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RECORD OF DECISION FOR THE MANAGEMENT OF THE BULK WASTES AT THE WELDON SPRING QUARRY

WELDON SPRING, MISSOURI

September 1990

DECLARATION

SITE NAME AND LOCATION

Weldon Spring site
St. Charles County, Missouri

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the quarry bulk waste operable unit of the Weldon Spring site in St. Charles County, Missouri. The Weldon Spring site consists of two distinct areas that comprise one contiguous site as listed on the National Priorities List (NPL). This remedial action was selected in accordance with 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 (NCP). This decision is based on the administrative record file for this site.

The State of Missouri concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this record of decision, may present an imminent and substantial endangerment to public health and welfare, or the environment.

DESCRIPTION OF REMEDY

This operable unit remedial action is the second of five response actions planned as part of the overall remedial action for the Weldon Spring quarry. The first response action to be initiated at the quarry is a removal action involving treatment of

contaminated surface water and discharge of the treated water to the Missouri River. An engineering evaluation/cost analysis (EE/CA) report has been prepared to evaluate alternatives for management of this water. The quarry water removal action is expected to be initiated in 1991.

The function of this operable unit is to remove bulk wastes from the quarry. This will eliminate the wastes as a potential continuing source of groundwater contamination and minimize risks associated with exposure to contaminants released into the air. It will also facilitate additional characterization of the wastes and residual contamination in and around the quarry.

Bulk wastes are defined as materials that can be removed from the quarry using standard equipment and procedures. This remedial action is not the final remedial action for the quarry, and it does not address final disposition of the bulk wastes. Disposal decisions for these wastes will be made as part of the remedial action decision for the chemical plant area of the Weldon Spring site. These decisions are being addressed in a remedial investigation and feasibility study which is currently in preparation. A decision on the final remedial action for the quarry will be made in a subsequent decision making process after the bulk wastes have been removed.

The major components of the selected remedy include:

- Removal of the bulk wastes from the quarry using standard equipment and procedures.

- Transporting the bulk wastes along a dedicated haul road to the chemical plant area of the Weldon Spring site.

- Placing the bulk wastes in controlled storage in an engineered temporary storage facility.

Following removal of the wastes, detailed studies will be made of the empty quarry and local groundwater system. These studies will facilitate decisions with regard to the three remaining components of the quarry remedial action, i.e., (1) residual materials remaining in the quarry walls and fissures, (2) groundwater, and (3) vicinity properties. The vicinity properties are contaminated properties that are outside the quarry and for which the U.S. Department of Energy is responsible (e.g., the Femme Osage Slough). Comprehensive response actions for residual materials, groundwater, and vicinity properties can be developed only after the bulk wastes have been removed from the quarry so that the nature and extent of residual contamination and migration pathways can be fully assessed. These actions, which will address final quarry cleanup criteria, will be developed in consultation with Region VII of the U.S. Environmental Protection Agency (EPA) and the State of Missouri and will be described in future documents.

DECLARATION

The selected remedy is protective of human health and the environment; it complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, unless those requirements have been properly waived in accordance with CERCLA; and it is cost effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable given the limited scope of this remedial action. However, because this action constitutes neither the final remedy for the quarry nor the final decision for disposition of the bulk wastes, it does not satisfy the statutory preference for treatment as a principal element of the remedy. Potential treatment technologies will be considered in the process for selection of the final remedy for the quarry and for final disposition of the bulk wastes.

Because this remedy may result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of this remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

9-28-90

Regional Administrator, U.S. Environmental Protection Agency Region VII

Date

3-7-91

Oak Ridge Operations Office Manager, U.S. Department of Energy

Date

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DECISION SUMMARY

1 SITE NAME, LOCATION, AND DESCRIPTION

The Weldon Spring site is located in St. Charles County, Missouri, near the city of Weldon Spring, about 48 km (30 mi) west of St. Louis (Figure 1). The site consists of two noncontiguous areas: (1) the chemical plant area and (2) the quarry. The chemical plant area is about 3.2 km (2 mi) southwest of the junction of Missouri (State) Route 94 and U.S. Route 40/61. The quarry is about 6.4 km (4 mi) south-southwest of the chemical plant area and about 8 km (5 mi) southwest of the town of Weldon Spring. Both the chemical plant area and the quarry are accessible from State Route 94 and are fenced and closed to the public. The locations of the chemical plant area and the quarry are shown in more detail in Figure 2.

The chemical plant area covers about 88 ha (217 acres) and contains various buildings and ponds (including four raffinate pits) as well as gravel and paved surfaces. Vegetation in this area is predominantly grasses, shrubs, and small trees. The August A. Busch Memorial Wildlife Area is located to the north, the Weldon Spring Wildlife Area to the south and east, and the U.S. Army Reserve and National Guard Training Area to the west.

The quarry was excavated into a limestone bluff that forms a valley wall at the edge of the Missouri River alluvial floodplain. Prior to 1942, it was mined for limestone to support various construction activities. The quarry is about 300 m (1,000 ft) long by 140 m (450 ft) wide and covers an area of approximately 3.6 ha (9 acres). The main floor comprises approximately 0.8 ha (2 acres) and currently contains about 11,000 m^3 (3,000,000 gal) of ponded water covering about 0.2 ha (0.5 acre). The quarry is vegetated

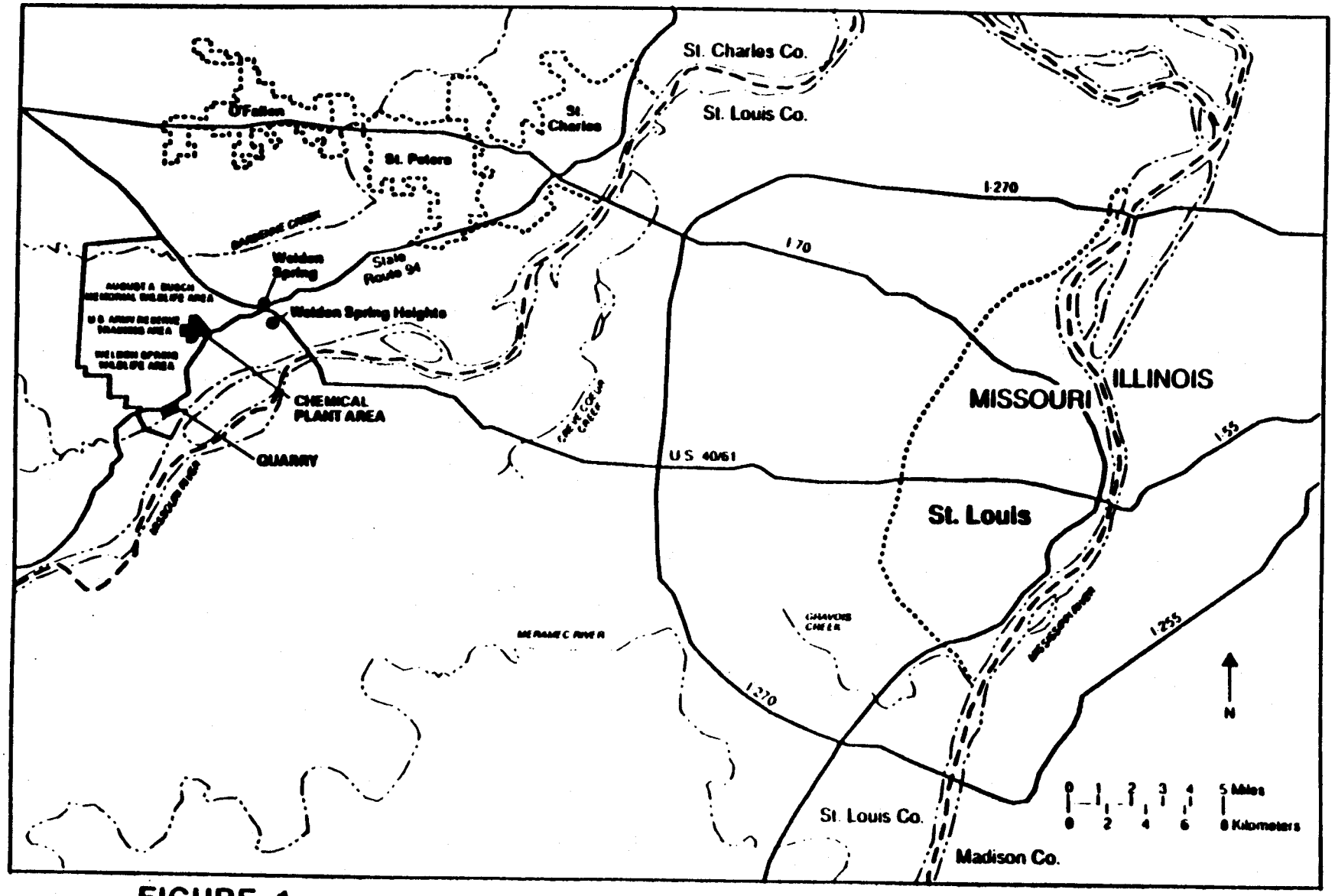


FIGURE 1

LOCATION OF THE WELDON SPRING SITE, WELDON SPRING, MISSOURI

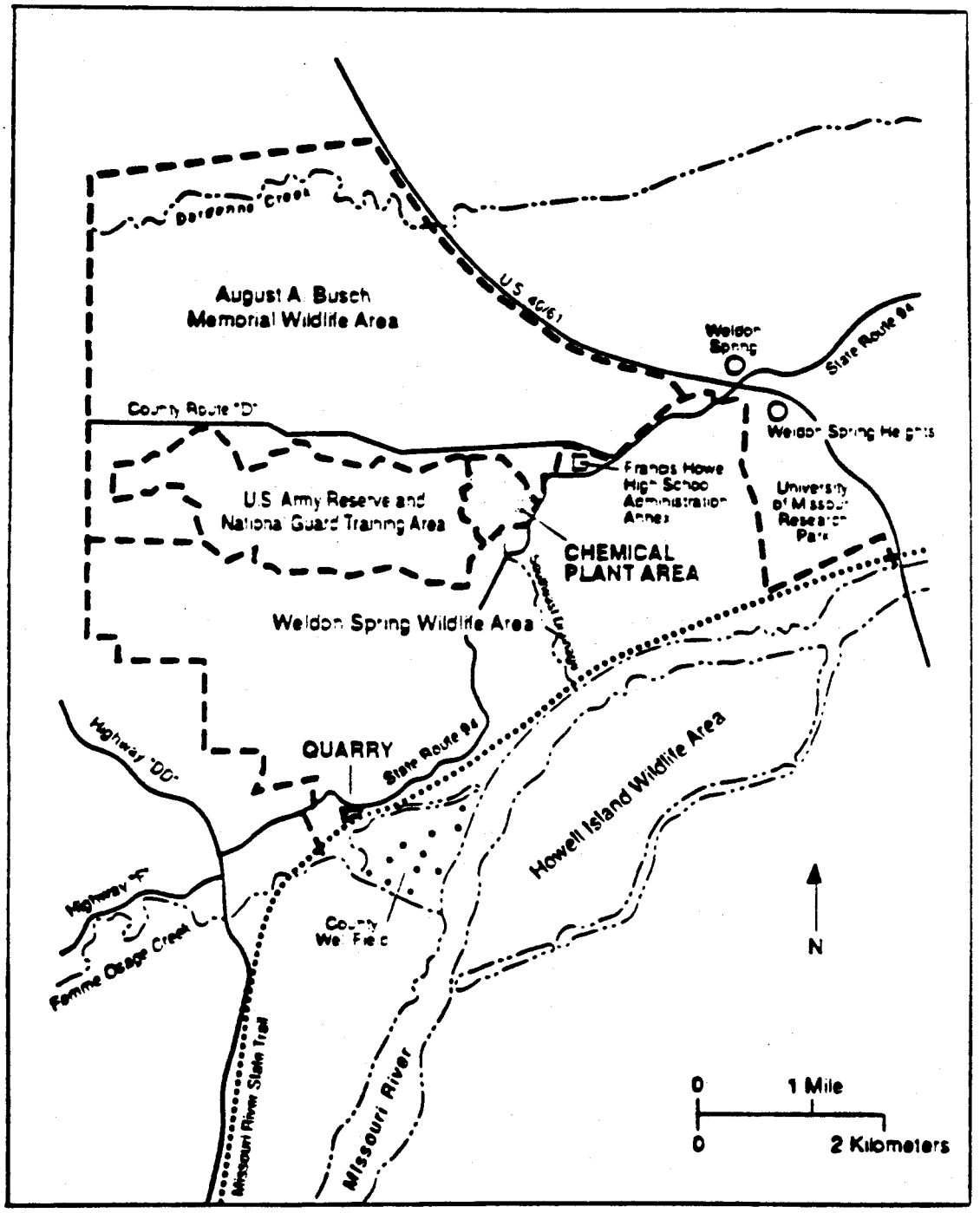


FIGURE 2

MAP OF THE WELDON SPRING SITE AND VICINITY

with grasses, shrubs, and trees, and is surrounded by the Weldon Spring Wildlife Area. The general layout is shown in Figure 3.

The Missouri-Kansas-Texas Railroad line formerly passed just south of the quarry. This line was recently dismantled, and the right-of-way has been converted to a gravel-based public trail for hiking and biking (the Missouri River State Trail). A rail spur enters the quarry at its lower level from the west and extends approximately one-third of its length. The spur is overgrown with vegetation and is in a state of disrepair. The St. Charles County well field is located to the southeast between the quarry and the Missouri River (Figure 4). The nearest well is located about 0.8 km (0.5 mi) from the quarry.

The quarry and the chemical plant area are related as to history and purpose, are reasonably close in proximity, and are compatible with regard to remediation approach. Therefore, they are considered one Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) site for purposes of this response action.

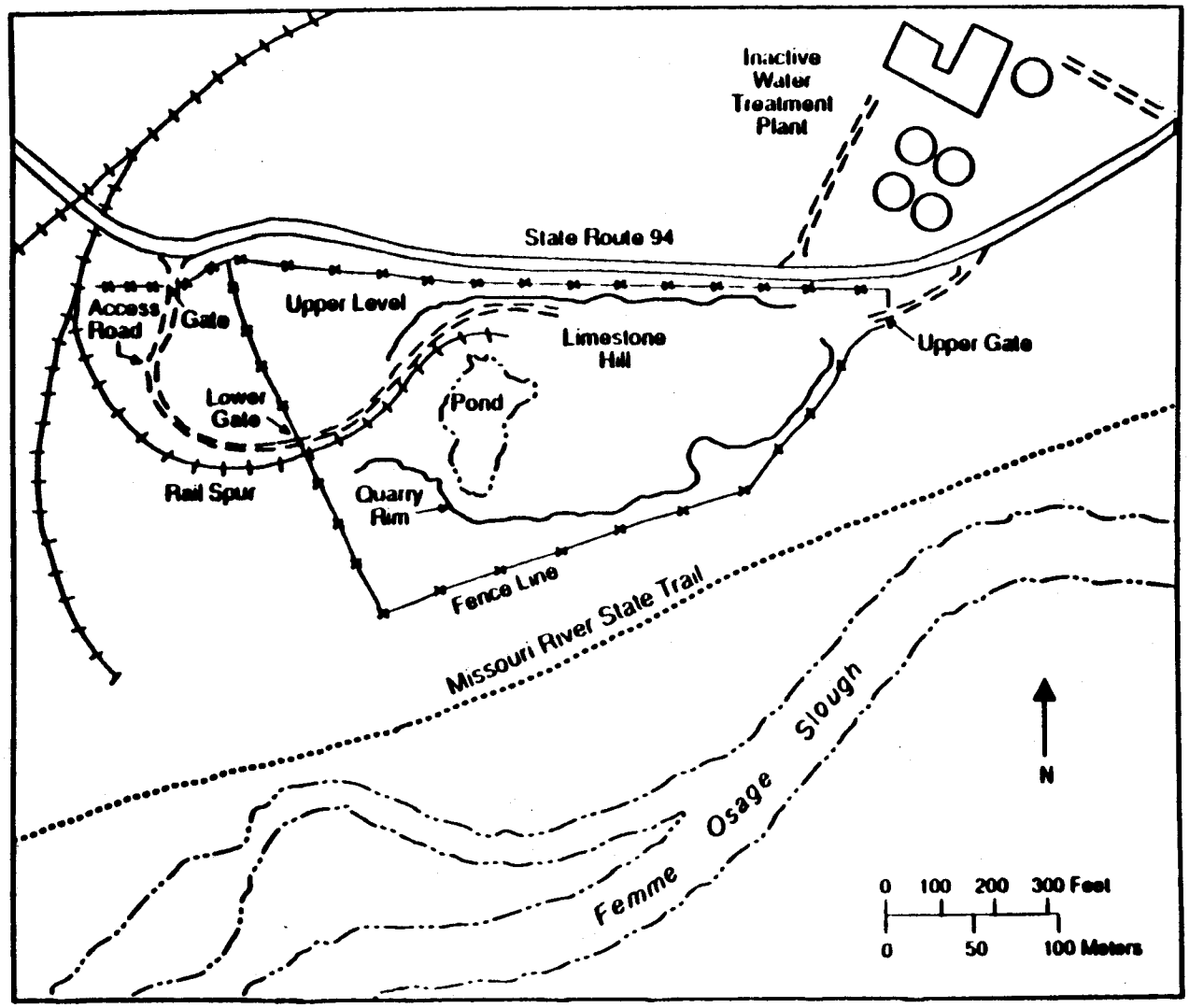


FIGURE 3

LAYOUT OF THE WELDON SPRING QUARRY

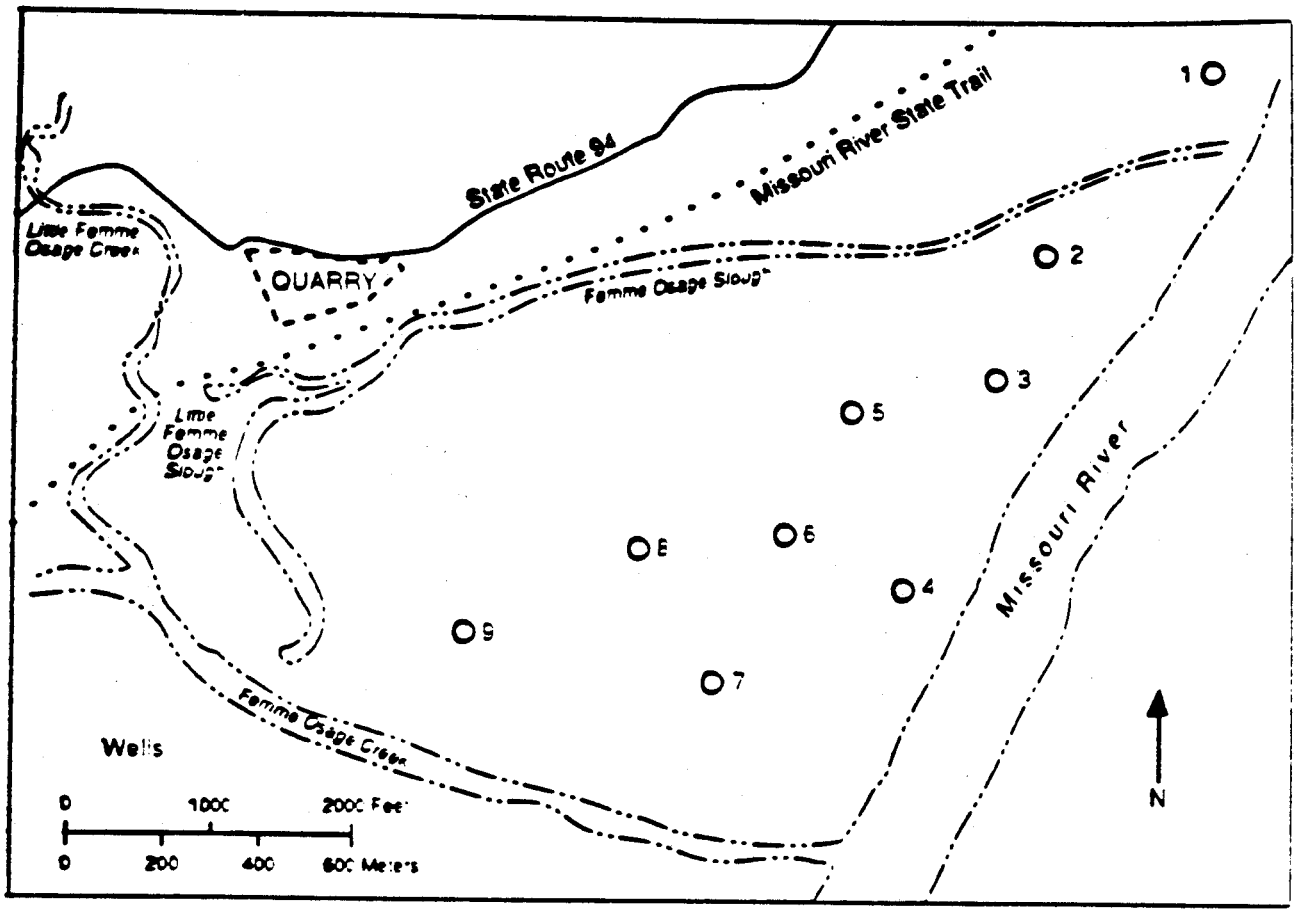


FIGURE 4

SURFACE HYDROLOGICAL FEATURES IN THE VICINITY OF THE QUARRY AND LOCATION OF PRODUCTION WELLS IN THE ST. CHARLES COUNTY WELL FIELD

2 SITE HISTORY

In April 1941, the U.S. Department of the Army acquired about 7,000 ha (17,000 acres) of land in St. Charles County, Missouri, for construction of the Weldon Spring Ordnance Works. From November 1941 through January 1944, the Atlas Powder Company operated the ordnance works for the Army to produce trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives. The ordnance works was reopened during 1945 and 1946 but was closed and declared surplus to Army needs in April 1946. By 1949, all but about 810 ha (2,000 acres) had been transferred to the State of Missouri (now the August A. Busch Memorial Wildlife Area) and the University of Missouri (as agricultural land). Much of the land transferred to the University of Missouri was subsequently developed into the Weldon Spring Wildlife Area. Except for several small parcels transferred to St. Charles County, the remaining property became the current chemical plant area and adjacent U.S. Army Reserve and National Guard Training Area.

The U.S. Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE), acquired 83 ha (205 acres) of the former ordnance works property from the Army by permit in May 1955, and the property transfer was approved by Congress in August 1956. An additional 6 ha (15 acres) was later transferred to the AEC for expansion of waste storage capacity. The AEC constructed a feed materials plant, now referred to as the chemical plant, on the property for the purpose of processing uranium and thorium ore concentrates. The quarry, which had been used by the Army since the early 1940s for disposal of chemically contaminated materials, was transferred to the AEC in July 1960 for use as a disposal site for radioactively contaminated materials.

