RECORD OF DECISION: DOE/OR/21548-725

Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri

September 1998

prepared by

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

DECLARATION STATEMENT

Site Name and Location

Weldon Spring Quarry
St. Charles County, Missouri

Statement of Basis and Purpose

This Record of Decision (ROD) presents the selected remedial action for the Quarry Residuals Operable Unit (QROU) of the U.S. Department of Energy's Weldon Spring Site in St. Charles County, Missouri. This action was selected following requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. National Environmental Policy Act (NEPA) issues related to the quarry area have also been addressed and have been integrated into the CERCLA decision-making process for the QROU.

This decision is based on the *Administrative Record* for the QROU. Major documents include the (1) RI/FS Work Plan, (2) Remedial Investigation and Baseline Risk Assessment Reports, (3) Feasibility Study Report, and (4) Proposed Plan. Public comments received during the review period for the Proposed Plan were considered and have been incorporated into this decision.

The State of Missouri concurs with the selected remedy.

Assessment of the Site

The response action selected by this ROD addresses actual or threatened releases of hazardous substances from this site that were not addressed under previous response actions.

Description of the Selected Action

The QROU is the second of two operable units established for the quarry area of the Weldon Spring site. The first operable unit, the Quarry Bulk Waste Operable Unit, addressed the excavation and relocation of the source materials located in the quarry proper. This operable unit addresses residual conditions at the quarry, including contaminated groundwater and surface water. Based on exposure assessments under current and reasonably anticipated land uses, no further action is necessary to protect human health and the environment. However, because contamination will remain on-site, long-term monitoring will be undertaken as described below.

The major components of the selected remedy are:

- Monitor long term to verify that conditions at the quarry area and the St. Charles County well field remain protective of human health and the environment;

- Implement institutional controls to prevent uses inconsistent with recreational use or uses that would adversely affect contaminant migration.

Further sampling activities are planned for two purposes. Given the presence of significant levels of contamination in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field, and the reliance on natural systems to limit potential exposure, a field test will be performed to further evaluate the effectiveness of groundwater remediation. This activity will include the operation of a pilot-scale extraction trench. Sampling will also be performed to establish the extent of contamination for the two soil areas (i.e., the northeast slope and the ditch area near the transfer station) within the quarry proper. Preliminary sampling has indicated the presence of radiological contamination. A complete characterization of these areas could not be performed because access to these areas is limited. If contaminant levels are found to be unacceptable following a risk evaluation, these areas will be addressed under a subsequent response action.

Statutory Determinations

The selected action is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. This remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because groundwater contamination will remain at the quarry at levels that exceed those for unlimited land use and unrestricted exposure, a review will be conducted within five years after commencement of the action to evaluate conditions at the quarry area and to ensure that the remedy continues to provide adequate protection of human health and the environment. The five-year reviews will be developed in consultation with the U.S. Environmental Protection Agency and the Missouri Department of Natural Resources and will be made available to the public for review and comment.

Martha R. Steincamp for

Regional Administrator
U.S. Environmental Protection Agency Region VII

9/30/98
Date

Roger R. Nelson

Assistant Manager for Environmental Management
Oak Ridge Operations Office
U.S. Department of Energy

9-22-98
Date

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The following is a list of the acronyms, initialisms, and abbreviations (including units of measure) used in this document. Acronyms and abbreviations used only in tables and figures are defined in the respective tables and figure captions.

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BRA	baseline risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
CSR	*Code of State Regulations*
1,3-DNB	1,3-dinitrobenzene
2,4-DNT	2,4-dinitrotoluene
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FS	feasibility study
MCL	maximum contaminant level
MDNR	Missouri Department of Natural Resources
MDOH	Missouri Department of Health
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	operation and maintenance
PP	proposed plan
QROU	quarry residuals operable unit
RD/RA	remedial design/remedial action
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
TBC	to-be-considered (requirement)
WSCC	Weldon Spring Citizens Commission
WSSRAP	Weldon Spring Site Remedial Action Project

Units of Measure

cm	centimeter(s)	m	meter(s)
ft	foot (feet)	m^3	cubic meter(s)
g	gram(s)	µg	microgram(s)
gal	gallon(s)	mi	mile(s)
gpm	gallon(s) per minute	mL	milliliter(s)
ha	hectare(s)	pCi	picocurie(s)
km	kilometer(s)	ppm	part(s) per million
L	liter(s)	s	second(s)
		yd^3	cubic yard(s)

RECORD OF DECISION FOR REMEDIAL ACTION FOR THE QUARRY RESIDUALS OPERABLE UNIT AT THE WELDON SPRING SITE, WELDON SPRING, MISSOURI

1 SITE HISTORY

The Weldon Spring Quarry is one of two noncontiguous areas that constitute the U.S. Department of Energy's (DOE) Weldon Spring site. The main area of the site is the chemical plant. Both areas are located in St. Charles County, Missouri, about 48 km (30 mi) west of St. Louis (Figure 1). The U.S. Environmental Protection Agency (EPA) listed the quarry on the National Priorities List (NPL) in 1987, and the chemical plant area was added to the list in 1989. The quarry is about 6.4 km (4 mi) south-southwest of the chemical plant area; it is accessible from State Route 94 and is currently fenced and closed to the public (Figure 2). The quarry is approximately 300 m (1,000 ft) long by 140 m (450 ft) wide and covers an area of approximately 3.6 ha (9 acres). The quarry was used by the Army for disposal of chemically contaminated (explosive) materials in the 1940s and was later used for the disposal of radioactively contaminated material by the Atomic Energy Commission (AEC) in the 1960s.

Approximately 110,000 m^3 (144,000 yd^3) of soil and waste material was removed from the quarry and transported to the chemical plant area as part of completing the remedial action stipulated in the Record of Decision (ROD) for the Quarry Bulk Waste Operable Unit (DOE 1990). Bulk waste removal was completed in October 1995. These wastes have been placed in the disposal cell at the chemical plant. Prior to bulk waste removal, contaminated water contained in the quarry pond was also removed; approximately 170 million L (44 million gal) has been treated as of March 1998.

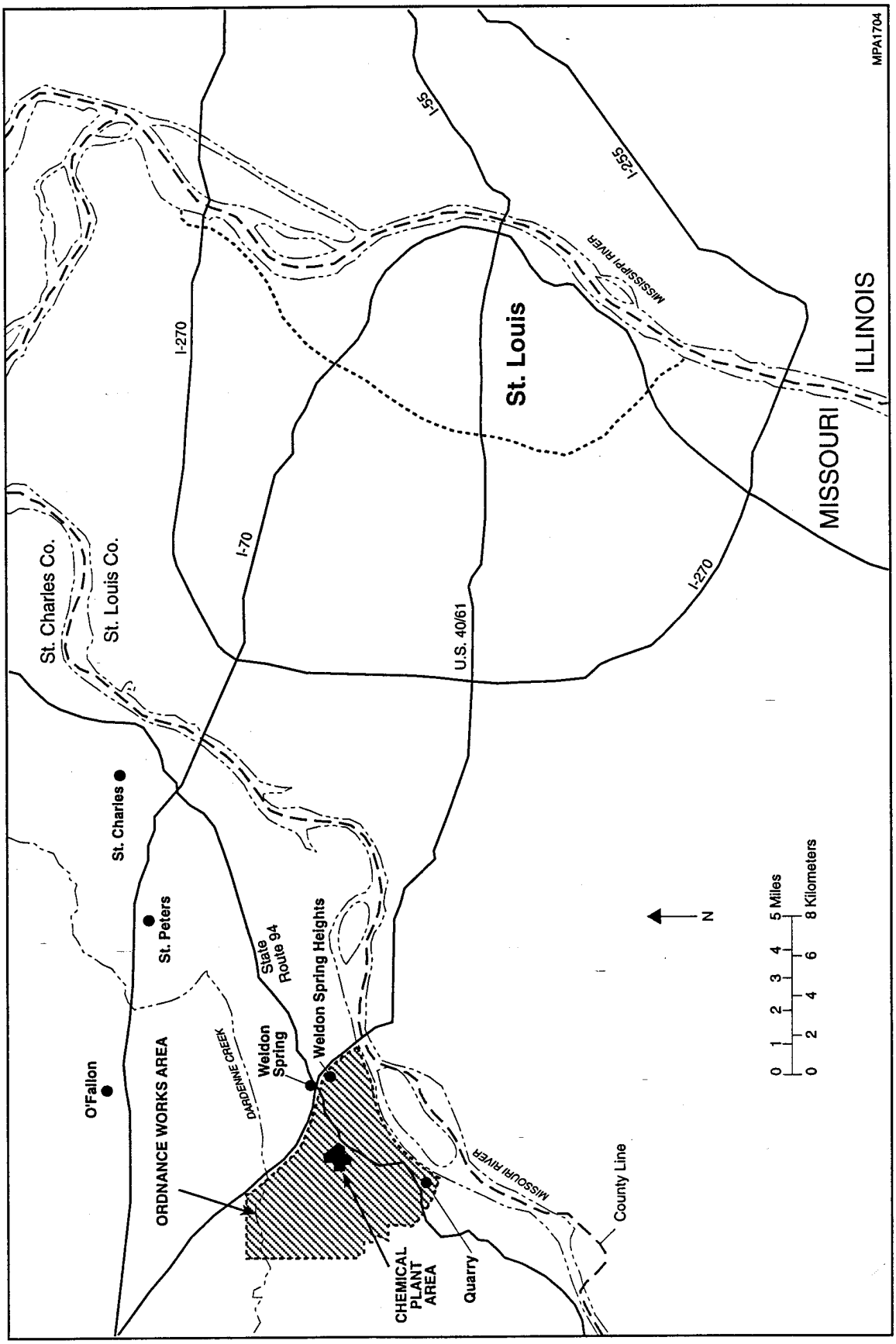

FIGURE 1 Location of the Weldon Spring Site

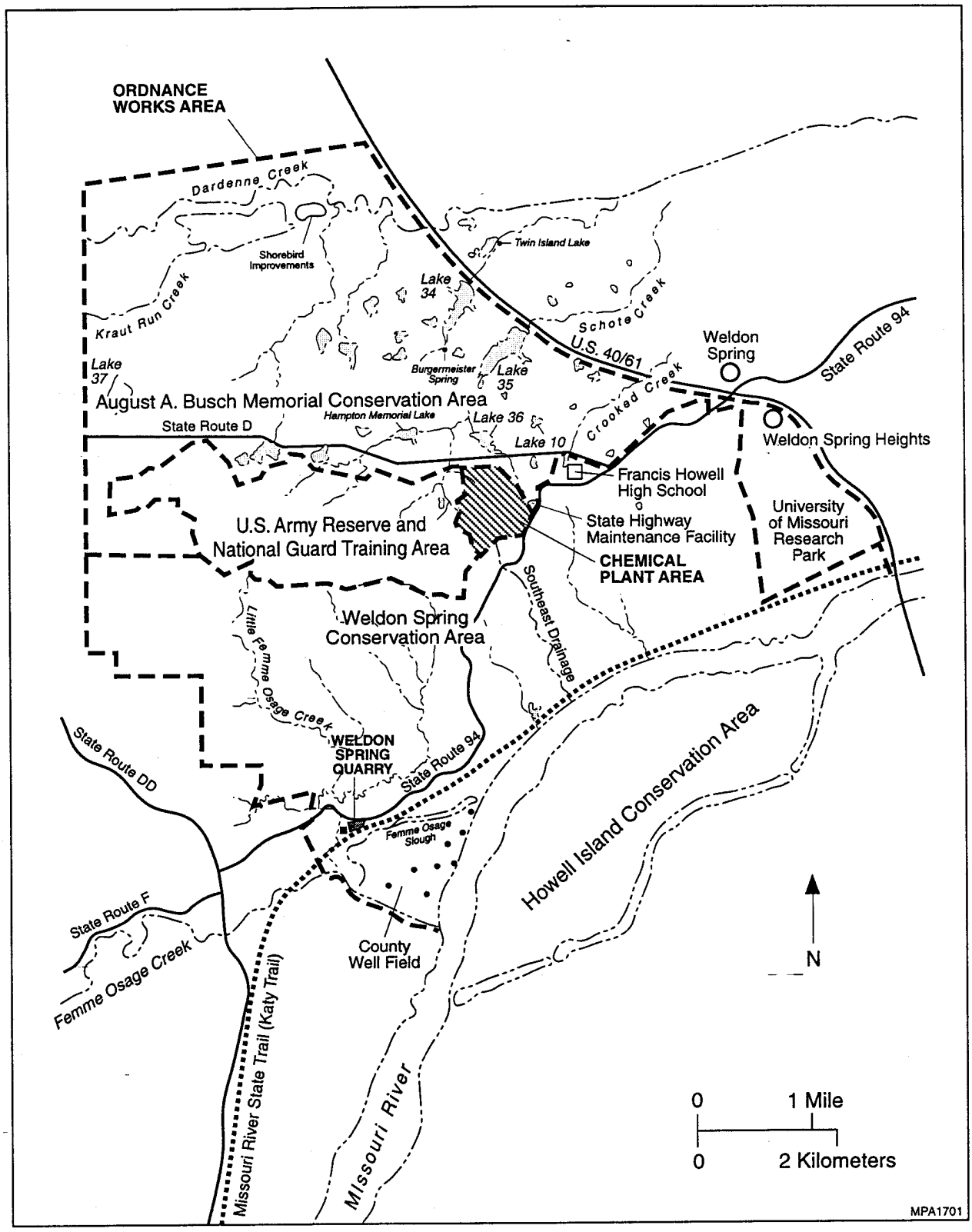

FIGURE 2 Area near the Weldon Spring Quarry

2 SCOPE AND ROLE OF REMEDIAL ACTION

The Quarry Residuals Operable Unit (QROU) is the second of two operable units established for the quarry area of the Weldon Spring site. The first operable unit, referred to as the Quarry Bulk Waste Operable Unit, addressed the excavation and relocation of the source materials within the quarry to temporary storage at the chemical plant area. Bulk waste excavation was carried out in conjunction with a removal action to extract, treat, and discharge contaminated water from the quarry sump. This operable unit addresses residual conditions at the quarry, including (1) residual contamination at the quarry proper, (2) the Femme Osage Slough and nearby creeks, and (3) contaminated groundwater located north of the Femme Osage Slough.

