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WELDON SPRING QUARRY CONSTRUCTION STAGING AREA AND WATER TREATMENT PLANT SITE REMEDIAL ACTION CHARACTERIZATION REPORT

For the
Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

Prepared by MK-Ferguson Company and Jacobs Engineering Group

SEPTEMBER 1991

REV. 0

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

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	Rev. No. 0
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9/20/91
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Weldon Spring Site Remedial Action Project

Weldon Spring Quarry Construction Staging Area and
Water Treatment Plant Site Remedial Action Characterization Report

September 1991

Revision 0

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Prepared for

U.S. DEPARTMENT OF ENERGY
Oak Ridge Operations Office
Under Contract DE-AC05-86OR21548

ABSTRACT

The quarry construction staging area (QCSA) and water treatment plant (WTP) are located in the areas that border the western edge of the Weldon Spring quarry (WSQ). These facilities were constructed to support bulk waste removal from the WSQ. This area was contaminated with U-238, Ra-226, and Th-230 and was remediated prior to construction in order to allow release of the area for use without radiological restrictions.

This report documents the methods of characterization, the remediation activities, and the post remedial action sampling methods and analytical results.

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1 INTRODUCTION

The Weldon Spring site (WSS) is located near the community of Weldon Spring, in St. Charles County, Missouri, about 30 miles west of St. Louis. The site consists of two noncontiguous areas: (1) the raffinate pits and chemical plant area and (2) the quarry. The raffinate pits and chemical plant are about 2 mi southwest of the junction of Missouri Route 94 and U.S. Route 40/61. The quarry is located about 4 mi south-southwest of the raffinate pits and chemical plant area and about 5 mi southwest of the community of Weldon Spring. Both areas are accessible from State Route 94, and are fenced and closed to the public.

The 9-acre Weldon Spring quarry (WSQ) was excavated into a bluff which forms a valley wall at the edge of the Missouri River floodplain. A small pond, 0.5 acre in size, occupies the lowest point of the quarry.

An estimated 95,000 cu yd of bulk waste are present within the WSQ. The heterogeneous material includes rubble, drummed waste, sludge, and soil contaminated with both radionuclides and chemical species. In addition, both pond water and groundwater within the saturated portions of the waste materials are contaminated.

In order to remediate the WSQ a quarry construction staging area (QCSA) and water treatment plant (WTP) will be constructed and used to support the treatment of contaminated water from the quarry pond and subsequent removal of bulk wastes from the quarry. The area which will accommodate the QCSA and WTP borders the western edge of the quarry site and is bounded on the west by the Little Femme Osage Creek, on the north by Missouri State Highway 94, and on the south by an abandoned Missouri-Kansas-Texas (MKT) railroad bed now known as the Katy Trail. The QCSA and WTP area is shown on Figure 1-1. The QCSA and WTP is to include an equalization basin, two effluent ponds, roads, parking areas, and infrastructures along with a water treatment plant.

The area that will support the QCSA and WTP probably became contaminated due to the transportation of wastes by truck and railroad car enroute to the quarry. The Project Management Contractor (PMC) characterized the area and found six zones of contamination above the generic guidelines for residual radioactive materials stated in DOE Order 5400.5,

QUARRY CONSTRUCTION AREA AND WATER TREATMENT PLANT SITE

FIGURE 1-1

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Radiation Protection of the Public and the Environment, for Ra-226, Ra-228, Th-230 and Th-232 and a site adopted reference-level for uranium.

The generic guidelines for residual radioactive materials stated in DOE Order 5400.5 are as follows: 5 pCi/g in soils from ground level to 15 cm (0.5 ft) in depth and 15 pCi/g in soils beneath 15 cm (0.5 ft) in depth for Ra-226, Ra-228, Th-230, and Th-232. These concentrations correspond to those stated in 40 CFR 192, which applies to the DOE Uranium Mill Tailings Remedial Action Project and to U.S. Department of Energy (DOE) guidelines for surplus facilities. The site adopted reference-level currently being used at the Weldon Spring Site Remedial Action Project (WSSRAP) for U-238 is 15 pCi/g. A site-specific U-238 concentration is currently being derived for the WSSRAP by means of the WSSRAP Baseline Risk Assessment. The six zones of contamination are shown on Figure 1-2.