The feed materials plant was operated for the AEC by the Uranium Division of Mallinckrodt Chemical Works from 1957 to 1966. During this period, the AEC used the quarry to dispose of uranium

and thorium residues (drummed and uncontained), radioactively contaminated building rubble and process equipment, and TNT and DNT residues from cleanup of the former ordnance works. Following closure by the AEC, the Army reacquired the chemical plant site in 1967 and began converting the facility for herbicide production. The buildings were partially decontaminated, and some equipment was dismantled. Contaminated rubble and equipment from some buildings were placed in the quarry. In 1969, prior to becoming operational, the herbicide project was canceled. Since that time, the plant has remained essentially unused and in caretaker status.

In 1971, the Army returned the 21-ha (51-acre) portion of the property containing the raffinate pits to the AEC but retained control of the rest of the chemical plant area. As successor to the AEC, the DOE assumed responsibility for the raffinate pits. In 1984, the Army repaired several of the buildings; decontaminated some of the floors, walls, and ceilings; and removed some contaminated equipment to areas outside of the buildings. In May 1985, the DOE designated control and decontamination of the Weldon Spring site as a major Federal project under its Surplus Facilities Management Program. In May 1988, the DOE redesignated the project as a major system acquisition.

On October 1, 1985, custody of the Army portion of the chemical plant area was transferred to the DOE. On October 15, 1985, the U.S. Environmental Protection Agency (EPA) proposed to include the Weldon Spring quarry on its National Priorities List (NPL); this listing occurred on July 22, 1987. On June 24, 1988, the EPA proposed to expand the listing to include the chemical plant area. This proposal was finalized on March 13, 1989, and the expanded site was placed on the NPL under the name "Weldon Spring Quarry/Plant/Pits (USDOE/Army)." The balance of the former Weldon Spring Ordnance Works property, which is adjacent to the DOE portion and for which the Army has responsibility, was included on

the NPL as a separate listing on February 21, 1990, under the name "Weldon Spring Former Army Ordnance Works."

A summary of disposal activities at the quarry is presented in Table 1. Based on historical data and characterization results, an estimated 73,000 m^3 (95,000 yd^3) of contaminated materials is present in the quarry; of this, approximately 31,000 m^3 (40,000 yd^3) is rubble, 39,000 m^3 (51,000 yd^3) is soil and clay, and 3,000 m^3 (4,000 yd^3) is pond sediment.

TABLE 1 History of Disposal Activities at the Weldon Spring Quarry

Time Period	Waste Type	Estimated Volume[a]	
		m^3	yd^3
1942 - 1945	TNT and DNT waste	- -	- -
1946	TNT and DNT waste	b	b
1946 - 1957	TNT and DNT residues and contaminated rubble from cleanup of the ordnance works (in deepest part and in northeast corner of quarry)	- -	- -
1959	3.8% thorium residues (drummed, currently below water level)	150	200
1960 - 1963	Uranium- and radium-contaminated rubble from demolition of the St. Louis Destrehan Street feed plant (covering 0.4 ha [1 acre] to a 9-m [30-ft] depth in deepest part of quarry)	38,000	50,000
1963 - 1966	High-thorium-content waste (in northeast corner of quarry)[c]	760	1,000
1963 - 1966	Uranium and thorium residues from the chemical plant and off-site facilities; building rubble and process equipment (both drummed and uncontained)	- -	- -
1966	3.0% thorium residues (drummed, placed above water level in northeast corner of quarry); TNT residues from cleanup of the ordnance works (placed to cover the drums)	460	600
1968 - 1969	Uranium- and thorium-contaminated rubble and equipment from interiors of some chemical plant buildings (101, 103, and 105)	4,600	6,000

a A hyphen indicates that the waste volume estimate is not available.

b An estimated 90 tons of TNT/DNT waste was disposed of in 1946.

c This was a portion of the waste originally stored at the Army arsenal in Granite City, Illinois; most of this material was subsequently removed from the quarry for the purpose of recovering rare earth elements.

3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

A remedial investigation/feasibility study (RI/FS) was conducted in accordance with the requirements of CERCLA, as amended, to document the proposed management of the quarry bulk wastes as a focused interim remedial action. Documents developed during the RI/FS included the RI report, a baseline risk evaluation (BRE), and an FS report. The RI/FS and proposed plan were released to the public on March 5, 1990. An informational bulletin was also prepared to summarize this proposed action and facilitate the community participation process.

These documents, along with other documents in the administrative record file, have been made available to the public in the public reading room at the Weldon Spring site. Copies of these documents have also been provided at five additional information repositories at the following locations: the Memorial Arts Building at Lindenwood College (St. Charles, Missouri), Kathryn M. Linneman Branch of the St. Charles City/County Library (St. Charles, Missouri), Spencer Creek Branch of the St. Charles City/County Library (St. Peters, Missouri), Kisker Road Branch of the St. Charles City/County Library (St. Peters, Missouri), and Francis Howell High School (St. Charles, Missouri). A notice of availability of these documents was published in the St. Charles Journal on March 4, 1990, and the St. Charles Section of the St. Louis Post Dispatch on March 28, 1990.

A public comment period was held from March 5, 1990, through April 9, 1990. A public meeting was held on March 29, 1990, at the Ramada Inn in Wentzville, Missouri, as a part of the public participation process. This public meeting was advertised in the two newspaper announcements described above. At this meeting, representatives from the DOE, EPA Region VII, and the State of Missouri answered questions about the site and the remedial alternatives under consideration for the quarry bulk wastes.

Transcripts of the meeting are included as part of the administrative record file for this operable unit remedial action. The administrative record file includes the information used to support the selected remedy. Documents in the administrative record include the RI, BRE, and FS reports.

In addition to the public meeting, the DOE held numerous briefings and meetings with public officials, school administrators, special interest groups, and members of the general public. These meetings, which were generally informal, allowed for an effective exchange of information and receipt of public input. A response to the comments received during the public comment period is included in a responsiveness summary, which was prepared as a separate document. A summary of the major issues raised during the public comment period is provided in this record of decision. This decision document presents the selected remedial action for management of the bulk wastes at the Weldon Spring quarry in accordance with CERCLA, as amended, and to the maximum extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this site is based on the administrative record.

4 SCOPE AND ROLE OF OPERABLE UNIT

The DOE is addressing the quarry bulk wastes as an operable unit remedial action (OURA) as part of the overall remedial action planned for the Weldon Spring site. The two general types of remedial actions that can be addressed as OURAs are (1) final actions that completely remediate a discrete area of a site or (2) interim actions taken to facilitate cleanup and to mitigate an ongoing release or threat of a release or to limit a potential pathway of exposure. Remedial action for the quarry bulk wastes falls into the second category. The implementation of a response action as an OURA must be consistent with the permanent remedy for the entire site, even though the action might be implemented prior to selection of the final remedy.

Defining the quarry bulk wastes as an OURA of the Weldon Spring site makes it possible to expedite management of these wastes. This action does not address final disposal of the quarry bulk wastes. As discussed in more detail below, that decision will be made as part of a subsequent remedy selection process for the chemical plant area.

Quarry bulk wastes are defined as the chemically and radioactively contaminated solids present in the quarry that can be removed using standard equipment and techniques. The total volume of these wastes--which consist primarily of soils, sludges, equipment, and structural debris--is about 73,000 m^3 (95,000 yd^3).

This OURA for the quarry bulk wastes is one of several components for overall remediation of the Weldon Spring site. An overview of the environmental strategy for achieving overall site remediation is presented in Figure 5. Remedial action alternatives for the chemical plant area will be evaluated in a separate RI/FS. This RI/FS will be modified to incorporate the requirements of an

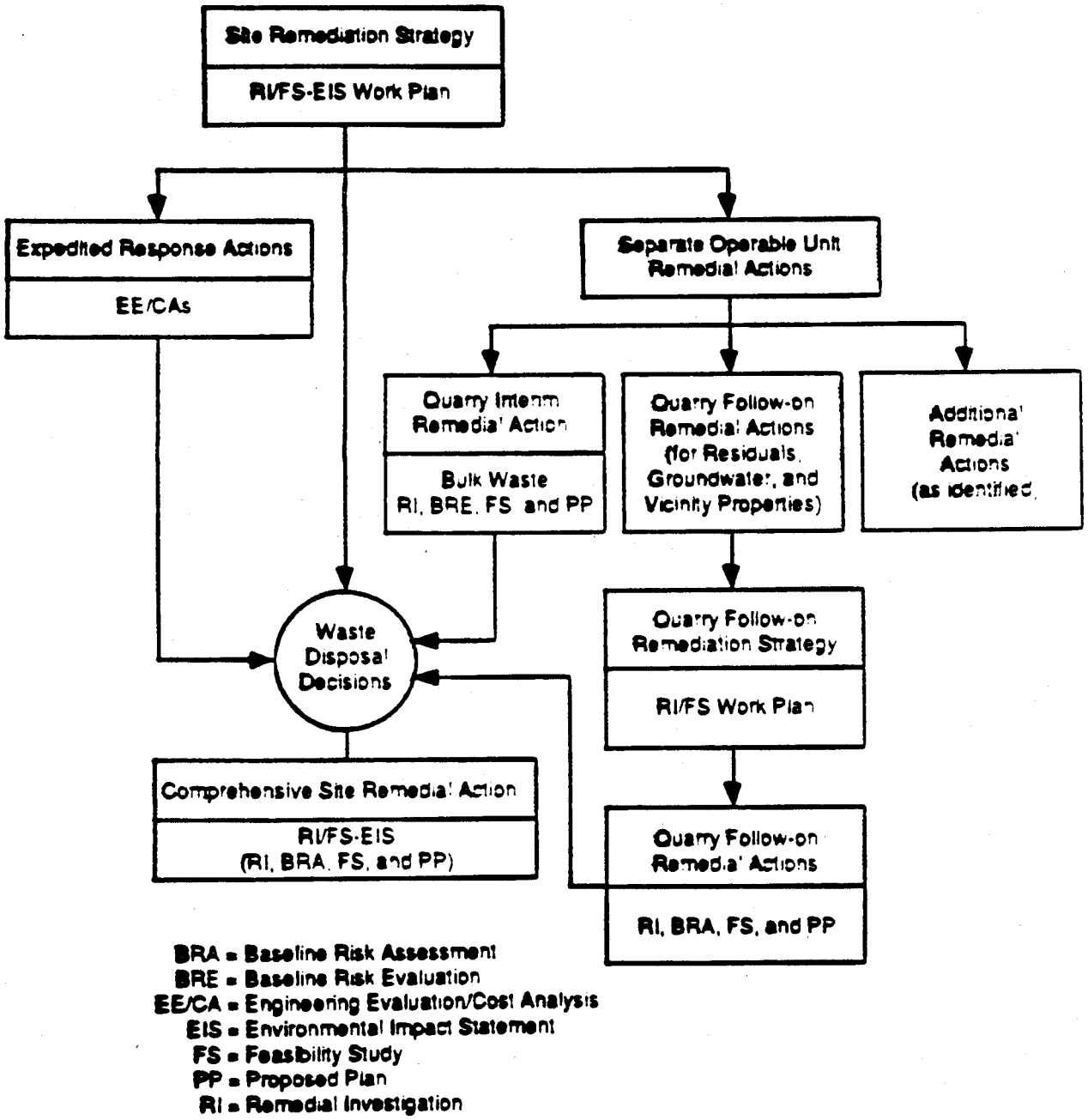


FIGURE 5

MAJOR ENVIRONMENTAL COMPLIANCE ACTIVITIES AND RELATED DOCUMENTS FOR THE WELDON SPRING SITE REMEDIAL ACTION PROJECT

environmental impact statement (EIS) for compliance with the National Environmental Policy Act (NEPA). This integrated process is being referred to as an RI/FS-EIS.

As depicted in Figure 5, various interim actions (both removal actions and operable unit remedial actions) will be performed prior to completion of this RI/FS-EIS in order to mitigate actual or potential releases of radioactive or chemical contaminants into the environment. Disposal decisions will be made as part of the remedial action decision for the chemical plant area and will be addressed in the RI/FS-EIS that is currently in preparation.

Management of the bulk wastes is one of five separate components of the overall environmental response under consideration for the quarry (Figure 6). The five components are (1) surface water, which provides the hydraulic gradient for contaminant migration to groundwater; (2) bulk wastes, which constitute the source of contaminants migrating into the air and underlying groundwater at the quarry; (3) materials remaining in the quarry walls and floor after bulk waste removal (i.e., residuals); (4) groundwater; and (5) vicinity properties, which are contaminated properties outside the quarry for which the DOE is responsible (e.g., the Femme Osage Slough).

In response to a potential threat to the nearby St. Charles County alluvial well field, management of contaminated surface water is the first of these five components being addressed. This well field supplies drinking water to more than 60,000 residents of St. Charles County. It is located within 1.6 km (1 mi) of the quarry. The quarry pond is providing a hydraulic gradient for contaminant migration into the local groundwater because the pond surface is higher than the nearby groundwater table.

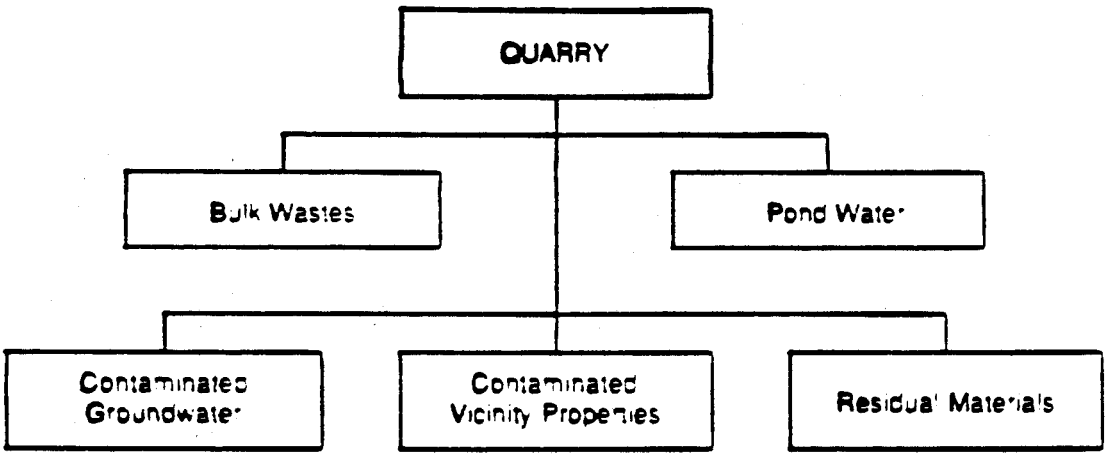


FIGURE 6

ENVIRONMENTAL COMPLIANCE COMPONENTS FOR THE WELDON SPRING QUARRY

The expedited response action for component has been documented in an engineering evaluation/cost analysis (EE/CA) report. The alternative selected as a result of the EE/CA process, which included public review and comment, was to treat the ponded water in a facility constructed adjacent to the quarry and release the treated water to the Missouri River in compliance with a permit issued to the DOE by the Missouri Department of Natural Resources. The action is expected to be initiated in 1991 and will continue until subsequent decisions are implemented for a permanent solution at the quarry.

The purpose of the quarry bulk waste OURA is to minimize the potential for further migration of contaminants from the quarry into the environment and to facilitate overall site cleanup by making it possible to assess the extent of residual contamination in the quarry and identify pathways for migration of contaminants from the quarry. The bulk wastes constitute the source of contaminants that are being released into the air at the quarry and which are migrating through the fractured walls and floor of the quarry into the underlying groundwater.

The comprehensive response actions for residual materials, groundwater, and vicinity properties can be developed only after the bulk wastes are removed from the quarry so that the nature and extent of residual contamination and migration pathways can be fully assessed. These actions, which will address final quarry cleanup criteria, will be developed in consultation with EPA Region VII and the State of Missouri and will be described in future documents on the quarry.

5 SITE CHARACTERISTICS

5.1 SETTING

The Weldon Spring quarry is situated in a relatively remote location along Missouri State Route 94 about 6.4 km (4 mi) south-southwest of the chemical plant area and about 8 km (5 mi) southwest of the city of Weldon Spring. The quarry is surrounded by the Weldon Spring Wildlife Area, which is managed by the Missouri Department of Conservation and is open throughout the year to the general public for a variety of recreational uses. This wildlife area is largely undisturbed, heavily wooded, and contains regions of heavy underbrush. Vegetation at the quarry consists primarily of grasses, shrubs, and trees. Agricultural crops are grown on much of the land south of the quarry. Access to the quarry is restricted by a 2.1-m (7-ft) high chain link fence which is topped by three strands of barbed wire. This fence completely surrounds the quarry.

The quarry was excavated into a limestone bluff of the Kimmswick Limestone Formation that forms a valley wall at the edge of the Missouri River floodplain; this limestone formation contains numerous cracks and fissures. The quarry is about 300 m (1,000 ft) long by 140 m (450 ft) wide and covers an area of approximately 3.6 ha (9 acres). The main floor of the quarry comprises approximately 0.8 ha (2 acres) and currently contains about 11,000 m^3 (3,000,000 gal) of ponded water covering about 0.2 ha (0.5 acre). The Missouri River is located approximately 1.6 km (1 mi) to the southeast. Nearby streams include Little Femme Osage Creek to the west, an unnamed tributary of Little Femme Osage Creek to the north, and Femme Osage Creek to the southwest. The Femme Osage Slough is located about 210 m (700 ft) south of the quarry (Figure 4).

The quarry borders the Missouri River alluvial floodplain. The surrounding topography, except for the floodplain area to the south, is rugged, heavily wooded, and characterized by deep ravines. The surface elevation of waste in the quarry is about 145 m (480 ft), and the elevation of the quarry rim is about 170 m (550 ft) mean sea level (MSL). The average surface elevation of the water ponded in the quarry is about 142 m (465 ft) MSL. A pyramid-shaped limestone hill rises from the quarry floor to an elevation of about 158 m (518 ft) MSL. The upper elevations at the quarry are well above the Missouri River floodplain. The quarry was originally excavated to a bottom elevation of approximately 136 m (446 ft) MSL.

The ponded quarry water is hydraulically connected to the local groundwater system in the underlying fractured bedrock, and its elevation appears to be a hydrologically high elevation for the vicinity. Most of the groundwater flow from the quarry is transported by the local gradient toward the alluvium of the Missouri River floodplain. The connection between the fractured limestone aquifer beneath the quarry and the unconfined alluvial aquifer near Femme Osage Slough is not clearly understood. Although it is certain that groundwater flows toward the Missouri River from the quarry, the influence of Femme Osage Slough on this flow and the associated solute transport is uncertain. It appears that the clay and silty alluvium at the slough may act as a groundwater barrier. Although at present there is no evidence of groundwater flow through the alluvial material below the slough to the alluvial aquifer, the existing groundwater monitoring system will be expanded. Groundwater velocity in the bedrock below the alluvium is not known.

The St. Charles County well field lies between the quarry and the Missouri River; it is separated from the quarry by the Femme Osage Slough (Figure 4). Monitoring wells located between the quarry and the well field are sampled routinely in order to monitor

for both chemical and radiological contaminants. Groundwater in the unconfined alluvial aquifer south of Femme Osage Slough is not radioactively contaminated; concentrations of radioactive constituents in samples from this aquifer are within the typical background range for this region. However, nitroaromatic compounds have been detected at low levels (less than 1 μg/l) in groundwater south of the slough. These compounds have been detected sporadically in 5 of the 10 DOE monitoring wells located south of the slough.

Nitroaromatic compounds have not migrated to the county well field. Nitroaromatic compounds detected south of the slough may be the result of contamination in slough sediments due to discharges of nitroaromatically contaminated wastes into Little Femme Osage Creek during World War II, past pumping tests on the quarry pond in which pond water was discharged directly into Little Femme Osage Creek, or transport via the groundwater pathway. (Femme Osage Slough was formerly a portion of Femme Osage Creek and received water from Little Femme Osage Creek prior to discharge to the Missouri River.)

The alluvial aquifer south of Femme Osage Slough appears not to be contaminated with uranium. Monitoring will be expanded to establish solute concentrations and groundwater flow directions in the deeper bedrock aquifer.

5.2 WASTE CHARACTERISTICS

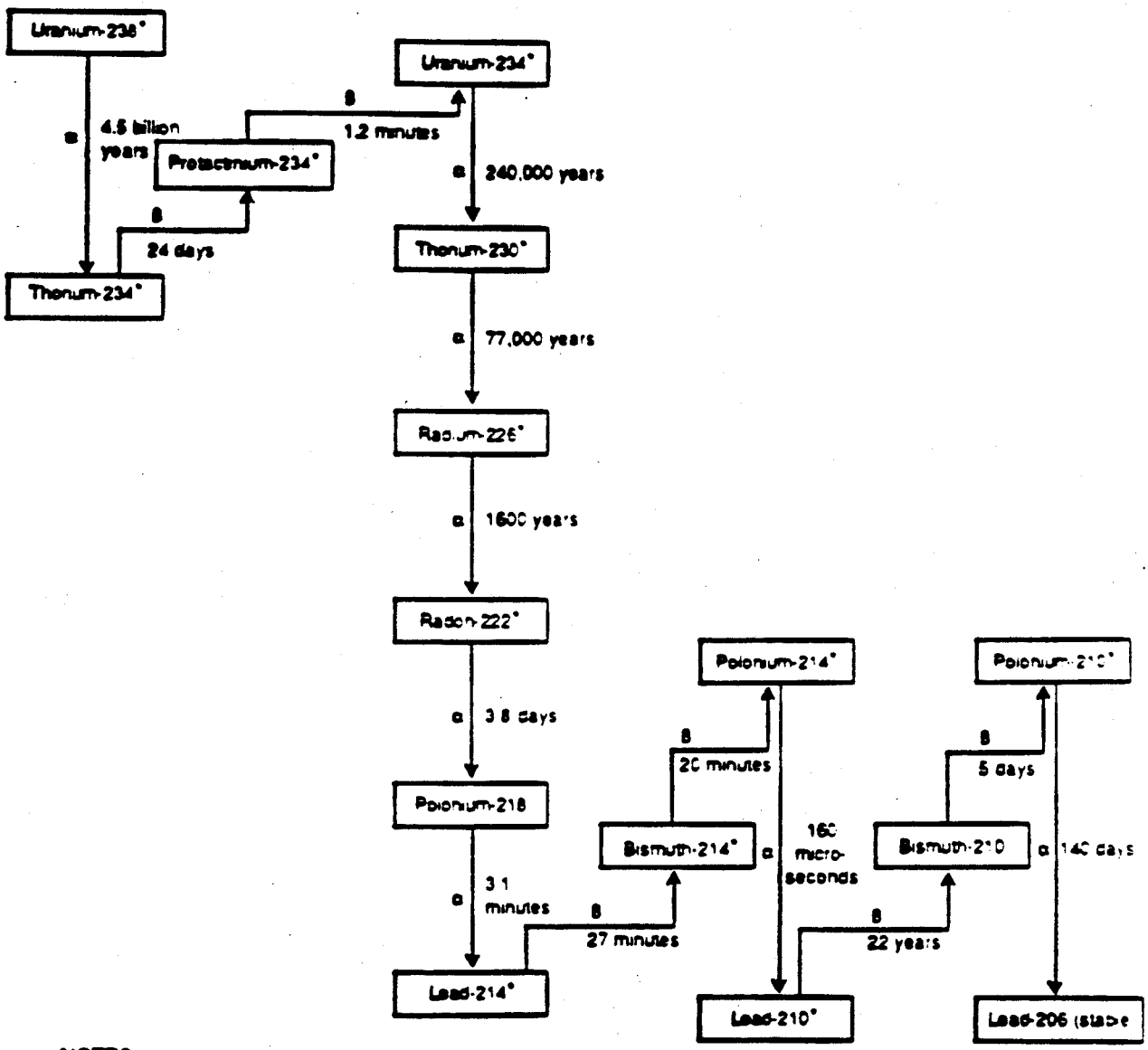
The materials disposed of in the quarry consist of wastes from the chemical plant as well as wastes brought in from other areas in the past, including (1) materials associated with the processing of uranium and thorium concentrates, (2) uranium- and radium-contaminated rubble, (3) high-thorium-content materials (most of which were subsequently removed from the quarry for the purpose of recovering rare earth elements), and (4) 3.0% thorium residues.