The Weldon Spring site consists of two distinct geographical areas (1) the quarry area, which is the subject of this ROD, and (2) the chemical plant area. Under the chemical plant ROD, wastes and contaminated media from the chemical plant area and the quarry area will be disposed of in an on-site cell. The only remaining remedial decision to be made for the Weldon Spring site concerns the management of contaminated groundwater at the chemical plant area.

3 COMMUNITY PARTICIPATION

A remedial investigation/feasibility study (RI/FS) process was conducted for the QROU of the Weldon Spring site in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, to document the proposed management of the quarry proper, the Femme Osage Slough and nearby creeks, and quarry groundwater north of the Femme Osage Slough as components of the QROU. Documents developed during the RI/FS process included the *Remedial Investigation* (DOE 1998d), *Baseline Risk Assessment* (BRA) (DOE 1998a), *Feasibility Study* (DOE 1998b), and *Proposed Plan* (PP) (DOE 1998c). Together, the RI, BRA, FS, and PP constitute the required primary documents, consistent with the provisions of the *First Amended Federal Facility Agreement* entered into between DOE and the EPA. In accordance with Section 117 of CERCLA, copies of these final documents were released to the public on March 18, 1998.

The RI, BRA, FS, and PP, along with other documents in the *Administrative Record*, have been made available for public review at the Weldon Spring site. Copies also have been made available to the public in information repositories at Francis Howell High School and at four branches of the St. Charles City/County Library: Kathryn M. Linneman, Spencer Creek, Middendorf-Kradell, and Kisker Road. A notice of availability of these documents was published in the *St. Charles Journal* on March 22 and April 5, 1998.

A public comment period for this remedial action was held from March 18, 1998, through May 21, 1998. A public hearing was held on April 16, 1998, at the Administration Building of the Weldon Spring Site Remedial Action Project (WSSRAP) as a part of the public participation process. This public hearing was advertised in the newspaper cited above. At this meeting, representatives from DOE and EPA Region VII received comments from the public about the site and the remedial alternatives under consideration. Transcripts of the public meeting are included as part of the *Administrative Record* for this operable unit remedial action. The *Administrative Record* includes the information considered in deciding on the selected action. All public comments, oral and written, were considered in the decision-making process for determining the selected action (see Appendix A).

4 SITE CHARACTERISTICS

4.1 SOIL AND GEOLOGY

Unconsolidated surficial materials are present in the area of the Weldon Spring quarry: loess deposits and residual soils cover the upland regions, and alluvium occurs along the stream and river valleys. Coarse-grained deposits constitute the bottom 6 to 24 m (20 to 80 ft) of the Missouri River floodplain. Fine-grained deposits constitute the upper 4.6 to 7.6 m (15 to 25 ft) of the Missouri River floodplain and the full thickness of Little Femme Osage Creek and the Femme Osage Creek alluvium (DOE 1998d).

The uppermost bedrock unit in the vicinity of the quarry is the Kimmswick Limestone. The Kimmswick Limestone is underlain in descending order by the Decorah Group, Plattin Limestone, Joachim Dolomite, and St. Peter Sandstone (see Figure 3). The sides of the quarry expose the Kimmswick Limestone, whereas the bedrock floor of the quarry lies in the upper portion of the Decorah Group. The contact between the Kimmswick Limestone and Decorah Group, which may provide the primary pathways for contaminant migration from the quarry area, is in contact with fine-grained soils, silty clay, and organic silt and clay north of Femme Osage Slough (DOE 1998d).

4.2 HYDROGEOLOGY/GROUNDWATER

Groundwater in the vicinity of the quarry occurs in alluvium, fractured limestone, and sandstone (Berkeley Geosciences Associates 1984). The uppermost groundwater unit is composed of carbonate rocks near the quarry, tributary alluvium near little Femme Osage Creek, and Missouri River alluvium between the quarry bluff and the Missouri River. Water table (unconfined) conditions typically occur in the alluvium; confined to semiconfined conditions occur in the bedrock and alluvium where layers of varying permeability are present. The St. Peter Sandstone, approximately 90 m (300 ft) below the floor of the quarry, constitutes the deeper aquifer.

In the vicinity of the quarry, groundwater flows primarily from north to south, and a westward gradient runs from the quarry to Little Femme Osage Creek. South of the quarry rim, the direction of the groundwater flow is generally south to southeast toward the Femme Osage Slough. In the alluvium south of the slough, groundwater is within 3 m (10 ft) of the ground surface, although the depth to water varies with seasonal pumping demands in the nearby St. Charles County well field and with water levels in the Missouri River.

For the purposes of this action, alluvial aquifer in the vicinity of the quarry is composed of two horizons: the overlying fine-grained deposits and the underlying coarse-grained deposits referred

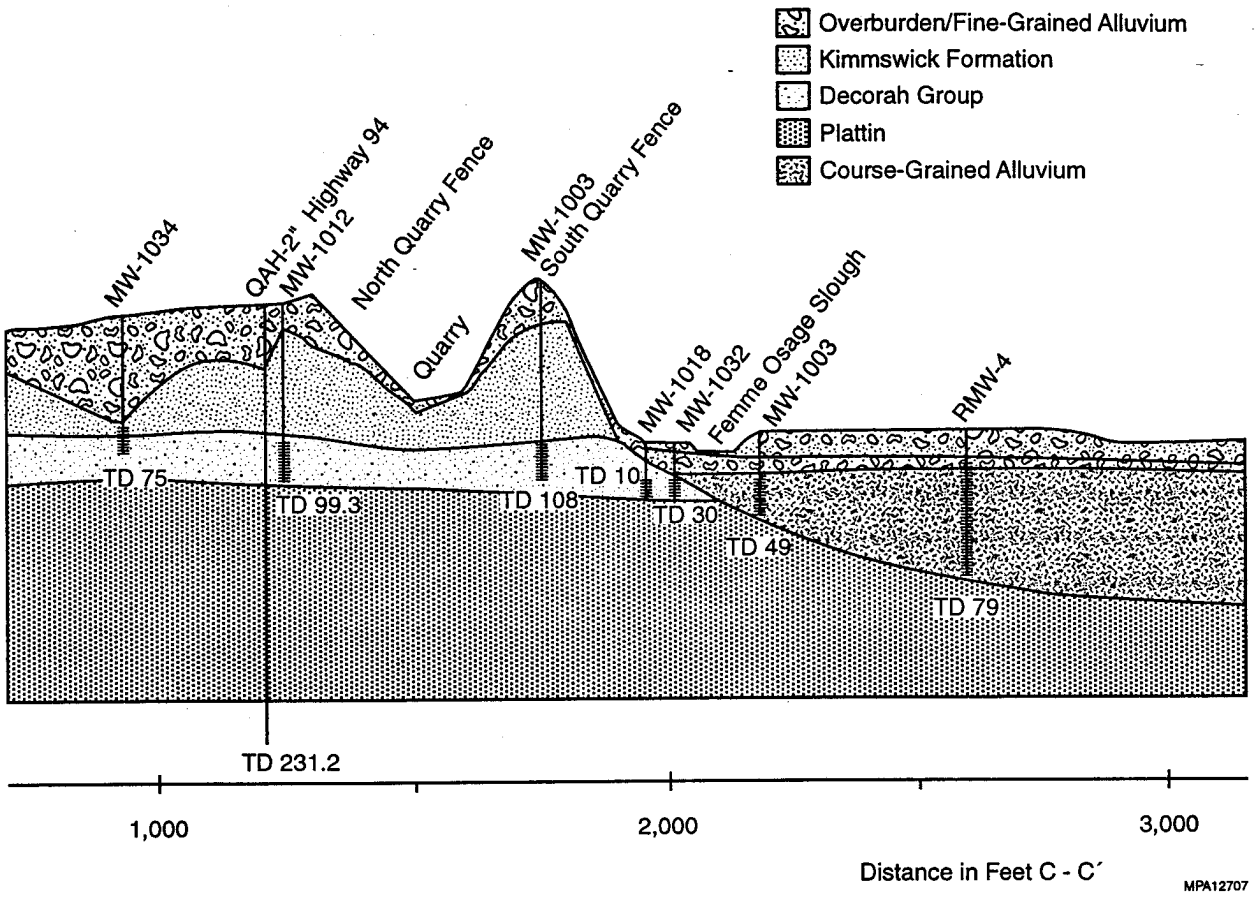

FIGURE 3 Cross Section through the Quarry Area

to as the Missouri River alluvium. The deep bedrock aquifers underlying the alluvial deposits are considered outside the area of potential impacts from this site.

The upper horizon is fine grained and has low, yet spatially variable, hydraulic conductivity because of the heterogeneous nature of the clay and silty clay materials composing this unit. In a marginal zone that lies between the bluff and the slough, the full sequence of materials consists of the fine-grained deposits. Only in two bedrock lows, which extend into this area, do coarser materials (silt and fine sand) occur. Groundwater impact from quarry contaminants is generally confined to the fine-grained materials. Well yields in this area typically range from less than 0.03 to 0.16 L/s (0.5 – 2.5 gpm); these yields are not sustainable for any length of time, and the wells typically dewater. The lower yields occur in the low conductivity clay and silty clay materials, whereas the higher yields occur in the wells situated in the previously described bedrock lows. Consistent with the EPA's guidelines for groundwater classification, groundwater in this zone is not considered a potential source of drinking water because yields are insufficient to sustain any routine production sufficient for household use.

The Missouri River alluvial aquifer in which the St. Charles County well field is located is the principal aquifer in the area. The alluvial aquifer thins to the north, away from the river, until it is truncated by the rising bedrock and the overlying fine-grained unit. The alluvial aquifer is characterized by 6 to 24 m (20 – 80 ft) of coarse-grained deposits consisting of fine- to medium-grained sand with some silt that grades with depth to coarse-grained sand with cobbles and boulders. These deposits are overlain by 5 to 8 m (15 – 25 ft) of fine-grained deposits. Recharge to the coarse-grained materials occurs primarily from the Missouri River, intermittent surface flooding, infiltration of precipitation, and discharge from the underlying bedrock.

The hydraulic gradient between the bluff and the slough is generally southward toward the slough. In general, the groundwater elevation data indicate a southeasterly gradient across the slough. At most locations, the slough is a source of recharge to the shallow groundwater. However, at some locations north of the slough, groundwater levels are higher, which indicates discharge to the slough (DOE 1998d).

A notable decrease of uranium (from 3,400 to 10 pCi/L) occurs over a short distance (30 to 91 m [100 – 300 ft]) north of the slough, which indicates that processes other than dilution are reducing the amount of dissolved uranium in groundwater. These processes include sorption onto the aquifer matrix and organics and precipitation of dissolved uranium from the groundwater. Uranium migration in the groundwater will be limited to some extent by sorption onto the aquifer materials. Site-specific distribution coefficient estimates range from 5 to 50 mL/g for materials north of the slough. Contaminant removal from groundwater via precipitation of solid phases typically results from changes in geochemical conditions in the aquifer system. In the shallow aquifer north of the slough, uranium activity decreases abruptly near the northern margin of the slough in response to a sudden decrease in the oxidation potential, which is coincident to a reduction of dissolved uranium in groundwater. The sharp decrease in uranium levels indicates that sorption, which typically generates more diffuse boundaries, is not the only process attenuating the uranium in groundwater.

4.3 BIOTIC RESOURCES

Much of the land surrounding the quarry consists of state-owned conservation areas containing second-growth forest. Nonforested areas, which cover much of St. Charles County, are largely used for crop production and pasture or are old-field habitat.

Aquatic habitats in the vicinity of the quarry include the Missouri River, Little Femme Osage Creek, Femme Osage Slough, and numerous small, unnamed creeks, drainages, and ponds throughout the Weldon Spring Conservation Area. In addition, the nearby August A. Busch Memorial Conservation Area contains more than 35 ponds and lakes; however, these ponds and lakes are in the Mississippi River drainage and are not influenced by the quarry area.

The U.S. Fish and Wildlife Service (Frazer 1995; DOE 1998d) has identified the potential for five federal-listed threatened or endangered species to occur in the vicinity of the quarry area: three birds (bald eagle, peregrine falcon, and interior least tern), one fish (pallid sturgeon), and one plant (decurrent false aster). The Fish and Wildlife Service has also identified several candidate species as possibly occurring in the area. The Missouri Department of Conservation has identified 13 state endangered and 19 state rare species for St. Charles County (Dickneite 1995). However, many of these species are not expected to occur at the quarry area; some only pass through the area during migration. For other species, suitable habitat is absent from the quarry. To date, only the bald eagle has been observed in the vicinity of the quarry area (DOE 1998d); all of those birds were sighted near the Missouri River and away from the quarry proper.

4.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at the QROU are discussed in detail in the RI (DOE 1998d). Contaminated media at the QROU can be generally categorized into three separate entities: (1) residual contamination at the quarry proper, (2) the Femme Osage Slough and nearby creeks (Little Femme Osage Creek and Femme Osage Creek), and (3) quarry groundwater north of the Femme Osage Slough. A summary of the data collected to support the RI is presented in Table 1. Samples were also collected for each medium of concern to delineate naturally occurring levels of chemical and radiological constituents (i.e., background levels) from those levels that may have resulted from site activities.

4.4.1 Soil

At the quarry proper, soil was sampled from the rims and slopes, and sediment was sampled from wall and floor fractures and from the ramp and floor of the quarry sump. Potential contaminants identified in soil samples from the rims and slopes included several metals, radionuclides, nitroaromatic compounds, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). In disturbed soil on the rim and knoll of the quarry, only selenium, silver, zinc, radium-226, thorium-230, and uranium-238 were detected at concentrations significantly higher than background levels. In samples from the quarry fractures, lower levels of contamination were found in the wall fractures than in floor fractures. Radium, thorium, and uranium isotopes, and aluminum, selenium, and silver were detected at some fractures at concentrations exceeding background levels. Samples collected from the sump area were primarily contaminated with radium-226, thorium-230, uranium, and low levels of PAHs.