Zone 1 includes part of the quarry haul road to a depth of 3 ft with the principle contaminant being Th-230. Zone 2 includes part of the haul road to a depth of 1 ft, and the principle contaminant is also Th-230. Zone 3 includes a major portion of the railroad spur to a depth of 6 in.; the principle contaminant is radium. The characterization also established the outer perimeters of contaminated Zones 1-3 to extend 7 ft from the outer edge of the road and railroad tracks giving Zones 1-3 widths of 25 ft (12.5 ft from the road and the railroad tracks center lines). The section of railroad track that continues northward of Zone 3 to State Highway 94 revealed elevated gamma readings. However, analytical results from soil samples collected in this area indicated no radionuclide concentration above the guidelines stated above.

Zones 4, 5, and 6 included small portions of the railroad spur and the principle contaminants were radium. These areas were previously identified by Oak Ridge Associated Universities (ORAU) as vicinity property (VP) location No. 8. Specific information on characterization of VP-8 performed by ORAU can be found in *Radiological Survey Of The August A. Busch and Weldon Spring Wildlife Areas Final Report*, (Boerner 1986).

No elevated concentrations of chemical compounds were observed. Zone dimensions and volumes are listed in Table 1-1. Further information may be found in the *Radiological and Chemical Characterization Report for the Planned Quarry Construction Staging Area and Water Treatment Plant*, (MKF and JEG 1989).

This report presents the methods by which the PMC collected measurements and samples for assessment of remediation success.

In summary, the PMC analytical results for postremediation success concluded that remediation activities were successful relative to site-specific U-238 and generic radium and thorium guidelines stated in DOE Order 5400.5.

 • CONTAMINATED AREAS
REQUIRING REMEDIATION

0 100 200 FT
 0 30.5 61.0 M
 SCALE

CONTAMINATED ZONES

FIGURE 1-2

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TABLE 1-1 Dimension of Contaminated Zones

	Depth	Width	Length	Volume
Zone 1	0.9 m (3 ft)	7.6 m (25 ft)	42.1 m (138 ft)	293 m ³ (383 yd ³)
Zone 2	0.3 m (1 ft)	7.6 m (25 ft)	97.5 m (320 ft)	226 m ³ (296 yd ³)
Zone 3	0.2 m (0.5 ft)	7.6 m (25 ft)	158.5 m (520 ft)	184 m ³ (241 yd ³)
Zone 4	0.6 m (2 ft)	0.9 m (3 ft)	0.9 m (3 ft)	0.5 m ³ (1 yd ³)
Zone 5	0.8 m (2.5 ft)	0.9 m (3 ft)	0.9 m (3 ft)	0.6 m ³ (1 yd ³)
Zone 6	0.5 m (1.5 ft)	0.9 m (3 ft)	0.9 m (3 ft)	0.4 m ³ (1 yd ³)

2 AREAL EXTENT SAMPLING

In order to ensure remedial success, 34 sample grids bordering the perimeters of contaminated Zones 1, 2, and 3 previously identified in the initial characterization, were established prior to excavation activities. These grids were established to ensure that the perimeters of contaminated areas were adequately defined during initial characterization. The sample grids consisted of approximately 100 m² areas and are shown on Figure 2-1. Sample grids bordering Zones 4, 5, and 6 were not established due to their small areas.