Most of the estimated 73,000 m^3 (95,000 yd^3) of bulk wastes in the quarry is radioactively contaminated. The radioactive contaminants of concern are those associated with the uranium-238 and thorium-232 decay series (Figures 7 and 8).

Radioactive contamination on the main floor of the quarry covers an area of almost 5,600 m^2 (60,000 ft^2) and extends to depths of about 12 m (40 ft); radioactive contamination in the entire quarry covers an area of about 15,900 m^2 (171,000 ft^2) and extends to an average depth of about 4 m (13 ft). The locations and depths of radioactive contamination at the quarry are shown in Figures 9 and 10. The concentrations of the major radionuclides in the quarry wastes are summarized in Table 2.

In each of the uranium-238 and thorium-232 decay series, one member of the series is a gas (radon-222 and radon-220, respectively). Elevated concentrations of radon-222 and radon-220 and their short-lived decay products have been measured in the atmosphere within the quarry and at the quarry fence. The average concentration of radon gas (radon-222 and radon-220) in the atmosphere within the quarry is 14 pCi/l based on previous measurements. The annual average concentration at the fence line varies from year to year and has averaged about 2 pCi/l over the past few years. The background concentration of radon gas in the Weldon Spring area is about 0.3 pCi/l.

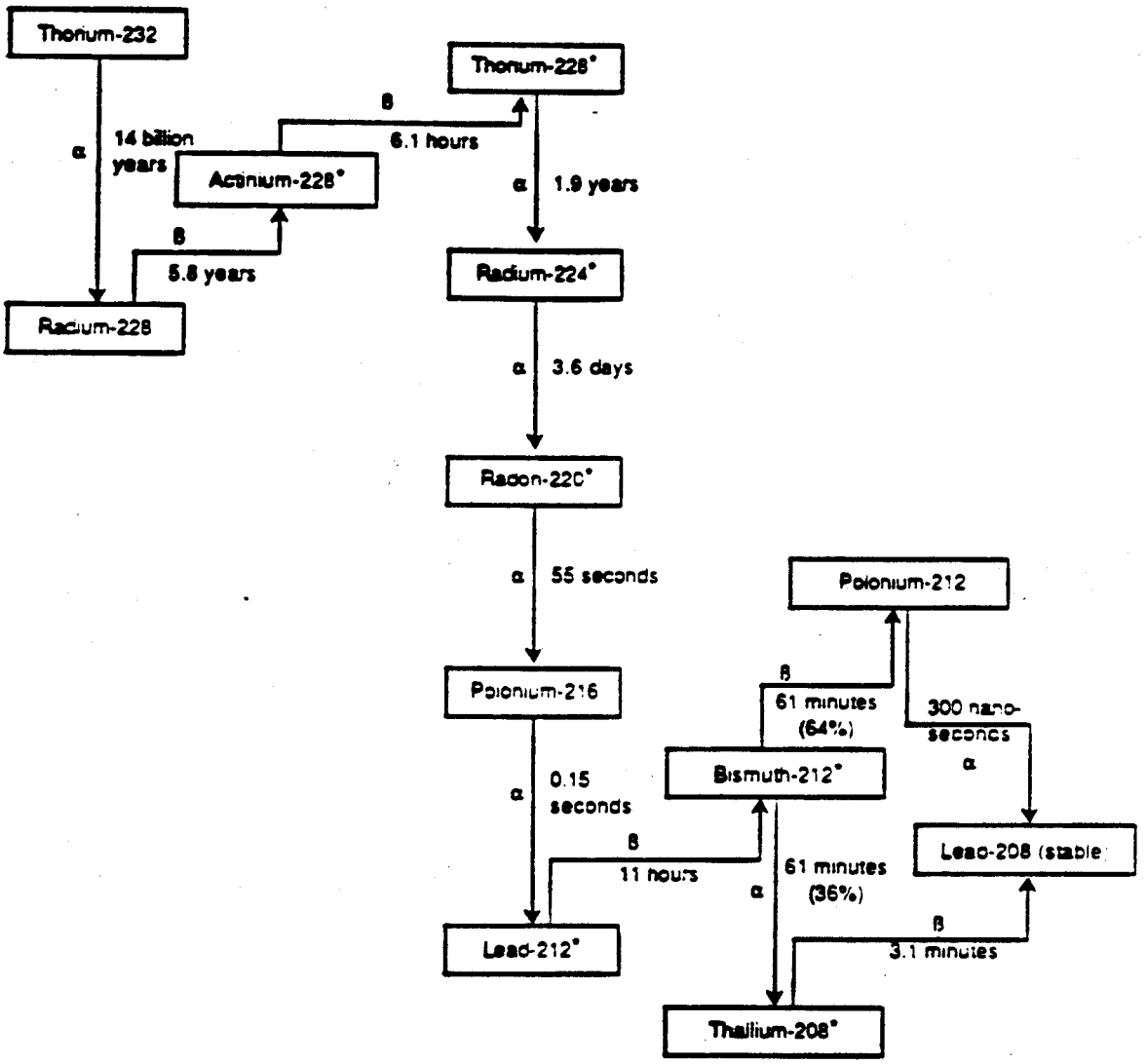
As radionuclides decay, they emit various types of radiation; certain of these can traverse environmental media and penetrate human skin. Hence, close proximity to radioactive materials can pose hazards to individuals without actual uptake by the body (i.e., through ingestion or inhalation). The most energetic form of electromagnetic radiation emitted by radionuclides is the gamma ray. Elevated gamma exposure rates have been measured at the quarry fence and within the quarry. The highest measured gamma



NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and β indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE 7

URANIUM-238 RADIOACTIVE DECAY SERIES



NOTES:
Only the dominant decay mode is shown.
The times shown are half-lives.
The symbols α and β indicate alpha and beta decay.
An asterisk indicates that the isotope is also a gamma emitter.

FIGURE 8

THORIUM-232 RADIOACTIVE DECAY SERIES

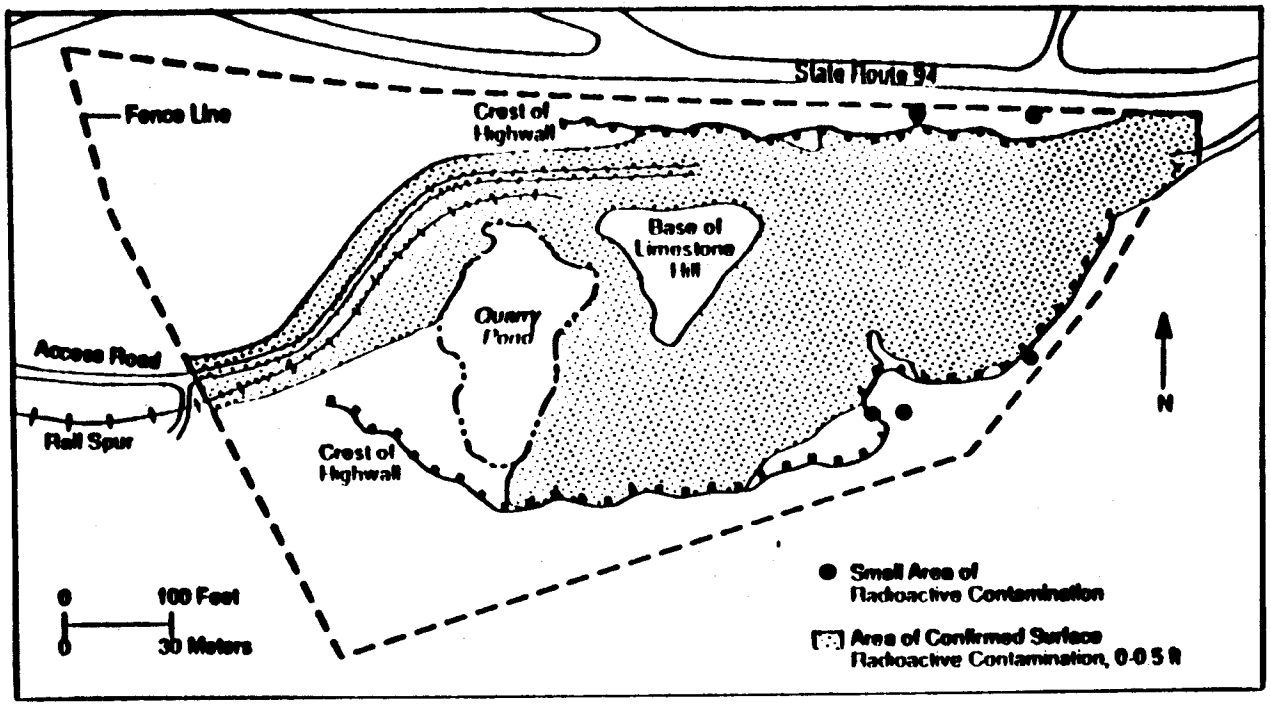


FIGURE 9

SURFACE RADIOACTIVE CONTAMINATION AT THE QUARRY

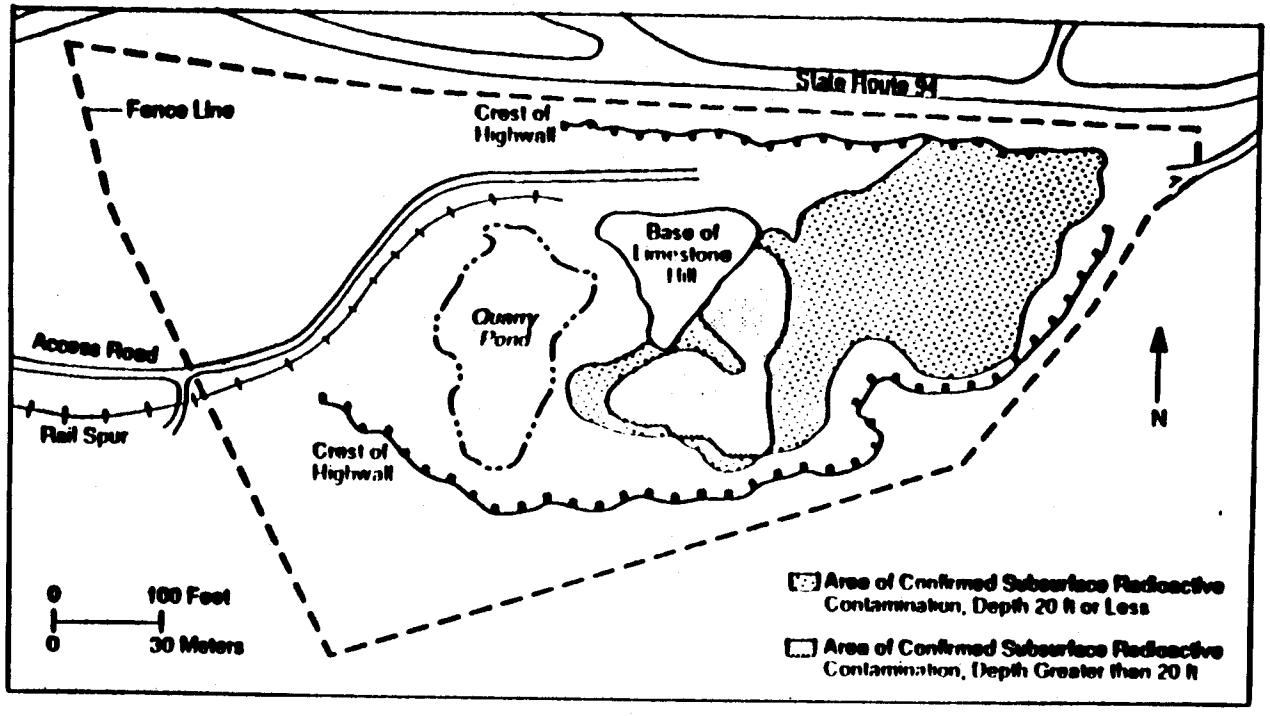


FIGURE 10

SUBSURFACE RADIOACTIVE CONTAMINATION AT THE QUARRY

TABLE 2 Concentrations of Radionuclides in the Quarry Bulk Wastes

Radionuclide	Bulk Waste concentration (pCi/g) Range	Average	Average Surficial Concentration[a] (pCi/g)	Average Background Concentration (pCi/g)
Uranium-238	1.4 - 2,400	200	170	1.3
Thorium-238	0.7 - 36	26	(b)	1.0
Thorium-230	0.7 - 6,800	330	150	1.3
Radium-228	0.1 - 2,200	96	20	1.0
Radium-226	0.2 - 2,800	110	110	0.9

[a] Samples obtained from the top 15 cm (6 in.) of the quarry bulk wastes.

[b] No data available.

exposure rate at the quarry fence is about 8 μR/hr above background; the background gamma exposure rate in the Weldon Spring area is about 10 μR/hr. The gamma exposure rate within the quarry averages 60 μR/hr; the maximum measured rate is 625 μR/hr.

Nonradioactive contaminants in the quarry bulk wastes are consistent with those expected from the disposal history. Both the type of waste material present and the contaminant concentrations in this material are highly variable. As part of the radiological characterization conducted in 1984 and 1985, one surface and six subsurface samples were collected for nonradiological analysis. These samples were analyzed for priority pollutant metals, organic compounds, cyanide, and other selected compounds. Some organic contaminants and elevated levels of some metals were detected. Results for contaminants that were measured above detection limits are summarized in Table 3.

A more extensive chemical characterization study was conducted at the quarry in 1986 when samples were taken from 17 boreholes. The depths of the boreholes were highly variable, ranging from 0.61 m (2 ft) to 12 m (40 ft). The borehole locations were selected on the basis of historical data on waste disposal at the quarry.

TABLE 3 Concentrations of Chemicals Detected in the Quarry Bulk Wastes in the 1984-1985 Characterization Study and Background Concentrations in Missouri Soils

Chemical[a]	Composite Borehole Sample Concentration (mg/kg) Range[b]	Average[b]	Number of Boreholes in which Chemical Detected	Surface Sample Concentration (mg/kg)	Average Background Concentration[c] (mg/kg)
Priority Pollutant Metals and Cyanide					
Antimony	<20[d]		0	71	<200[d]
Arsenic	73-120	100	6	100	8.7
Beryllium	0.45-0.83	0.62	6	0.61	0.8
Cadmium	1.8-98	19	6	2.0	<1
Chromium	19-49	30	6	24	54
Copper	38-160	100	6	140	13
Lead	130-410	280	6	950	20
Mercury	0.18-6.3	2.0	6	0.7	0.039
Nickel	19-120	43	6	300	14
Selenium	17-28	23	6	22	0.28
Silver	5.8-8.3	7.0	3	7.5	<0.7
Thallium	3.0-6.2	4.7	6	5.1	<50[d]
Zinc	68-870	340	6	39	49
Cyanide	0.2-0.6	0.38	5	0.2	NA[e]
Organic Priority Pollutants					
α-Benzene hexachloride	0.0051-0.0053	0.0052[g]	2	-	NA
β-Benzene hexachloride	0.019-0.095	0.045[g]	3	0.0035	NA
γ-Benzene hexachloride (lindane)	0.0013	0.0013[g]	1	-	NA
PCBs (Aroclor 1254)	0.56-46	12	5	1.0	NA
PCBs (Aroclor 1260)	9.0	9.0	1	-	NA
Other Organic Pollutants					
2-Pentanone-4-hydroxy-4-methyl (diacetone alcohol)	2-6[h]	4.6[h]	5	14[h]	NA
2-Methylnaphthalene	0.67	0.67	1	<0.06[d]	NA

[a] All compounds that had one or more positive results above detection limits are listed; concentrations are rounded to two significant figures. Samples were taken from six boreholes in the bulk wastes and from a surface waste pile.

[b] Ranges and averages are for detected values only and do not necessarily indicate the average concentration for the entire waste material.

[c] Concentration in Missouri agricultural soils.

[d] Lower limit of detection.

[e] NA means data not available.

[f] The 29 volatile priority pollutants measured for were not detected at a sensitivity level of 20 pg/kg. Thirteen semivolatile organic compounds were detected in on borehole; these compounds are indicated in Table 4 (identified by footnote f). The presence of PCBs prevented the detection of most pesticides.

[g] Concentrations of α, β, and γ-benzene hexachloride, were reported for only 2, 3, and 1 of the borehole samples, respectively.

[h] Estimated concentrations.

Nitroaromatic compounds, polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs) were detected in these samples. The results of this study are summarized in Table 4. Because of the heterogeneous nature of the wastes and the limited number of samples taken, the results are expected to be indicative of, rather than representative of, the wastes present in the quarry.

Three surface samples were collected in May 1987 from an area in the northeastern corner of the quarry where surficial discoloration suggested the presence of nitroaromatic compounds. Various nitroaromatic compounds were detected in the samples. The compound 2,4,6-TNT was detected at an average concentration of 13,000 mg/kg. The results of the analyses for nitroaromatic compounds are summarized in Table 5.

These characterization results indicate that chemical contamination is present throughout much of the quarry bulk wastes and that the distribution of the contaminants is highly heterogeneous. However, general locations of various waste types can be defined in some cases. For example, nitroaromatic compounds are found in the eastern end of the quarry, which is consistent with the disposal history. The PCBs do not show a defined pattern of distribution but are typically limited to near-surface depths (0 to 1.8 m [0 to 6 ft]). Most chemical contaminants are found at depths of less than 3.6 m (12 ft).

TABLE 4 Concentrations of Chemicals Detected in the Quarry Bulk Wastes in the 1986 Characterization Study

Chemical[a]	Concentration (mg/kg) Range[b]	Average[b]	Number of Boreholes in which Chemical Detected[c]
Volatile Compounds [d,e]			
Acetone	1.4-52	13	6
2-Butanone	0.86-1.7	1.4	2
Ethylbenzene	0.68-1.8	0.99	8
Methylene chloride	0.79-6.4	2.9	8
Toluene	0.75	0.75	1
Total xylenes	0.66-1.4	0.95	2
Trichloroethene	0.9	0.9	1
Semivolatile Compounds [e]			
Acenaphthene[f]	1.7-18	7.6	4
Dibenzofuran[f]	1.4-3.6	2.5	2
Fluorene[f]	6.6-19	13	2
Phenanthrene[f]	0.73-150	26	6
Anthracene[f]	0.34-37	9.7	6
Fluoranthene[f]	0.78-190	24	6
Pyrene[f]	0.68-170	23	6
Benz(a)anthracene[f]	0.53-86	15	6
Chrysene[f]	0.46-89	13	6
Benzo(b)fluoranthene[f]	0.62-110	17	6
Benzo(k)fluoranthene[f]	0.78-0.98	0.88	2
Benzo(a)pyrene[f]	0.46-68	11	6
Indeno(1,2,3-cd)pyrene	0.45-49	9.3	6
Dibenz(a,h)anthracene	0.33-17	2.9	4
Benzo(g,h,i)perylene	0.41-50	10	6
2,4-DNT[g]	1.7-10	6.3	1
2,6-DNT[g]	0.53-3.7	1.6	1
Di-n-butylphthalate[f]	0.47-0.58	0.53	2
Bis(2-ethylhexyl)phthalate	0.66-1.6	1.0	3
Naphthalene[f]	1.3	1.3	1
PCBs [e]			
Aroclor 1254[f]	0.46-120	21	9
Aroclor 1260[f]	9.1-12	11	1
Nitroaromatic Compounds [h]			
2,6-Diamino-4-nitrotoluene	0.33-0.58	0.47	3
2,4,6-TNT	0.38-1600	260	6
2,4-DNT[i]	0.46-33	8.1	3
2,6-DNT[i]	0.36-68	9.5	3
2,4-Diamino-6-nitrotoluene	1.3-7.3	4.8	2

[a] All compounds that had one or more positive results above detection limits are listed; concentrations are rounded to two significant figures. Samples were taken in the last quarter of 1986 from 17 boreholes in the bulk wastes.

[b] Ranges and averages are for detected values only and do not necessarily indicate the average concentration for the entire waste material.

[c] Detection of a chemical indicates that the species was detected in at least one incremental sample from a borehole. Each incremental sample was not necessarily tested for all chemical species.

[d] Except for trichloroethene, all of the volatile compounds detected in the samples were also detected in method and field blanks.

TABLE 5 Concentrations of Nitroaromatic Compounds in Surface Soils at the Quarry[a]

Nitroaromatic Compound	Concentration (mg/kg) Range	Average
2,4,6-TNT	4,900-20,000	13,000
2,4-DNT	6.6-29	18
2,6-DNT	<1.2-8.6	5.0
Nitrobenzene	8.4-130	78
1,3,5-Trinitrobenzene	18-280	140
1,3-Dinitrobenzene	<0.8[b]	-

[a] Three surface samples were taken from the exposed slope in the northeastern corner of the quarry.

[b] Lower limit of detection.

[e] Analyses for volatile organics, semivolatile organics, and PCBs were performed in accordance with the EPA Contract Laboratory Program.

[f] This compound was also detected in the 1984-1985 investigation by Bechtel National, Inc.

[g] This compound is also listed in this table under nitroaromatic compounds (see footnote i).

[h] Analyses for nitroaromatic compounds were performed according to Method 48 of the U.S. Army Toxic and Hazardous Materials Agency using high-pressure liquid chromatography.

[i] This compound is also listed in this table under semivolatile compounds. Split samples were analyzed in accordance with the EPA Contract Laboratory Program and Method 48 of the U.S. Army Toxic and Hazardous Materials Agency.