Outside the quarry proper, surface and subsurface soil samples were collected, with a focus on the area south of the quarry between the Katy Trail and Femme Osage Slough. The area sampled included Vicinity Property 9, which was remediated in 1996. Low concentrations (but higher than

TABLE 1 Summary of Contaminant Data Collected for the QROU[a]

	Quarry Proper		Femme Osage Slough/Creeks			Background			
Contaminant	Soil	Fractures	Surface Water	Sediment	Groundwater	Soil	Surface Water	Sediment	Groundwater
Radionuclides	*(pCi/g)*[b]	*(pCi/g)*[b]	*(pCi/L)*	*(pCi/g)*	*(pCi/L)*	*(pCi/g)*	*(pCi/L)*	*(pCi/g)*	*(pCi/L)*
Radium-226	0.28–50	0.20–96	-[c]	-	-	0.69–1.2	0.060–0.24	0.56–1.2	0.040–1.4
Radium-228	0.16–23	0.22–84	-	-	-	0.70–1.4	0.060–0.86	0.28–2.1	0.20–7.3
Thorium-230	0.81–570	0.77–630	-	-	-	0.72–1.2	0.080–1.3	0.54–2.2	0.040–9.7
Thorium-232	0.45–25	0.21–60	-	-	-	0.60–1.2	0.040–0.32	8.2–1.1	0.010–1.0
Uranium-238[d]	0.44–21	1.3–200	0.47–53	1.0–180	0.020–4,200	0.94–1.6	2.5–2.9	0.64–0.69	0.20–11
Chemicals	*(mg/kg)*	*(mg/kg)*	*(µg/L)*	*(mg/kg)*	*(µg/L)*	*(mg/kg)*	*(µg/L)*	*(mg/kg)*	*(µg/L)*
Metals									
Aluminum	4,200–20,000	4,000–31,000	67–200	1,100–20,000	22–26,000	1,300–12,000	67–200	1,100–13,000	18–4,800
Antimony	-	-	-	6.9–36	-	ND[e]	33	ND	86
Arsenic	-	-	3.1–6.8	-	-	3.5–15	ND	2.5–6.8	2.0–8.8
Barium	-	-	-	-	29–1,200	9.3–210	56–97	27–150	75–700
Beryllium	-	-	-	0.27–1.6	-	0.44–0.74	ND	0.27–0.85	0.7–1.7
Cadmium	-	-	-	0.20–3.5	0.26–4.3	0.46–0.98	ND	ND	ND
Chromium	-	-	ND	2.8–24	0.72–150	3.3–13	ND	2.8–16	3.0–54
Cobalt	-	-	-	-	1.4–15	2.0–9.1	ND	2.2–9.5	4.3–6.6
Copper	-	-	-	2.9–30	2.2–120	11–19	16–17	2.9–14	2.2–49
Lead	-	-	ND	-	-	9.2–27	ND	2.7–15	1.0–77
Manganese	-	-	240–1,300	58–1,100	4.3–5,000	170–1,000	270–370	58–810	16–790
Mercury	-	-	-	0.060–0.10	0.16–2.4	0.090–0.10	ND	0.10	0.040–0.40
Molybdenum	-	-	-	0.80–3.9	-	0.59–1.3	ND	ND	17–19
Nickel	-	-	ND	12.3–28	4.2–66	15–28	ND	12–22	12–43
Selenium	0.21–6.0	23–150	-	0.77–2.7	-	0.62–2.0	ND	0.99	2.6–8.9
Silver	0.36–11	10–39	ND	-	-	0.97	ND	ND	22
Strontium	-	-	120–260	-	-	ND	100–110	5.5–17	250–1,200
Thallium	-	-	-	-	1.1–8.3	0.61–2.0	ND	1.5–14	2.9–6.1
Uranium, total	1.4–63	3.9–600	0.70–80	3.0–540	0.03–10,000	0.72–3.0	3.7–4.3	1.6–3.7	0.45–17
Vanadium	-	-	-	4.8–44	1.2–67	6.2–20	10–14	4.8–31	3.2–41
Zinc	24–810	60–820	8.9–78	-	2.4–160	18–66	8.9–13	8.9–69	4.7–53

TABLE 1 (Cont.)

Contaminant	Quarry Proper		Femme Osage Slough/Creeks			Background			
	Soil	Fractures	Surface Water	Sediment	Groundwater	Soil	Surface Water	Sediment	Groundwater
Organic Compounds									
1,3,5-TNB	0.0030–3.8	1.3	ND	0.14	0.015–270	NA[f]	NA	NA	NA
1,3-DNB	0.002	ND	ND	ND	0.045–3.5	NA	NA	NA	NA
2,4,6-TNT	0.00020–0.69	0.0010–1.2	ND	ND	0.014–60	NA	NA	NA	NA
2,4-DNT	0.0003–0.05	0.00040–1.2	ND	0.0070	0.011–4.6	NA	NA	NA	NA
Nitrobenzene	-	ND	ND	ND	ND	NA	NA	NA	NA
PCBs	0.031–4.5	0.036–1.5	ND	ND	ND	NA	NA	NA	NA
PAHs	0.0075–1.4	0.009–1.4	ND	ND	ND	NA	NA	NA	NA

[a] The range of detected concentrations for contaminants of potential concern (COPCs) identified for each medium are provided. Contaminants identified as COPCs are those contaminants with concentrations exceeding the statistically determined background concentration. The identification of COPCs was performed by using all of the data collected for each medium (i.e., since 1987). For groundwater and surface water, the ranges of reported concentrations are for recent data collected from 1995 to 1997. These recent data are considered more representative of current conditions and indicate a decreasing trend as a result of bulk waste removal from the quarry. Sources: Weldon Spring Remedial Action Project Database 1997; DOE (1998d).

[b] The majority of the samples from quarry soil and fractures indicate low concentrations for radionuclides, as reflected by low mean concentrations. Mean quarry concentrations for quarry soil and fractures are as follows:

Soil	Mean	Fractures	Mean
Radium-226	2.4	Radium-226	4.5
Radium-228	2.3	Radium-228	4.6
Thorium-230	30	Thorium-230	58
Thorium-232	1.5	Thorium-232	5.7
Uranium-238	4.8	Uranium-238	17

[c] A hyphen denotes that the contaminant was not identified as a COPC.

[d] For groundwater and surface water, reported concentrations are for total uranium.

[e] ND = not detected.

[f] NA = not applicable. Background concentrations of organic compounds that are considered anthropogenic are assumed to be zero.

background levels) of uranium are sorbed onto soils located between the quarry and the slough. Lead and zinc were detected at low levels above background in shallow soils south and east of the quarry. Low levels of nitroaromatic compounds (i.e., <1.7 ppm) were detected in soils to the east, west, and south of the quarry.

4.4.2 Femme Osage Slough and Creeks

Surface water and sediment samples from the upper and lower reaches of the Femme Osage Slough, Little Femme Osage Creek, and downstream portion of Femme Osage Creek have been characterized for radiological and chemical contamination. Contaminants identified as contaminants of potential concern (COPCs) for surface water and sediment included several metals and uranium (see Table 1). Nitroaromatic compounds were also identified as COPCs for surface water, but were only detected at low concentrations in the Little Femme Osage Creek upgradient of the quarry. The source of this contamination is believed to be runoff from the Weldon Springs Ordnance Works (WSOW) area. In general, contaminant concentrations were lower in the creek than in the slough. Plausible sources of contamination in the slough include groundwater seepage, runoff from Vicinity Property 9 prior to remediation, and mixing with Missouri River water. Several metals that were elevated in the creek and slough were also elevated in the Missouri River.

Fish from Femme Osage Slough were collected and analyzed to investigate any potential impacts from site contaminants. Species sampled from the slough included white and black crappie, largemouth bass, sunfish, and several bottom feeders such as bigmouth buffalo, yellow bullhead, and common carp. Fish samples were analyzed for uranium, radium, thorium, arsenic, lead, and mercury. Samples were prepared as fillets, fish cakes, and whole body samples. Analyses indicated low-level concentrations of metals (i.e., lead, arsenic, and mercury) and uranium, similar to concentrations detected in the background samples collected from Busch Lakes 33 and 37. Radium and thorium isotopes were not detected in any samples.

4.4.3 Groundwater

Contamination of groundwater underlying the quarry area has been characterized from data collected from a network of monitoring wells. This network includes 19 wells that monitor groundwater in the bedrock system and 26 wells that monitor groundwater in the alluvium. Four additional alluvium wells are owned by St. Charles County (see Figure 4). Data over a 10-year period were evaluated in determining the nature and extent of contamination. The primary contaminants in quarry groundwater north of the slough are uranium and nitroaromatic compounds. These contaminants were likely derived from contaminated bulk wastes that were previously disposed of in the quarry. Although other contaminants were present in quarry bulk wastes, uranium and

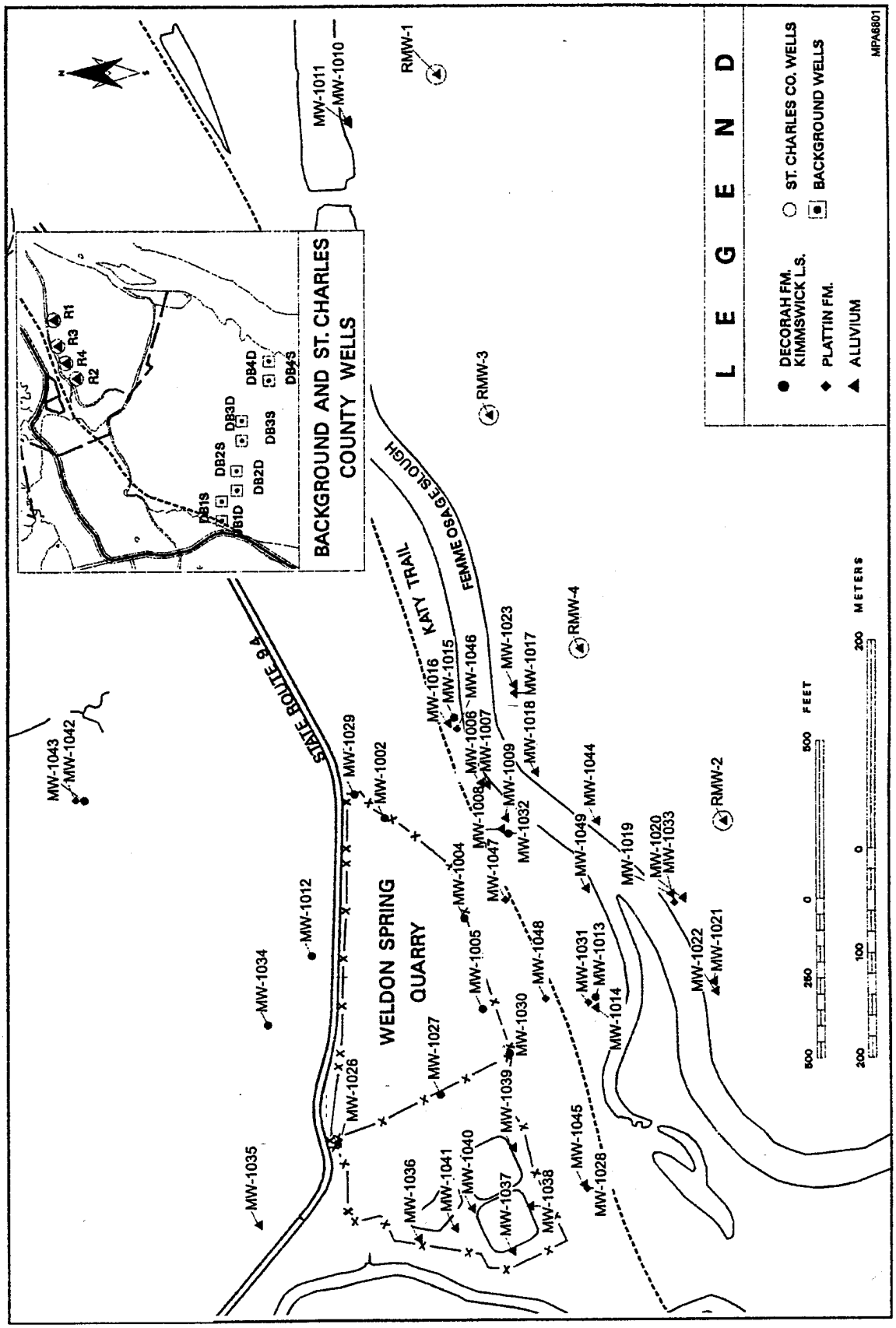

FIGURE 4 Locations of Background Wells, DOE Wells (1,000 series), and St. Charles County Wells

nitroaromatic compounds are more soluble and were leached from the bulk wastes into the shallow groundwater.

The extent of the uranium contamination is limited to the area north of the slough. The highest concentrations of uranium were detected in wells along the southern rim of the quarry and southward in the alluvium near Vicinity Property 9. South of the slough, slightly elevated uranium levels with respect to the statistically determined background value (i.e., 2.8 pCi/L) were detected at RMW-2. However, the maximum uranium concentration detected at RMW-2 (i.e., 10 pCi/L) is within the range of concentrations detected in the background wells. Uranium concentrations in the remaining wells south of the slough have been in the background range.

Prior to removal of the bulk wastes from the quarry, nitroaromatic compounds were also detected at concentrations greater than 1 µg/L in four shallow bedrock wells and two alluvial wells located north of the slough. Between 1996 and 1997, a 40% reduction in TNT and an 18% reduction in DNT concentrations have been observed.

5 SUMMARY OF SITE RISKS

Potential impacts to humans, biota, and other environmental resources that might occur at the quarry area if no remedial action is conducted were assessed as part of the process for selecting an appropriate remedial action. Current and future land use conditions were considered in the assessment presented in the *Baseline Risk Assessment* report (DOE 1998a) prepared for the QROU. Key results of the human health and ecological assessment are summarized in Sections 5.1 and 5.2.

5.1 HUMAN HEALTH

Potential carcinogenic risks for both radiological and chemical exposures were assessed in terms of the increased probability that an individual would develop cancer over a lifetime. The U.S. Environmental Protection Agency (EPA) has indicated that for known or suspected carcinogens, the acceptable exposure levels for the general public at sites on the NPL are generally concentrations that represent an excess upper-bound lifetime cancer risk to an individual of between 1×10^{-6} and 1×10^{-4} (i.e., 1 in 1,000,000 to 1 in 10,000 [EPA 1989]). This "acceptable range" is used as a point of reference for discussing the results of the carcinogenic risk assessment for the QROU.