Soil samples were taken in each grid at 6 in. increments using a hand auger. Ten locations within each grid were sampled and mixed in a bucket and a 500 g composite sample obtained. The composite sample was then prepared and analyzed in the same manner as the initial characterization soil samples. Off-site Th-230 analysis and on-site U-238, Ra-226, and Th-232 analyses were performed for all samples. Sample results are listed in Table 2-1. As a result of areal extent sampling, the contaminated zone perimeters were unchanged from that previously determined by initial characterization, with the exception of sample grid QS13 which was contaminated to a depth of 6 in. and was added to areas requiring remediation shown on Figure 2-1. The volume of material requiring excavation from sample grid QS13 was approximately 15 cu m and is not included in the zone dimensions and volumes listed in Table 1-1.

TABLE 2-1 Areal Extent Soil Sample Results

AREA	ON-SITE LAB pCl/g			OFF-SITE LAB pCl/g
	U-238	RA-226	RA-228	TH-230
QA01	<1.17	0.69±0.11	0.49±0.09	1.6±0.4
QB01	<1.35	0.79±0.12	0.83±0.09	1.7±0.4
QS02	<4.26	1.67±0.13	1.33±0.13	5.3±0.5
QS03	<1.77	1.33±0.14	0.94±0.10	4.3±0.4
QS04	<3.62	1.07±0.14	0.86±0.09	1.2±0.2
QS05	<1.51	1.65±0.15	0.89±0.11	5.3±0.5
QS06	<4.10	1.47±0.16	1.11±0.15	3.4±0.4
QS07	<4.27	1.70±0.17	1.11±0.11	1.8±0.3
QS08	<1.41	1.26±0.11	0.81±0.09	1.6±0.2
QS09	<1.35	1.14±0.13	0.69±0.09	2.0±0.3
QS10	<2.15	1.41±0.19	1.39±0.13	2.1±0.4
QS11	<1.52	1.09±0.14	0.80±0.10	2.5±0.3
QS12	<1.33	1.30±0.15	0.71±0.10	1.8±0.2
QS13	<4.84	1.77±0.16	1.72±0.16	6.9±0.5
QS14	<1.75	1.59±0.17	1.59±0.12	2.4±0.3
QS15	<3.51	1.29±0.14	0.68±0.08	2.0±0.3
QS16	<1.16	1.13±0.14	0.86±0.09	1.0±0.2
QS17	<1.04	0.99±0.12	0.45±0.08	0.8±0.2
QS18	<1.13	1.15±0.11	0.57±0.09	1.1±0.2
QS19	<3.04	0.76±0.13	0.82±0.10	1.1±0.2
QS20	<1.62	1.24±0.13	1.03±0.12	1.1±0.2
QS21	<1.67	1.17±0.16	1.31±0.12	1.0±0.2
QS22	<4.71	1.45±0.14	1.40±0.12	1.7±0.3
QS23	<1.87	1.36±0.15	1.02±0.11	1.2±0.2
QS24	<1.85	1.68±0.15	1.60±0.14	1.2±0.2
QS25	<1.71	1.54±0.16	1.28±0.11	1.2±0.3
QS26	<1.89	1.08±0.16	1.22±0.14	1.7±0.3
QS27	<4.50	1.08±0.14	1.47±0.13	2.5±0.3

TABLE 2-1 Areal Extent Soil Sample Results (Continued)

ON-SITE LAB pCi/g				OFF-SITE LAB pCi/g
AREA	U-238	RA-226	RA-228	TH-230
QS28	<4.10	1.49±0.15	1.28±0.11	1.5±0.3
QS29	<1.61	0.95±0.13	0.86±0.09	1.2±0.3
QS30	<0.97	0.79±0.09	0.43±0.07	3.5±0.6
QS31	<0.99	0.94±0.11	0.44±0.06	1.76±0.3
QA32	<4.21	1.34±0.13	1.22±0.11	2.62±0.5
QB32	<1.16	0.84±0.12	0.63±0.09	1.19±0.4

NOTE: EACH GRID AREA 100 m².
Results include natural background.

