

SET I.D. _____

DOE/OR/21548-382
CONTRACT NO. DE-AC05-86OR21548

QUARRY RESIDUALS SAMPLING PLAN ADDENDUM 2: PHASE 2 SAMPLING

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

NOVEMBER 1995

REV. 0



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

Prepared by MK-Ferguson Company and Jacobs Engineering Group

	
	Rev. No. 0
Weldon Spring Site Remedial Action Project Contract No. DE-AC05-86OR21548	
PLAN TITLE: Quarry Residuals Sampling Plan Addendum 2: Phase 2 Sampling	

APPROVALS

W. J. P.
 Department Manager

11/6/95
 Date

[Signature]
 ES&H Department Manager

11/8/95
 Date

[Signature]
 Data Administration Manager

11/10/95
 Date

[Signature]
 Quality Assurance Manager

11/13/95
 Date

[Signature]
 Project Director (or Deputy Project Director)

11-13-95
 Date

Printed in the United States of America. Available from the National Technical Information Service, NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161

NTIS Price Codes - Printed copy: A02
Microfiche: A01

DOE/OR/21548-382

Weldon Spring Site Remedial Action Project

Quarry Residuals Sampling Plan Addendum 2: Phase 2 Sampling

Revision 0

November 1995

Prepared by

MK-FERGUSON COMPANY
and
JACOBS ENGINEERING GROUP
7295 Highway 94 South
St. Charles, Missouri 63304

for the

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

TABLE OF CONTENTS

<u>NUMBER</u>	<u>PAGE</u>
1 INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Flood and Other Impacts on Schedule	1
2 DATA QUALITY OBJECTIVES	3
2.1 State the Problem	3
2.2 Identify the Decision	3
2.3 Identify Inputs to the Decision	3
2.4 Define Boundaries of the Study	3
2.5 Develop a Decision Rule	3
2.6 Developing Uncertainty Constraints	4
2.7 Optimize the Design	4
3 WATER QUALITY OF THE RESURGENT QUARRY POND	5
3.1 Quarry Recharge	5
3.1.1 Water Sampling Inside the Quarry	7
3.1.2 Groundwater Sampling at Monitoring Wells	7
4 MODIFICATIONS AND ADDITIONS TO PHASE 1 SAMPLING ACTIVITIES	9
4.1 Contaminants of Concern	9
4.2 Additional Sampling in Quarry Vicinity Areas	9

TABLE OF CONTENTS (Continued)

<u>NUMBER</u>	<u>PAGE</u>
4.2.1 Soil Sampling	9
4.2.2 Surface Water Sampling	10
4.2.3 Sediment Sampling	12
4.2.4 Groundwater Sampling	13
4.2.4.1 New Monitoring Wells	13
4.2.4.2 Groundwater Analyses	14
4.2.4.3 Well Point Sampling	19
4.2.4.4 Other Tests	19
4.2.4.5 Identification of Bedrock Fractures	19
 5 REFERENCES	 20

LIST OF FIGURES

<u>NUMBER</u>		<u>PAGE</u>
3-1	Flow Chart Showing Plan for Quarry Recharge	6
3-2	Selected Monitoring Well Locations at the Weldon Spring Quarry	8
4-1	Weldon Spring Quarry Area Locations of Soil Borings	11

LIST OF TABLES

<u>NUMBER</u>	<u>PAGE</u>
4-1 Phase 1 Contaminants of Concern	9
4-2 Surface Water Sampling Locations	12
4-3 QROU 1B Sediment Sampling Matrix	15
4-4 Monitoring Well Analyses	17

1 INTRODUCTION

This addendum of the *Quarry Residuals Sampling Plan (Sampling Plan)* (Ref. 1) addresses Phase 2 characterization activities and modifications to Phase 1 characterization activities. Data Quality Objectives (DQOs) for Phase 2 activities are presented in this plan. Phase 1 DQOs, sampling locations, and topics common to both phases (e.g., quality assurance/quality control (QA/QC), health and safety issues, and sampling procedures) are addressed in the *Sampling Plan* (Ref. 1).

1.1 Purpose

Addendum 2 describes the following: (1) Recharge and sampling of the quarry pond (the only activity identified for Phase 2), (2) Modifications to Phase 1 objectives or sampling requirements (as presented in the *Sampling Plan*), and (3) The status of Phase 1 sampling activities.

1.2 Scope

The scope of the Phase 2 activities outlined in this Addendum is limited to water within the resurgent quarry pond. The scope of the Phase 1 activities discussed in this Addendum include soil, sediment, surface water, and groundwater sampling outside the quarry. The study area is illustrated in Ref. 1, Figure 2-2.

1.3 Flood and Other Impacts on Schedule

The schedule for completion of Phase 1 and Phase 2 sampling is affected by the following conditions:

- Missouri River flooding: Flooding from the Missouri River inundated the area south of the quarry, including the well field, on May 19, 1995. Once flooded, water typically remains in this area until St. Charles County breaches the levy, which prevents the water from flowing back into the river. The levy was

breached on July 14, 1995; therefore, piezometer and monitoring well installation and sampling in flooded areas could not be resumed until mid September.