Potential health effects other than cancer from exposure to chemical contaminants were also assessed. The quantitative measure of noncarcinogenic health effects is the hazard index. The EPA has defined a hazard index of greater than 1 as the level of concern for noncarcinogenic health effects.

A recreational visitor scenario was used to project human exposures to contaminants identified in the RI for the quarry area (DOE 1998d) on the basis of current and assumed future land uses. This scenario is consistent with current land use at the quarry area (primarily north of the slough and the slough itself); future land use is expected to remain similar to current use. Groundwater is used for residential purposes at the county well field; however, monitoring data indicate that concentrations at the county well field are consistent with background, and this is not expected to change in the future.

In this case, reasonable maximum exposure is not considered to include residential or other scenarios that include direct, long-term consumption of localized contaminated groundwater. Because of the localized nature of the contamination and physical constraints, such as low groundwater yields and unsustainable production of these low yields, the surficial nature of the groundwater, and the location of the area within the Missouri River floodplain, which makes the area susceptible to routine flooding, such scenarios are not considered plausible.

Exposure pathways and associated risk estimates evaluated for the quarry proper and Femme Osage Slough and nearby creeks are summarized in Table 2. Exposure pathways evaluated for the quarry proper included external irradiation, incidental ingestion and dermal contact with soil, inhalation of air particulates, and ingestion of surface water from the quarry pond. Exposure pathways evaluated for the slough and creeks included ingestion of surface water, sediment, and fish; dermal contact with surface water and sediment; and inhalation of air particulates. The recreational visitor was assumed to visit each area for 4 hours, 20 times per year, over a period of 20 years.

The results of the risk calculations for the recreational visitor at the quarry proper and Femme Osage Slough indicate that radiological and chemical risks are below to within the EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4} (EPA 1989). Hazard indices are also less than 1, which indicates that noncarcinogenic health effects are not a concern. The estimated radiological risk is 3×10^{-5} for the recreational visitor exposed to contaminants at the various locations (i.e., cumulative risk from exposure to contaminants at the quarry proper and at Femme Osage Slough and creeks); this estimate incorporates multiple contaminants, multiple media, and multiple pathways. The estimated chemical carcinogenic risk and hazard index for this recreational visitor are 4×10^{-6} and 0.05, respectively.

The estimated risks are within the acceptable risk range and do not indicate the need for further remediation of the quarry proper, the Femme Osage Slough and nearby creeks, or the quarry groundwater north of the Femme Osage Slough.

The available hydrological and geochemical information, as well as long-term environmental monitoring data, support the conclusion that site contaminants will not measurably affect the Missouri River alluvial aquifer. However, given the reliance on natural systems to preclude potential significant impacts to the aquifer, alternatives addressing groundwater remediation were evaluated in the FS (DOE 1998b).

5.2 ECOLOGICAL ASSESSMENT

Femme Osage Slough and Little Femme Osage Creek are the principal habitats at the QROU where biota could be exposed to quarry-related contaminants. A screening level assessment employing very conservative exposure scenarios was conducted for these habitats. This assessment identified current levels of aluminum, barium, manganese, and uranium in the surface water of Femme Osage Slough and Little Femme Osage Creek as posing a potential risk to aquatic biota using these habitats. Risk estimates or quotients for these contaminants were greater than 1, indicating the potential for risk and a need for further ecological evaluations of the aquatic habitats in the slough and creek. These ecological evaluations were conducted, and the results are discussed below. For other contaminants in surface water at the quarry area, no or low risks were identified. Arsenic,

TABLE 2 Summary of Human Health Risk Estimates for the Quarry Area

Pathways (Recreational Visitor)	Radiological Carcinogenic Risk	Hazard Index	Chemical Carcinogenic Risk
Quarry proper			
Soil			
External irradiation	1×10^{-5}	NA[a]	NA
Ingestion	4×10^{-7}	0.004	1×10^{-7}
Dermal	1×10^{-7}	0.0009	1×10^{-8}
Inhalation	2×10^{-9}	< 0.0001	1×10^{-12}
Fractures[b]			
External irradiation	3×10^{-5}	NA	NA
Ingestion	7×10^{-7}	0.008	6×10^{-8}
Inhalation	4×10^{-9}	< 0.0001	7×10^{-13}
Femme Osage Slough[c]			
Surface water			
Ingestion	3×10^{-7}	0.003	9×10^{-7}
Dermal	7×10^{-9}	< 0.0001	2×10^{-8}
Sediment			
Ingestion	3×10^{-8}	0.006	2×10^{-7}
Dermal	1×10^{-10}	0.001	4×10^{-9}
Inhalation	1×10^{-10}	< 0.0001	1×10^{-13}
Fish			
Ingestion	8×10^{-9}	0.03	3×10^{-6}
Total[d,e,f]	3×10^{-5}	0.05	4×10^{-6}
Overall carcinogenic risk[g]	3×10^{-5}		

[a] NA = not applicable.

[b] Dermal contact with soils in the fractures is assumed to be unlikely.

[c] Estimates for Femme Osage Slough are representative of those for Little Femme Osage and Femme Osage Creeks.

[d] These totals represent risks and the hazard index for the multiple pathways exposure scenario, which projects a recreational visitor who is exposed to contaminants present at the quarry area (including at the quarry proper and Femme Osage Slough).

[e] Ingestion of groundwater is unlikely because there is no access for a recreational visitor to the quarry groundwater. However, calculations were performed for potential risk to a hypothetical resident from ingestion of and dermal contact with groundwater (see Section 5.2.3 of the BRA [DOE 1998a]) for informational purposes only.

[f] External irradiation for quarry proper soil and fractures was not summed because it is not appropriate to do so; the higher of the two risks was used to calculate the total.

[g] The sum of chemical and radiological carcinogenic risks rounded to one significant figure.

cadmium, lead, manganese, mercury, nickel, and zinc are present in sediments at concentrations estimated to result in low risk to aquatic biota. No risks from nitroaromatic compounds were indicated in either surface water or sediment. Modeling results indicated no risks to modeled terrestrial wildlife receptors foraging in Femme Osage Slough or drinking from Little Femme Osage Creek.

Because screening risk estimates for several metals indicated potential risks, as discussed above, further ecological evaluations or surveys of aquatic and terrestrial biota were conducted at the quarry area to further evaluate actual impacts. The survey results indicate that the existing aquatic and terrestrial communities consist of species that would be expected to occur in the area. No impacts to abundance or species diversity of aquatic invertebrates were detected. Internal and external examinations of small mammals collected from the site showed no abnormalities that might indicate adverse effects from exposure to site contaminants. Analyses of tissue from fish and small mammals indicated uranium concentrations within the range reported in the literature for North America for which no adverse effects have been observed. Concentrations of radionuclides in the tissues of small mammals collected from the quarry area were comparable to levels detected in specimens from reference sites.

In summary, the current levels of contamination in surface water and sediments from Femme Osage Slough and Little Femme Osage Creek do not appear to be affecting ecological resources at these habitats and do not pose a future risk to biota at the site. This conclusion is supported by the absence of any observable adverse effects to aquatic or terrestrial biota, the generally low levels of potential risk estimated for aquatic biota, and the lack of risks estimated for terrestrial biota. Thus, remediation of these habitats is not indicated on the basis of potential ecological concerns.

6 DESCRIPTION OF REMEDIAL ALTERNATIVES

Six preliminary alternatives for addressing groundwater contamination were assembled from combinations of technologies and associated management strategies that were retained following a screening and evaluation process. Potential remedial action alternatives were screened to eliminate those alternatives determined too difficult to implement on the basis of unproven technologies, those determined not sufficient to remediate the site within a reasonable time period, or those determined to have limited application for specific contaminant or site conditions. Details of these evaluations are presented in the *Feasibility Study* report (DOE 1998b) prepared for the QROU. The three final alternatives retained for detailed analysis are described in Sections 6.1 to 6.3.

6.1 ALTERNATIVE 1: NO ACTION

Under Alternative 1, no further action would be taken at the QROU. CERCLA requires consideration of a "No Action" alternative. No containment, removal, treatment, or other mitigative measures would be implemented. This alternative does not include groundwater monitoring or any active or passive institutional controls (e.g., physical barriers, deed restrictions). Under this alternative, it was assumed that all existing activities, including monitoring by DOE, would be discontinued. Existing land use and natural conditions and processes are expected to continue and provide continued protection to the downgradient well field. However, this alternative does not provide for the collection of data that would verify the continued protectiveness of future conditions.

No cost is associated with the performance of this alternative. No net present worth, capital costs, or annual operation and maintenance (O&M) costs are associated because no activities would be undertaken.

6.2 ALTERNATIVE 2: MONITORING WITH NO ACTIVE REMEDIATION

Under Alternative 2, long-term monitoring of groundwater in the quarry area would be performed; results would be evaluated at five-year review periods as required by CERCLA. Contaminant concentrations in the groundwater north of Femme Osage Slough are expected to decrease with time as a result of (1) adsorption of uranium onto the fine-grained aquifer materials and (2) precipitation in the area of the slough where decaying organic matter maintains a reducing condition. These reducing conditions convert uranium to the +4 state, thus forming uranium dioxide (UO_2), which is highly insoluble. Continued migration of very small concentrations of uranium in the groundwater to the St. Charles County well field is probable; however, concentrations greater than the background range have not been detected. In addition, concentrations are not expected to increase because of the removal of the bulk waste source materials. Monitoring data collected for

the past 10 years from wells south of the slough and at the production wells have indicated uranium concentrations to be consistent with the statistically derived background level of approximately 2.8 pCi/L. Contaminated groundwater migrating south of the slough would be significantly diluted with uncontaminated water from the Missouri River. Groundwater originating from the quarry area contributes less than 1% of the groundwater available to the production wells. Infiltration from rainwater, runoff, and sporadic local flooding could also dilute the groundwater at the quarry area north of the slough (DOE 1998d).

Groundwater monitoring would be conducted in the existing well network, as appropriate. This network would be expanded or reduced, depending on the results of future efforts to optimize the network for long-term monitoring. Optimization efforts would evaluate contaminant distribution, groundwater flow paths, and geochemical constraints that govern contaminant fate and transport in the aquifer system. The network of wells to be monitored as part of this alternative would be formulated from the existing network to include monitoring of the area west of RMW-2. The exact monitoring network and details regarding frequency of sampling and parameters analyzed would be identified in subsequent remedial design/remedial action (RD/RA) reports for the QROU.

Under Alternative 2, the monitoring response would continue in perpetuity or until judged unnecessary based on a review of the data. A judgment to discontinue monitoring would be developed in consultation with the EPA and the Missouri Department of Natural Resources. Because contamination would remain on-site above levels that allow for unlimited use and unrestricted exposure, reviews would be conducted at least every five years to ensure that the remedy continued to provide adequate protection of human health and the environment.

Costs for this alternative would be associated with performing periodic monitoring of an optimized monitoring network to provide data for verifying that conditions in the quarry area and the well field remain protective of human health and the environment. Routine sampling and analysis of uranium and nitroaromatic compound concentrations would be performed, as well as data collection to verify the continued effects of natural processes on contaminant concentrations within the area.

The annual O&M cost for the monitoring effort is estimated to be no greater than $0.6 million. This estimate is an upper bound because the sampling frequency and number of wells assumed were based on the current network and frequency of sampling. The final monitoring network is expected to be smaller and would be sampled at a lower frequency. The capital cost for this alternative is estimated to be approximately $0.15 million for the construction of up to seven additional groundwater monitoring wells.

6.3 ALTERNATIVE 6: GROUNDWATER REMOVAL AT SELECTED AREAS, WITH ON-SITE TREATMENT

Under Alternative 6, an interceptor trench would be installed north of the Femme Osage Slough in a selected area bounded by and encompassing monitoring wells MW-1014 and MW-1016 (approximately 340 m [1,100 ft]). This trench would be installed in the unconsolidated materials to the top of bedrock. The purpose of the trench would be to create a high-permeability channel through the native soil so that more groundwater could be recovered. Extracted groundwater would be treated, as necessary, to meet discharge limits.

Groundwater modeling using analytical methods indicates that the effect of the extraction system may reduce the mass of uranium within the alluvial aquifer by 8 to 10% over a two-year operating period (see Figure 5). This constitutes a relatively small reduction and does not provide a measurable increase in protectiveness over the foreseeable future.

The capital cost is estimated to be between $1 and $2 million for construction of the interceptor trench. The O&M costs for a two-year testing period are estimated to be between $1 and $2 million. The O&M costs are primarily for treatment of the extracted groundwater (which ranges from $0.4 to $0.5 million per year), if treatment is necessary to meet discharge limits.

The costs associated with the long-term monitoring portion of this alternative would be identical to those discussed in Section 6.2. The monitoring approach for this alternative would not be significantly different from that designed for Alternative 2: Monitoring With No Active Remediation.