6 SUMMARY OF SITE RISKS

A baseline risk evaluation was prepared to assess the potential risks associated with the contamination present at the quarry. Risk assessment is a key component of the RI/FS process and is typically conducted for the baseline (no-action) case to (1) determine potential impacts to human health and the environment, (2) support the determination of appropriate cleanup criteria, and (3) provide a basis for evaluating the effectiveness of proposed remedial action alternatives. However, because management of the bulk wastes is a focused interim action of the overall remedial action for the quarry, the scope and purpose of this assessment was less comprehensive than that generally performed in a baseline risk assessment. Because site characterization data on the nature and extent of the contamination and the pathways and mechanisms for contaminant migration from the quarry is limited, a comprehensive baseline risk assessment could not be prepared. For this reason, the assessment was referred to as a baseline risk "evaluation," to distinguish it from the more comprehensive baseline risk "assessment." The analyses in this risk evaluation were carried out to meet, within the limits of available data, the first of the three objectives of a risk assessment, i.e., to assess the potential impacts on human health and the environment. The scope of the evaluation was limited to an assessment of the potential risks associated with the bulk wastes. It addressed exposures that could occur in the short term under existing site conditions. Risks will be assessed further as part of other RI/FS processes before the wastes are finally disposed of and the overall remediation of the quarry is completed.

6.1 CONTAMINANT IDENTIFICATION

The BRE identified those radionuclides and chemicals present in the quarry bulk wastes that pose the greatest potential risk to human health. The radioactive contaminants of concern (i.e.,

indicator radionuclides) are those associated with the uranium-238 and thorium-232 decay series (see Table 2 and Figures 7 and 8). The radiological hazards of the various radionuclides in these series were determined from the activity concentrations of uranium-238, thorium-232, thorium-230, radium-228, and radium-226 and from measured values of radon-222, radon-220, and their short-lived decay products. The risks associated with gamma radiation were also assessed.

The indicator chemicals were selected from contaminants detected in the wastes (see Tables 2, 3, 4, and 5). They were selected mainly on the basis of their toxicological properties and their concentrations in surface soils at the quarry. (Under current site conditions, the only complete exposure pathways at the quarry result from surface soil contamination.) The indicator contaminants for the BRE were nitroaromatic compounds (2,4,6-TNT, 2,4-DNT, 2,6-DNT, and 1,3,5-trinitrobenzene), metals (arsenic, lead, nickel, selenium, and uranium), PCBs, and PAHs. Of these contaminants, TNT, DNT, arsenic, lead, nickel, PCBs, and PAHs are considered to be potential carcinogens.

6.2 EXPOSURE ASSESSMENT

The key factors considered in developing the exposure pathways at the quarry include (1) the quarry is fenced, closed to the public, and surrounded by wildlife areas; (2) the nearest residence is 0.8 km (0.5 mi) west of the quarry on State Route 94; and (3) no remedial action activities are currently taking place at the quarry. The exposure assessment in the BRE was based on current land-use conditions and contaminant concentrations.

The main source of contamination within the quarry is the bulk wastes, and the exposure pathways considered in the risk evaluation are those directly associated with these wastes. It has been shown that the groundwater at the quarry contains elevated concentrations

of chemical and radioactive contaminants, but this water is not a drinking water source. The groundwater south of the quarry and at the nearby St. Charles County well field is monitored routinely, and mitigative measures would be taken if elevated concentrations were detected in the well field. Thus, because there are no known or indicated points of current exposure, the groundwater pathway is incomplete and was not considered in the BRE. The potential risks associated with contaminated groundwater will, however, be addressed in the comprehensive risk assessment to be prepared following implementation of the bulk waste remedial action and completion of detailed characterization of the quarry area. No private residences or other structures are located within the area that could be impacted by releases from the quarry.

Based on an evaluation of waste characteristics and potential release mechanisms, the BRE identified the principal contaminants at the quarry to which individuals could be exposed and the potential routes of human exposure to these contaminants as:

- Inhalation of radon-222, radon-220, and their short-lived decay products.
- Exposure to external gamma radiation.
- Inhalation of radioactively and chemically contaminated airborne dusts.
- Dermal contact with chemically contaminated surface soils.
- Ingestion of radioactively and chemically contaminated surface soils.

Scenarios of human activities that could result in exposures by these pathways were developed for individuals temporarily

occupying the impacted area. "Passerby" and "trespasser" scenarios were evaluated. These scenarios were realistic but conservative descriptions of activities that could result in human exposures to quarry contaminants. Under each scenario, two "cases" were developed to estimate "representative" exposure and "plausible maximum" exposure.

The passerby scenario considered potential exposures to an individual who routinely walks by the northern boundary of the quarry along State Route 94. For the representative exposure case, it was assumed that the individual walks by the quarry twice per day, 250 days per year over a period of five years; for the plausible maximum exposure case, the exposure period was increased to 365 days per year over a period of 10 years. The exposure pathways evaluated for this scenario were inhalation of radon-222 and radon-220 and their short-lived decay products, exposure to external gamma radiation, and inhalation of dusts contaminated with nitroaromatic compounds and uranium. (Nitroaromatic compounds and uranium are the only contaminants found in exposed areas of the quarry that are subject to fugitive dust emissions.)

The trespasser scenario considered exposures to a youth who enters the quarry several times per year. For the representative exposure case, it was assumed that an individual (11 to 15 years old) enters the quarry, remains there for a period of two hours, and repeats this activity 12 times per year over a period of five years. For the plausible maximum exposure case, it was assumed that an individual (9 to 18 years old) enters the quarry once per week for a period of four hours, 50 weeks per year over a period of 10 years. The exposure pathways evaluated for the trespasser scenario included the same pathways considered for the passerby as well as direct contact with contaminated soils, which could result in dermal absorption of the organic indicator chemicals and incidental ingestion of all compounds.

The conditions of the passerby scenario were selected to represent (1) the exposure occurring at the location of highest off-site radon and airborne particulate concentrations (along State Route 94) and (2) a frequency and duration of exposure (i.e., daily, for a total duration of 24 minutes) that, over the long term, would not be exceeded by an individual routinely entering any area impacted by contaminant releases from the quarry. Thus, although other potential receptors were identified (e.g., individuals driving by the quarry on State Route 94 or a hiker on the Missouri River State Trail), they were not explicitly evaluated because their exposures would be similar to, or less than, the exposures estimated for the passerby. Although access to the quarry is restricted by a chain-link fence, the area is not guarded, hence it is reasonable to assume that a trespasser could enter the contaminated area. The trespasser scenario is considered to be a conservative estimate of potential exposures to any individual coming into direct contact with the contamination in the quarry.

6.3 POTENTIAL HEALTH RISKS

The BRE assessed the radiological and chemical health risks resulting from potential exposures to the quarry contaminants under current site conditions. Health effects resulting from radiation exposure were evaluated in terms of the increased likelihood of inducing fatal cancers and serious genetic effects in future generations. The risk of cancer induction from the radionuclides present in the quarry bulk wastes is much greater than the risk of serious genetic effects. The potential for adverse health effects (other than cancer) from exposure to chemical contaminants was assessed by dividing the estimated average daily intake by established reference doses. This calculation determined the "hazard index". A hazard index of less than 1 indicates a nonhazardous situation while a hazard index greater than 1 indicates a potential for adverse health effects.

The estimated carcinogenic risks and hazard indexes for the passerby and trespasser scenarios are summarized in Table 6. The carcinogenic risks from radiation exposures range from 4.2×10^{-6} for the passerby representative exposure case to 8.7×10^{-5} for the trespasser plausible maximum exposure case, and the carcinogenic risks from chemical exposures range from 1.0×10^{-9} to 3.6×10^{-5}, respectively. The risk from radiation exposure exceeds that from chemical exposure for both scenarios. The major exposure pathway for the radiological risk in all cases is inhalation of radon-222 and its short-lived decay products. The major contributor to the chemical carcinogenic risk for the trespasser is 2,4,6-TNT, which accounts for approximately 40% of the risk; arsenic, PCBs, and PAHs account for the remaining 60%.

The very low hazard indexes estimated for the passerby scenario (less than 2×10^{-3}) indicate that there is little potential for noncarcinogenic health impacts to individuals outside the quarry. However, for the trespasser, the hazard index is 2.0 for the representative exposure case and 8.5 for the plausible maximum exposure case. For both cases, the major contributor to the noncarcinogenic hazard is exposure to 2,4,6-TNT. This is not unexpected given the presence of this contaminant at concentrations greater than 1% in surface soils at the quarry. The estimated hazard indexes for 2,4,6-TNT are 1.7 and 7.2 for the representative and plausible maximum trespasser exposure cases, respectively. These results indicate the potential for the occurrence of adverse health effects to an unprotected individual frequently entering the quarry. However, under current site conditions in which access to the quarry is restricted, it is unlikely that an individual would routinely enter the quarry.

TABLE 6 Carcinogenic Risks and Health Hazard Indexes for the Passerby and Trespasser Scenarios

Exposure Scenario/Case	Carcinogenic Risks: Radiological[a]	Carcinogenic Risks: Chemical[b]	Health Hazard Index for Noncarcinogenic Effects[c]
Passerby			
Representative	4.2×10^{-6}	1.0×10^{-9}	1.0×10^{-3}
Plausible maximum	1.2×10^{-5}	3.0×10^{-9}	1.6×10^{-3}
Trespasser			
Representative	6.0×10^{-6}	4.3×10^{-6}	2.0
Plausible maximum	8.7×10^{-5}	3.6×10^{-5}	8.5

[a] Risk of a fatal cancer; the rate of cancer induction will be higher.

[b] Rate of cancer induction. The NCP establishes that, for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response.

[c] The health hazard index is a measure of the potential for adverse chronic health effects other than cancer. A value greater than 1 indicates a potential for adverse health effects.

6.4 POTENTIAL ENVIRONMENTAL RISKS

The potential risks to the environment considered in the BRE were impacts on soil resources, air quality, vegetation and wildlife, and water resources. No adverse impacts have been observed for soil resources, air quality, or vegetation and wildlife as a result of the bulk wastes in the quarry. The major impact that could result from gaseous releases, i.e., radon, is addressed in the human health assessment portion of the BRE.

Water resources have been impacted by the presence of the bulk wastes. The ponded water is already contaminated as a result of contact with the bulk wastes, but incremental contamination from continued contact, e.g., future surface runoff, is not expected to significantly alter the existing water quality. Similarly, Femme Osage Slough, south of the quarry, already contains radioactive and chemical contaminants. This contamination may have resulted from subsurface migration from areas north of the slough and/or from

past discharges into Little Femme Osage Creek. Groundwater in the vicinity of the quarry has been contaminated as a result of contaminant migration from the bulk wastes. If the bulk wastes remain in the quarry, contaminants could migrate farther into the surrounding environment via the fractured limestone of the Kimmswick Limestone Formation, and contaminant concentrations might increase in the vicinity of Femme Osage Slough.

7 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d)(2) of CERCLA requires that for any hazardous substance, pollutant, or contaminant that remains on site, the remedial action must attain a level or standard of control at least equal to requirements, criteria, or limitations under Federal environmental laws or more stringent State environmental laws or facility siting laws which are legally applicable or relevant and appropriate (ARAR) under the circumstances of the release or threatened release at the completion of the remedial action. Furthermore, the NCP requires attainment of ARARs during implementation of a remedial action when an ARAR is pertinent to the action itself as well as at the completion of the action. Under certain conditions, compliance with these ARARs may be waived.

The limited scope of the quarry bulk waste operable unit remedial action, including the fact that it is not the final remedial action for either the bulk wastes or the quarry, was considered in analyzing potential ARARs.

A number of Federal and State environmental laws were evaluated as to legal applicability or relevance and appropriateness to the circumstances of the releases and threatened releases at the quarry. Those requirements considered to be most likely to be applicable or relevant and appropriate to the remedial alternatives under consideration are discussed below.

7.1 FEDERAL ENVIRONMENTAL LAWS

7.1.1 Resource Conservation and Recovery Act

Subtitle C of the Resource Conservation and Recovery Act (RCRA) regulates the generation, transportation, treatment, storage and disposal of hazardous wastes as defined in 40 CFR 261. RCRA includes several requirements that might be applicable or relevant and appropriate to the remedial action alternatives under consideration, including requirements and standards pertaining to closure of hazardous waste management units, groundwater monitoring, location standards, minimum technology requirements, land disposal restrictions, and unit design and operating standards.

Under 40 CFR 261, a solid waste is a regulated hazardous waste if it is not otherwise excluded from regulation as a hazardous waste and exhibits any of the characteristics identified in 40 CFR 261 Subpart C, or is listed in 40 CFR 261 Subpart D, or is a mixture of a solid waste and a hazardous waste listed in 40 CFR 261 Subpart D.

RCRA hazardous waste management requirements would be legally applicable to this remedial action if a combination of the following conditions were met:

1. The waste is a regulated hazardous waste, as described above, and either

2a. The waste was treated, stored, or disposed of after the effective date of the RCRA requirements, or

2b. The activity at the CERCLA site constitutes treatment, storage, or disposal as defined by RCRA.

Although the quarry bulk wastes were not treated, stored, or disposed of after the effective date of RCRA, some of the remedial alternatives considered would include activities currently regulated by RCRA if the bulk wastes are RCRA hazardous wastes. Therefore, an evaluation of the applicability of RCRA Subtitle C requirements to the various response alternatives must include a determination as to whether the bulk wastes are RCRA regulated hazardous wastes.

In order to determine if the quarry contains listed wastes, it is necessary to consider information as to the source of the wastes. Based on the source of the quarry bulk wastes, the materials disposed of in the quarry could have included the following hazardous wastes that are listed in 40 CFR 261 Subpart D:

- K-044 listed wastes, which are defined as wastewater treatment sludges from the manufacturing and processing of explosives.

- K-047 listed wastes, which are defined as pink/red water from TNT operations.

- U-105 listed waste, which is the commercial chemical product, manufacturing intermediate, or off-specification commercial chemical product 2,4-dinitrotoluene.

- U-106 listed waste, which is the commercial chemical product, manufacturing intermediate, or off-specification commercial chemical product 2,6-dinitrotoluene.

An extensive document search was conducted of all available records and reports pertaining to the sources of the wastes disposed of in the quarry. While the results of this search

indicate that both wastewater treatment sludges from the manufacturing of explosives and pink/red water from TNT operations were generated at the Weldon Spring Ordnance Works facility, no information was found to substantiate that such wastes were disposed of in the quarry. Furthermore, there is no information to suggest that commercial chemical products, manufacturing intermediates, or off-specification commercial chemical products 2,4-dinitrotoluene or 2,6-dinitrotoluene were disposed of in the quarry. It is concluded, therefore, that the quarry bulk wastes are not a listed hazardous waste under RCRA.

None of the quarry bulk waste samples tested to date have exhibited any of the RCRA hazardous waste characteristics. Therefore, the DOE considers the quarry bulk waste not to be a RCRA characteristic hazardous waste, and the RCRA Subtitle C requirements are not legally applicable. This testing is not conclusive, however, given that the heterogeneity of the waste mass precludes representative sampling of the in-place material. In addition, the EPA has recently established an additional RCRA characteristic test (Toxicity Characteristic Leaching Potential [TCLP]) which has not yet been performed on the waste material.

However, even if these requirements are not legally applicable to the response action, they may be relevant and appropriate to the circumstances of the release or threatened release. A determination of relevance and appropriateness includes consideration of a number of factors, including the purpose of the requirement and the purpose of the CERCLA action, the medium regulated or affected by the requirement and the medium contaminated or affected by the CERCLA site, the substances regulated by the requirement and the substances found at the CERCLA site, and the actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site.

The available data indicate that the DNT contaminated soil and debris in the quarry is present in low concentrations and dispersed in soil over a wide area. Thus, even though some hazardous constituents are present in the quarry bulk wastes, the low concentrations and the physical and chemical condition of the contaminated soils and debris matrix of the wastes are inherently different from what was envisioned by RCRA. Therefore, the DOE does not consider RCRA Subtitle C requirements to be relevant and appropriate on the basis of similarity of the wastes present at the site to a RCRA listed waste.

However, some of the wastes present in the quarry may exhibit characteristics similar to RCRA hazardous wastes. Furthermore, some of the remedial alternatives under consideration for the quarry are similar to some of the hazardous waste actions regulated by RCRA. Therefore, in analyzing the various remedial alternatives for compliance with ARARs, the DOE will consider whether RCRA requirements for hazardous wastes are relevant and appropriate.

Prior to selection of the final remedial action for treatment and/or disposal of the quarry bulk wastes, additional tests will be performed once the wastes have been placed in storage to establish more definitively whether the quarry bulk wastes are RCRA characteristic hazardous wastes. This information will then be considered in future decision making processes regarding subsequent management of the quarry bulk wastes.

7.1.2 Safe Drinking Water Act

Potential ARARs under the Safe Drinking Water Act (SDWA) include Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). MCLs are enforceable standards which apply to public drinking water supplies. MCLGs are unenforceable health based goals for maximum contaminant levels in drinking water.

Section 121(d)(2) of CERCLA requires on-site remedies to attain MCLGs if they are relevant and appropriate to the release.

The DOE does not consider either MCLs or MCLGs to be applicable or relevant and appropriate requirements for this action since this operable unit remedial action does not address groundwater remediation. MCLs and MCLGs will be evaluated as potential ARARs during the decision making process for groundwater at, and downgradient of, the quarry.

7.1.3 Clean Water Act

Potential ARARs under the Clean Water Act (CWA) include Federal Water Quality Criteria, standards for discharge of wastes to publicly owned treatment works (POTW), effluent limitations and guidelines for discharges directly to waters of the United States, and requirements for dredge and fill activities. The DOE does not consider any of these requirements to be either applicable or relevant and appropriate to this operable unit remedial action because the action does not involve remediation of releases to waters of the United States, discharges to either a POTW or to waters of the United States, or dredge and fill activities. Potential ARARs under the CWA will be evaluated during subsequent remedial action decision making.

7.1.4 Clean Air Act

Potential ARARs under the Clean Air Act (CAA) include National Emission Standards for Hazardous Air Pollutants (NESHAPs) and National Ambient Air Quality Standards (NAAQS). The NESHAP requirements are codified in 40 CFR 61 and the NAAQS requirements are codified in 40 CFR 50. The NESHAP provisions of the CAA authorize the Administrator of the EPA to establish emission standards for hazardous air pollutants. The NESHAP provisions further limit the construction of new sources or modification of

existing sources which will not be in compliance with such emission standards. The NESHAP standards have been set for several contaminants present in the quarry bulk wastes which are currently being released into the air or which may be released during remedial alternatives under consideration. These contaminants include radionuclides, arsenic, and asbestos.

The standards for radionuclides in 40 CFR 61 are applicable to remedial alternatives under consideration.

The standards for arsenic in 40 CFR 61 are based on glass manufacturing, primary copper smelting, and arsenic trioxide and metallic arsenic production. These standards are not applicable to any aspect of this operable unit remedial action since the source of the air emissions is not a source addressed by the regulations defining the standard. Furthermore, after evaluating the purpose of the requirement versus the purpose of the quarry response action and taking into consideration the actions regulated by the requirement versus the action contemplated for the quarry, the DOE does not consider these standards to be relevant and appropriate. The DOE considers other emission standards, such as the standards found at 29 CFR 1910.1000 for compliance with the Occupational Safety and Health Act (OSHA), to be better suited to the remedial alternatives under consideration.

The asbestos standard in 40 CFR 61 requiring no visible emissions is considered to be applicable to some of the remedial alternatives under consideration.

The CAA provides for the promulgation of two types of NAAQs, i.e., primary and secondary standards, which apply to the ambient air. Primary ambient air quality standards are standards which the Administrator of the EPA finds to be necessary to protect public health. Secondary standards are those standards which the

Administrator of the EPA finds are necessary to protect the public welfare from the presence of air pollutants in ambient air.

The NAAQS are not ARARs because they do not apply directly to source-specific emissions; rather they are national limitations on ambient concentrations intended to protect public health and welfare. The State of Missouri's Implementation Plan, however, does provide source-specific emission limitations and is considered to be an ARAR. This is discussed in Section 7.2.1 which considers Missouri Air Quality Standards.

7.1.5 Toxic Substances Control Act

Potential ARARs under the Toxic Substances Control Act (TSCA) include standards and requirements for the storage and disposal of PCBs, for cleanup of PCB spills and for asbestos abatement projects. PCB storage and disposal requirements are found in 40 CFR 761 Subpart D. TSCA PCB storage and disposal requirements generally apply to PCBs at concentrations greater than 50 ppm; PCB articles, e.g. transformers, capacitors, etc.; PCB containers with concentrations greater than 500 ppm; and PCB spills greater than 50 ppm.

Any PCBs, PCB articles, and PCB containers in the quarry bulk wastes would have been placed there prior to the effective date of these regulations, so they would not be legally applicable to these wastes as they presently exist. However, various remedial alternatives under consideration could trigger the applicability of these requirements.

The PCB Spill Cleanup Policy, found in 40 CFR 761 Subpart G, establishes criteria to be used in determining the adequacy of the cleanup of spills which occurred after May 4, 1987, which resulted in the release of materials containing PCBs at concentrations of 50 ppm or greater. Since any spills resulting from the presence of

PCBs in the bulk wastes occurred long before this date, the PCB Spill Cleanup Policy is not applicable to this remedial action. However, certain cleanup criteria in the PCB Spill Cleanup Policy may be considered relevant and appropriate to some aspects of some of the remedial alternatives under consideration.

Various requirements pertaining to asbestos abatement projects were promulgated at 40 CFR 731 Subpart G. These requirements include limits on permissible exposures of workers to airborne concentrations of asbestos during asbestos abatement projects, requirements for asbestos removal, demolition and renovation operations, and exposure monitoring. Since this operable unit remedial action does not fit the regulatory definition of an asbestos abatement project, these standards and requirements are not legally applicable to the remedial alternatives under consideration. The requirements do, however, include health-based standards for asbestos exposure and may be considered relevant and appropriate to certain aspects of some of the remedial alternatives.

7.1.6 Atomic Energy Act

In regulations promulgated pursuant to the Atomic Energy Act (AEA), radiation exposure limits and acceptable concentrations of radionuclides in restricted and unrestricted areas are established in 10 CFR 20. These standards are applicable only to activities carried out under licenses issued by the U.S. Nuclear Regulatory Commission (NRC). These requirements are not applicable to this action since the DOE is not an NRC licensee. Although portions of the requirements given in 10 CFR 20 could be considered relevant to the quarry bulk waste remedial action, they are not appropriate since the requirements are based on radiation dosimetry models that are out of date. The radiation protection requirements given in 10 CFR 20 are currently being revised to incorporate new radiation dosimetry considerations. The requirements in DOE Orders for

radiation protection of individuals and the environment have recently been updated and are comparable to those in proposed revisions to 10 CFR 20. Remedial actions will be conducted in compliance with DOE Orders for radiation protection which are more up to date. Provisions in DOE Orders for radiation protection of individuals and the environment are identified in Section 7.3 which discusses "to be considered" requirements.

The revisions to 10 CFR 20 are expected to be promulgated prior to removal of the bulk waste from the quarry. The requirements in 10 CFR 20 will be reviewed following revision to ensure that all substantive requirements are met. Any provisions in the revised 10 CFR 20 that are more restrictive than requirements in the DOE Orders for radiation protection will be complied with.