- **End of bulk waste removal activities:** The completion of this task impacts the date that pumping the quarry can stop and natural recharge of the quarry pond can begin. At the time this document was being prepared, final washing of the quarry walls and floor was expected to be completed by the first week in December.
- **Quarry Pond:** Evaluating the quality of the quarry pond water is dependant on the time required to refill the pond and to establish steady-state conditions in the pond water.
- **License agreements with the Missouri Department of Natural Resources (MDNR) and with the Missouri Department of Conservation (MDC):** License agreements between the DOE and these agencies must be established to perform work in areas under their control.

2 DATA QUALITY OBJECTIVES

2.1 State the Problem

The quarry pond has been continuously dewatered during bulk waste operations to facilitate removal of the wastes and final washing of the quarry floor and walls. Once dewatering is stopped, the quarry pond will begin to refill. The equilibrium water quality and water level of the resurgent pond cannot be predicted, because the waste removal process has altered the chemical and physical properties of the quarry. Allowing the quarry pond to reestablish steady-state conditions with the surrounding environment is necessary to determine the risk associated with the resurgent water that is projected to remain in the quarry and which will be addressed as residuals under the Quarry Residuals Operable Unit (QROU).

2.2 Identify the Decision

A decision has been made to collect data to evaluate potential human health and ecological risks from resurgent pond water.

2.3 Identify Inputs to the Decision

The concentration of radiological and chemical contaminants in the quarry pond will contribute to this decision.

2.4 Define Boundaries of the Study

The study is confined to ponded water in the quarry proper.

2.5 Develop a Decision Rule

The quarry pond data collected under this addendum will be used in the *Baseline Risk Assessment*. Quarry pond sampling will continue until sufficient data have been collected to support determination of risk values with the confidence specified in Section 2.6.

2.6 Developing Uncertainty Constraints

Based on the null hypothesis that the quarry pond water is contaminated, sampling in the quarry area is designed to minimize the probability of false negatives (i.e., the probability of determining that an area is clean when it is actually contaminated). Where applicable, the objective is to achieve a false negative rate of <5% and a false positive rate of <20%, relative to concentrations associated with 10^{-5} risk levels or with hazard quotients of 0.5. The 10^{-4} risk level will be used for Ra-226, Ra-228, and Th-232 because the 10^{-5} values are within background ranges. Evaluation of data will include determining the performance criteria achieved. This information will be incorporated into the *Baseline Risk Assessment*, which will be prepared in the near future.

2.7 Optimize the Design

The plan for quarry recharge and sampling is diagramed in Figure 3-1. Sampling for risk assessment purposes will not be conducted until Step 2 (as identified in Figure 3-1) of the plan to provide data that are likely to be representative of equilibrium conditions in the pond water.

3 WATER QUALITY OF THE RESURGENT QUARRY POND

3.1 Quarry Recharge

The risk posed by water in the quarry pond after completion of bulk waste removal cannot be evaluated without data from the pond, itself. Although data from soil and rock samples collected from the remediated quarry can be used to predict the risk to a potential recreational visitor to the quarry, these data cannot be used to predict the quality of the pond water because inaccessible zones of contamination, which could leach contaminants to the water, may still be present in the fractures and voids in the quarry walls and floor.

During bulk waste removal, water has been continuously pumped from the quarry pond to depress the groundwater level below the level of wastes. Along the southern margin of the quarry these dewatering activities have reversed the flow of groundwater from its normal outward (or southerly) direction to an inward direction. Evidence of this draw-down and flow reversal is the significant drop in water levels in wells along the southern rim of the quarry. To adequately assess the impact of residual contamination on the groundwater, the water level in the quarry will be allowed to return to equilibrium or steady state conditions with respect to the surrounding environment. Allowing groundwater and surface runoff to naturally accumulate in the quarry will provide information on the quality of the water inside the quarry and that of water migrating from the quarry southward into the alluvium.

Quarry recharge will be conducted in three discrete steps, as outlined in Figure 3-1. In Step 1, the quarry will be allowed to fill to the "rapid recharge" level (the level where rapid recharge of the quarry stops), the water will be sampled, and then the quarry will be pumped down. This process, which will continue to clean the quarry, will be repeated two to three times, depending on the time required for recharge and measured contaminant levels in the water.

In Step 2, pumping will be discontinued and the quarry will be allowed to refill to the 454 ft elevation level. Based on historic data, this elevation was determined to be the level where water begins to flow outward from the quarry to the alluvium. Physical changes to the quarry during waste removal may have opened fractures or flow paths from the quarry, which may in turn affect this level. Sampling will be conducted periodically during Step 2, as

QUARRY RECHARGE

STEP 1

End Bulk Waste Sampling

Process:
Allow QY to recharge to level*
-sample water
-pump down

* = Rapid Recharge Level (3-5 days)

Repeat process for 14 days

Continue process?