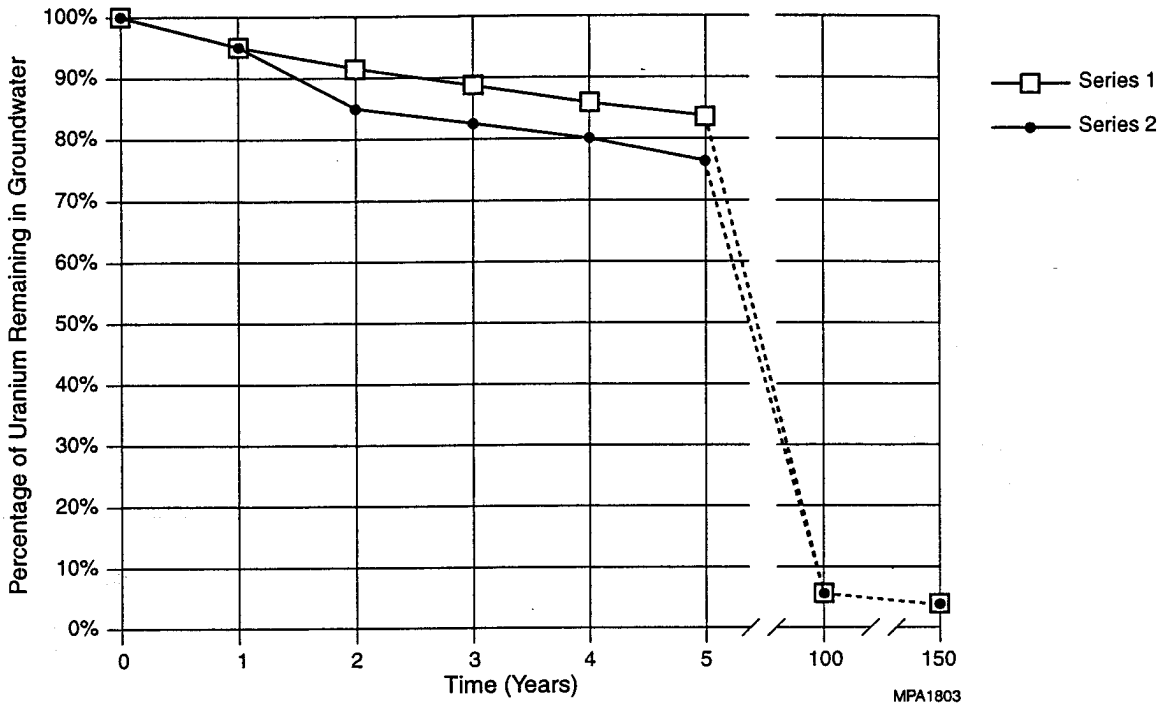

FIGURE 5 Predicted Percentage of the Mass of Uranium Remaining in the Groundwater in the Area of the Contaminated Alluvium North of the Femme Osage Slough during Remediation

7 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

A comparison of the final remedial action alternatives for the QROU was conducted by categorizing the nine evaluation criteria of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (EPA 1990) into the following three groups: threshold criteria, primary balancing criteria, and modifying criteria.

The threshold category contains the two criteria that each alternative must meet in order to be eligible for selection:

- Overall protection of human health and the environment; and
- Compliance with applicable or relevant and appropriate requirements (ARARs), unless a waiver condition applies.

These threshold criteria ensure that the remedial action selected will be protective of human health and the environment, and that the action will either attain the ARARs identified at the time of the ROD or provide grounds for obtaining a waiver.

The primary balancing category contains the five criteria that are used to assess the relative advantages and disadvantages of each alternative to determine which is most appropriate:

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

The first two criteria consider the preference for treatment as a principal element and the bias against off-site land disposal of untreated waste. Cost-effectiveness is determined by evaluating the following three of the five balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. Overall effectiveness is then compared with cost to ensure that the costs are proportional to the overall effectiveness of a remedial action.

The modifying category consists of two criteria that are considered in remedy selection and that are addressed in the responsiveness summary (see Appendix A) of this ROD:

- State acceptance and
- Community acceptance.

Table 3 summarizes the analysis performed for the first seven criteria.

TABLE 3 Comparative Analysis of Alternatives

Evaluation Criterion	Alternative 1: No Action	Alternative 2: Monitoring with No Active Remediation	Alternative 6: Groundwater Removal at Selected Areas, with On-Site Treatment
Overall protection of human health and the environment	Would be protective of human health and the environment in both the short and long term.	Would provide protection similar to Alternatives 1 and 6. Monitoring data would be collected to verify that conditions continue to be protective of human health and the environment.	Would provide protection similar to Alternatives 1 and 2. This alternative would remove and treat a percentage of the contaminated volume of groundwater north of the slough and would lead to a slight reduction in the amount of uranium that could potentially migrate south of the slough toward the St. Charles County well field. However, the additional slight reduction would not result in greater protectiveness than Alternatives 1 and 2. This alternative would also provide for monitoring.
Compliance with ARARs	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
Long-term effectiveness and permanence	Future conditions are expected to be at least similar to current, if not better. Continued slow decreases in contaminant concentrations are expected as a result of source removal and naturally occurring processes.	Similar to Alternative 1. In addition, data would be available to verify that conditions at the quarry area continue to be protective of human health and the environment.	Would be similar if not slightly better than that of Alternatives 1 and 2 because of the reduction in the amount of uranium that could potentially migrate south of the Femme Osage Slough toward the St. Charles County well field. However, the additional slight reduction would not result in greater protectiveness than Alternatives 1 and 2.
Reduction of toxicity, mobility, or volume through treatment	No immediate reduction of toxicity, mobility, or volume because no treatment would be performed. However, slow reduction of contaminant concentrations is expected as a result of natural processes.	Same as for Alternative 1.	Would satisfy the statutory preference for treatment as a principal element of remediation and would provide reduction in the toxicity, mobility, or volume of a small portion of the contaminated groundwater through treatment. The effects of the extraction system may reduce the mass of uranium within the alluvial aquifer by 8 to 10% relative to the baseline (no action).
Short-term effectiveness	No potential impacts on workers or the environment, because no activities would be undertaken.	Expected to be low, with less than one case of occupational injury and no occupational fatalities during proposed monitoring well construction. Any potential short-term environmental impacts would be limited to the immediate vicinity of the quarry area, and mitigative measures would be applied to minimize potential impacts.	Similar to Alternative 2. Expected to be low, with less than two cases of occupational injury and no occupational fatalities during proposed construction activities.

TABLE 3 (Cont.)

Evaluation Criterion	Alternative 1: No Action	Alternative 2: Monitoring with No Active Remediation	Alternative 6: Groundwater Removal at Selected Areas, with On-Site Treatment
Implementability	No implementability concerns because no action would be taken.	Few implementability concerns because of the limited actions taken. Monitoring would be performed with the use of readily available resources.	Few implementability concerns. Groundwater extraction and treatment are well-developed technologies. Further development of these technologies would not be required.
Cost	No cost is expected to be associated with this alternative.	Is cost-effective because it would provide overall protection of human health and the environment for a reasonable cost. Costs are associated with continuing the existing environmental monitoring program, potential construction and operation of additional monitoring wells, and conducting a performance review at least every five years. Could be implemented with existing resources and maintained at a relatively low cost.	Not cost-effective compared with Alternatives 1 and 2, because the expenditure of funds for removal of a minimal amount of contamination would not be cost effective.

8 SELECTED ACTION

DOE's selected action for the QROU is Alternative 2: Long-Term Monitoring. This decision was based on the requirements of CERCLA, the detailed analysis of alternatives using the nine NCP criteria, and input received during the public comment period. The selected action will ensure continued protection of groundwater resources within the St. Charles County well field over the long term.

On the basis of the exposure assessment discussed in Section 5, no further remediation is necessary to protect human health and the environment. Because source removal was accomplished under a previous action, no new migration of contaminants to the groundwater system should occur. However, because of the presence of significant levels of uranium in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field, it was considered prudent to continue to evaluate the need for and effectiveness of reducing or removing the uranium from quarry groundwater and to confirm the behavior of natural processes occurring at the quarry area. These natural processes are expected to mitigate any potential migration of the uranium toward the well field.

The FS evaluations (DOE 1998b) indicate that available engineering technologies could achieve only a very small and slow reduction of the uranium in quarry groundwater at high costs without achieving increased protection. Accordingly, the selected action for the QROU has the following components that the DOE will implement:

1. A long-term groundwater monitoring strategy will be implemented to confirm expectations that significant impacts to the Missouri River alluvial aquifer will not occur and that conditions at the quarry area will continue to be protective of human health and the environment.

2. Institutional controls will be necessary to prevent uses inconsistent with recreational use, or uses that would adversely affect contaminant migration. DOE will continue to coordinate with the Missouri Department of Conservation and the Missouri Department of Natural Resources-Parks to establish a written agreement, such as a license agreement, memorandum of understanding, or deed attachment, outlining and agreeing to the terms of the institutional controls. Terms may include limiting access to groundwater north of the slough for the following uses: irrigation, consumption, or as a surface water source. The terms of the agreement will be evaluated at each five-year review, at which time changes or deletions to the terms would be made, as appropriate. The *Well Field Contingency Plan* (DOE 1998e) provides for ongoing availability of a safe water supply.

3. The quarry proper will be restored through backfilling with soil to reduce fall hazards, stabilize the highwalls, eliminate ponding of surface water, and minimize infiltration through the inner quarry area to the groundwater.

In addition, further data collection will be performed by DOE to support ongoing evaluations regarding the need for and effectiveness of groundwater remediation. This activity will include a pilot study involving the construction of a trench. Soil sampling at the quarry proper will also be conducted to delineate the full extent of radiological contamination at the northeast slope and ditch area within the quarry proper.

8.1 QUARRY GROUNDWATER MONITORING

The selected action addresses groundwater contamination by monitoring to provide data for verifying that conditions in the quarry area and the well field remain protective of human health and the environment. These data will also indicate the continued effects of natural processes on contaminant concentrations within the area. Routine sampling and analysis of uranium and nitroaromatic compound concentrations in groundwater will be performed. It is anticipated that existing patterns of contaminant migration will persist over time. However, if long-term monitoring identifies a trend or change resulting in increased levels of contaminants south of the slough approaching a trigger level of 30 pCi/L, the potential for significant impacts to the well field and the alluvial aquifer will be reevaluated. This reevaluation will include a risk evaluation consistent with CERCLA, identification of ARARs, and a determination of need of any groundwater remediation. The trigger level of 30 pCi/L is sufficiently above the established natural variation (nondetect to 16 pCi/L) of uranium in the aquifer to be a useful indicator of currently unanticipated migration from the site. In addition, this level is considered protective under hypothetical exposure assessments and is consistent with the standard in Title 40, Part 192.02, of the *Code of Federal Regulations* (40 CFR 192.02).

Remedial design activities will define an optimal monitoring network, identify appropriate frequencies and parameters for monitoring, and provide for interpretations of the results that will determine the criteria for continuation or ultimate conclusion of monitoring activities as part of the QROU ROD. The decision to continue or conclude monitoring activities will be made at the initial five-year review period and during each subsequent five-year review, as appropriate.

To optimize logistics, monitoring activities stipulated in this ROD may be correlated with those for the *Well Field Contingency Plan* (DOE 1998e). The option to combine these two monitoring requirements will also be evaluated before initiation of monitoring activities for this ROD.

A network of wells to be monitored as part of the action in this ROD will be designed to provide for long-term monitoring of groundwater, including the groundwater in the area west of RMW-2. The final design of the optimized network will be presented in the RD/RA reports. Existing wells that are likely to be included in the post-ROD monitoring network are shown in Figure 6. These wells were selected on the basis of the following preliminary selection criteria: distribution of contamination; the hydrological, geochemical, and contaminant fate and transport models; and the location and screening interval for each well. This preliminary network includes existing wells located north of the slough that would monitor changes in the horizontal and vertical distribution of contaminants. On the basis of the hydrological conceptual model depicting groundwater flow from the north of the slough to the south of the slough, existing wells that monitor groundwater along the base of the alluvium could also be selected and included in the monitoring network. The existing RMW wells will also be included to monitor the portion of the alluvial aquifer that supplies the well field.

8.2 QUARRY PROPER RESTORATION

The current restoration design plan includes backfilling the quarry with soil to reduce fall hazards, to stabilize the north and south highwalls, and to eliminate ponding of surface water. The floor and benches of the quarry would be covered by the backfill. The backfill would reduce the potential for mobilization of any potential residual contaminants into the groundwater. Restoration would be designed to force groundwater flow around the inner quarry area by backfilling with a relatively low permeability material. Infiltration would be reduced through the installation of a low permeability cover. More definitive specifications for the backfill would be included in subsequent RD/RA reports.

The design would also effectively prevent any potential residual contaminants in the cracks and fissures (i.e., flakes of yellowcake) from mobilizing to the surface through erosion and/or freeze/thaw action, thus reducing the already low potential risks associated with external gamma radiation and ingestion. Mobilization of contaminants into the groundwater would not be likely because the benches are in the unsaturated portions of the bedrock, and infiltration of precipitation would be prevented by the final grading designed to promote sheetflow and to return the area to conditions that are as close as possible to natural contours. Dismantlement of facilities utilized during bulk waste removal activities would also be performed during this time. Haul road restoration is expected to be minimal. Restoration activities are currently planned for the fall of 1999.

8.3 WELL FIELD CONTINGENCY PLAN

The *Well Field Contingency Plan* (DOE 1998e) was developed by DOE to ensure the continued availability of a safe and reliable public water supply for St. Charles County during bulk