3 POST REMEDIAL ACTION SAMPLING RESULTS

Remediation of the zones was performed under subcontract 3589-WP157. Each zone was excavated by using a backhoe and dumptruck. The excavated soil was placed in a soils staging area within the fenced inner quarry area. Continuous radiological coverage and decontamination of equipment were primary components of remediation during excavation of soils.

Post remedial action characterization was performed immediately following excavation of each zone. Post remedial action characterization includes a gamma radiation walk-over scan, excavation control soil sampling, and post remedial action soil sampling. Zones 4, 5, and 6 were the first zones to be remediated. Zones 3, 2, and 1 were then remediated in descending order by the same technique.

After each individual zone was remediated, a gamma radiation walk-over scan of the exposed surface was performed using a Ludlum 44-10 NaI 2 x 2 scintillation probe coupled to a Ludlum model 2220 meter. The gamma radiation walk-over scan was performed to determine if areas of elevated gamma radiation were present. This would immediately indicate if additional excavation was necessary. Walkover scans of all zones after remediation revealed natural background gamma radiation levels.

Excavation control and post remedial action soil sampling were performed in each zone after walkover scans were performed. Sampling grids 100 m² were established for Zone 1 and Zone 2 (haul road) to facilitate both excavation control sampling and post remedial action sampling. Excavation control sample grids for Zone 3 (railroad) were 200 m². Post remedial action sample grids for Zone 3 were 100 m². Due to the small areas of Zones 4, 5, and 6, the post remedial action sample grids were the same as the area of each contaminated zone. See Figures 3-1 and 3-2 for excavation control and post remedial action sample grids, respectively.

Soil samples were collected using an auger tool. For each 100 m² sample grid area, 10 random soil sample locations were selected and a 6 in. sample collected from each location. Thus, for the 200 m² excavation control grids used in Zone 3, 20 random soil sample locations were selected. The material from the soil sample locations was mixed in

-AREA REQUIRING EXCAVATION

EXCAVATION SAMPLE GRIDS

FIGURE 3-1

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-AREA REQUIRING EXCAVATION

POST REMEDIAL ACTION SAMPLE GRIDS

FIGURE 3-2

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ORIGINATOR	MAP	DRAWN BY	GLN
		DATE	9/91

a bucket and a 500 g excavation control and/or a 500 g post remedial action composite sample was taken. The samples were bagged, labeled, and sent to the on-site laboratory for sample preparation and analysis. Excavation control samples were prepared by canning only. Post remedial action samples were prepared by drying, grinding, and canning.

Excavation control samples were analyzed on site for U-238, Ra-226, and Ra-228 by gamma spectroscopy. A wet chemical field method followed by alpha spectroscopy for determining Th-230 in soils developed by United Nuclear Corporation (UNC) was utilized by the on-site laboratory. Post remedial action samples were analyzed off site for U-238, Ra-226, Ra-228, and Th-230. Analysis results were then compared to the guidelines stated in Section 1 of this report. All excavation control and post remedial action samples performed after remediation revealed concentrations for U-238, Ra-226, Ra-228, and Th-230 below the U.S. Department of Energy (DOE) guidelines and the site-adopted reference-level for uranium. The results of excavation control samples are listed in Table 3-1. The results of post remedial action samples are listed in Table 3-2.

Table 3-1 Excavation Control Soil Sample Results ^(a)