Environmental Radiation Protection Standards for Nuclear Power Operations are applicable to operations within the uranium fuel cycle. These requirements are published in 40 CFR 190 under the authority of the AEA. On the basis of jurisdictional prerequisites, the standards are not applicable, i.e., the proposed action is not part of the nuclear fuel cycle as defined in 40 CFR 190.02. Further, the requirements are considered relevant but not appropriate since the intent is to regulate normal uranium fuel cycle production operations and planned discharges. There are variances in the requirements for unusual occurrences which would include operations such as implementation of the proposed action. Although these standards are not ARAR, it is DOE policy to maintain exposures as low as reasonably achievable.

7.1.7 Uranium Mill Tailings Radiation Control Act

Pursuant to the Uranium Mill Tailings Radiation Control Act (UMTRCA), various control standards for inactive uranium processing sites have been promulgated. These standards were evaluated as

potential ARARs for the quarry bulk waste remedial action. The requirements are not applicable since the Weldon Spring site is not a uranium mill tailings site. Furthermore, most of these requirements are not considered to be relevant and appropriate to this action primarily on the basis of consideration of the actions or activities regulated by the requirement and the remedial action contemplated at this site. For example, 40 CFR 192.12(b)(1) and 40 CFR 192.12(b)(2) are considered not relevant nor appropriate because no habitable buildings are involved in the remedial action. 40 CFR 192.12(a) might be relevant and appropriate to the identification and management of residual materials in the quarry, but this is beyond the scope of the proposed action. These requirements will be evaluated as part of the follow-on remedial actions planned for the quarry.

However, 40 CFR 192.02(b)(1), which addresses releases of radon from tailings disposal piles, is considered to be relevant and appropriate to those aspects of the remedial alternatives which involve storage of the bulk wastes. At completion, the bulk waste storage facility will have to meet the radon-222 flux standards specified in 40 CFR 192.02(b)(1). This standard requires reasonable assurance that radon-222 from residual radioactive material will not (1) exceed an average release rate of 20 picocuries per square meter per second (20 $pCi/m^2/sec$), or (2) increase the annual average concentration of radon-222 in air at or above any location outside the site perimeter by more than one-half picocurie per liter (0.5 pCi/l).

7.1.8 Other Potential Federal ARARs

Other Federal laws, including the National Historic Preservation Act, the Archeological Protection Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the Wilderness Act, and the Wildlife Management Act, will be evaluated as potential ARARs in light of specific remedial action proposals.

7.2 STATE ENVIRONMENTAL AND FACILITY SITING LAWS

7.2.1 Missouri Air Quality Standards

The State of Missouri has adopted the NAAQS criteria specified in the CAA through the State Implementation Plan. The State of Missouri has promulgated ambient concentration standards under 10 CSR 10-6.010. Implementation of some of the remedial alternatives could result in emissions of several of the criteria pollutants, including particulate matter (50 $\mu g/m^3$ annual average or 150 $\mu g/m^3$ over a 24 hour period) and lead (1.5 $\mu g/m^3$ quarterly average). As stated earlier, ambient standards for these contaminants are not ARAR; however they provide a sound technical basis for assuring protection of public health and welfare during implementation and will be considered for remedial alternatives involving potential air releases.

7.2.2 Missouri Air Pollution Control Regulations

Various standards to control emissions of particulate matter have been promulgated under Missouri air pollution control regulations. The standards addressed in 10 CSR 10-5.050 are not applicable nor relevant and appropriate since the source definitions relate to industrial processes.

The standards addressed in 10 CSR 10-5.090 are not applicable nor relevant and appropriate since the requirement applies to single industrial source emissions.

The standards addressed in 10 CSR 10-5.100 are applicable to the prevention of airborne particulate matter during construction activities. The standard of control relates to "unnecessary amounts of fugitive emissions" and minimizing complaints. Particulate standards promulgated under 10 CSR 10-5.180 for

internal combustion engines (no release for more than 10 seconds at one time) are applicable during implementation.

7.2.3 Missouri Radiation Regulations

The Missouri Department of Health has issued Standards for Protection Against Ionizing Radiation in 19 CSR 20. These requirements are similar to those currently in 10 CFR 20. As discussed in Section 7.1.6, these standards are based on radiation dosimetry models that are out of date. The requirements in DOE Orders for radiation protection of individuals and the environment are more up to date. The quarry bulk waste remedial action will therefore be implemented using DOE radiation protection requirements.

There are, however, specific State requirements that are more restrictive then Federal requirements, specifically a radon-222 concentration limit of 1 pCi/l in uncontrolled areas. Baseline data indicate that radon-222 levels in the area controlled by fencing around the quarry render compliance with this requirement unachievable during implementation of the action based remedial action alternatives. This requirement could be met upon completion of the action based alternatives.

7.2.4 Missouri Hazardous Waste Management Laws

Missouri has adopted by reference a number of the RCRA Subtitle C hazardous waste management regulations. To the extent that State requirements are the same as Federal requirements, the State requirements are not more stringent and will not be further considered as ARARs. However, Missouri has also adopted some requirements which are not identical to the Federal requirements, including landfill siting requirements, waste pile location requirements, and storage facility lining requirements, which may be more stringent than Federal requirements. As discussed above

under potential RCRA ARARs, these State hazardous waste management requirements are not considered legally applicable to the bulk wastes, but may be relevant and appropriate.

7.2.5 Other Potential State ARARs

Other State laws will be considered in light of specific remedial action proposals.

7.3 TO BE CONSIDERED REQUIREMENTS

The NCP provides that in addition to applicable or relevant and appropriate requirements, other advisories, criteria, and guidance may be considered for a particular release. DOE Orders, which are not ARARs in that they are not promulgated standards (e.g., public laws codified at the State or Federal level), provide a sound basis for conducting this action. The DOE will implement this action in compliance with all of its Orders, independent of their evaluation as ARAR.

Two of the more significant Orders for this action are DOE Orders 5400.5 and 5480.11 which provide requirements for radiation protection. The key elements of these Orders are as follows.

7.3.1 DOE Order 5400.5--Radiation Protection of the Public and the Environment

The basic dose limit for protection of members of the general public is 100 mrem/yr, above background, effective dose equivalent from all exposure modes. This dose is the sum of the effective dose equivalent from all exposures to radiation sources external to the body during the year plus the committed effective dose equivalent from radionuclides taken into the body during the year. Doses from specific exposure modes must comply with those required by other Federal statutes such as the CAA and the SDWA. Further,

all radiation exposures must be reduced to levels as low as reasonably achievable.

The DOE derived concentration guides (DCGs) for airborne radionuclides address protection of the general public from airborne radioactive contaminants. The DCGs are concentrations which, under conditions of continuous inhalation exposure for one year, would result in an effective dose equivalent of 100 mrem. The DCGs are provided in Chapter III of DOE Order 5400.5.

7.3.2 DOE Order 5480.11--Radiation Protection for Occupational Workers

The effective dose equivalent received by any member of the public entering a controlled area is limited to 100 mrem/yr above background. In addition, exposures shall not cause a dose equivalent to any tissue (including the skin and lens of the eye) to exceed 5 rem/yr. The limits for assessed dose from exposure of workers to radiation are shown on Table 7. (These values represent maximum limits; it is DOE policy to maintain radiation exposures as far below these limits as is reasonably achievable.)

TABLE 7 Radiation Protection Standards - Limiting Values for Assessed Dose from Exposure of Occupational Workers to Radiation

Radiation Effect	Annual Dose Equivalent (rem)
Stochastic effects	5[a]
Nonstochastic effects	
Lens of eye	15
Organ, extremity, or tissue including skin of whole body	50
Unborn child Entire gestation period	0.5

[a] Annual effective dose equivalent

The DOE derived air concentrations (DACs) for airborne radionuclides address protection of workers from airborne radioactive contaminants. The DACs are based on limiting either the committed effective dose equivalent to 5 rem/yr, or the dose equivalent to any organ to 50 rem/yr, whichever is more restrictive. If airborne concentrations are likely to approach or exceed DACs, respiratory protective equipment is required. The DACs are provided in Attachment 1 to DOE Order 5480.11.

8 DESCRIPTION OF ALTERNATIVES

Following an analysis of potentially applicable response technologies that might satisfy the remedial action goals for the operable unit, five alternatives were developed for further consideration. In addition, a no-action alternative was included to provide the baseline for a comparative evaluation. Hence, six preliminary remedial alternatives have been evaluated. These alternatives are as follows.

8.1 ALTERNATIVE 1: NO ACTION

The no-action alternative is included as a baseline for comparison with the other alternatives. As part of this baseline condition, no further action would be taken at the quarry, i.e., the bulk wastes would remain in their current condition but the quarry water treatment plant, selected as a removal action under the preceding EE/CA, would be in operation. Institutional controls currently in effect at the quarry, including fences and locked gates, monitoring, and site ownership, would remain in place.

8.2 ALTERNATIVE 2: SURFACE CONTAINMENT

Under Alternative 2, all surface vegetation would be removed and a surface containment layer, such as a soil cap or synthetic geotextile fabric, would be installed over the entire area of the quarry. Surface containment would reduce the release of contaminants via surface pathways (e.g., wind dispersal) and could limit percolation of precipitation or snowmelt through contaminated materials in the bulk wastes. This would reduce contaminant migration into the groundwater. However, since the bulk wastes would remain in contact with the groundwater, contaminant migration resulting from lateral flow of groundwater through the bulk wastes would not be reduced.

8.3 ALTERNATIVE 3: SURFACE AND SUBSURFACE CONTAINMENT

Under Alternative 3, the quarry bulk wastes would be isolated in place by installing a surface layer, as in Alternative 2, in conjunction with placement of a natural or polymeric grouting material around the periphery of the quarry and beneath the entire area at a depth greater than that of the buried wastes. The components of Alternative 3 are the same as those of Alternative 2, i.e., surface preparation and installation of a surface containment layer, with the addition of subsurface containment. The containment system for Alternative 3 would consist of an underlying confinement layer and lateral cutoff walls installed around the periphery of the bulk wastes, in addition to the surface cover or cap. A continuous surface and subsurface containment system would minimize contaminant migration resulting from lateral migration of groundwater through the bulk wastes. It would also reduce surface releases of contaminants and contaminant migration due to percolation of precipitation and snowmelt through the bulk wastes. The subsurface containment system could be installed by drilling through the wastes and injecting a confining layer around and beneath the entire quarry.

8.4 ALTERNATIVE 4: IN SITU TREATMENT

Under Alternative 4, the contaminated materials would be solidified in situ by mixing them with a cementitious material to form a solid mass or by vitrifying them with an electrical current to form a glass-like matrix. The resultant waste would limit surface releases, percolation, and lateral and downward migration of contaminants. The effectiveness of in situ treatment cannot be guaranteed due to uncertainties associated with verifying treatment success and ensuring the integrity of the solidified waste over time. If cementation were used, complete mixing and stabilization would be difficult to ensure because the bulk wastes extend over a significant area and depth and include process equipment and other

unwieldy debris. In situ vitrification is generally feasible only if the wastes contain less than 5% metal by weight and if less than 90% of the linear separation between electrodes is occupied by metal. In situ vitrification is infeasible because of the metal debris, e.g., drums, process equipment, and building rubble, scattered throughout the quarry.

8.5 ALTERNATIVE 5: EXPEDITED EXCAVATION WITH TEMPORARY STORAGE AT THE CHEMICAL PLANT AREA

Under Alternative 5, the bulk wastes would be excavated from the quarry and transported along a dedicated haul road to the chemical plant area. There, they would be unloaded and temporarily stored in an engineered facility pending a final decision on disposal of all wastes generated by remediating the Weldon Spring site. Transportation activities and construction and maintenance of the temporary storage facility would be carried out in a manner that would minimize potential releases of contaminants to the environment. Limited treatment would be conducted, as appropriate, to facilitate implementation (e.g., post-excavation dewatering to facilitate waste transport and storage control). Subsequent treatment and/or disposal would be addressed in conjunction with other on-site materials after completion of the RI/FS-EIS process and approval of the record of decision for remediation of the chemical plant area.

A variation of this alternative was considered at the preliminary analysis stage, i.e., excavation and replacement of the bulk wastes back into the quarry for temporary storage after chemical sealant or a liner had been placed in the quarry. However, technical difficulties associated with cover and seal emplacement would compromise the effectiveness of this option, and protection of human health and the environment could not be ensured. In addition, the availability of land at the quarry for staging is extremely limited due to constraints imposed by

ownership and topography. Therefore, storage of the required volume of material pending preparation of the quarry for waste emplacement would be infeasible. Thus, this variation was not considered further.

8.6 ALTERNATIVE 6: DELAYED ACTION PENDING THE RECORD OF DECISION FOR THE SITE

Under Alternative 6, no response action would be taken with respect to the quarry bulk wastes until the remedy is selected for the entire Weldon Spring site. Thus, the bulk wastes would remain in their current condition for the short term.

8.7 EVALUATION OF PRELIMINARY ALTERNATIVES

Migration control at the quarry (via containment) is the primary emphasis of Alternatives 2 and 3, whereas source control (via excavation and/or treatment) is the primary emphasis of Alternatives 4 and 5. Alternative 6 (delayed action) is essentially the same as Alternative 1 (no action) in the short term. For purposes of evaluating alternatives, Alternative 6 is expected to be similar to one of the action alternatives (i.e., Alternatives 2 through 5) in the long term. However, this would depend upon the action selected following the delay.

Each of the action alternatives would require various support activities prior to implementation. These activities include (1) design and construction of staging and support areas, (2) procurement of appropriate equipment, and (3) development of planning and operational controls to minimize contaminant releases. In addition, the institutional controls that now exist at the quarry, i.e., DOE ownership, fences and locked gates, and monitoring, are implicitly included as support activities for the alternatives, as appropriate. Under the action alternatives, these controls would be upgraded as needed. For example, certain

portions of the fence and gates would be repaired, additional signs would be posted, and monitoring would increase.

These preliminary alternatives were screened in the FS according to the three screening criteria provided in the NCP: effectiveness, implementability, and cost. Effectiveness is defined as the ability of an alternative to protect human health and the environment in both the short term and the long term. The reduction of contaminant toxicity, mobility, or volume is considered a measure of effectiveness. Implementability is defined as the technical feasibility, resource availability, and administrative feasibility (i.e., acceptability) of an alternative. Costs can be considered on a relative basis at the screening stage but cannot be the sole reason for eliminating an alternative from consideration.

Results of the screening of preliminary alternatives are presented in Table 7. Based on this screening, three final alternatives were identified for managing the quarry bulk wastes:

- Alternative 1: No action.
- Alternative 5: Expedited excavation with temporary storage at the chemical plant area.
- Alternative 6: Delayed action pending the record of decision for the site.

TABLE 8 Screening of Preliminary Alternatives

Alternative	Effectiveness	Implementability	Cost
Alternative 1: No action	Continued migration of contaminants from the bulk wastes could increase exposures of human, animal, and plant populations to chemicals and radionuclides over time. Contaminant toxicity, mobility, and volume would not be reduced.	Not applicable.	Not applicable.
Alternative 2: Surface containment	Exposures could be reduced in the short term but are not expected to be effectively reduced over the long term due to the potential for subsurface migration. Contaminant mobility would be somewhat reduced, but toxicity and volume would not be reduced.	Very difficult due to the topography and extent of the contaminated area.	Lower than other action alternatives in the short term but expected to be higher than those alternatives over time due to monitoring and maintenance and questionable effectiveness (i.e., the eventual need for a more effective response), which would increase costs due to inflation and the potential increased extent of contamination.
Alternative 3: Surface and subsurface containment	Reduction of potential exposures could be greater than for Alternative 2 in the short term, but effectiveness over the long term is doubtful due to difficulties in ensuring and maintaining containment in a fractured setting.	Essentially infeasible due to difficulties associated with surface containment (as in Alternative 2) and with subsurface containment due to the extent of the affected area, depth and type of waste material, and fractured nature of the bedrock.	Significantly greater than Alternatives 2 and 5 due to serious difficulties associated with attempting to drill and grout under existing waste conditions, the fractured subsurface, and questionable effectiveness.
Alternative 4: In situ treatment	More protective than Alternatives 1, 2, or 3, but effectiveness over the long term is questionable due to uncertainties associated with verifying treatment success and ensuring the integrity of the solidified waste form over time. Contaminant mobility would be reduced, but not toxicity; the volume might increase or decrease depending on the treatment method.	Essentially infeasible due to the nature and extent of the bulk wastes.	Significantly greater than Alternatives 2 and 5 could be greater than Alternative 3 due to the type and placement of the wastes, the extensive resource requirements, the need to control moisture content, and questionable effectiveness.
Alternative 5: Expedited excavation with temporary storage	More protective of all the alternatives; initiates a permanent solution at the quarry and supports follow-on comprehensive quarry remediation and waste management decisions for the entire project. Contaminant mobility would be reduced, but not toxicity; the total volume of materials would increase because some uncontaminated materials would be included.	Relatively straightforward, using standard equipment and procedures.	Low relative to other alternatives that would be equally or less effective; costs of monitoring and maintenance at the quarry would decrease over time; total project costs could be minimized due to the coordination of decisions for waste disposition.

Alternative	Effectiveness	Implementability	Cost
Alternative 6: Delayed action	Similar to Alternative 1 in the short term and expected to be similar to one of the action alternatives in the long term (i.e., if a similar response was selected following the delay).	Not applicable during the short term and expected to be similar to one of the action alternatives in the long term.	Expected to be higher than certain action alternatives in the long term due to the costs associated with monitoring until action is eventually taken and due to inflation and the potential increased scope of the cleanup effort as a result of contaminant migration.

9 SUMMARY OF COMPARATIVE ANALYSIS OF FINAL ALTERNATIVES

9.1 EVALUATION OF THE FINAL ALTERNATIVES

The final alternatives for managing the quarry bulk wastes were evaluated according to the nine criteria provided in the NCP for final remedial actions, as appropriate to this interim action. These evaluation criteria are:

- Threshold criteria -- Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements.

- Primary balancing criteria -- Long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost.

- Modifying criteria -- State acceptance and community acceptance.

9.1.1 No Action

Consist with EPA guidance, the no-action alternative was carried through the detailed evaluation phase of the remedial action decision making process to provide a baseline for comparison with the remaining final alternatives. The no-action alternative would not be protective of human health and the environment. Contaminant toxicity, mobility, and volume would not be reduced. The no-action alternative would not be effective in either the short term or the long term. Radon releases from the uncontrolled wastes, which have exceeded regulatory limits, would continue at present levels as would releases of other materials. The no-action

alternative would not provide a permanent remedial action solution at the quarry.

Timeliness, engineering controls, construction and operational factors, waste handling and implementation requirements, and costs do not apply to the no-action alternative.

9.1.2 Expedited Excavation with Temporary Storage at the Chemical Plant Area

Under the expedited excavation and temporary storage alternative, the bulk wastes would be excavated from the quarry with standard equipment and practices, then transported along a dedicated haul road to the chemical plant area of the Weldon Spring site. There, the wastes would be unloaded and temporarily stored in an engineered facility pending a final decision on disposal of all wastes generated by remediating the Weldon Spring site. The storage facility would be constructed and maintained in a manner that would minimize potential releases. Limited treatment may be conducted as appropriate to facilitate implementation (e.g., dewatering could be used after excavation to facilitate waste transport and storage). This alternative would expedite cleanup without adversely affecting ultimate waste management decisions for the Weldon Spring site or limiting the choice of reasonable alternatives. Subsequent treatment and/or disposal of the bulk wastes would be addressed in conjunction with other on-site materials in the RI/FS-EIS that is being prepared for remediation of the chemical plant area.

The total volume of materials that would be handled if this alternative were implemented is estimated to be about 110,000 m^3 (140,000 yd^3). This volume includes materials resulting from preparatory clearing and grubbing activities at the quarry, the excavated bulk wastes, uncontaminated materials excavated along with the wastes, expansion of excavated materials following their

removal from the quarry, and a 15% contingency factor. An estimated 15 months would be required to implement this alternative at a cost of about $11 million. These figures, however, are preliminary and may increase as engineering design is completed. Institutional controls would consist of continued site ownership, monitoring, and improvement and extension of existing physical barriers as needed (e.g., for the haul road and quarry support area). Engineering controls would be implemented to minimize potential releases of contaminants (e.g., radon and fugitive dusts) in order to ensure protection of the workers, the public, and the environment during the action period. These controls include limiting the extent of the work area and wetting and/or covering exposed surfaces at the quarry; controlling the speed of transport vehicles on the haul road; and utilizing liners, run-on/runoff control systems, and covers for the temporary storage facility at the chemical plant area.

The expedited-action alternative would be timely and would support overall protection of human health and the environment at the quarry in both the short term and the long term. This alternative would (1) reduce contaminant toxicity, mobility, and volume through source control; (2) reduce contaminant mobility of the excavated wastes by placing them in controlled storage in the chemical plant area; and (3) facilitate subsequent response activities at the Weldon Spring site, including follow-on quarry remediation, waste characterization, and comprehensive waste management decisions. Hence, this alternative is consistent with, and would contribute to, a permanent solution at the quarry and the efficient performance of overall remedial actions being planned for the site. Furthermore, it could be implemented with readily available equipment and standard engineering procedures. It would also be cost effective because it would limit both inflationary effects and potential increased cleanup efforts that would result if contamination at the quarry spread before a response was implemented.

9.1.3 Delayed Action Pending the Record of Decision for the Site

Under this alternative, no action would be taken for the quarry bulk wastes until a decision was made regarding the ultimate disposition of the entire Weldon Spring site. Rather than being expedited, remedial action at the quarry would be postponed until the site record of decision was approved. This approval would follow issuance of the RI/FS-EIS currently being prepared. Hence, this alternative is similar to the no-action alternative in the short term. The delay period is expected to last two to five years.

In the longer term, when the response was implemented following the delay period, many of the considerations for this alternative could be similar to those for the expedited-action alternative, i.e., if an excavation alternative were eventually selected pursuant to the record of decision. That is, waste handling and implementation requirements and engineering and institutional controls would be similar to those for the expedited-excavation alternative. Delaying initiation of a response action would result in continued migration of contamination from the quarry, and this could adversely impact human health and the environment. The cost of implementing this alternative is expected to increase because of inflation; the total cost of comprehensive quarry remediation could increase even further if the extent of contamination and the resultant scope of required cleanup increased as a result of the delay.

9.2 COMPARISON TO THE NINE EVALUATION CRITERIA

9.2.1 Threshold Criteria

9.2.1.1 Overall Protection of Human Health and the Environment.

Of the three final alternatives, the expedited-action alternative would provide the greatest short-term level of protection of human health and the environment. It would control the primary source of ongoing contaminant releases via air and groundwater and maintain the wastes in controlled storage at a facility engineered to prevent contaminant releases to the environment. The no-action alternative would not be protective of human health and the environment in either the short term or long term since releases would continue unmitigated. While the delayed-action alternative would not provide such protection in the short term, it is expected that at such time as the final quarry remedial action decision is made, a remedy providing a similar level of long-term protection would be selected.