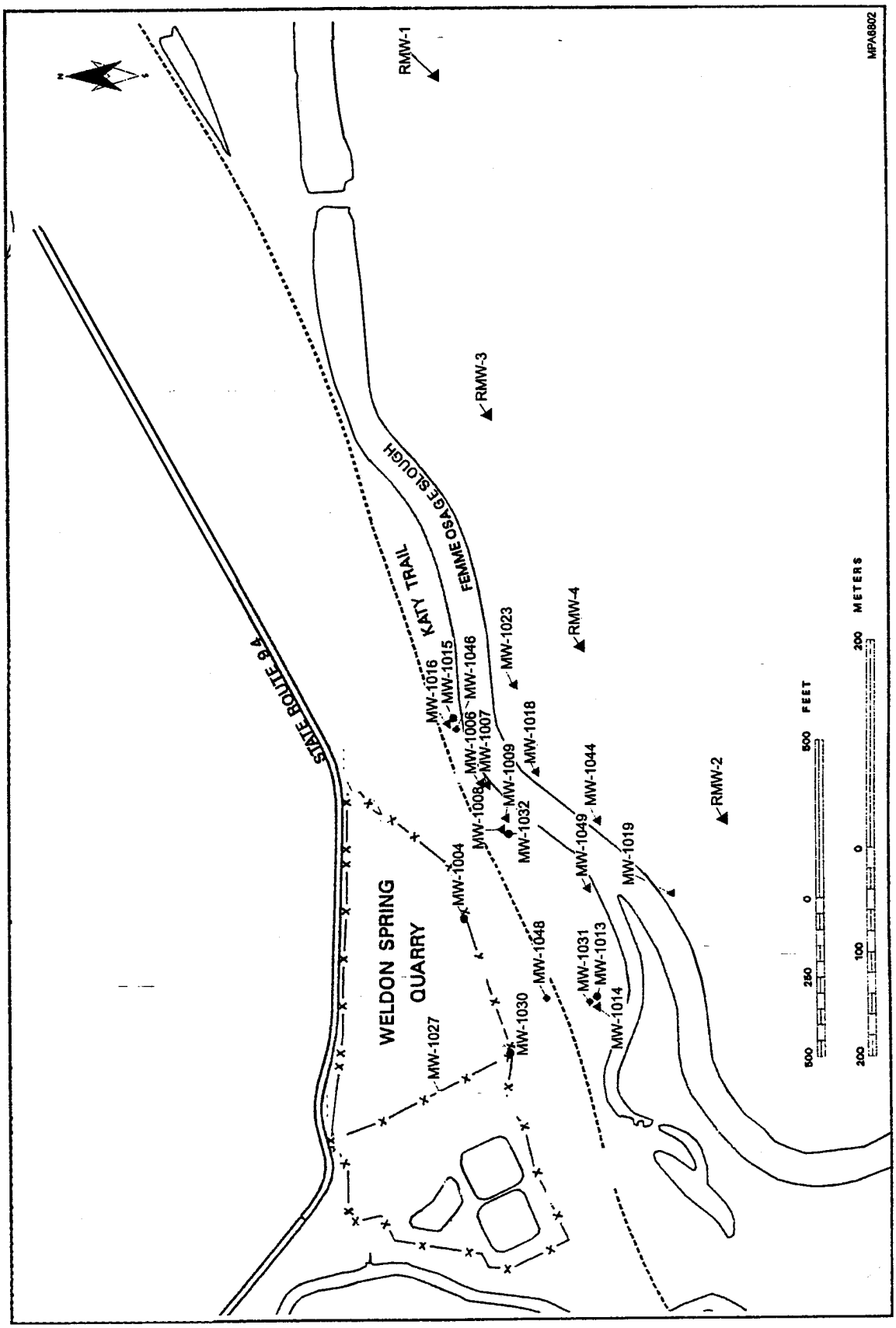

FIGURE 6 Preliminary Monitoring System for Quarry Area Groundwater

waste removal activities. This plan provides for groundwater monitoring to detect any contaminant migration beyond the presently known boundaries, defines action levels, and identifies response actions that could be taken in the unlikely event of elevated contaminant levels at the well field. To date, no impacts to the well field have been observed, and none are expected in the future. The *Well Field Contingency Plan* (DOE 1998e) also discusses the preparation of hydrogeological characterization plans to support development of criteria for the design and construction of a replacement well field in the unlikely event that should prove necessary.

In developing the approach contained in the *Well Field Contingency Plan* (DOE 1998e), data from south of the slough were evaluated to identify trends or changes indicative of impacts to the Missouri River alluvium from the quarry. The level adapted as a trigger for reevaluation of the conditions in the Missouri River alluvium has been established at 30 pCi/L in a RMW-series well. Should such a level occur, DOE would initiate a more rigorous monitoring effort to investigate the cause and source of this impact. On the basis of conservative modeling performed in this portion of the aquifer, impacts to the production wells would not occur within the 100-year modeling period if levels of 30 pCi/L were indicated in a RMW-series well.

8.4 ADDITIONAL DATA NEEDS

DOE will conduct further data collection for two purposes: (1) to gather data to continue the evaluation to determine the effectiveness of groundwater remediation and (2) to define the extent of radiological soil contamination at the northeast slope and ditch area at the quarry proper.

8.4.1 Field Test

Given the presence of significant levels of uranium in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field, and the reliance on the natural systems to limit potential exposure, evaluation to determine the effectiveness of groundwater remediation will be continued, and field data related to uranium recovery in quarry groundwater will be collected. This field test, conducted to verify predictive models that were presented in the FS (DOE 1998b) relating to groundwater remediation, will be essentially a scaled down version of the approach evaluated under Alternative 6. Alternative 6 is considered to be the most effective approach to groundwater extraction. Groundwater removal will be facilitated with the use of a trench sufficiently large to intercept a representative cross section of alluvial material and optimally located to extract groundwater in areas with high uranium contamination. The system will be evaluated and monitored for up to two years, and the data collected will be compared with a set of predetermined performance goals. These performance goals will be identified on the basis of the predictive model shown in Figure 5. This predictive model indicates that this trench could only reduce the uranium mass by no more than 10% for the two-year operational period. The evaluations in the FS also

indicate that the time frame for remediation of uranium-contaminated groundwater north of the slough would be greater than 100 years. If performance of the trench system exceeds the performance goals, the need for and effectiveness of groundwater remediation will be reevaluated. Conversely, if the performance of the removal system is less effective or within the specified performance goals, further evaluation of groundwater will not be necessary. The determination of the performance goals for the removal system and details pertaining to structure, size, location, and sampling parameters will be presented in the RD/RA work plan developed in consultation with the EPA and the Missouri Department of Natural Resources.

The determination of the effectiveness of active groundwater remediation will include consideration of factors consistent with those presented in Office of Solid Waste and Emergency Response (OSWER) Directive 9234.2-25, "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration."

Field tests will be conducted in the marginal alluvium north of the slough to provide site-specific estimates for parameters (i.e., hydraulic conductivity, distribution coefficients, and oxidation potential) that demonstrate the engineering feasibility and reliability of groundwater remediation in the area of uranium impact. These tests will also ascertain the variability of these parameters because of the heterogeneity of the aquifer materials. This information will be used to supplement the present hydrological, geochemical, and contaminant fate and transport models for the quarry area north of the slough for evaluating the need for and effectiveness of groundwater remediation.

Data have been previously compiled that indicate the distribution of uranium and fate and transport mechanisms in the aquifer system both north and south of the slough (see Chapter 4). These data indicate that the hydrogeologic and geochemical systems in the quarry area are complex and result in a system with a limited capability of effectively remediating groundwater.

8.4.2 Soil Sampling at the Northeast Slope and Ditch Area

At the quarry proper, additional sampling is planned at the northeast slope and the ditch area near the transfer station (see Figure 7). Only a few samples were collected from these two areas during the RI phase because access was difficult. The samples collected indicate the presence of radiological contamination; however, additional samples need to be collected to sufficiently define the extent of contamination. Risk calculations will be performed consistent with the approach presented in the *Baseline Risk Assessment* report (DOE 1998a), to include these additional data points. If response action is necessary, the cleanup criteria for radionuclides presented in the chemical plant ROD (DOE 1993) will be applied. This response action would involve removal of contaminated soil from the northeast slope and the ditch area. Finally, DOE intends for the extent of any soil removal at the northeast slope to be protective of human health and the environment, but not to include the relocation of State Route 94.

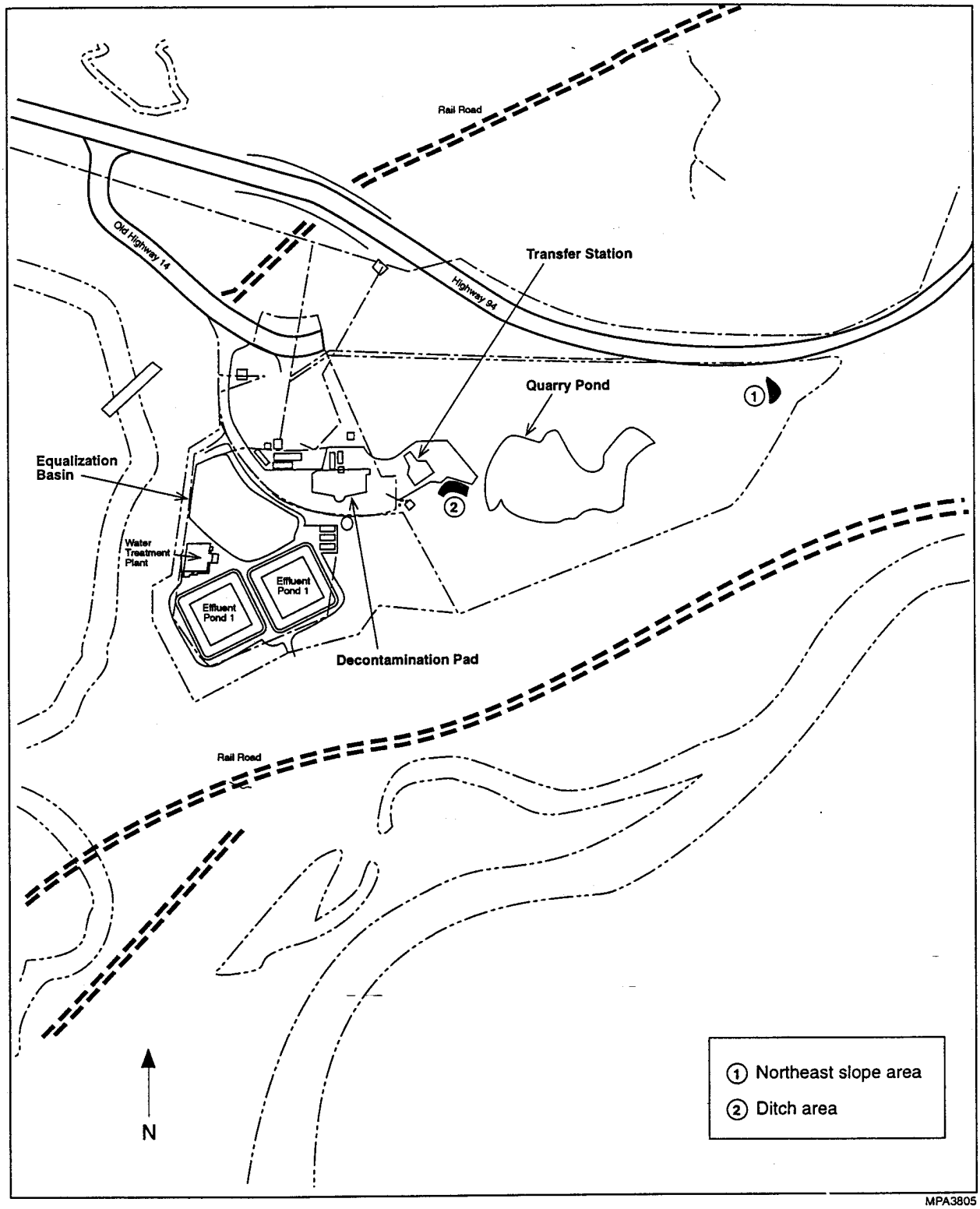

FIGURE 7 Areas with Suspected Contamination to be Fully Characterized during Quarry Restoration

9 STATUTORY DETERMINATIONS

In accordance with the statutory requirements of Section 121 of CERCLA, as amended, remedial actions shall be selected that:

- Are protective of human health and the environment;
- Comply with ARARs;
- Are cost-effective; and
- Utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

The selected action is discussed below in relation to how it fulfills the requirements. In addition, CERCLA Section 121's preference for treatment as a principal element is discussed.

9.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected action will be protective of human health and the environment. Because source removal has been accomplished under a previous action, no new migration of contaminants to the groundwater system should occur. Long-term monitoring will be used to confirm expectations that uranium located between the quarry and the Femme Osage Slough will not significantly affect the Missouri River alluvial aquifer or the St. Charles County well field.

9.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A comprehensive list of potential chemical- and action-specific ARARs and to-be-considered requirements (TBCs) for the selected action are presented in Appendix A of the FS (DOE 1998b). The listed ARARs were identified according to the NCP and procedures outlined in the most recent EPA guidance. The selected action would comply with the following ARARs, as required by Section 121(d) of CERCLA.

9.2.1 Chemical-Specific ARARs

Chemical ARARs set concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants of concern. Missouri water quality standards in groundwater for nitrobenzene (17 µg/L), 2,4-dinitrotoluene (2,4-DNT) (0.11 µ/L), and 1,3-dinitrobenzene (1,3-DNB) (1.0 µg/L) are chemical-specific ARARs for quarry groundwater. The limit for 1,3-DNB is a health advisory level that is used to establish a groundwater cleanup criterion until additional data become available to support alternative criteria or until other standards are established.

Currently, only a few data points marginally exceed the Missouri water quality standards for groundwater. It is projected that these ARARs are likely to be met within a reasonable period of time (i.e., several years) after implementation of the selected action for this ROD (see Section 8). Appropriate action will be taken either to meet or obtain a waiver of the ARARs in the event the selected action fails to meet them. However, at this time it is expected that the selected action will meet ARARs.

The FS (DOE 1998b) and the PP (DOE 1998c) considered whether the 40 CFR 192.02 standard for uranium is a potential ARAR for this action. The quarry groundwater north of the slough is impacted; however, it is not considered to be a usable groundwater source. Conversely, the Missouri River alluvium south of the slough, which includes the well field, is currently not impacted and is presently being used as a potable water source. Because quarry groundwater north of the slough is not a usable source, 40 CFR 192.02 is not considered an ARAR for that groundwater. However, 40 CFR 192.02 would likely be an ARAR for any remedial action considered for the usable groundwater source south of the slough in the unlikely event of contaminant migration from north of the slough. While 40 CFR 192.02 currently appears to be the only groundwater standard that would be considered as a potential ARAR for any future remedial action to address contamination of usable groundwater, other standards in place at the time of the future action would also be considered in the ARAR analysis.

9.2.2 Chemical-Specific TBCs

The proposed maximum contaminant level (MCL) of 20 µg/L for uranium identified in the Proposed National Primary Drinking Water Regulations (Volume 56, page 33050, of the *Federal Register* [56 FR 33050] [July 18, 1991]) is treated as a TBC because it does not meet the requirements to be considered an ARAR (20 µg/L for uranium corresponds to 13.6 pCi/L for the distribution of uranium isotopes present in groundwater at the quarry area.). This standard is not an ARAR because it is a proposed regulation and is not promulgated. Section 121 (d) of CERCLA does not require compliance with TBCs. Although TBC, the proposed MCL is not useful for evaluating groundwater impact at this site, because it falls within the range of natural background

concentrations of uranium in groundwater in this area. A more appropriate level of 30 pCi/L has been selected as a trigger level for reevaluating the decisions made regarding the QROU. The trigger level of 30 pCi/L total uranium is considered to be sufficiently above the natural variation of uranium in the aquifer to be indicative of site impact and is a level considered to be protective under hypothetical exposure assessment.