YES

Repeat process for 14 days

STEP 2

STOP PUMPING

Is water level 454?

NO

Have 3 months elapsed?

YES

Evaluate Options
-Continue natural recharge
-Change objectives of test
-Move Forward

YES

Is U<600 pCi/L?

Move Forward

STEP 3

NO

Evaluate Options
-Pump down
-Continue recharge
-Artificial recharge

YES

Have >2 months elapsed?

Continue natural recharge

YES

Evaluate artificial recharge to 464 or new static water level

FIGURE 3-1

REPORT NO.:	DOE/OR/21548-382	EXHIBIT NO.:	A/PI/103/1195
ORIGINATOR:	JGP	DRAWN BY:	SRS
		DATE:	11/2/85

described below, to assess the quality of the pond water and changes in adjacent monitoring wells.

To prevent any potential adverse effects on the groundwater, dewatering and treatment could be resumed if elevated contaminant levels (e.g., total uranium > 600 pCi/l) are observed in the quarry pond or if increasing contaminant levels are measured in monitoring wells surrounding the quarry.

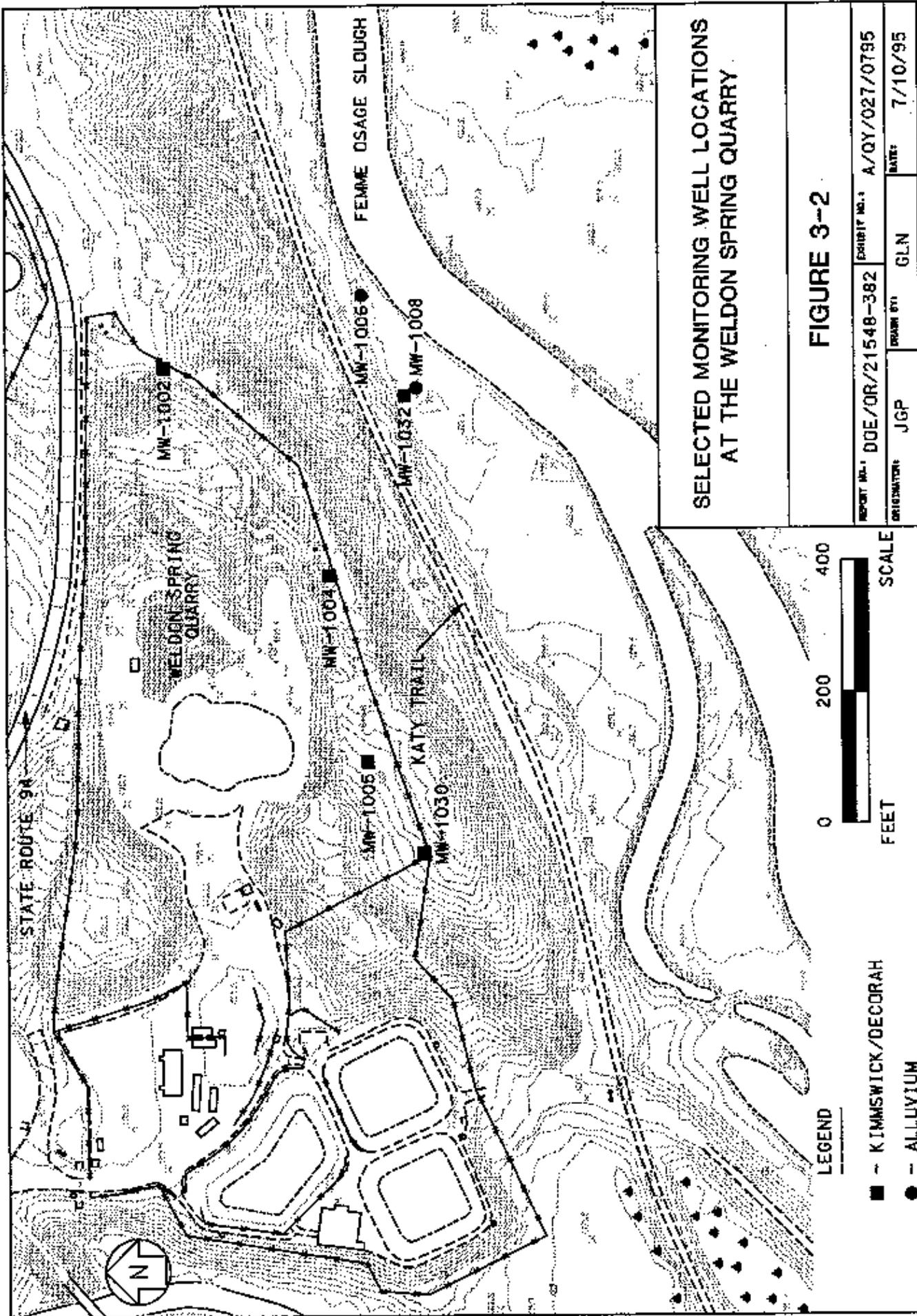
If the quality of the pond water would not adversely impact the downgradient groundwater system, Step 3 will be implemented. In Step 3, the pond will be allowed to rise to its equilibrium level. Historically, this level has been 464 ft. If recharge is slow, water may be added to the pond to expedite determination of the new equilibrium water level of the pond.