SOIL CONCENTRATION, pCi/g

GRID I.D.	SAMPLE GRID AREA SIZE	U-238	Ra-226	Ra-228	Th-230 ^(b)
QUARRY ACCESS ROAD EXCAVATION CONTROL (ZONES 1 AND 2)					
QRE-1	100 m ²	<2.80	0.51±0.10	0.49±0.07	1.8
QRE-2	100 m ²	<3.56	0.90±0.12	0.88±0.10	3.2
QRE-3	100 m ²	<1.61	0.96±0.15	1.20±0.11	1.0
QRE-4	100 m ²	<1.32	<0.52	0.66±0.08	1.1
QRE-5	100 m ²	<1.24	0.87±0.12	0.96±0.10	1.4
QRE-6	100 m ²	<2.79	0.84±0.11	0.55±0.07	0.9
QRE-7	100 m ²	<0.89	0.76±0.10	0.25±0.06	0.7
QRE-8	100 m ²	<1.04	<0.42	0.58±0.08	1.4
QRE-9	41 m ²	2.35±0.93	0.81±0.11	0.92±0.11	1.4
QRE-10	100 m ²	<1.77	<0.37	0.69±0.09	1.0
QRE-11	100 m ²	<1.42	0.96±0.12	0.93±0.11	2.0
QRE-12	100 m ²	<3.58	0.88±0.88	1.11±0.11	1.4
QSE-13A	100 m ²	<1.07	0.68±0.10	0.75±0.10	0.30
QSE-13B	100 m ²	<1.20	0.66±0.10	0.54±0.09	0.10
TRACK EXCAVATION CONTROL (ZONE 3)					
QTE-1	200 m ²	<1.10	<0.62	0.79±0.10	0.1
QTE-2	200 m ²	<1.36	<0.80	0.87±0.10	0.6
QTE-3	200 m ²	<1.38	<0.95±0.11	0.83±0.11	0.1
QTE-4	200 m ²	<1.43	0.77±0.14	0.67±0.10	0.4
QTE-5	200 m ²	<1.16	<0.61	0.70	1.4
QTE-6	200 m ²	<3.32	<0.41	0.75±0.10	0.7
QTE-7	100 m ²	<3.79	0.89±0.08	0.76±0.09	2.5

Table 3-1 Excavation Control Soil Sample Results (Continued)

SOIL CONCENTRATION, pCi/g

GRID I.D.	SAMPLE GRID AREA SIZE	U-238	Pb-226	Pb-228	Th-230 ^(b)
LOCATION NO. 8 (ZONES 4, 5, AND 6)					
QRE-5 HTSPT	0.01 m ²	<9.00	<0.61	14.85±0.86	0.70
QRE-12HTSPT	0.01m ²	<3.67	1.16±0.14	1.19±0.16	1.30
VP-8 NORTH	1.4 m ²	<1.49	1.62±0.14	0.85±0.11	0.3
VP-8 EAST	1.6 m ²	<4.16	2.00±0.18	0.49±0.13	2.2
VP-8 WEST	1.8 m ²	<1.80	1.96±0.20	0.65±0.13	0.6

- (a) Excavation control soil results reported here are biased low because samples are not dried and samples are not stored for several weeks prior to analysis to allow equilibrium between radon and gamma-emitting daughter products. This bias is taken into account when determining whether additional excavation is required.
- (b) No error limits are provided because Th-230 is analyzed by a quick screening procedure.