9.2.1.2 Compliance with ARARs.

The only identified requirement that is currently not being met and is applicable to the no-action and delayed-action alternatives is the State requirement of 1 pCi/l outside a controlled area. Since radon-222 levels currently exceed this limit at the quarry fence line, these alternatives would not comply with this requirement. While the expedited-response action could not meet this requirement during implementation, the requirement could be achieved upon completion of the remedial action both at the quarry and at the temporary storage area.

RCRA Subtitle C requirements for closure of a landfill are also considered relevant and appropriate requirements for the no-action alternative, but the alternative would not meet this

requirement. Since the expedited-action alternative is not considered the final remedial action for the quarry, landfill closure requirements are not considered to be relevant and appropriate. Even if RCRA closure requirements were considered relevant and appropriate to excavation at the quarry, they could properly be waived pursuant to Section 121(d)(4)(A). This is because the quarry bulk waste remedial action is only part of a total remedial action which will attain that standard upon completion. The applicability and relevance and appropriateness of the closure requirements to the delayed-action alternative would be determined at the time the final remedy selection decision is made.

The expedited-response action can be conducted in compliance with other Federal and State ARARs.

9.3 PRIMARY BALANCING CRITERIA

9.3.1 Long-term Effectiveness and Permanence

The expedited-action and delayed-action alternatives provide similar levels of long-term effectiveness and permanence. The no-action alternative would not be effective over the long term and would not provide a permanent remedy for the quarry.

9.3.2 Reduction of Toxicity, Mobility, and Volume through Treatment

The no-action alternative would not reduce the toxicity, mobility, or volume of the wastes through treatment. The expedited-action and delayed-action alternatives are expected to provide a comparable degree of reduction in waste mobility by removing the bulk wastes to a separate area of the site where storage could be controlled. However, the reduction in waste mobility would not be timely in the delayed-action alternative because of the delay period. The wastes would be subsequently

treated and/or disposed of pursuant to the decisions made in the RI/FS-EIS currently being developed for the Weldon Spring site. Neither alternative would reduce the toxicity or volume of the bulk wastes.

9.3.3 Short-Term Effectiveness

The expedited-action alternative would provide a timely response to ongoing releases of contaminants to the environment. The no-action and delayed-action alternatives would not be effective in the short term.

9.3.4 Implementability

The expedited-action and delayed-action alternatives are both technically and administratively feasible. Implementability does not apply to the no-action alternative.

9.3.5 Cost

The expedited-action alternative is estimated to cost about $11 million. The cost of implementing the delayed-action alternative cannot be estimated at this time. However, assuming the delayed action is similar to the proposed expedited action, costs would be somewhat higher because of inflation. Furthermore, the total cost of comprehensive quarry remediation could increase even further if the extent of contamination and the resultant scope of required cleanup efforts increased as a result of the delay. The no-action alternative has no cost.

9.4 MODIFYING CRITERIA

9.4.1 State Acceptance

The State of Missouri supports the selected alternative.

9.4.2 Community Acceptance

A public comment period was held from March 5, 1990, through April 9, 1990. In addition, a public meeting was held on March 29, 1990, to explain the preferred remedy and elicit comments from the public. Public comments received during the comment period indicate that the majority of the community directly impacted by this action (i.e., residents of St. Charles County) support the expedited-action alternative. With the exception of members of the Coalition for the Environment, citizens in neighboring counties provided no comments on the proposed action. Members of the Coalition for the Environment, who reside in St. Louis County, oppose the expedited-action alternative citing a lack of characterization data and engineering detail in the RI/FS and supporting documents. This organization stated that more information is needed before one of the alternatives is selected. No group or individual supported any of the rejected alternatives. Responses to the comments received during the public comment period are included in the responsiveness summary, which was prepared as a separate document. A summary of the major issues raised during the public comment period is included in this record of decision.

10 SELECTED REMEDY

Based on an evaluation of the final alternatives for managing the quarry bulk wastes, expedited action has been selected as the remedy. Under this alternative, the bulk wastes will be excavated from the quarry, transported along a dedicated haul road, and placed in controlled storage in the chemical plant area pending a final decision on disposal of all wastes generated by remediating the Weldon Spring site.

The expedited-action alternative represents the best balance among the evaluation criteria for remedial actions. The no-action and delayed-action alternatives would not support a permanent solution during the short term, and they would hinder the decision making process for, and implementation of, overall site cleanup. Timeliness, implementability, and cost do not apply to the no-action alternative. Although implementation of the delayed-action alternative might be similar to that of the currently preferred alternative during the action period, it is not considered timely because of the delay. Delaying cleanup could also increase the contaminant migration problem which would negatively impact overall protectiveness and cost effectiveness.

Expedited excavation of the bulk wastes would protect human health and the environment by (1) controlling the primary source of ongoing contaminant releases via air and groundwater and (2) maintaining the wastes in controlled storage at a facility engineered to prevent contaminant releases to the environment. Expedited excavation would also promote the effectiveness of site cleanup by facilitating detailed characterization of (1) the quarry subsurface to address complete follow-on remediation, and (2) the bulk wastes to support comprehensive waste management decisions for the project.

11 STATUTORY DETERMINATIONS

Consistent with the statutory requirements of Section 121 of CERCLA, as amended, remedial actions should be selected that:

- Are protective of human health and the environment.
- Comply with ARARs.
- Are cost effective.
- Utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.
- Satisfy the preference for treatment which, as a principle element, reduces toxicity, mobility, and volume.

The quarry bulk waste remedial action is only one of several actions that will be taken to remediate the Weldon Spring site (see Figure 5). The manner in which this focused action satisfies these five requirements is discussed in the following subsections.

11.1 PROTECTION OF HUMAN HEATH AND THE ENVIRONMENT

The selected remedy is protective of human health and the environment by (1) controlling the primary source of ongoing contaminant releases from the quarry via air and groundwater and (2) maintaining the wastes in controlled storage at a facility engineered to prevent release of contaminants to the environment. Although the quarry bulk wastes do not pose a significant risk to human health and the environment in the short term, the continued presence of the bulk wastes could pose significant threats in the future.

The bulk wastes contain elevated concentrations of both radioactive and chemical contaminants, and the limestone underlying the quarry contains fractures and fissures that constitute potential pathways for contaminant migration. Contaminants are currently migrating into the groundwater beneath the quarry, and radon gas concentrations and gamma exposure rates within the quarry and at the fence line are elevated above background levels.

In addition, some types of vegetation in the vicinity contain elevated levels of radioactivity. This contamination does not pose an immediate risk because site access is controlled, the nearby environment is continuously monitored, and corrective actions to protect human health and the environment would be implemented if warranted. However, if administrative control of the quarry were lost at some point in the future, exposure to the bulk wastes could potentially result in excessive health risks to persons frequently entering it.

Procedures to protect human health and the environment will be implemented during the quarry bulk waste remedial action. The environmental pathway of most concern is atmospheric releases. Extensive control measures will be implemented during all phases of the action that could create airborne emissions. During excavation of the wastes, emissions will be controlled by water sprays, foams, and tarpaulins, as needed. The wastes will be transported to the chemical plant area in trucks along a dedicated haul road. Current plans are to package the wastes in containers to ensure minimal releases. Dust control measures similar to those at the quarry will be used while the wastes are being unloaded at the temporary storage area. Finally, all wastes susceptible to windblown erosion or release of radon gas will be covered as soon as practical following placement in the temporary storage area. These measures will ensure minimal atmospheric releases as a result of implementing this action and thus be protective of human health and the environment.

The selected remedy further protects human health and the environment in that it supports overall remediation of the Weldon Spring site by facilitating further investigations at the quarry area. These investigations are essential for evaluating the various response action alternatives for the quarry. An understanding of the nature and extent of fracture joints and fissures and associated soil and groundwater contamination can be established only after the bulk wastes have been removed. Hence, the proposed removal of bulk wastes from the quarry would facilitate the development of a comprehensive plan to address the issue of subsurface remediation in this area.

11.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy will comply with applicable or relevant and appropriate requirements, unless those requirements have been properly waived in accordance with CERCLA, and will be performed consistent with all pertinent DOE Orders as set forth below. The ARARs are presented below according to location-specific, action-specific, and contaminant-specific requirements. The excavation, transportation, and storage of the wastes are considered to be on-site actions and need only comply with the substantive requirements of Federal and State environmental laws that are ARARs.

11.2.1 Location-Specific ARARs

The analysis of location-specific ARARs included a review of the Resource Conservation and Recovery Act, the Missouri Hazardous Waste Management Laws, the National Historical Preservation Act, the Archeological and Historic Preservation Act, the Archeological Protection Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the Clean Water Act, the Wilderness Act, the Wildlife Management Act, the Coastal Barrier Resources Act, the

Clean Air Act, and the Surface Mining Control and Reclamation Act as outlined in the CERCLA Compliance with Other Laws Manual.

The planned installation of a 10-cm (4-in) pipe to connect the quarry with an existing county water main (for decontamination, fire-fighting capability, and other water requirements) could impact cultural resources. Requirements associated with protection of cultural resources are applicable (i.e., National Historic Preservation Act, Archeological and Historic Preservation Act, and Archeological Resources Protection Act). Construction of the water line will be coordinated with the Missouri State Historic Preservation Officer to ensure compliance with these requirements.

The proposed action will not impact floodplains, wetlands, or sensitive ecosystems.

No other location-specific requirements were found to be either applicable or relevant and appropriate to the proposed action.

11.2.2 Action-Specific ARARs

The analysis of action-specific ARARs addressed the following tasks for the quarry bulk waste remedial action:

- Excavation - removal of bulk wastes from the quarry.

- Storage - temporary storage in a waste management unit defined as a waste pile which includes surface impoundments for runoff control.

Presented below is a discussion of the ARARs for these activities.

Excavation

Requirements associated with the excavation of wastes are found in RCRA closure requirements. A complete analysis of closure requirements for the quarry is not within the scope of the quarry bulk waste remedial action since the action will be complete with excavation of the bulk wastes. The follow-on residual RI/FS will characterize the nature and extent of any contamination left in the cracks and fissures of the rock, develop risk-based cleanup criteria, and define appropriate closure requirements. As discussed previously, closure requirements for the quarry are neither applicable nor relevant and appropriate to the excavation phase of remedial action.

Closure requirements will be considered in more detail in the follow-on residual RI/FS. After excavation of the bulk wastes, additional characterization work will be performed to better characterize the nature and extent of any contamination left in the cracks and fissures of the rock, and to define appropriate closure requirements.

Occupational safety and health standards for workers involved in activities at CERCLA sites are given in 29 CFR 1910.120. These requirements are not applicable under exemptions in the Atomic Energy Act. These requirements are, however, relevant and appropriate to this remedial action.

Storage

RCRA Subtitle C requirements for waste piles and surface impoundments are considered possible ARARs for the selected action. Missouri Hazardous Waste Management requirements are similar to Federal requirements, with some differences as discussed below. The areas of the regulations that were evaluated include those for waste management units defined as waste piles and surface

impoundments. The respective requirements are presented in 40 CFR 264 Subparts L (Waste Piles), K (Surface Impoundments), G (Closure and Post Closure), and F (Groundwater Protection).

The RCRA design requirements for waste piles are found in Subpart L, Section 264.251. These requirements are relevant and appropriate to this remedial action. Therefore, the waste pile will be designed in accordance with 40 CFR 264.251 to store the material as if RCRA were applicable. The facility will include a liner, a leachate collection and removal system, a run-on control system, a runoff management system and a cover for areas which contain particulate matter subject to wind dispersal.

The collection and holding facilities within the temporary storage area were evaluated with respect to RCRA requirements in Subpart K, Section 264.221 and the Missouri Hazardous Waste Management Laws for surface impoundments. The State and Federal RCRA requirements for surface impoundments are not legally applicable but may be relevant and appropriate. The design requirements for a double liner system specified in 40 CFR 264.221(c) are relevant and appropriate. However, considering the expected duration of storage, the clay liner requirement of 10 CSR 25-7.264(2)(k) is not appropriate. The soil underlying the proposed location for the temporary storage area is already contaminated; the eventual remedy of the chemical plant area will include remediation of on-site contaminated soil.

Similarly, the groundwater protection requirements of 40 CFR 264 Subpart F are not legally applicable but the groundwater monitoring requirements are considered to be relevant and appropriate. The groundwater response requirements, however, are not considered to be relevant and appropriate to this remedial

action, which does not address groundwater remediation. Even if the groundwater response requirements were found to be relevant and appropriate, they could be waived pursuant to Section 121(d)(4)(A) and Section 121(d)(4)(C) of CERCLA. While not a part of this remedial action, groundwater remediation will be addressed in the final remediation of the chemical plant area. In addition, it is not practical to separate groundwater under the temporary storage area from groundwater being addressed as part of the overall RI/FS-EIS currently being prepared for remediation of the entire chemical plant area.

Similarly, the requirements of 40 CFR 264.258, Closure and Post-Closure Care, are not legally applicable and are not considered to be relevant and appropriate to the quarry bulk waste remedial action. If found to be relevant and appropriate, these requirements could be waived under Section 121(d)(4)(A) and Section 121(d)(4)(C) of CERCLA. The closure requirements are not pertinent since the bulk waste removal and storage is an interim action and closure of the temporary storage area cannot adequately be addressed until the final remedy for the chemical plant area is selected. In addition, it is technically impractical to close the temporary storage area until the material can be removed for final disposition consistent with the ultimate site remedy. The temporary storage area will not be closed with the wastes in place.

Other considerations for storage include portions of the Land Disposal Restrictions, 40 CFR 268 Subpart E and the Toxic Substances Control Act, 40 CFR 761.65. These requirements deal with prohibitions on storage and may be applicable for this action. The limitations on storage time are waived under the provisions of Section 121(d)(4)(A) and Section 121(d)(4)(C) of CERCLA since the schedule for final disposition of the quarry bulk wastes is controlled by the decision making process for remediation of the chemical plant area. It is not technically feasible to comply with

the time limitations since a remedy for the chemical plant area will not be selected in the required time frame.

An additional action-specific consideration is for transportation. Requirements pertaining to transportation of radioactive and chemically hazardous wastes are not legally applicable to this action, but some portions are relevant and appropriate. For purposes of this action, a simplified manifest system will be developed. This system will include tracking waste shipments from the quarry to the temporary storage area; placarding the trucks; and using strong, tight containers to prevent leakage under conditions normally incident to transportation.

11.2.3 Contaminant-Specific ARARs

The analysis of contaminant-specific ARARs was performed to address each major environmental law or regulation pertinent to the types of contaminants that will be encountered during this remedial action.

NESHAP requirements for radionuclides, given in 40 CFR 61 Subparts H and Q, and asbestos given in Subpart M are legally applicable to all phases of the action.

State standards found in 10 CSR 10-5.100 pertaining to control of airborne particulate matter, and in 10 CSR 10-5.180 pertaining to particulate standards for internal combustion engines are applicable to the implementation phase and will be met.

40 CFR 192.02(b)(1) addresses releases of radon from uranium mill tailings disposal piles. These standards will be relevant and appropriate after the bulk wastes have been placed in controlled storage. At that time, the temporary storage area will meet the radon-222 flux standards specified in 40 CFR 192.02(b)(1). These standards require reasonable assurance that radon-222 releases will

not (1) exceed an average release rate of 20 pCi/m^2/sec or (2) increase the annual average concentration of radon-222 in air at or above any location outside the site perimeter by more than 0.5 pCi/l.

Although DOE Orders are not ARARs in that they are not promulgated standards, the radiation protection requirements given in DOE Orders 5400.5 and 5480.11 are most suitable for this action. The requirements in these two orders are based on recent radiation dosimetry models while the radiation protection requirements in both 10 CFR 20 and 19 CSR 20 are based on out-of-date dosimetry considerations. Hence, the action will be conducted in accordance with these two DOE Orders for radiation protection. As discussed in Section 7.1.6, the requirements in 10 CFR 20 are currently being revised. The action will comply with any provisions in the revised 10 CFR 20 and subsequent revisions to 19 CSR 20 that are more stringent than those in these two DOE Orders.

The State radon-222 limit of 1 pC/l in uncontrolled areas cannot be achieved during implementation of this action. This standard is waived pursuant to Section 121(d)(4)(C) of CERCLA during implementation. This requirement will be achieved upon completion of the action.

Standards of control are established under the Toxic Substances Control Act for the cleanup of PCB spills and for asbestos exposure limits. 40 CFR 761.125 addresses cleanup requirements for PCB spills and is applicable during transport of the bulk wastes. Permissible exposure limits to asbestos fibers are addressed in 40 CFR 763.121(c). The standard is relevant and appropriate to the implementation phase of this action.

11.3 COST EFFECTIVENESS

The selected remedy is estimated to cost about $11 million and is expected to be implemented in 15 months. These figures, however, are based on conceptual estimates performed early in the RI/FS process and both are likely to increase as engineering design is completed. This remedy is cost effective since postponing the action could result in the continued spread of contamination in the quarry area. This would result in the need for a more extensive cleanup effort in the future. In addition, delaying action would result in higher costs due to inflation. Both of these effects will be minimized by implementing the selected remedy. In addition, this remedy would promote the effectiveness of remediation of the entire Weldon Spring site by facilitating detailed characterization of (1) the quarry subsurface to address follow-on remediation, and (2) the bulk wastes to support comprehensive waste management decisions for the entire Weldon Spring site.

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

The selected remedy will result in the permanent removal of the bulk wastes from the quarry. This will remove the source of contaminant releases to the air and groundwater in the quarry area. The use of alternative treatment technologies or resource recovery technologies is beyond the scope of the quarry bulk waste remedial action. This action will not result in a permanent solution for either the quarry or the bulk wastes. A final decision for the quarry area will be made following removal of the bulk wastes (this action) and completion of detailed studies on the need to perform additional remediation in the quarry area. Treatment and disposal decisions for the wastes will be included in the RI/FS-EIS for remediation of the chemical plant area.

11.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Treatment of the bulk wastes to reduce toxicity, mobility, and volume is beyond the scope of this action. The action is limited to excavation of the bulk wastes from the quarry with transport to, and temporary storage at, the chemical plant area. The wastes will be treated only to facilitate transportation and storage activities (e.g., segregation, dewatering). They will be characterized in detail after they are placed in controlled storage in the chemical plant area. The results of this detailed characterization will be used to finalize decisions on potential treatment strategies to reduce toxicity, mobility, and volume.

RESPONSIVENESS SUMMARY

The remedial investigation/feasibility study (RI/FS) documents were issued to the general public on March 5, 1990, and the public comment period extended through April 9, 1990. A public meeting was held on March 29, 1990, at the Ramada Inn in Wentzville, Missouri, as a part of the community participation process. In addition to the public meeting, the U.S. Department of Energy (DOE) held numerous briefings and meetings with public officials, school administrators, special interest groups, and members of the general public. A separate responsiveness summary document has been prepared to address the issues raised during the public comment period. This document lists the major issues raised in oral and written comments on the RI/FS documents and provides the DOE responses to these issues. In addition, individual responses to all written comments are provided. The following discussion, which has been extracted from the responsiveness summary document, provides summaries of the major issues associated with the proposed action followed by DOE responses.

The conceptual approach for implementing the preferred alternative, as presented in Chapter 8 of the FS report, was revised following receipt of the public comments. The approach currently being evaluated is to conduct basic waste sorting at the quarry, load the sorted wastes into containers such as large steel boxes, and transfer the containers to trucks for transport to the chemical plant area. At the chemical plant area, the containers will be unloaded and the wastes placed directly into controlled storage. The empty containers will be returned to the quarry for reuse. Such an approach could allow for the return trip to be on the dedicated haul road eliminating all truck traffic on State Route 94. This approach will be evaluated in detail after this record of decision is issued.

Issue 1

Comment. The RI/FS documents include a disclaimer in which it is stated that the DOE does not assume any legal liability or responsibility for the accuracy, completeness, or usefulness of the information included in the documents. How can the DOE proceed with this action when it does not stand behind the information supporting its selection?

Response. The disclaimer was included in these documents by mistake. The DOE does indeed stand behind the information and analyses provided in the RI, Baseline Risk Evaluation (BRE), and FS. This disclaimer is used in documents summarizing work sponsored by the DOE that is experimental or developmental in nature. Its purpose is to exempt the DOE and its contractors from legal liability for research activities so that new ideas and concepts can be explored without being restricted by legal constraints. These conditions do not apply to this RI/FS.

Issue 2

Comment. The proposed action entails temporary storage of the bulk wastes at the chemical plant area. How long is "temporary" storage?

Response. The quarry bulk wastes are scheduled to be in temporary storage for three to six years.

Issue 3

Comment. How do we know that temporary storage will not become permanent?

Response. The temporary storage facility will not be designed to meet permanent disposal requirements nor is there any consideration of ever upgrading it to meet such requirements. Permanent disposal requires separate processes of environmental compliance, regulatory concurrence, and public involvement. This does not mean that construction of a permanent disposal cell on site will not be considered in the future; however, it does mean that temporary storage of the bulk wastes will not influence that disposal decision.

Issue 4

Comment. Removal of the quarry bulk wastes with temporary storage in the chemical plant area is only an interim action in the overall remediation of the Weldon Spring site. When will a decision on the permanent disposal of all site wastes be reached?

Response. The DOE is currently preparing an RI/FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to evaluate alternatives for the permanent disposal of all wastes generated by remediating the Weldon Spring site. The analyses in that RI/FS will include those required in an environmental impact statement (EIS) for compliance with the National Environmental Policy Act (NEPA). This integrated CERCLA/NEPA approach is being referred to as the RI/FS-EIS process. The RI/FS-EIS is being prepared consistent with U.S. Environmental Protection Agency (EPA) guidance; a preliminary internal review draft will be available in late 1990. The RI/FS-EIS documents will be available for review by EPA Region VII, the State of Missouri, and the general public in 1991, and a joint EPA/DOE record of decision for this proposed action will be issued in 1992.

Issue 5

Comment. The quarry bulk wastes should not be moved until a permanent disposal decision has been reached for managing all wastes from the Weldon Spring site and a disposal facility is ready to accept the wastes. This interim remedial action is not a wise expenditure of tax dollars.

Response. Delaying this interim remedial action would postpone the attainment of remedial action objectives at the quarry (e.g., to respond to ongoing releases by removing the primary source of contamination from the quarry and to initiate necessary characterization activities). The preferred alternative can be implemented in a manner that will not endanger students and staff at Francis Howell High School or any other individuals in the area. The extensive monitoring program currently in place will be expanded prior to initiating the proposed action to ensure the health and safety of nearby residents and the environment.

The DOE is currently preparing an RI/FS-EIS to evaluate alternatives for the permanent disposal of all wastes generated by remediating the Weldon Spring site. Although the RI/FS-EIS will be available for public review and comment in 1991, the length of time to implement permanent disposal options will take several more years. Delaying the proposed removal of the bulk wastes would result in continued uncontrolled release of contaminants to the environment in the quarry area. The proposed action is being taken at this time to respond to this release.