3.1.1 Water Sampling Inside the Quarry

The schedule for sampling resurgent water in the quarry will be based on the volume and/or depth of water in the quarry pond. For example, samples may be collected for every 5 ft increase in depth. The exact schedule will be developed once dewatering of the quarry has been discontinued. Initially, the quarry pond will be divided into four quadrants and a sample will be collected from each quadrant. If concentrations in these samples are similar, sampling locations may be deleted. When the pond water depth exceeds 15 ft, a comparison of the water quality between shallow and deep samples will be conducted. Samples will be analyzed for the radiological, nitroaromatic, and hazardous metal parameters that have been identified as potential contaminants during bulk waste removal and previous groundwater sampling. The analytical parameters will be reevaluated as recharge and sampling progresses.

3.1.2 Groundwater Sampling at Monitoring Wells

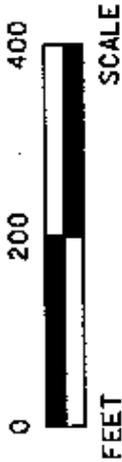
Monitoring wells that are adjacent to the quarry or are known to be hydrologically connected to the quarry will be sampled along with the quarry pond to monitor changes in water quality as the pond recharges. The analytical parameters will include the parameters that are being monitored in the quarry pond. The selected wells are shown in Figure 3-2.



SELECTED MONITORING WELL LOCATIONS
AT THE WELDON SPRING QUARRY

FIGURE 3-2

REPORT NO.: DOE/OR/21548-382	EXHIBIT NO.: A/QY/027/0795
ORIGINATOR: JGP	DRAWN BY: GLN
	DATE: 7/10/95



- LEGEND
- - KIMMSWICK/DECORAH
 - - ALLUVIUM

4 MODIFICATIONS AND ADDITIONS TO PHASE 1 SAMPLING ACTIVITIES

4.1 Contaminants of Concern

During Phase 1 of the remedial investigation sampling effort, soil, sediment, surface water, and groundwater samples were collected from areas adjacent to the quarry. Analytical results from these samples were compared with background levels and concentrations associated with the target risk levels, which were identified in the *Work Plan for Remedial Investigation/Feasibility Study - Environmental Assessment for the Quarry Residuals Operable Unit at the Weldon Spring Site* (Ref. 2). These comparisons are presented in Table 4-1. All data collected under the Sampling Plan (Ref. 1) will be summarized in the *Quarry Residuals Remedial Investigation Report*.

TABLE 4-1 Phase 1 Contaminants of Concern

MEDIA	CONTAMINANTS EXCEEDING BACKGROUND	CONTAMINANTS EXCEEDING 10^{-5} RISK LEVEL OR HAZARD QUOTIENT OF 0.5
Soil	U-238	U-238
Sediments*	U-238	None identified
Surface Water*	U-238	None identified
Groundwater*	U-238; Sulfates; Nitroaromatics	U-238; Nitroaromatics

* Background characterization not complete.

4.2 Additional Sampling in Quarry Vicinity Areas

4.2.1 Soil Sampling

In accordance with the *Sampling Plan* (Ref. 1), two separate soil sampling efforts were conducted during Phase 1. Surface soil samples were collected from the area between the Katy Trail and the Femme Osage Slough. This area was divided into 14 units and a composite sample comprising samples collected from the 0 - 6 in. depth interval was taken from each unit (Ref. 1;