9.2.3 Action-Specific ARARs

Action-specific ARARs are standards that restrict or control specific remedial activities related to the management of hazardous substances or pollutants for a variety of media. These requirements are triggered by a particular activity, not by specific chemicals or the location of the activity. Several action-specific ARARs may exist for any specific action. These action-specific ARARs do not in themselves determine the appropriate remedial alternative, but indicate performance levels to be achieved for the activities performed under the selected action. On-site actions must comply with all substantive provisions of an ARAR, but not with related administrative and procedural requirements (e.g., filing reports or obtaining a permit). The term "on-site" includes the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary to implement the response action. No permit applications would be necessary for any on-site activities. The selected action would comply with all pertinent action-specific ARARs, which are listed in Appendix A of the FS (DOE 1998b) and summarized below.

All activities that may result in the disturbance of media contaminated with radionuclides (e.g., well construction) would conform to the operational standards for uranium and thorium mill tailings promulgated by the EPA (Title 40, Part 192, Subparts D and E of the *Code of Federal Regulations* [40 CFR 192, Subparts D and E]) that establish certain annual dose limitations for exposure to radiation. Although not applicable to Weldon Spring site activities, these requirements are relevant and appropriate to these activities because they specifically address exposures of workers to radiation associated with the same radionuclides during remediation activities. Similarly, radiation exposure limits for the public established in Missouri Radiation Regulations, Protection Against Ionizing Radiation (Title 19, Part 20-10.040, et al., of the *Code of State Regulations* [19 CSR 20-10.040, et al.]), as they apply to nonoccupational exposures, are ARARs with which the selected action will comply.

A National Pollutant Discharge Elimination System (NPDES) permit for construction or operation (including discharge) of a water treatment facility is not required under Section 121 (e) (1) of CERCLA codified at 40 CFR 300.400 (e)(1). Use of an existing NPDES permitted facility is an option for groundwater treatment. Discharge contaminant concentrations will be consistent with those of the existing facility.

In addition, any release of radionuclides to the ambient air during soil excavation activities will comply with the limitations set forth in the EPA's National Emission Standards for Hazardous Air Pollutants (40 CFR 61, Subpart H). Similarly, the release of particulate matter during other earth-disturbing activities must comply with Missouri Air Pollution Control Regulations (10 CSR 10-5.180 and 10-6.170). Missouri requirements for well construction would be an ARAR for any newly installed wells or for the plugging of wells under the selected action (10 CSR 23-4.050).

Appendix A of the FS (DOE 1998b) also lists several regulations that set occupational exposure limits for activities involving media contaminated with radionuclides, including the Missouri Radiation Regulations, Protection Against Ionizing Radiation (19 CSR 20-10.040 et al.); Occupational Safety and Health Administration (OSHA) Occupational Safety and Health and Environmental Controls (29 CFR 1910, Subpart G); and DOE Occupational Radiation Protection (10 CFR 835). These regulations are not ARARs because they are not environmental or siting regulations; however, as employee protection regulations, these requirements must be complied with by employees working with contaminated media or in contaminated areas.

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," has been established as a TBC. Because DOE Orders are not promulgated regulations, they are not ARARs but are considered as TBCs. The selected action will comply with all DOE Orders.

9.3 COST-EFFECTIVENESS

The selected action would be cost-effective because it provides overall protection of human health and the environment at a reasonable cost. Costs are associated primarily with activities associated with long-term monitoring of groundwater (see Section 6.2).

The annual O&M cost for long-term monitoring is estimated to be no greater than $0.6 million. The capital cost is estimated to be approximately $0.15 million for potential construction of up to seven additional monitoring wells. Costs associated with the field tests and additional soil sampling would be identified in the RD/RA work plan. Preliminary estimates indicate that the cost for the additional field tests and additional soil sampling at the quarry proper would be approximately $0.4 million. Costs for construction of a trench are estimated to be between $1 and $2 million. The O&M costs for a two-year testing period are estimated to be between $1 and $2 million. The annual O&M costs would be primarily for treatment of extracted groundwater (which ranges from $0.4 to $0.5 million per year), if treatment is necessary to meet discharge limits.

9.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected action does not involve alternative treatment technologies, but it is expected to provide permanent protectiveness.

9.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

This remedy does not satisfy the statutory preference for treatment as a principal element. The selected action involves long-term monitoring. Treatment was not included because it was not a necessary element in achieving protectiveness.

9.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The implementation of the selected action would not result in permanent commitment of land at the quarry area. Current and future land use at the quarry area would not have to change as a result of the implementation of this action.

9.7 SIGNIFICANT CHANGES

The selected action differs from that of the preferred alternative presented in the *Proposed Plan* (DOE 1998c) in that it does not include the construction of a trench. The selected action calls for long-term monitoring to ensure protectiveness of human health and the environment. However, as part of additional sampling activities to be conducted by DOE, a pilot-scale study would be conducted involving construction of a trench to collect data that would support ongoing evaluations regarding the need for and effectiveness of groundwater remediation (see Section 8). This decision was reached after further discussions with the EPA and the Missouri Department of Natural Resources and in consideration of the overall concern for the effectiveness of the removal system. This concern was also expressed by the Weldon Spring Citizens Commission (WSCC).

10 REFERENCES

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DOE: see U.S. Department of Energy.

EPA: see U.S. Environmental Protection Agency.

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APPENDIX A:

RESPONSIVENESS SUMMARY

APPENDIX A:

RESPONSIVENESS SUMMARY

The *Proposed Plan* (DOE 1998b) for the Quarry Residuals Operable Unit (QROU) was issued to the public for review and comment on March 18, 1998. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) held a public meeting to discuss the proposed action on April 16, 1998, at the Administration Building of the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. Representatives of the State of Missouri were also in attendance. The DOE and the EPA responded to oral comments made on the *Proposed Plan* (DOE 1998b) at this meeting; those responses are included in the meeting transcript. The meeting transcript is part of the *Administrative Record* for the QROU and is on file at the information repositories for the WSSRAP. The repositories are located in the project office reading room at Francis Howell High School and at four branches of the St. Charles City/County Library as listed in Section 3 of this Record of Decision (ROD).

The public comment period for the *Proposed Plan* (DOE 1998b) was initially scheduled to end on April 18, 1998. However, the period was extended by 30 days to accommodate requests from the Weldon Spring Citizens Commission (WSCC) and the State of Missouri. The comment period formally ended on May 21, 1998. In addition to oral comments received and responded to at the public meeting, comment letters were received from the Missouri Department of Health (MDOH), the Missouri Department of Natural Resources (MDNR), and the WSCC. These letters are also part of the *Administrative Record* for the QROU. In this responsiveness summary, the comment letters are referred to by an alphabetical identifier determined by the order in which they were received by the project office. Each comment letter has been reproduced to provide detailed responses to comments or issues raised in the individual letters.

MISSOURI DEPARTMENT OF HEALTH

Mel Carnahan
Governor
Maureen E. Dempsey, M.D.
Director

P.O. Box 570, Jefferson City, MO 65102-0570 • 573-751-6400 • FAX 573-751-6010

March 23, 1998

Stephen McCracken
Project Manager
Department of Energy
7295 Highway 94 South
St. Charles, MO 63304

RE: Weldon Spring Quarry Proposed Plan

Dear Mr. McCracken:

The Department of Health (MDOH) has reviewed the Proposed Plan and associated documents for the Weldon Springs Quarry Site in Weldon Spring, Mo. MDOH is encouraged by the decision of the US Department of Energy to take a proactive approach to reduce contamination north of the slough. Alternative 3, Groundwater Removal at Selected Areas, with On-Site Treatment, is acceptable to our office if the well contingency plan is determined to be protective of the St. Charles County water supply. MDOH requests the opportunity to review this plan before it's approval. As MDOH has stated in the past, our concern is for the continued protection of the St. Charles County well field, therefore, our office would like to be assured that there will be appropriate monitoring, action levels set, and a response plan in place to address any threat to the public water supply in the event of contamination progressing south of the slough.

A-1

We appreciate the opportunity to participate in this matter. If you have any questions, please contact Pam Holley at (573) 751-6111.

Sincerely,

Daryl Roberts
Director
Section of Environmental Public Health

dr/sc/ph

cc: Larry Erickson, MDNR

Response A-1

The DOE recognizes the importance of the monitoring effort described in the *Well Field Contingency Plan* (DOE 1998d) for protecting the well field. This plan has been made available for review and comment. All input or comments will be considered to make this plan protective of the St. Charles County well field. It is our intent that the contingency plan provides for adequate monitoring, action levels, and appropriate actions ranging from increased monitoring to the relocation of the well field if indicated by the data.

Mel Carnahan, Governor • Stephen M. Mahfood, Director
STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
P.O. Box 176 Jefferson City, MO 65102-0176

MAY 21 1998

Steve McCracken
Project Manager
U.S. Department of Energy
Weldon Spring Site Remedial Action Project
7295 Highway 94 South
St. Charles, MO 63303

Re: *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri*, March 1998; and *Proposed Plan for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri*, March 1998

Dear Mr. McCracken:

We have reviewed the above referenced reports and cannot yet concur with the proposed remedial alternative as described therein.

B-1 The Department of Energy (DOE) has stated that complete cleanup of groundwater at the Weldon Spring quarry is not warranted by the likelihood of radioactive and chemical contamination reaching the St. Charles County wellfield, and that subsurface hydrogeological conditions make such cleanup technically practicable. The Missouri Department of Natural Resources (MDNR) believes that the data and their uncertainties warrant active remediation of contaminated groundwater to achieve groundwater cleanup standards and disagrees with an approach that calls for monitoring only.

B-2 MDNR does agree that a demonstration to determine practicality of a groundwater cleanup is necessary; however, we disagree that the existing data shows this to be impractical.

B-3 Complying with groundwater cleanup standards (i.e., the Applicable or Relevant and Appropriate Requirements (ARARs)) is not contingent on demonstrating the cleanup is practicable. The demonstration of technical impracticability should not be the only or even primary goal of the proposed remedy. Rather, the first goal of the proposed remedial alternative must be achieving the groundwater cleanup standards. If after a good faith attempt to implement the remedy, achieving the cleanup standards is not practicable, then those standards may be waived.

B-4 The proposed remedy does not appear to have as its goal achieving the groundwater cleanup standards. The proposed remedial alternative clearly is intended to provide the

Response B-1

Evaluations based on over 10 years of monitoring data and various field studies supporting the remedial investigation (RI) (DOE 1998c) indicate that impact from quarry contamination is limited to north of the Femme Osage Slough. Data collected from the well field indicate conditions consistent with the naturally occurring conditions in the upgradient Darst Bottoms. Further, the tightness of the aquifer, affinity of the soil for uranium, and redox conditions present in the quarry area north of the slough contribute to the relatively small and slow migration of uranium to the well field; these very same features, in turn, do not allow for effective removal of the uranium from the system.

Response B-2

Ample data are available to indicate that current conditions at the well field are protective of human health and the environment. The selected action calls for long-term monitoring. However, additional data will be collected via a pilot-scale trench to evaluate the need for and effectiveness of groundwater remediation. The data collected will be used to verify predictive models relating to groundwater remediation and support the hydrological, geochemical, and contaminant fate and transport models for the quarry area.

Response B-3

The goal of the selected action is to ensure protection of human health and the environment. The selected action complies with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, requirements. It is expected that the selected action will meet all ARARs identified in the ROD. Establishing technical impracticability would only be necessary in the event the selected action was not able to meet a particular applicable or relevant and appropriate requirement (ARAR).

Response B-4

See responses B-2 and B-3. The MDNR will have the opportunity to provide input to define additional field measurements that would supplement the current database and increase confidence in the evaluations that support the decisions for the QROU.

Mr. McCracken
Page two

necessary data to demonstrate technical impracticability and waive the groundwater cleanup standards. MDNR does not object to further investigations in this area, and we
B-4 reiterate our offer to work with DOE to define a set of performance-based criteria necessary and sufficient to justify the granting of such a waiver if supported by data from the field.

To the extent the *Proposed Plan* is not explicit on the goal of achieving groundwater cleanup standards, the *Proposed Plan* should be revised to state:

B-5
1) The goal of the proposed remedial alternative is achieving groundwater cleanup standards,

2) How the proposed remedial alternative will achieve that goal, and

3) The implementation of the remedial alternative will continue until ARARs are attained or until waived.

B-6 We do not object to the *Proposed Plan* including as an *additional* goal the collection of data intended to demonstrate technical impracticability.

Specifically, several significant issues remain unresolved:

- The proposed remedy will not attain ARARs. The National Contingency Plan at 40 CFR 430(f)(1)(ii)(B) requires that "On-site remedial actions selected in a ROD must attain those ARARs that are identified at the time of [*Record of Decision* (ROD)] signature or provide grounds for invoking a waiver." The proposed remedy
B-7 will not attain ARARs for uranium or for some nitroaromatics. If DOE does not plan to attain ARARs, a waiver of the ARAR should be obtained before the ROD is signed. MDNR reiterates its offer to work with DOE to define a set of criteria necessary and sufficient to justify granting a Technical Impracticability waiver of ARARs.

- The proposed remedy leaves the cleanup of the quarry incomplete. Currently, there are no cleanup levels provided for the remaining contaminated material in the quarry proper. Contamination, including flakes of yellowcake, remains in cracks and
B-8 crevices of the quarry floor and walls. This residual material is a concern because it is a source of contamination to groundwater and because it involves a risk from direct exposure. DOE continues to postpone a final remedial action for contamination in the quarry proper to final restoration of the quarry.

- The proposed remedy omits appropriate remediation goals. DOE rejects containment as a remediation goal. DOE responds, "[T]he current goal of achieving
B-9 as much reduction as possible of the uranium present north of the slough is appropriate and adequate." "[A]chieving as much reduction as possible" is not an appropriate remediation goal. The NCP at 40 CFR 430(f)(1)(ii)(B) requires that

Response B-5

The *Proposed Plan* (DOE 1998b) that was released for public comment was a final document and will not be revised per CERCLA protocols. With respect to groundwater standards, see responses B-3 and B-7.

Response B-6

See response B-2.

Response B-7

The selected action will meet ARARs; no ARARs have been identified for uranium in groundwater. For a detailed discussion of ARARs, see Section 9.2. of this ROD.