Although some additional cost will be incurred by placing the bulk wastes in temporary storage, most of the components associated with this action will be required whether the action is taken now or in the future. The wastes must be removed and characterized to permit an informed evaluation of various treatment options prior to final disposal. Hence, the incremental cost is a

good expenditure of funds based on the considerable benefits associated with expediting the action, i.e., the proposed action will protect human health and the environment and support overall waste management decisions for the project. These and other reasons for conducting the proposed action are discussed in greater detail in the FS.

Issue 6

Comment. Why not simply move the well field to ensure the safety of this source of potable water? This would be a much simpler and cheaper solution.

Response. There is currently no need to consider moving the well field or providing an alternative source of potable water because the water in this well field is not contaminated. Removing the source of potential threat to the well field is only one of the reasons for this action. The bulk wastes must be removed in order to perform detailed characterization of the wastes for evaluating appropriate treatment technologies and disposal alternatives. In addition, the wastes must be removed to allow for detailed characterization of the quarry area. Removal of the bulk wastes is responsive to the need to protect human health and the environment and also serves to protect an important natural resource (i.e., the groundwater in this area).

Issue 7

Comment. Will any wastes from other areas be brought to the Weldon Spring site for disposal?

Response. The proposed action is limited to management of the quarry bulk wastes. Management of all wastes from cleanup of the Weldon Spring site is the subject of a separate RI/FS-EIS process that is currently under development. There are no plans to

bring wastes from other areas to the Weldon Spring site for disposal. The record of decision for remediation of the chemical plant area of the Weldon Spring site will address the scope of waste disposal and limitations on use of the Weldon Spring site for future actions.

Issue 8

Comment. The wastes should be sorted and containerized at the quarry prior to transport to the chemical plant area for temporary storage.

Response. This type of issue would typically be addressed during the engineering design phase of the project. However, the DOE has reviewed this concept and believes it has merit. The approach currently being evaluated is to conduct basic sorting at the quarry, load the sorted wastes into containers such as large steel boxes, and transfer the containers to trucks for transport to the chemical plant area. At the chemical plant area, the containers will be unloaded and the wastes placed directly into controlled storage; the empty containers will be returned to the quarry for reuse.

This approach would tend to decouple the excavation, transportation, and unloading activities. For example, extra containers could be loaded at the quarry during a second shift or while wastes were being transported to the temporary storage area. Trucks could travel along the haul road in small convoys (i.e., three to six trucks) to the temporary storage area where the containers would be off-loaded. The wastes would be removed from the containers and placed into controlled storage. Empty containers would be loaded onto the trucks and returned to the quarry. Such an approach could allow for the return trip to be on the dedicated haul road. Plans for the haul road may need to be

modified to include several turnouts which, in conjunction with radio contact, would allow safe passage of truck traffic. This would eliminate all truck traffic on Route 94.

Issue 9

Comment. Why is it necessary to move the wastes closer to Francis Howell High School for temporary storage? Why not take the quarry wastes somewhere else for disposal?

Response. No disposal facility is currently available for the quarry wastes. Furthermore, a permanent waste disposal decision is a very complex issue and will not be made for a few years. Therefore, the only alternatives at this time are either to remove the quarry bulk wastes and temporarily store them pending a waste disposal decision or delay the quarry cleanup action. The DOE believes it is important to initiate the quarry cleanup action as soon as possible (see responses to Issues 5 and 6). The question then becomes where to store these wastes.

In addition to the fact that there is simply no other available space, there are several good reasons for temporarily storing the wastes in the chemical plant area. On-site storage will ensure that no individuals are inadvertently exposed because access to the chemical plant area is controlled. Also, the presence of on-site DOE and contractor staff will ensure continuous oversight. The wastes can be safely and expeditiously characterized to allow for an informed decision on their final disposal to be made as soon as possible. Finally, the extensive monitoring capability available in the chemical plant area can be used to ensure the health and safety of nearby residents. This is the best way to store these materials in the near term.

Issue 10

Comment. There is insufficient engineering information on the proposed action to adequately assess the feasibility of its implementation. It is not possible to select an alternative with the level of detail provided in the RI/FS documents.

Response. The level of detail provided in the RI/FS documents is consistent with that required by the EPA for actions of this magnitude. Detailed engineering for this action cannot be initiated until the record of decision has been issued. However, the analyses presented in the RI/FS and supporting documents demonstrate that this action can be performed safely and in compliance with all applicable standards and regulations. This information is sufficient to allow for selection of an alternative.

The level of detail necessary to determine the engineering feasibility of this action is presented in the preliminary engineering report supporting the FS. The design documents to be developed following issuance of the record of decision will focus on the physical aspects of this action such as equipment needs, operational requirements, material handling, and cost. Planning related to dealing safely with the various types of contaminants and hazards that may be encountered will be presented in an operational environmental, safety, and health plan. The results of these two planning efforts will ensure that this action is implemented safely.

Issue 11

Comment. There is insufficient characterization data to adequately plan this action.

Response. Previous investigations have provided a significant amount of information on the physical, chemical, and

radiological characteristics of the wastes. The results of these investigations, which are presented in the RI, are consistent with the disposal history at the quarry. This information is sufficient to design a safe plan for the removal, transport, and temporary storage of the bulk wastes.

It is possible that some unknown waste material was placed in the quarry. In designing the waste removal process, an observational approach will be used to deal with this possibility. In this approach, planning is based on available data and realistic assumptions concerning field conditions. Adjustments are made in the field as work proceeds. Deviations from expected conditions and mechanisms by which to identify their occurrence are defined, and plans are developed to address or mitigate adverse effects that result from these deviations. This approach ensures responsiveness to actual field conditions.

Issue 12

Comment. The quarry bulk wastes contain residual concentrations of trinitrotoluene (TNT), dinitrotoluene (DNT), and their decomposition products. Is there any possibility that an explosion could occur while the bulk wastes are being removed?

Response. The highest measured concentration of TNT in the bulk wastes is about 2%. This value is the result of biased sampling in which areas of surficial discoloration were targeted in an effort to define the maximum concentrations. The measured value of 2% is well below the concentration that presents an explosive hazard during excavation (which is 12% to 15%). The concentrations of DNT and decomposition products of TNT and DNT in the bulk wastes are much lower than the measured concentration of TNT. The proposed action has been reviewed by Hercules, Inc., a company with extensive expertise in dealing with explosives. Their technical review concluded that the current plan is feasible and that an

explosion is highly unlikely. However, the concentration of nitroaromatic compounds in the bulk wastes will be evaluated as the wastes are being excavated to ensure that there are no pockets containing much higher concentrations of TNT that could present an explosive hazard. Plans will be in place to deal with explosive concentrations of TNT in the unlikely event of such an occurrence.

Issue 13

Comment. Effective radon and dust control measures should be used to minimize atmospheric releases while implementing this action.

Response. Extensive radon and dust control measures will be implemented during all phases of this action that have a potential for creating airborne emissions. During excavation of the wastes, emissions will be controlled by water sprays, foams, and tarpaulins, as needed. The wastes will be transported to the chemical plant area in trucks along a dedicated haul road. Current plans are to package the wastes in containers to ensure minimal releases. Dust control measures similar to those at the quarry will be used while unloading the bulk wastes at the temporary storage area. Finally, all wastes susceptible to windblown erosion or release of radon gas will be covered as soon as practical following placement in the temporary storage area. These measures ill ensure minimal releases of radon gas or contaminated dust as result of implementing this action.

ssue 14

Comment. It is essential that remedial actions at the Weldon Spring site be implemented in a manner that will not compromise the health and safety of the people of St. Charles County. A thorough environmental monitoring program should be put in place prior to initiating this action to ensure the health and

safety of nearby residents and students and staff at Francis Howell High School.

Response. An extensive environmental monitoring program is currently in place at both the quarry and chemical plant areas. This program provides extensive information on the current status of these two areas. The monitoring program will be expanded at both areas before the bulk waste remedial action is initiated. An operational environmental, safety, and health plan is currently being prepared to address the specific needs of this action. An array of air monitors will be placed at the temporary storage area and site perimeter to detect any airborne contamination that could impact Francis Howell High School. The health and safety of nearby individuals will not be compromised by this action.

Issue 15

Comment. An emergency response plan should be developed before this action is initiated to address actions that would be taken if there are any spills or natural disasters. This plan should address earthquakes, high winds, tornadoes, spills, and any other events that could cause large releases of radioactive and chemical contaminants to the environment. The Francis Howell School District should be part of the planning process because of the close proximity of its elementary and high schools.

Response. The DOE will develop an emergency response plan to address credible emergency situations consistent with the hazards posed by the proposed action. This plan will identify measures to be taken in the event of a spill, transportation accident, or natural disaster. In developing this plan, the DOE will involve the Francis Howell School District and local officials who would require notification or coordination in the event of an emergency. Removal of the bulk wastes will not begin until an emergency response plan is in place.

Issue 16

Comment. The ongoing environmental monitoring program at the quarry needs to continue without interruption before, during, and after removal of the bulk wastes. This is the only way to ensure the safety of the St. Charles County well field.

Response. The St. Charles County well field is being extensively monitored by Federal, State, and local authorities. This monitoring indicates that the well field has not been impacted by contaminants migrating from the quarry. The DOE will increase its monitoring efforts during the bulk waste remedial action to ensure that this action does not result in contamination impacting the well field. Monitoring of the well field will continue following removal of the bulk wastes while studies are undertaken to evaluate the need for additional remediation of this area. Monitoring activities at the quarry will not be discontinued until all follow-on studies have been completed and any additional remedial actions have been implemented. Such future decisions will rely on input from EPA Region VII, the State of Missouri, and officials from St. Charles County.

Issue 17

Comment. Since the levels of radon are elevated at the quarry, why move these materials closer to Francis Howell High School and increase the risk to students from radiation exposure?

Response. The bulk wastes are being removed in part to control radon emissions from these materials. The radium-contaminated soils will be placed in controlled storage in the temporary storage area and covered with a liner that is very effective at reducing radon gas releases. Modeling studies described in the FS indicate that the radon concentrations at Francis Howell High School resulting from this action would be

indistinguishable from background levels. The DOE will monitor for radon-220, radon-222, and their short-lived decay products at the temporary storage area, the site perimeter, and Francis Howell High School during implementation of the action and during the temporary storage period. This monitoring program will allow for upgrading of radon emission controls, if necessary, to prevent impacts to the high school.

Issue 18

Comment. Results of environmental monitoring activities need to be provided to the general public in a timely manner. The results of 1988 environmental monitoring activities were not issued until January 1990. The general public needs to be kept better informed, especially as the bulk waste remedial action proceeds.

Response. The 1988 environmental monitoring report was issued late due to the internal review process within the DOE. The 1989 environmental monitoring report will be issued in the near future. The DOE agrees on the need to provide environmental monitoring results in a timely manner and is currently developing a plan to issue the results of environmental monitoring on a more frequent basis. Any anomalous environmental monitoring data associated with the bulk waste remedial action will be made available to local authorities and any potentially affected individuals as soon as possible.

Issue 19

Comment. The report recently released by the Committee on the Biological Effects of Ionizing Radiations (i.e., the BEIR V report) indicates that the biological effects of exposure to low levels of radiation are greater than previously estimated. Are there likely to be any changes in Federal limits on permissible levels of radiation exposure to workers or the general public as a

result of this study? What impact do these results have on the proposed action?

Response. The recently issued BEIR V study includes a detailed description of current data on the health risks of exposure to low levels of ionizing radiation. This study estimates that the health risk is about three times greater than estimated in the previously issued BEIR III report. However, it should be noted that the data used to reach these conclusions have limitations, as noted in the BEIR V study. Assessment of the carcinogenic risks that may be associated with low doses of radiation were extrapolated from effects observed at doses larger than 10 rem delivered over a short period of time. In addition, it was necessary to use assumptions about the relevant dose-effect relationships and the underlying mechanisms of carcinogenesis.

Health hazards associated with chronic exposure to low levels of ionizing radiation have been studied in areas such as those having high levels of background radiation, areas receiving fallout from nuclear weapons testing, and areas near nuclear installations. The data from these studies do not indicate an elevated level of cancer risk. Hence, it is still not possible to draw definitive conclusions of the cancer risks associated with chronic exposure to low levels of ionizing radiation.

The permissible level of radiation exposure for workers is based on limiting their health risk to levels that are comparable to the occupational risks from other industries that are considered to be safe. The permissible level (5 rem/yr) may be reduced as a result of recent studies that indicate that the risk from exposure to low levels of ionizing radiation is higher than previous estimates. The DOE and other Federal agencies are currently examining this issue. The radiation doses to workers who would implement this action would be considerably below current limits.

The results of the BEIR V study are not expected to result in significant changes in the permissible levels of radiation exposure to the general public or in DOE concentration limits for radionuclides in liquid or gaseous effluents. The risk factors presented in the BEIR V report are consistent with those used by the EPA in developing revisions to the National Emission Standards for Hazardous Air Pollutants under Section 112 of the Clean Air Act for radionuclides and the U.S. Nuclear Regulatory Commission (NRC) in developing revisions to 10 CFR 20 for permissible levels of radionuclides in air and water in controlled and uncontrolled areas. The DOE standards are consistent with those developed by the EPA and NRC.

A major element of the DOE radiation protection program for occupational and public exposures is the as low as reasonably achievable (ALARA) concept. Under the ALARA process, all exposures to radiation and all releases of radioactivity to the environment must be reduced to levels that are as low as reasonably achievable. The DOE is committed to this approach. The proposed action would not be impacted even if more stringent standards were in effect because the predicted levels of radiation exposure to workers and the public are well below applicable standards.

Issue 20

Comment. Transporting the wastes by truck from the quarry to the chemical plant area has the potential for spreading contamination to currently clean areas. How will this possible spread of contamination be controlled?

Response. The wastes will be transported to the chemical plant area in trucks that will travel at low speeds along a dedicated haul road. Current plans are to package the wastes in containers to ensure minimal releases during transport. The exteriors of the trucks will be surveyed for contamination before

leaving the quarry and chemical plant area, and any loose contamination will be removed before the trucks are allowed to exit either area. Finally, periodic surveys of the haul road will be performed to ensure that contamination controls are effective. If any contamination is detected on the haul road, the area will be cleaned up immediately and measures will be taken to prevent a reoccurrence. This approach will ensure that contamination is not being spread to the environment as a result of waste relocation.

Issue 21

Comment. As currently planned, trucks leaving the quarry would cross State Route 94 near the quarry and then proceed along a dedicated haul road to the chemical plant area. Empty trucks would return to the quarry using Route 94. The DOE should investigate further the use of grade separation (i.e., an underpass) at the intersection of State Route 94 and the haul road to avoid any crossing of Route 94 by trucks. In addition, plans should be developed to minimize or eliminate truck traffic on Route 94 during time periods that bus or student traffic are on this roadway.

Response. The DOE agrees that transportation safety is one of the most significant issues associated with this action. As presented in the FS, wastes would be loaded directly into trucks. In this approach, the rate of waste removal could be limited by the time required for a truck to travel to the temporary storage area and return to the quarry for another load. By staging the containers at the quarry, and using the trucks only to shuttle containers back and forth to the temporary storage area, the entire operation can sustain the extra time required for trucks to share the single lane haul road. To provide further flexibility, plans for the haul road could be modified to include turnouts which, in conjunction with radio contact, would allow safe passage of truck traffic. This would eliminate all truck traffic on Route 94.

In addition, discussions are currently taking place with the State of Missouri on the use of grade separation where the dedicated haul road crosses State Route 94. This would eliminate all crossing of Route 94 by trucks. Use of grade separation would require reconstruction of a section of Route 94. The decision on use of this option will be largely dictated by the cost of the reconstruction relative to that associated with other safety measures that could be used at this crossing (e.g., flagmen, traffic signals). The DOE will continue working with the State to resolve this issue.

Issue 22

Comment. Will this action have any impact on wildlife in the immediate area?

Response. Activities related to this action will destroy about 15 ha (37 acres) of vegetation at the quarry, along the haul road, and at the chemical plant area. Some small, relatively immobile wildlife will be lost, and other more mobile wildlife will be disturbed, displaced, and possibly lost during construction and operation. However, the overall impact will be very minor given the extensive amount of wildlife habitat in the surrounding area.

Issue 23

Comment. There has been a higher incidence of childhood leukemia in St. Charles County than that expected in the general population. It is imperative that this action be conducted in a manner to ensure that no additional cancers will result from removing the bulk wastes from the quarry and transporting them to the chemical plant area for temporary storage.

Response. The Missouri Department of Health retrospective childhood leukemia study does not support the contention that there

are elevated levels of childhood leukemia in St. Charles County. The study indicates an increased level of childhood leukemia cases during the period of 1975 through 1979, but the incidence rate over the entire period of the study (i.e., 1970 through 1983) was not statistically different from that to be expected in the general population. The Department of Health was not able to establish a link between these leukemia cases and any specific cause. They specifically ruled out exposure to releases from the Weldon Spring site.

Even though the risks to the general public from this action are estimated to be very low, the DOE, under its ALARA process, will ensure that the risks are reduced to extremely low levels. It is highly unlikely that there will be any health impacts associated with radiation exposure resulting from this action.

Issue 24

Comment. What will become of the quarry after the bulk wastes have been removed?

Response. After the bulk wastes have been removed, detailed studies will be performed to evaluate the need for additional remedial action (such as the removal of residual materials from the cracks and fissures in the quarry and the remediation of contaminated groundwater). The water treatment plant at the quarry will continue to operate to keep the quarry pond from refilling. After all necessary remedial actions are complete, the quarry area will be stabilized. Plans for stabilizing this area will be prepared cooperatively with State of Missouri agencies such as the Missouri Departments of Natural Resources and Conservation to ensure that future uses of the quarry area are consistent with those planned for the surrounding Weldon Spring Wildlife Area.

Issue 25

Comment. How do we know that sufficient funds will be available to complete all necessary remedial actions.

Response. Funding for remediation of the Weldon Spring site is provided by Congress on an annual basis. There is no guarantee that all required funds will be made available each and every year. However, cleanup projects such as that at the Weldon Spring site are currently top priority activities within the DOE. In addition, because the site is on the National Priorities List (NPL), EPA Region VII is responsible for ensuring the adequacy of the cleanup. Representatives from EPA Region VII have made it very clear that they will not delist the site from the NPL until they are satisfied that all required remedial actions have been completed.

Issue 26

Comment. The proposed plan states that Alternative 5 is preferred by the DOE. Has the DOE already decided on implementing this alternative?

Response. The DOE had not yet reached a decision on implementing Alternative 5 when the proposed plan was issued to the public. However, this alternative was preferred by the DOE. This joint EPA/DOE record of decision provides the rationale for selection of this alternative.

Issue 27

Comment. The DOE has apparently already concluded that truck transport of the bulk wastes is the preferred mode of transportation. Additional consideration should be given to using the existing rail spur between the quarry and chemical plant area.

Response. The existing rail spur between the quarry and chemical plant area is in a state of disrepair and would require a significant amount of effort (and cost) to upgrade for use. The results of a recent detailed cost estimate indicate that the rail option would cost about $1 million more than the haul road option. In addition, this rail spur crosses State Route 94 three times between the quarry and chemical plant area. Each crossing presents a safety concern. The wastes can be safely and efficiently transported by truck along a dedicated haul road that will be constructed using portions of the existing rail spur. This dedicated haul road will cross State Route 94 only once (near the quarry). Discussions are currently taking place with the State of Missouri on the use of grade separation where the haul road crosses Route 94. This would eliminate any crossing of Route 94 by trucks.

Issue 28

Comment. The sorting pad at the temporary storage area should be completely enclosed and ventilated to minimize airborne releases of contaminants. In addition, the entire quarry area should be enclosed during removal of the bulk wastes.

Response. The need for an extensive sorting pad at the temporary storage area is being reevaluated because the current plan is to conduct basic waste sorting at the quarry. Although some sorting may still be required at the temporary storage area, enclosing the sorting pad with an engineered structure is probably unnecessary. However, this consideration will be evaluated as engineering design proceeds.

Enclosing the entire quarry during excavation of the bulk wastes was considered in the preliminary engineering report and rejected due to its high cost. In addition, there is simply no need to enclose the quarry to remove the wastes safely. Radon and

dust suppression measures will be implemented to ensure that releases of hazardous contaminants to the atmosphere will be low and not present a health risk to nearby individuals.