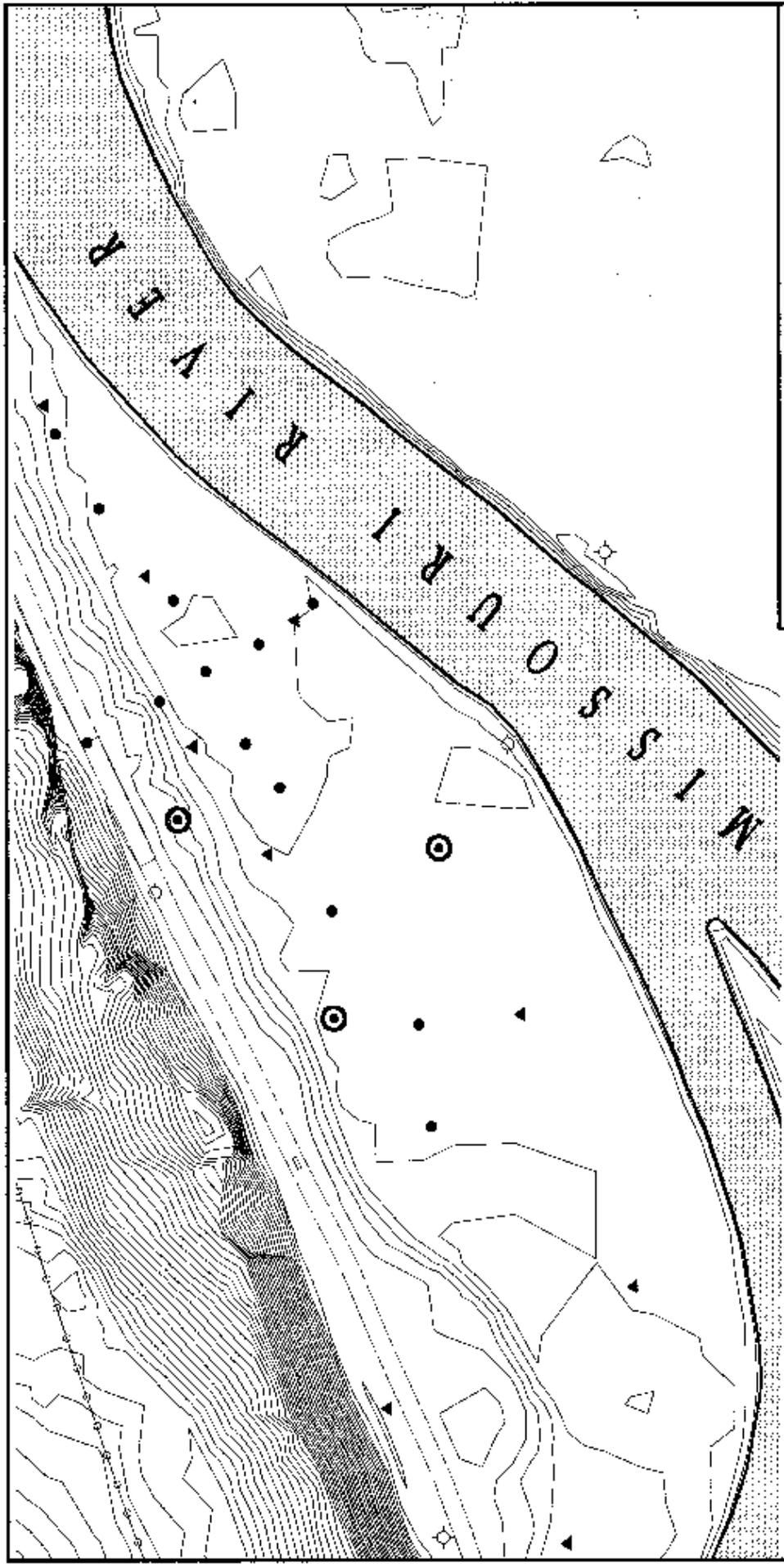
Figure 8-13). The results, which are presented in the *Surface Soil Analytical Results for the Vicinity Property 9 Area* (Ref. 4), indicate that uranium is elevated in three units, with the highest values occurring in Sample Area 5, which contains Vicinity Property 9 (VP-9). None of the composite samples contained uranium concentrations that would exceed the 1×10^{-5} risk level, based on a recreational scenario. Other radionuclides, nitroaromatics, and metals were below detection limits or were present at background or low levels.

Surface and subsurface soil samples were collected from 22 vertical borings and three angled borings located around the quarry area (Ref. 1, Figures 8-11 and 8-12). Background samples were collected from two vertical borings in the Darst Bottoms and from one vertical boring east of the St. Charles County well field. This sampling effort included 219 samples collected from predetermined depths. All samples were analyzed for total uranium and arsenic. Nitroaromatics, radionuclides, geochemical parameters, metals, polycyclic (or polynuclear) aromatic hydrocarbons (PAHs), polyvinyl chloride (PVC) and volatile organic compounds were analyzed at selected locations and intervals.

Soil borings that were scheduled to be collected during installation of three alluvial and three bedrock monitoring wells have not been collected due to delays in these drilling tasks. These tasks are expected to be completed by January 1, 1996. In addition to these borings, two additional borings will be collected to fill data gaps in the Phase 1 characterization (Figure 4-1). The data quality objectives (DQOs) and collection methods for all borings are specified in the *Sampling Plan* (Ref. 1). Additional soil sampling in the 0 to 1 ft depth interval has been performed in the VP-9 area to support engineering design for remediation of this area (Ref. 7). Aside from the borings discussed here, no further soil sampling is proposed for any other area outside the quarry at this time.