Response B-8

As part of the selected action described in Section 8 of this ROD, the DOE has proposed additional characterization at the northeast slope and drainage ditch area within the quarry proper. These data would then be used to perform risk calculations consistent with the approach presented in the BRA (DOE 1998a) for the QROU. If calculations indicate risks to be greater than the EPA's acceptable risk range of 10^{-6} to 10^{-4} for a recreational scenario, soil removal would be undertaken to meet cleanup criteria presented in the chemical plant ROD (DOE 1993) for radionuclides.

In addition, quarry restoration by backfilling with soil is planned; this will prevent further infiltration to groundwater of any residual yellowcake or flakes in cracks and crevices that may be present.

Response B-9

Evaluations indicate already protective conditions at the quarry area and the well field. The implementation of engineering methods to provide containment of the plume of contamination is not warranted. In fact, current hydrological and geochemical models indicate contamination to be confined to the quarry area north of the slough. In addition, no ARARs have been identified that require containment.

B-10 "On-site remedial actions selected in a ROD must attain those ARARs that are identified at the time of ROD signature or provide grounds for invoking a waiver."

Plume containment should be included as a remediation goal. DOE states, "The primary remediation goal for the QROU is to reduce the amount of uranium in quarry groundwater north of the slough, thereby reducing the amount of uranium that could migrate to the St. Charles County well field." Plume containment could be effected under the proposed alternative by either active means (e.g., continued water extraction from the trench after groundwater cleanup standards are achieved) or passive means (e.g., grouting the trench after active measures are completed).

B-11 Including plume containment as a remediation goal is appropriate since 1) as stated in the *Proposed Plan*, "migration of uranium to the county well field is possible and could be occurring (probably at very low rates)" (MDNR believes the Draft Final *Proposed Plan* describes the situation more accurately, i.e., migration of uranium "is most likely occurring (albeit at very low rates)."); 2) any contamination which migrates into the alluvium south of the Femme Osage Slough cannot leave the alluvium other than through the public wells (QROU *Remedial Investigation*, Figure 8-19 at p. 8-33); 3) current DOE plans leave residual contamination in the quarry proper which is a source of further groundwater contamination; and 4) migration of any contamination into the public water supply should be avoided.

- Groundwater cleanup levels are not achieved throughout the area outside the quarry proper. Groundwater contamination outside the quarry proper and north of the Femme Osage Slough exceeds groundwater cleanup standards. DOE proposes that the area south of the Femme Osage Slough (i.e., the "RMW" monitoring wells) as the point of compliance for demonstrating compliance with groundwater cleanup standards. This conflicts with EPA guidance that "groundwater cleanup standards should generally be attained throughout the contaminated plume, or at and beyond the edge of the waste management area, when the waste is left in place." Since the proposed remedy leaves waste within the quarry proper that must be managed, the quarry proper constitutes a waste management area outside of which cleanup levels must be achieved.

B-12

- A two-year implementation period is inappropriate. DOE specifies only a two-year "implementation period" for the remedial action "to gauge the performance of this proposed action" and to reevaluate the need for waivers of the nitroaromatic ARARs. MDNR does not object to periodic reviews of the remedy's performance. However, in response to our comment that no fixed time period would be appropriate, DOE stated, "If the reduction achieved [in two years] is as estimated or greater, the goal of providing as much reduction as possible would have already been achieved. The implementation of the action beyond the two-year period proposed would not be cost-effective in light of the acceptable and protective conditions that exist in the well field and the contingencies already planned for the wellfield via the Wellfield Contingency Plan."

B-13

Response B-10

See response B-3.

Response B-11

See response B-9.

Response B-12

See Response B-7 and Section 8 of this ROD.

Response B-13

Data collection involving a trench will be conducted for up to two years; at which time, data collected will be compared with a predetermined set of performance goals. If performance of the removal system exceeds the performance goals, the need for and effectiveness of groundwater remediation will be reevaluated. However, if the performance is less effective or within the specified performance goals, then further evaluation of groundwater remediation will not be necessary (see Section 8 of this ROD).

An understanding or clarification needs to be given that explains how the remedial action can go forward, beyond the two-year period, if the effectiveness exceeds estimates. It is unclear how the Department of Energy can deem an action as "not cost-effective" at the time, even though future actual performance data may exceed modeling estimates. It would appear that if actual contamination reductions are greater than model estimates, this would support the decision to continue active remediation until ARARs are achieved.

B-14

- Review of the *Wellfield Contingency Plan* is not complete. The 1988 draft version of the *Wellfield Contingency Plan* referenced in the *Proposed Plan* was received after the *Feasibility Study* and *Proposed Plan* were submitted for public comment. The *Proposed Plan* takes credit for the *Wellfield Contingency Plan*, which describes groundwater monitoring, action levels, and planned responses to "ensure the safety of drinking water supplied to residents of St. Charles County from this wellfield." Concurrence with the *Proposed Plan* is not possible until a review of the *Wellfield Contingency Plan* is complete.

B-15

- Natural resources damages are not assessed. The Director, Missouri Department of Natural Resources, is the State of Missouri's trustee for natural resources. Pursuant to Section 107(f) of CERCLA or Section 311(f)(5) of the Clean Water Act, the state trustee for natural resources may act on behalf of the public to assess and recover damages to natural resources. The proposed remedial alternative will leave contaminated groundwater to continue to threaten the St. Charles County wellfield and may limit the ability to expand production of the wellfield to provide drinking water to residents in this rapidly growing area. Natural resources damages have not yet been assessed. This may need to be in the *Record of Decision*.

B-16

We look forward to working with you to resolve these issues and executing a *Record of Decision* which is protective of human health and the environment and attains all applicable or relevant and appropriate laws and regulations. If you have any questions, please contact Larry Erickson at (573) 751-6838.

Sincerely,

DIVISION OF ENVIRONMENTAL QUALITY

John A. Young
Director

c: Weldon Spring Citizens Commission
Dan Wall, EPA Region VII
St. Charles County Executive

Response B-14

See Response B-13.

Response B-15

The most recent draft of the *Well Field Contingency Plan* was distributed for agency review on March 17, 1998. As stated in response A-1, input and comments provided on this plan will continue to be considered and incorporated, as appropriate, to ensure that protection of the well field is as comprehensive as possible.

Response B-16

The assessment to address natural resource damages does not occur as part of the remedy selection process. These issues are addressed following performance of remedial activities.

Weldon Spring Citizens Commission
100 N. Third Street
St. Charles, MO 63301

May 21, 1998

Mr. Stephen H. McCracken, Project Manager
U.S. Department of Energy
Weldon Spring Site Remedial Action Project Office
7295 Highway 94 South
St. Charles, Missouri 63304

Dear Mr. McCracken:

This letter is to serve as public comment from the Weldon Spring Citizens Commission on the *Proposed Plan for Remedial Action at the Quarry Residuals Operable Unit of the Weldon Spring Site,* March 1998, DOE/OR/21548-724. This response is in fulfillment of the Commission's primary goal which is "To ensure that the public has a voice in the safe and timely completion of the Weldon Spring project." One of the primary stated objectives that guided the Commission in formulating their response was "to maximize the quality of the cleanup while minimizing the impact to the surrounding environment and the public." Our written responses to the proposal described above are intended to reflect the collective perceptions, considered opinions, and concerns of informed local citizens who have a demonstrated interest in both short term and long term consequences of the remediation efforts of the WSSRAP

C-1 The Commission unanimously supports the Department of Energy's "alternative # 2"(monitoring with no active remediation) as described in the *Proposed Plan for Remedial Action at the Quarry Residuals Operable Unit of the Weldon Spring Site,* March 1998. The decision was reached after an exhaustive review of information evaluated over the last five months including independent technical review provided to the Commission. Our comments first address the quarry proper followed by comments regarding the groundwater remediation.

C-2 We believe that restoration of the quarry is essential and should be restored to eliminate physical and radiological exposure. This should be done by filling and capping the quarry with suitable material and taking whatever measures necessary to ensure that any residual contaminants do not migrate from the site. The Commission expects to be involved in the Remedial Design and Remedial Action Work Plan.

Response C-1

The DOE acknowledges the preference of the WSCC for Alternative 2 (monitoring with no active remediation) described in the *Proposed Plan* (DOE 1998b).

Response C-2

The DOE is planning to perform quarry restoration by backfilling with soil as discussed in previous sections of this ROD. The WSCC will continue to be given the opportunity to review and provide input on subsequent reports or documents prepared in support of the QROU, as well as other Weldon Spring site activities.

With respect to the groundwater, the Commission believes that the first line of defense to an unforeseen event which would contaminate the drinking water is continued monitoring backed up by an updated Well Field Contingency Plan. We believe that data from continuous review of alternative #2 can accomplish our goals. This would include data from existing monitoring wells as well as new strategic monitoring wells. This will
C-3 insure that the integrity of the well field is not compromised by a change in the existing plume and will allow us to make appropriate responses if the integrity is compromised. The Commission will review the data for the existing and proposed monitoring wells within a year of the completion of the Quarry Restoration. This will allow the Commission to decide whether there should be a change in the scope and/or frequency of future monitoring.

With respect to the Well Field Contingency Plan, the Commission believes that the plan is the only action to safeguard the drinking water if the monitoring proposed in alternative #2 shows migration of the plume toward the St. Charles County well field. This plan needs to be strengthened. The plan must state:

C-4
1. who will be responsible and update the implementation of the plan;
2. who will be involved in communicating the monitoring results if there is an increased presence of uranium in the water supply wells;
3. what will be the public involvement in the review and the evaluation of the plan.

The essential difference between alternative #2 and alternative #6 in the *Proposed Plan for Remedial Action at the Quarry Residuals Operable Unit of the Weldon Spring Site,* March 1998, was the construction of a trench to capture and remove residual groundwater contaminants. However, from the information provided to the Commission, there were serious doubts that the trench would be successful in reducing measurable amounts of contaminants. As stated, the best prediction called for only an 8-10% reduction in the mass of uranium over a two year period. With the stated length of operation of two
C-5 years, this predicted amount of reduction does not, in our opinion, support the possible unforeseen risks of the disturbance of the natural barrier. In addition, possible other negative effects are: the draining of the slough with increased contaminant concentrations, creating unknown pathways for the contaminants, breaking the natural barrier, and other technical reason as stated in the *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring Missouri*, March 1998, DOE/OR/21548-595, page 4-17.

Response C-3

Under the selected action described in this ROD, monitoring would be performed to ensure that conditions continue to be protective of human health and the environment at the well field. The specific process to be undertaken regarding review of data will be defined in post-ROD remedial design/remedial action reports. The WSCC will have the opportunity to provide input into this process and associated reports.

Response C-4

The March 1998 version of the *Well Field Contingency Plan* (DOE 1998d) will be revised to incorporate comments received from various stakeholders. The DOE is responsible for updating and implementing this plan. Specific information requested in this comment will be provided in the revised version of the report, as appropriate.

C-5 We cite the August 21,1997 Department of Energy's response to the Weldon Spring Citizens Commission's Comment #6 on the *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri*: "A risk to downgradient groundwater from concentrating uranium in soils in this area [north of the slough] could be the introduction of materials or a significant change in the natural system which might significantly alter the reducing nature of this area. Any change to a more oxidizing system would allow the precipitated uranium in the soil to become mobilized in the dissolved phase and migrate south of the slough."

C-6 In summary, the Commission unanimously supports alternative #2 and strongly urges the DOE to incorporate the recommendations submitted in this document in the final record of decision. The Commission would like to extend their gratitude to the Department of Energy for their candor and openness in providing the Commission with information as well as responding to our numerous requests for clarification and explanations associated with this proposal. This type of cooperation has allowed the Commission to maintain its objectivity and impartiality. We hope this level of honest and open dialog will continue in the future and we appreciate the opportunity to offer a community perspective on this ongoing remediation effort.

Sincerely,

Weldon Spring Citizens Commission

Weldon Spring Citizens Commission:
Glenn Hachey, Chair
Daryl Anderson, Co-Chair
Paul Mydler, past Co-Chair
John Urbanowicz
Larry Sharp
Shannon Dougherty

cc: Karen Reed, DOE
Dan Wall, EPA
Jim Garr, MDC
John Young, MDNR
Robert Geller, MDNR
Larry Erickson, MDNR
Glenn Carlson, MDNR

Response C-5

Construction of the trench should have little to no impact on the natural processes (adsorption and precipitation) presently mitigating the migration of uranium south of the slough. The high levels of uranium are present in an oxidizing portion of the aquifer; therefore, the trench would also be located in this portion of the aquifer. Because the trench will behave as a collection system, the groundwater will be pulled to this location. It is expected that the groundwater capture zone for this trench will not be large because of the fine-grained nature of the soils. South of the trench, a reducing zone is present that allows for the precipitation of uranium from the groundwater. The operation of the trench will not result in oxidizing groundwater invading the reducing zone and resulting in its degradation or remobilization of uranium because of the small area of influence the trench will have in comparison to the size of the reducing area. Also, the installation of the trench will not impact the capacity of the existing soils to adsorb uranium.

Response C-6

The selected action described in this ROD was reached after consideration of all comments received, including those from the WSCC. The process for exchange of information and communication between the DOE and the WSCC is expected to continue as it has.

REFERENCES FOR APPENDIX A

U.S. Department of Energy, 1993, *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-376, prepared by Argonne National Laboratory, Argonne, Ill., for U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Mo., Sept.

U.S. Department of Energy, 1998a, *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-595, prepared by Argonne National Laboratory, Argonne, Ill., for U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Mo., March.

U.S. Department of Energy, 1998b, *Proposed Plan for Remedial Action at the Quarry Residuals Operable Unit of the Weldon Spring Site,* prepared by Argonne National Laboratory, Argonne, Ill., for U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Mo., March.

U.S. Department of Energy, 1998c, *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-587, prepared by MK-Ferguson Company and Jacobs Engineering Group, Weldon Spring, Mo., for U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Mo., Feb.

U.S. Department of Energy, 1998d, *Well Field Contingency Plan,* Draft, prepared by MK-Ferguson Company and Jacobs Engineering Group, Weldon Spring, Mo., for U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Mo.

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DOE/OR/21548-725

RECORD OF DECISION FOR REMEDIAL ACTION FOR THE QUARRY RESIDUALS OPERABLE UNIT AT THE WELDON SPRING SITE, WELDON SPRING, MISSOURI