and transferable contamination according to TMA procedures 3A.2 and 3A.3 (References 4D and 4E).

Soil Sampling

TMA shall also collect post-remedial action soil samples to verify satisfactory remediation of the area. Samples shall be collected in each 10 m by 10 m grid as directed in 191-IG-032 and TMA procedure 4A.1 (References 4F and 5). Based on current estimates of anticipated areas of excavation, a minimum of 20 composite samples will be collected. ORNL may collect splits concurrently.

Samples from each grid shall be collected using properly decontaminated sampling equipment (Reference 6).

TMA samples shall be handled using the same custody and labeling methodology described for sediment samples in the "Instruction Guide for Surface Water and Sediment Sampling Activities" 191-IG-028 (Reference 7) and the sample surveying, packaging, and shipping methodology in PI R4.7 "How to Ship Samples from a FUSRAP Site" (Reference 8).

All samples shall be shipped to the TMA laboratory in Oak Ridge, TN for analysis by gamma spectroscopy. Five percent of the samples will be analyzed for total uranium.

Safety and Health

Safety and health risks associated with tasks described herein have been identified and addressed by the *Health and Safety Work Instruction for Ottawa Lake Remedial Action* (Reference 9).

The work will be performed under a Hazardous Work Permit specific to the survey activities.

Quality Assurance/Quality Control

QA/QC field duplicate samples and measurements shall be collected at a frequency of one additional sample/measurement for each 20 collected.

Rinse blanks from decontaminated sampling equipment shall be collected at the rate of one rinse per day of sampling. Rinse blanks shall be collected according to the recommendations in 191-IG-028 (Reference 7).

Data Quality Objectives

The detection limit for total uranium by gamma spectroscopy shall be less than 17 pCi/g (half criterion); therefore, the detection limit for uranium-238 shall be less than 8 pCi/g.

Quality indicator goals shall be as follows: Precision, ± 2 sigma; completeness, 75%; Accuracy, ± 25%). QA/QC samples are discussed in the previous section.

BECHTEL/ORNL COORDINATION

Bechtel is the contractor responsible for completing the remedial action. To define the areas for remediation, Bechtel used data collected by ORNL during designation, as well as supplemental information obtained by Bechtel as part of pre-RA planning and scoping activities.

Bechtel will have responsibility for excavation of contaminated soil. Upon completion of these activities, the RSS (TMA) will perform a post-RA survey. ORNL will then commence verification of the remediation of the property. ORNL will perform a walkover survey on the surface of the ground using a FIDLER or equivalent to measure beta-gamma radiation directly. The result of this walkover survey shall be used to determine whether there are areas requiring additional remediation. This survey is expected to include all areas previously identified as being contaminated on the designated property. Bechtel will assist ORNL in this survey by interfacing with property owners in advance to secure their approval for property access.

Bechtel will initiate remediation concurrent with ORNL verification activities, to the extent that remediation does not interfere with verification. Bechtel will provide ORNL access to remediation results as they become available. The Bechtel Site Superintendent will notify ORNL when remediation of an area is complete, and ORNL will perform final independent verification surveys of the area. ORNL may collect soil sample splits concurrent with Bechtel sampling efforts.

Measurements taken by Bechtel and ORNL at identical locations should agree within the 95 percent confidence interval for the analytical methods used (Reference 2). For consistency and ease of data comparison, Bechtel and ORNL shall utilize the same type of calibration techniques, calibration sources, and survey techniques in conducting the surveys. Bechtel and ORNL shall establish a mutually agreeable survey grid across the decontaminated areas and shall conduct their surveys referring to that grid.

Upon agreement by both parties that the site is decontaminated, ORNL will then demobilize, and Bechtel will remain to restore the site to the condition agreed upon by the property owner.

Bechtel will provide final verified sample results to ORNL as soon as they are available. Bechtel will also prepare a Post-Remedial Action Report (PRAR) for DOE review (copy to ORNL) within 3 months following demobilization. One Certification Docket will be prepared by Bechtel for the Ottawa Lake property and the former Baker Brothers site once both sites are complete. ORNL will issue a verification report to DOE (copy to Bechtel) within 4 months following demobilization (Reference 2).