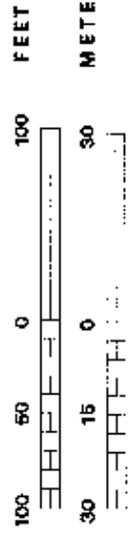
4.2.2 Surface Water Sampling

Analysis of initial Phase 1 data (as proposed in the *Sampling Plan* [Ref. 1]) and previous surface water data have identified total uranium as the only potential contaminant that significantly exceeds expected background levels. Consequently, the surface water locations listed in Table 4-2 (Ref. 1, Figure 7-10) will be sampled for total uranium only. These locations



L E G E N D

-  QRSB SAMPLING LOCATIONS
-  UNC SAMPLING LOCATIONS
-  SOIL BORINGS FROM MONITORING WELL INSTALLATION
-  PLANNED PHASE I BORINGS



WELDON SPRING QUARRY AREA
LOCATIONS OF SOIL BORINGS

Figure 4-1

EXHIBIT NO.: A/QY/939/1195	REPORT NO.: DOE/OR/21548-382
ORIGINATOR: JGP	DRAWN BY: WSSRAP GIS
	DATE: 11/95

will be sampled monthly for 3 months after the slough has returned to its banks to evaluate the impact of the recent flooding on uranium concentrations. Radium and thorium will also be measured at locations that have been sampled only once for these parameters. (Refer to Table 4-2.) The surface water data will be summarized in the *Quarry Remedial Investigation Report*.

The surface water background location, as specified in the *Sampling Plan* (Ref. 1), has been changed because the Weldon Spring Site Remedial Action Project (WSSRAP) was unable to gain access rights to the Augusta Slough or any other suitable sampling location. Instead, two locations on the Femme Osage Creek (SW-1023 and SW-1024), will be used for background comparisons for the Femme Osage Slough and other surface water locations. This substitution should provide a suitable reservoir for background comparisons, because the Femme Osage Slough formed the lower section of the Femme Osage Creek before the construction of the levy, which diverted the creek southward to the Missouri River and isolated the slough.

4.2.3 Sediment Sampling

Phase 1B of the sediment sampling activities, as described in the *Sampling Plan* (Ref. 1), was delayed until September 1995 due to flooding. Table 4-3 lists the locations (Ref. 1, Figure 8-10) and parameters that were sampled.

TABLE 4-2 Surface Water Sampling Locations

LOCATION	PARAMETER	SAMPLING FREQUENCY	TOTAL NUMBER OF SAMPLES
SW-1003	Total uranium	monthly	3
SW-1005	Total uranium	monthly	3
SW-1009	Total uranium	monthly	3
SW-1010	Total uranium	monthly	1
SW- (MO. River)	Uranium		
SW-1019	Ra* & Th*	NA	1
	Total uranium	monthly	3

TABLE 4-2 Surface Water Sampling Locations (Continued)

LOCATION	PARAMETER	SAMPLING FREQUENCY	TOTAL NUMBER OF SAMPLES
SW-1020	Total uranium	monthly	3
SW-1023 SW-1024	Ra* & Th*, Total Uranium, Nitroaromatics, Geochemical	NA	1

Ra* = Ra-226, Ra-228

Th* = Th-228, Th-230, Th-232

NA = Not applicable

Phase 1B completes Quarry Residuals Operable Unit (QROU) sediment sampling in the Femme Osage Slough and Little Femme Osage Creek. No additional sediment sampling is proposed for these areas. Similar to surface water, background sediment samples could not be collected from the Augusta Slough, as specified in the *Sampling Plan* (Ref. 1). Instead, locations SD-1023 and SD-1024 in the Femme Osage Creek will be used for background. Samples will be collected from these locations and analyzed for metals, radionuclides, and geochemical parameters.

Analysis of the contaminants of concern in different sediment size fractions, as specified in the *Sampling Plan* (Ref. 1), has been removed from Phase 1B sampling. These analyses were deleted because contaminant concentrations in the sediment samples collected during Phase 1 were low or at expected background levels. Thus, understanding the distribution of contaminants between the coarse and fine size fractions was determined to be unnecessary.

4.2.4 Groundwater Sampling

4.2.4.1 New Monitoring Wells. Installation of the new monitoring wells described in the *Sampling Plan* (Ref. 1) has not been completed due to delay of the licensing agreement between the U.S. Department of Energy (DOE) and the Missouri Department of Conservation (MDC) for access to the area where the wells are to be located, and due to

flooding of the Missouri River. At the time this plan was being prepared, two upgradient wells had been installed, but the six downgradient locations had not been installed. The locations of these wells are shown in Ref. 1, Figure 4-3.

Monitoring wells within the quarry proper have not been proposed for Phase 2, because angled boreholes completed during Phase 1 indicated that vertical migration from the quarry into the deeper bedrock is a minor pathway. The primary flow direction is toward the south and is controlled by fractures and bedding planes in the upper bedrock units (Kimmswick and Decorah).

The six wells that are yet to be installed as part of Phase 1 include three wells screened within the upper 20 ft of the Platin, the lowest bedrock unit to be sampled. These wells are to be located immediately south of the quarry and should adequately monitor possible impacts of quarry-derived contaminants on this deeper formation. Three of these wells are scheduled to be located adjacent to the Katy Trail and require a license agreement between the DOE and the Missouri Department of Natural Resources (MDNR)-Parks Division, which operates the Katy Trail. The three remaining wells, which will be screened in the alluvium, include two wells north and one well south of the slough.