Table 3-2 Post Remedial Action Soil Sample Results

SOIL CONCENTRATION, pCi/g

GRID I.D	SAMPLE GRID AREA SIZE	U-238	Ra-226	Ra-228	Th-230
QUARRY ACCESS ROAD POST REMEDIAL ACTION					
QRV-1	100 m ²	<3.74	1.25±0.13	0.84±0.10	1.87±0.32
QRV-2	100 m ²	<3.72	1.47±0.15	0.70±0.13	4.11±0.63
QRV-3	100 m ²	<1.77	1.47±0.15	1.16±0.12	1.60±0.34
QRV-4	100 m ²	<1.46	1.25±0.12	0.86±0.10	1.56±0.29
QRV-5	100 m ²	<1.43	1.50±0.15	1.29±0.12	1.97±0.49
QRV-6	100 m ²	<3.44	1.06±0.12	0.60±0.08	2.07±0.70
QRV-7	100 m ²	<1.01	0.87±0.11	0.30±0.07	1.21±0.23
QRV-8	100 m ²	<1.06	1.15±0.12	0.54±0.08	1.76±0.36
QRV-9	41 m ²	<1.40	1.22±0.13	0.83±0.10	2.52±0.44
QRV-10	100 m ²	<3.46	1.16±0.13	1.03±0.10	2.44±0.42
QRV-11	100 m ²	<1.39	1.19±0.12	1.12±0.11	1.82±0.42
QRV-12	100 m ²	<1.65	1.57±0.14	0.99±0.10	2.23±0.40
QSV-13A	100 m ²	<1.33	1.33±0.12	1.17±0.10	1.32±0.33
QSV-13B	100 m ²	<1.37	<0.56	0.66±0.09	0.95±0.23
TRACK POST REMEDIAL ACTION					
QTV-1A	100 m ²	<1.50	0.94±0.12	1.04±0.10	1.32±0.47
QTV-1B	100 m ²	<3.42	<0.64	0.93±0.11	1.28±0.31
QTV-2A	100 m ²	<1.58	1.12±0.12	0.99±0.12	1.54±0.32
QTV-2B	100 m ²	1.91±0.93	1.43±0.13	0.86±0.10	1.70±0.45
QTV-3A	100 m ²	<1.41	1.13±0.14	1.04±0.07	1.21±0.28
QTV-3B	100 m ²	<1.28	1.15±0.15	0.81±0.10	0.60±0.18
QTV-4A	100 m ²	<1.48	1.32±0.15	0.92±0.11	2.18±0.41
QTV-4B	100 m ²	<1.44	1.42±0.13	1.00±0.09	1.86±0.32
QTV-5A	100 m ²	<1.54	1.54±0.14	0.99±0.11	1.86±0.47
QTV-5B	100 m ²	<1.48	1.49±0.14	1.01±0.10	1.77±0.33
QTV-6A	100 m ²	<1.64	1.74±0.15	0.77±0.09	1.33±0.26
QTV-6B	100 m ²	<1.39	1.01±0.17	0.73±0.09	0.81±0.25

Table 3-2 Post Remedial Action Sample Soils (Continued)

SOIL CONCENTRATION, pCi/g

GRID I.D	SAMPLE GRID AREA SIZE	U-238	Re-226	Re-228	Th-230
QTV-7	100 m ²	<1.66	1.32±0.14	0.93±0.11	2.12±0.41
CLNZNE-1	200 m ²	<1.40	<0.35	0.35±0.09	2.80
CLNZNE-2	200 m ²	<1.57	<0.79	0.73±0.12	1.81±0.32

4 SUMMARY

The goal of remedial actions is to ensure that resulting radiological and chemical conditions at the site are in compliance with the established criteria and/or guidelines and that the public, environment, and workers are protected. Verification is an independent evaluation of the final site or facility conditions to ensure that remedial action criteria and/or guidelines are appropriately applied and met. The purpose of independent verification is to validate the accuracy and completeness of field measurements and the credibility of the procedures followed, resulting in an independent assessment.

Oak Ridge Associated Universities (ORAU) is the independent verification contractor for the Weldon Spring Site Remedial Action Project (WSSRAP). They conducted an independent verification of the remedial action performed at the quarry construction staging area (QCSA) and water treatment plant site (WTP) by the Project Management Contractor (PMC). After remediation of the contaminated areas, ORAU performed an independent verification survey that included a gamma walkover scan and the collection of soil samples. ORAU's soil sample locations are shown on Figure 4-1. ORAU gave the PMC verbal confirmation that the QCSA area had been adequately remediated.

The area was released for unrestricted use for the construction of the QCSA and WTP facilities. This allowed personnel to perform work activities in the area without radiological and chemical personal protection equipment and restrictions.

-AREA REQUIRING EXCAVATION

-ORAU SAMPLE LOCATIONS

ORAU SAMPLE LOCATIONS

FIGURE 4-1

REPORT NO	DOE/OR/21548-200	EXHIBIT NO	A/QY/071/0991
ORIGINATOR	MAP	DRAWN BY	GLN
		DATE	9/91

5 REFERENCES

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