4.2.4.2 Groundwater Analyses. Table 4-4 lists the analyses that will be performed to fill data gaps in the Phase 1 monitoring well sampling. The frequency for each type of analysis is given in the second row of the Table. Phase 1 DQOs and sampling procedures apply to these samples.

Although not identified as groundwater contaminants in the quarry wells, carcinogenic polycyclic (or polynuclear) aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) have been identified in the quarry wastes. These parameters will be measured in monitoring wells that are adjacent to the quarry and that have not been sampled for these parameters since 1990. Geochemical samples (which include analyses for hazardous metals) will be collected in

TABLE 4-3 QROU 1B Sediment Sampling Matrix

	LOCATION	ID	ANALYTICAL PARAMETERS	FIELD PARAMETERS ^(A)
1	Little Femme Osage Creek	SD-1001	Th*	pH, Water Level, T ^o , Eh, DO, Spec.Con.
2	Little Femme Osage Creek	SD-1016	Th*, Ra*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
3	Little Femme Osage Creek	SD-1017	Th*	pH, Water Level, T ^o , Eh, DO, Spec.Con.
4	Femme Osage Creek	SD-1014	Th*, Ra*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
5	Femme Osage Slough	SD-1010	Th*, Ra*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
6	Femme Osage Slough	SD-1018	Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
7	Femme Osage Slough	SD-1019	Th*, Ra*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
8	Femme Osage Slough	SD-1003	Th*, Ra*, Total U, Nitroaromatics	pH, Water Level, T ^o , Eh, DO, Spec.Con.
9	Femme Osage Slough	SD-1004	Th*, Ra*, Total U, Nitroaromatics	pH, Water Level, T ^o , Eh, DO, Spec.Con.
10	Femme Osage Slough	SD-1021	Th*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
11	Femme Osage Slough	SD-1005	Th*, Ra*, Total U, Nitroaromatics	pH, Water Level, T ^o , Eh, DO, Spec.Con.
12	Femme Osage Slough	SD-1007	Th*, Ra*, Total U, Nitroaromatics	pH, Water Level, T ^o , Eh, DO, Spec.Con.
13	Femme Osage Slough	SD-1022	Th*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
14	Femme Osage Slough	SD-1009	Th*, Ra*, Total U	pH, Water Level, T ^o , Eh, DO, Spec.Con.
15	Femme Osage Creek (background)	SD-1023 SD-1024	Th*, Ra*, Total U, metals, geochemical	pH, Water Level, T ^o , Eh, DO, Spec.Con.

All samples to be composites

TABLE 4-3 QROU 1B Sediment Sampling Matrix (Continued)

(a)	Measured in surface water at location where sample collected.
Th ⁺	Th-228, Th-230, Th-232
Ra ⁺	Ra-226, Ra-228

TABLE 4-4 Monitoring Well Analyses

MONITORING WELL	PAHS	PCBS	GEOCHEMICAL*	ANTIMONY	NITROAROMATICS
	1 time	1 time	3 times	3 times	1 time
MW-1002	✓	✓		✓	
MW-1004	✓	✓	✓		
MW-1005	✓	✓		✓	
MW-1006	✓	✓	✓		
MW-1007	✓	✓	✓		
MW-1008	✓	✓	✓		
MW-1009	✓	✓	✓		
MW-1010			✓		✓
MW-1011			✓		✓
MW-1012			✓		
MW-1013	✓	✓		✓	
MW-1014	✓	✓		✓	
MW-1015	✓	✓	✓		
MW-1016	✓	✓	✓		
MW-1017			✓		
MW-1018					✓
MW-1019					✓
MW-1020			✓		✓
MW-1021					✓
MW-1022					✓
MW-1023			✓		✓
MW-1024			✓		
MW-1025			✓		
MW-1026			✓		

TABLE 4-4 Monitoring Well Analyses (Continued)

MONITORING WELL	PAHS	PCBS	GEOCHEMICAL*	ANTIMONY	NITROAROMATICS
	1 time	1 time	3 times	3 times	1 time
MW-1027	✓	✓			
MW-1028	✓	✓			
MW-1029			✓		
MW-1030	✓	✓	✓		
MW-1031	✓	✓			
MW-1032	✓	✓			
MW-1034				✓	
MW-1035			✓		
MW-1036			✓		
MW-1037			✓		
MW-1038				✓	
MW-1040			✓		
MW-1041			✓		

* Defined in Sampling Plan

monitoring wells that were not included in the *1994 Environmental Monitoring Plan* sampling for these parameters. The results of the geochemical analyses will be used to support the baseline risk assessment and to evaluate geochemical controls on contaminant transport. Nitroaromatic compounds and degradation products will also be monitored in selected wells south of the slough to evaluate contaminant transport beneath the Femme Osage Slough. Antimony will be analyzed, using a method that provides detection limits below the Maximum Concentration Level (MCL) of 6 ug/L, at monitoring wells that only have antimony data with detection limits above this level only.

As specified in Ref. 1, Section 8.6.1, analytical results from filtered and unfiltered samples collected during the initial rounds of sampling, were compared. This comparison indicated that omitting filtering impacted the concentrations of only a few metals. Thus, with the exception of samples that will be analyzed for metals, filtering is no longer a routine part of groundwater collection procedures at the quarry.

4.2.4.3 Well Point Sampling. An additional phase (Phase 3) of well-point sampling will be conducted to further define the boundaries of the nitroaromatic and total uranium plumes down gradient from the quarry. Sampling will be limited to the area between the quarry and the Femme Osage Slough. Well point sampling in support of the quarry residuals remedial investigation has been conducted under the *Weldon Spring Quarry Supplementary Environmental Monitoring Investigations Sampling Plan* (Ref. 8). Phase 3 is described in Addendum 3 to that document.

4.2.4.4 Other Tests The tracer tests specified in Ref. 1, Section 7.5.3, have been deleted because investigations by the U.S. Geological Survey (USGS) indicated that useful information would not be generated. Groundwater models will be the primary tool used to evaluate the rate and direction of groundwater flow in the vicinity of the quarry. If the models cannot constrain these properties adequately, techniques to measure these properties in the field will be considered.

4.2.4.5 Identification of Bedrock Fractures. The predominant migration pathways for contaminated groundwater from the quarry are fractures and solution features within the bedrock (Kimmswick and Decorah) forming the southern rim of the quarry. The environmental monitoring results indicate that these fracture systems extend into the bedrock beneath the alluvial materials north of the slough. If continuous fracture zones connect the quarry to the alluvial materials south of the quarry, they may be the source of groundwater contamination south of the quarry. These fractures may contain contaminated soils that could continue to be a source of groundwater contamination after bulk waste is removed and the water level in the quarry is allowed to return to its natural state.

Fracture mapping, as outlined in Ref. 1, Section 7.2, will continue during Phase 2. The orientation and configuration of fractures exposed during bulk waste removal will be included in this task.

5 REFERENCES

1. MK-Ferguson Company and Jacobs Engineering Group. *Quarry Residuals Sampling Plan*, Rev. 1. DOE/OR/21548-382. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. January 1994.
2. Argonne National Laboratory. *Work Plan for the Remedial Investigation/Feasibility Study-Environmental Assessment for the Quarry Residuals Operable Unit at the Weldon Spring Site*. DOE/OR/21548-243. Prepared for the U. S. Department of Energy, Weldon Spring Site Remedial Action Project by the Environmental Assessment Division. St. Charles, MO. January 1994.
3. U.S. Department of Energy. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site*. DOE/OR/21548-376. Oak Ridge Field Office. St. Charles, MO. September 1993.
4. MK-Ferguson Company and Jacobs Engineering Group. *Surface Soil Analytical Results for the Vicinity Property 9 Area*, Rev. 0. DOE/OR/21548-463. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. June 1994.
5. Marutzky, S.J., R. Colby, and L. S. Cahn. *Radiologic Characterization of the Weldon Spring, Missouri, Remedial Action Site*, DOE/ID/12548-22. Prepared for the U.S. Department of Energy, by UNC Geotech. Grand Junction, CO. February 1988.
6. Boerner, A.J. *Radiological Survey of the August A. Busch and Weldon Spring Wildlife Areas Weldon Spring Site, St. Charles County, Missouri*, Final Report. Prepared by Oak Ridge Associated Universities, for U.S. Department of Energy, Division of Remedial Action Projects. April 1986.
7. MK-Ferguson Company and Jacobs Engineering Group. *Engineering Sampling to Delineate the Boundary of Vicinity Property 9*. Rev. 0. DOE/OR/21548-575. Prepared for the U. S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1995.

-
8. MK-Ferguson Company and Jacobs Engineering Group. *Weldon Spring Quarry Supplementary Environmental Monitoring Investigations Sampling Plan*, Rev. 0. DOE/OR/21548-264. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. August 1992.

CODE OF STATE REGULATIONS

10 CSR 23, *Missouri Water Well Law*

382 add 2

MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: 11/27/95 Transmittal No.: 62-0088-00

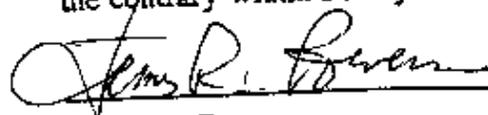
Title of Document: Quarry Residuals Sampling Plan Addendum 2 -
Phase 2 Sampling

Doc. Num.: 382 Rev. No.: 0 Date of Document: November 1995

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

The Project Management Contractor has reviewed and approved the attached document and hereby delivers it to the U.S. Department of Energy, Weldon Spring Site Office.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.


James R. Powers
Project Director

27483