SEPTEMBER 1990

QUARRY BULK WASTE ADMINISTRATIVE RECORD INDEX

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DOCNUMBER:1.01
TITLE:PRELIMINARY ASSESSMENT/
SITE INVESTIGATION
AUTHOR:EPA
RECIPIENT:FILE
DATE:11/01/79
TYPE:FORM
SECTION:1.0 PRE-REMEDIAL

DOCNUMBER:1.02
TITLE:WELDON SPRING QUARRY
WASTE REMOVAL
AUTHOR:R. NELSON, DOE
RECIPIENT:K. BIGGS, EPA
DATE:02/29/88
TYPE:LETTER
SECTION:1.0 PRE-REMEDIAL

DOCNUMBER:1.03
TITLE:REMOVAL ACTION DETERMINATION
AUTHOR:K. BIGGS, EPA
RECIPIENT:R. NELSON, DOE
DATE:04/15/88
TYPE:LETTER
SECTION:1.0 PRE-REMEDIAL

DOCNUMBER:1.04
TITLE:QUARRY BULK WASTE REMOVAL,
WELDON SPRING SITE
AUTHOR:R. NELSON, DOE

RECIPIENT:D. BEDAN, MDNR
DATE:05/12/88
TYPE:LETTER
SECTION:1.0 PRE-REMEDIAL

DOCNUMBER:1.01
TITLE:CHEMICAL CHARACTERIZATION
REPORT FOR WS QUARRY
AUTHOR:R. NELSON, DOE
ECIPIENT:DISTRIBUTION
DATE:08/25/87
TYPE:REPORT
SECTION:2.0 RI/BRE

DCNUMBER:1.02
TITLE:ASSESSMENT OF DROUGHT
CONDITIONS AT THE QY
AUTHOR:R. NELSON, DOE
ECIPIENT:ADDRESSEES
DATE:11/17/88
TYPE:LETTER
SECTION:2.0 RI/BRE

NUMBER:1.03
TITLE:EFFECTS OF PERTURBED SOURCE ON
CONTMAINANT TRANSPORT NEAR QY
AUTHOR:S.McCRACKEN,DOE
RECIPIENT:DISTRIBUTION
DATE:09/14/89
TYPE:REPORT
SECTION:2.0 RI/BRE

DOCNUMBER:1.04
TITLE:EVALUATION OF RADON
EMISSIONS REPORT
AUTHOR:S.McCRACKEN,DOE
RECIPIENT:DISTRIBUTION
DATE:02/28/90
TYPE:REPORT
SECTION:2.0 RI/BRE

DCNUMBER:1.05
TITLE:QUARRY RI AND BRE REPORTS
THOR:S.McCRACKEN,DOE
PIENT:DISTRIBUTION
DATE:03/05/90
TYPE:REPORT
SECTION:2.0 RI/BRE

NUMBER:1.06
TITLE:TEMPORARY STORAGE AREA
CHAR. REPORT
AUTHOR:S.McCRACKEN,DOE
RECIPIENT:DISTRIBUTION
DATE:03/05/90
TYPE:REPORT
SECTION:2.0 RI/BRE

DOCNUMBER:1.01
TITLE:QUARRY PROPOSED PLAN,
FS & WSSRAP UPDATE
AUTHOR:S.McCRACKEN,DOE
RECIPIENT:DISTRIBUTION
DATE:03/05/90
TYPE:REPORTS
SECTION:3.0 FS

NUMBER:1.01
TITLE:DOE NEWS: PUBLIC MEETING
ANNOUNCEMENT
AUTHOR:WSSRAP
RECIPIENT:PUBLIC
DATE:03/02/90
TYPE:NOTICE
SECTION:3.01 FS PP

NUMBER:1.02
TITLE:ANNOUNCEMENT OF THE AVAILABILI
OF FOUR PUBLIC DOCUMENTS
AUTHOR:WSSRAP
RECIPIENT:PUBLIC
DATE:03/04/90
TYPE:NOTICE
SECTION:3.01 FS PP

DOCNUMBER:1.03
TITLE:ENERGY DEPT PLANS MEETING ON
CLEANUP - NEWSPAPER ARTICLE
AUTHOR:POST
RECIPIENT:PUBLIC
DATE:03/06/90
TYPE:ARTICLE
SECTION:3.01 FS PP

DOCNUMBER:1.04
TITLE:ENERGY DEPARTMENT PLANS HEARIN
TO DISCUSS CHEM PLANT CLEANUP

AUTHOR:JOURNAL
'PIENT:PUBLIC
DATE:03/07/90
TYPE:ARTICLE
SECTION:3.01 FS PP

ICNUMBER:1.05
TITLE:QUARRY PUBLIC MEETING
PROGRAM BULLETIN
AUTHOR:WSSRAP
CIPIENT:PUBLIC
DATE:03/29/90
TYPE:BULLETIN
SECTION:3.01 FS PP

DOCNUMBER:1.06
TITLE:TRANSCRIPT OF PUBLIC MTG FOR
QY WASTE REMOVAL PROPOSED PLAN
AUTHOR:DOE
RECIPIENT:PUBLIC
DATE:03/29/90
TYPE:REPORT
SECTION:3.01 FS PP

DOCNUMBER:1.07
TITLE:RESPONSIVENESS SUMMARY FOR
RI/FS FOR MGMT OF QY BULK WAST
AUTHOR:DOE COMPILED
CIPIENT:PUBLIC
DATE:08/01/90
TYPE:REPORT
SECTION:3.01 FS PP

CNUMBER:1.01
TITLE:COMMUNITY RELATIONS PLAN
REVIEW
AUTHOR:R. NELSON, DOE
CIPIENT:R.MICHAELS, EPA
DATE:11/09/88
TYPE:LETTER
SECTION:5.0 COMM RELATIONS

MBER:1.02
ITLE:FACT SHEET
AUTHOR:WS SITE
CIPIENT:PUBLIC
DATE:01/05/89
TYPE:HANDOUT
SECTION:5.0 COMM RELATIONS

JMBER:1.03
TITLE:WSSRAP UPDATE
AUTHOR:DOE
RECIPIENT:PUBLIC
DATE:01/01/90
TYPE:BULLETIN
SECTION:5.0 COMM RELATIONS

CNUMBER:1.04
TITLE:WELDON SPRING QUARRY CLEANUP
AUTHOR:S.McCRACKEN,DOE
RECIPIENT:ADDRESSEES
DATE:02/28/90
TYPE:LETTER
SECTION:5.0 COMM RELATIONS

CNUMBER:1.01
TITLE:WORK PLAN FOR RI/FS-EIS
FOR WELDON SPRING SITE
UTHOR:DOE
IPIENT:DISTRIBUTION
DATE:08/01/88
TYPE:REPORT
SECTION:6.0 SITE MANAGEMENT

JUCNUMBER:1.02
TITLE:EE/CA FOR PROPOSED MGMT
OF WATER IN WS QY
AUTHOR:DOE
RECIPIENT:PUBLIC
DATE:01/19/89
TYPE:REPORT
SECTION:6.0 SITE MANAGEMENT

8.0 GUIDANCE AND REFERENCE DOCUMENTS RELIED UPON IN QUARRY BULK WASTE RECORD OF DECISION

8.01 REMEDIAL INVESTIGATION REFERENCE DOCUMENTS

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MK-Ferguson Company and Jacobs Engineering Group, 1988b. Chemical Soil Investigation Sampling Plan for the Weldon Spring Chemical Plant/Raffinate Pits, Rev.1. DOE/OR/21548-013. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, Missouri. May.

MK-Ferguson Company and Jacobs Engineering Group, 1988c. Chemical Soil Data Report To Support Interim Response Actions, Construction Staging Area and Administration Building, Rev. 0. DOE/OR/21548-051. Prepared for the U.S. Department of Energy. St. Charles, Missouri. November.

MK-Ferguson Company and Jacobs Engineering Group, 1989a. Chemical Soil Investigation Report For the Weldon Spring Chemical Plant/Raffinate Pits Phase II, Rev. 0. DOE/OR/21548-061. Prepared for the U.S. Department of Energy. St. Charles, Missouri. August.

MK-Ferguson Company and Jacobs Engineering Group, 1989b. Phase II Groundwater Quality Assessment for the Weldon Spring Site, Chemical Plant/Raffinate Pits and Surrounding Vicinity Properties, Rev. 0. DOE/OR/21548-078. Prepared for the U.S. Department of Energy. St. Charles, Missouri. June.

MK-Ferguson Company and Jacobs Engineering Group, 1989c. Weldon Spring Chemical Plant Buildings Radiological Characterization Report, Revision A. DOE/OR/21548-099. December.

MK-Ferguson Company and Jacobs Engineering Group, 1989d. Asbestos and Chemical Characterization Report for Non-Process Related Buildings and Equipment, Revision A. May.

Moylan, J.E. and L.G. Elser, 1967. Geologic Appraisal of Settlement Pits, Weldon Spring Ordnance Works. October.

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

1. Document Control Number: (not yet assigned)

Title: Report on Economical and Safe Disposal of TNT Waste Waters

Author: Greely and Hansen for DA

Date: July 1942

2. Document Control Number: GE-0007

Title: The Contamination of Ground and Surface Water by Liquid Wastes from the Weldon Spring Ordnance Works, Missouri

Authors: Fishel and Williams

Date: January 1944

3. Document Control Number: (not yet assigned)

Title: Report on Decontamination, Safety and Security Division

Author: Earl S. Hannan, WSOW

Date: May 1944

4. Document Control Number: (not yet assigned)

Title: Report of Survey Covering Salvageable Equipment and Buildings in TNT Area at Weldon Spring Ordnance Works

Author: Corps of Engineers - Kansas City District

Date: December 1946

5. Document Control Number: HG-0001

Title: Preliminary Investigations of Groundwater Occurrences in the Weldon Spring Area

Authors: Roberts and Theis

Date: December, 1951

6. Document Control Number: (not yet assigned)

Title: Demolition and Decontamination Procedures for Weldon Spring Site, Missouri

Author: E.E. Taylor (Fruin-Colnon and Utah Construction Company)

Date: March 7, 1955

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

7. **Document Control Number: GE-0009**

Title: Possible Use of Quarry at Mallinckrodt Chemical Works, Weldon Spring, Missouri, for the Disposal of Uranium Contaminated Building Debris and Rubble and Residues Containing Thorium and Uranium.

Author: R.M. Richardson

Date: June, 1960

8. **Document Control Number: RP-0002**

Title: None

Author: R.M. Richardson

Date: November 7, 1960

9. **Document Control Number:** (not yet assigned)

Title: Expansion Program at St. Louis Area, Project History and Completion Report

Author: AEC

Date: 1960

10. **Document Control Number:** (not yet assigned)

Title: Letter requesting expressions of interest from industry for possible commercial use of the Weldon Spring Plant

Author: S.R. Sapirie (Oak Ridge Office of AEC)

Date: July 15, 1966

11. **Document Control Number: RP-0002**

Title: Weldon Spring Raffinate Pits and Quarry Task Force Report

Author: AEC (?)

Date: June 1, 1967

8.03 ARAR DETRMINATION REFERENCE DOCUMENTS

12. Document Control Number: (not yet assigned)

Title: Fuel for the Atomic Age: Completion Report on St. Louis-Area Uranium Processing Operations, 1942-1967

Author: Fleischman-Hillard, Inc., for Mallinckrodt Chemical Works

Date: September 30, 1967

13. Document Control Number: GE-0010

Title: Geologic Appraisal of Settlement Pits, Weldon Spring Ordnance Works

Authors: Moylan and Elsner

Date: October 19, 1967

14. Document Control Number: DD-0001

Title: ERDA-Weldon Spring/Weldon Spring Decommissioning Study

Authors: National Lead Company of Ohio (NLO)

Date: June 20, 1975

15. Document Control Number: GR-410

Title: Assessment of Weldon Spring Chemical Plant in St. Charles County, Missouri

Author: DA

Date: March 1, 1976

16. Document Control Number: HP-0046

Title: Process Description and Resultant Radiological Contamination from Operation of the AEC Weldon Spring Chemical Plant 1956-1966

Author: Pennak (NLO)

Date: October 27, 1976

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

17. Document Control Number: EV-0002

Title: Installation Restoration at WSCP-Environmental Impact Assessment

Author: DA

Date: November, 1976

18. Document Control Number: (not yet assigned)

Title: Installation Assessment of Weldon Spring Training Area, St. Charles, Missouri

Author: U.S. Army Toxic and Hazardous Materials Agency

Date: April 1977

19. Document Control Number: (not yet assigned)

Title: Appendixes G-K of Installation Assessment of Weldon Spring Training Area, St. Charles, Missouri

Authors: DA

Date: April, 1977

20. Document Control Number: HP-0037

Title: Final Report Weldon Spring Chemical Plant Survey and Assessment

Author: Ryckman/Edgerly/Tomlinson & Associates (RETA) for DA

Date: June, 1978

21. Document Control Number: GR-0005

Title: Report on Preliminary Geological, Hydrological and Radiological Survey at the Weldon Spring Quarry

Author: Huey (NLO)

Date: December 14, 1978

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

22. Document Control Number: GR-0006

Title: Weldon Spring Site Background Report

Author: Wallo (Aerospace Corp.)

Date: May 8, 1979

23. Document Control Number: DD-0003

Title: Program Plan for the Decontamination and Disposition of Weldon Spring Chemical Plant

Author: Rockwell International for DA

Date: September 1979

24. Document Control Number: HP-0009

Title: Preliminary Risk Assessment of the Weldon Spring Rock Quarry

Author: Science Applications, Inc. for Oak Ridge National Laboratory

Date: September 1979

25. Document Control Number: GR-0007

Title: Preliminary Draft: Radiological, Hydrogeological, Geochemical and Geophysical Assessment of the Weldon Spring Quarry, Missouri Disposal Site

Author: Lawrence Berkeley National Laboratory for DOE

Date: January 1980

26. Document Control Number: PM-0006

Title: Characterization and Assessment for the Weldon Spring Quarry Low-Level Radioactive Waste Storage Site

Author: Berkeley Geosciences Associates for DOE

Date: September 1984

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

27. Document Control Number: (not yet assigned)

Title: Compilation and Preliminary Interpretation of Hydrologic Data for the Weldon Spring Radioactive Waste Disposal Sites, St. Charles County, Missouri -- A Progress Report

Authors: Kleeschulte and Emmett (U.S. Geological Survey)

Date: 1986

28. Document Control Number: (not yet assigned)

Title: Weldon Spring Historical Dose Estimate

Author: Argonne National Laboratory for DOE

Date: July 1986

29. Document Control Number: (not yet assigned)

Title: Preliminary Report: Research Investigation of Hazardous Wastes at Weldon Spring Army Reserve Training Area

Author: Campbell Design Group for DA (Army Corps of Engineers)

Date: March 1986

30. Document Control Number: (not yet assigned)

Title: Field Investigation of Hazardous Wastes at Weldon Spring Training Area (WSTA)

Author: Campbell Design Group for DA

Date: April 1987

31. Document Control Number: (not yet assigned)

Title: Geotechnical Report-Field Investigation of Hazardous Wastes at Weldon Spring Training Area, Vol. 2

Author: Campbell Design Group for DA

Date: April 1987

8.03 ARAR DETERMINATION REFERENCE DOCUMENTS

32. Document Control Number: EN-0016

Title: Chemical Characterization Report for the Weldon Spring Quarry
Author: Bechtel for DOE

Date: August 1987

33. Document Control Number: (not yet assigned)

Title: Weldon Spring Training Area Draft Remedial Investigation Report

Author: IT Corporation for DA

Date: June 1989

8.04 COMPENDIUM OF GUIDANCE REFERENCE DOCUMENTS

TITLE: 2002-GUIDANCE FOR CONDUCTING RI/FS STUDIES UNDER CERCLA
AUTHOR: OSWER/OERR
DATE: 10/01/88
TYPE: FINAL

TITLE: 2004-MODELING REMEDIAL ACTIONS AT UNCONTROLLED HW SITES
AUTHOR: OSWER/OERR
DATE: 04/01/85
TYPE: FINAL

TITLE: 2008-RI/FS IMPROVEMENTS
AUTHOR: LONGEST/OER
DATE: 07/23/87
TYPE: FINAL

TITLE: 2009-RI/FS IMPROVEMENTS FOLLOW-UP
AUTHOR: LONGEST/OERR
DATE: 04/25/88
TYPE: FINAL

TITLE: 2011-SUPERFUND REMEDIAL DESIGN & ACTION GUIDANCE
AUTHOR: OERR
DATE: 06/01/86
TYPE: FINAL

TITLE: 2211-TECHNICAL GUIDANCE DOCUMENT: CONSTRUCT QUALITY ASSURANCE FOR HAZARDOUS WASTE LAND DISPOSAL FACILITIES
AUTHOR: OSWER
DATE: 10/01/86
TYPE: FINAL

TITLE: 2306-GUIDANCE DOCUMENT FOR CLEANUP OF SURFACE TANK & DRUM SITES
AUTHOR: OERR
DATE: 05/28/85
TYPE: FINAL

TITLE: 2309-HANDBOOK REMEDIAL ACTION AT WASTE DISPOSAL SITES
AUTHOR: ORD/HWERL
DATE: 10/01/85
TYPE: FINAL

TITLE: 2310-LEACHATE PLUME MANAGEMENT
AUTHOR: JRB ASSO/EPA
DATE: 11/01/85
TYPE: FINAL

8.04 COMPENDIUM OF GUIDANCE REFERENCE DOCUMENTS

TITLE: 3002-CERCLA COMPLIANCE WITH OTHER LAWS MANUAL
AUTHOR: OERR
DATE: 08/08/88
TYPE: FINAL

TITLE: 5001-CHEMICAL,PHYSICAL & BIOLOGICAL PROPERTIES OF COMPOUNDS PRESENT AT HAZARDOUS WASTE SITES
AUTHOR: CLEMENT ASSOC.
DATE: 09/27/85
TYPE: FINAL

TITLE: 5003-GUIDELINES FOR CARCINOGEN RISK ASSESSMENT (FR 09/24/86 pg. 33992)
AUTHOR: EPA
DATE: 09/24/86
TYPE: FINAL

TITLE: 5004-GUIDELINES FOR EXPOSURE ASSESSMENT (FR 09/24/86 pg. 34042)
AUTHOR: EPA
DATE: 09/24/86
TYPE: FINAL

TITLE: 5005-GUIDLINE FOR HEALTH ASSESSMENT OF SUPSPECT DEVELOPMENTAL TOXICANTS (FR 9/24/86 pg. 34028)
AUTHOR: EPA
DATE: 09/24/86
TYPE: FINAL

TITLE: 5006-GUIDELINES FOR MUTAGENICITY RISK ASSESSMENT (FR 09/24/86 pg. 34006)
AUTHOR: EPA
DATE: 09/24/86
TYPE: FINAL

TITLE: 5007-GUIDELINES FOR THE HEALTH RISK ASSESSMENT OF CHEMICAL MIXTURES (FR 9/24/86 pg. 34014)
AUTHOR: EPA
DATE: 09/24/86
TYPE: FINAL

TITLE: 5008-HEALTH EFFECTS ASSESSMENT DOCUMENT
AUTHOR: ORD/OHEA/ECAO
DATE: 09/01/84
TYPE: FINAL

TITLE: 5009-INTEGRATED RISK INFORMATION SYSTEM (IRIS)
AUTHOR: OHEA
TYPE: FINAL

8.04 COMPENDIUM OF GUIDANCE REFERENCE DOCUMENTS

TITLE: 5011-PUBLIC HEALTH RISK EVALUATION DATABASE (PHRED)
AUTHOR: OERR/TOXICS
DATE: 09/16/88
TYPE: FINAL

TITLE: 5013-SUPERFUND EXPOSURE ASSESSMENT MANUAL
AUTHOR: OERR
DATE: 04/01/88
TYPE: FINAL

TITLE: 5014-SUPERFUND PUBLIC HEALTH EVALUATION MANUAL
AUTHOR: OERR/OSWER
DATE: 10/01/86
TYPE: FINAL

TITLE: 9000-INTERIM GUIDANCE ON SUPERFUND SELECTION OF REMEDY
AUTHOR: OSWER
DATE: 12/24/86
TYPE: FINAL

TITLE: 9001-RCRA/CERCLA DECISIONS MADE ON REMEDY SELECTION
AUTHOR: OWPE
DATE: 06/24/85
TYPE: FINAL

TITLE: DRAFT MINIMUM TECHNICAL GUIDANCE DOUBLE LINER SYTEMS
AUTHOR: EPA
DATE: 05/24/85
TYPE: DRAFT

TITLE: OUTLINE OF EE/CA GUIDANCE
AUTHOR: T. FIELDS, EPA
DATE: 03/30/88
TYPE: MEMO

9.0 QUARRY SAMPLING DATA AND BORING LOGS

Boring logs and well completion diagrams have been consolidated in the Quarry Geologic Compendium. Public veiwing is available by appointment.

The sampling data is available for public veiwing by appointments.

ATTACHMENT A

Comments of Mr. Dave Freise from the State of Missouri Department of Natural Resources

Comment 1

Section 3.6 discusses the retardation effects of the site soils on a few elements and refers to attenuation of nitroaromatic compounds. The report should more fully discuss nitroaromatics since they may need to be disposed of on site as well.

Response 1

Agreed. A sentence has been added stating research results on the attenuation of nitroaromatics in the Ferrilview and clay till units. The USGS is presently conducting studies using soil samples from the Army Training Property to determine the coefficient of adsorption potential for TNT and DNT. The USGS has indicated these results may be published in late fall 1990.

Comment 2

Has any consideration been given to evaluating enough of the site to account for two complete disposal units? Due to the longevity of the waste life and the uncertainty of a permanent solution it would appear to be prudent to plan for a system whereby the waste volume could be transferred between two sites. One for active disposal the other as a spare or under repair. The point being the longevity of the waste makes remedial action at some future date more likely.

Response 2

Such discussions are beyond the scope of this report. The purpose of this report is to provide sufficient information to the MDNR to allow a determination of the suitability of this site for location of a disposal facility. Conceptual design options will be addressed in future DOE documents.

Comment 3

Has any effort been made to determine soil permeabilities from perched water tables near the existing surface impoundment. What about the relationship between impoundment water level, percolation, rainfall, and evapotranspiration?

Response 3

The following will be added to Section 4.2.2.2.

A water balance study was conducted by Shell Engineering Associates from 1983 through 1985 at the Weldon Spring Raffinate Pits. The results from the annual seven-month study periods show volumetric loss of fluid from the pits due to seepage ranging from 50 m^n/d for Pit 3 to 6.2 m^n/d for Pit 2 (see Bechtel National, Inc., 1986. Report on Water Balance Studies from 1983 to 1985, Weldon Spring Raffinate Pits. DOE/OR/20722-94, March).

In March 1987 slug tests were performed at three overburden monitoring wells (MW-3001, MW-3004, and OW-3503). The results of these tests indicate an average saturated hydraulic conductivity of 1.2E-08 cm/sec.

The mean hydraulic conductivity based on seepage rates from the water balance study was 1.6E-06 cm/sec. This mean value corresponds with the upper end of values for hydraulic conductivity for the Ferrelview Formation and clay till unit as determined by triaxial tests.

Comment 4

Please verify permeability and Atterberg limit tests were performed per ASTM D2435-80 and D4318-84 respectively.

Response 4

Agree. Table 3-1 will be expanded to include the standard used for each test.

% of Grain Size	ASTM C136
Atterberg Limits	ASTM D4318
Unified Soil Classification	ASTM D2487
Specific Gravity	ASTM D854
Unit Weight	ASTM D2937
Moisture Content	ASTM D2216

In the first paragraph of Section 3.3 (page 12) the following text will be inserted after the third sentence.

"These tests were performed according to the Army Corps of Engineers procedure EM 1906."

Comment 5

The report briefly discusses the pilings at the proposed site. These should be discussed in greater detail since they can penetrate to unweathered bedrock and may be difficult to deal with in preparing the site.

Response 5

As part of engineering cell design, all available as-built drawings of the WSCP were examined with particular emphasis toward addressing the influence of pilings on the disposal cell option. Several pilings (less than 20) are present in the disposal cell footprint but all are less than 14' deep with the majority being less than 6' deep. The effect of the piling and the decision to mitigate any effects will be addressed in detail if the on site disposal option is selected. The cell design report will include mitigative measures for footing pile as necessary to meet regulatory requirements.

Comment 6

When are the "additional studies" discussed on page 15 to be completed?

Response 6

Additional vadose zone studies are scheduled to be completed in December 1990 with a data report available in January 1991. This assumes a start date of 1 October 1990. The vadose zone study focuses on in situ hydraulic conductivity determinations and is expected to have not direct bearings on the issue of site suitability. The new study will provide information relevant to the necessity of whether or not to rework or compact the overburden unit.

Comment 7

What were the chemical concentrations in the water used for the soil retardation tests discussed in Section 3.4, page 15? Were they representative of the range of anticipated leachate?

Response 7

The following changes text will be added at the end of the first paragraph of Section 3.4.

"The leachate used was drawn from Raffinate Pit 3 and spiked with aluminum, chromium, lead, nickel, and uranium. Initial contaminant concentrations are listed in Table 3-4."

Table 3-4 Initial Contaminant Concentrations for Soil Batch Tests (ppb)

F	7.0-7.2	Mo	4000-4400
NO3	1300-1400	Ni	43-59
SO4	610-660	Se	260
Al	70-330	Sr	2000-2300
Cr	52-60	V	480-520
Pb	96-115	U	3100-3400
Li	3900-4100		

"Although these concentrations may not be representative of leachate from the proposed disposal facility, the ability of the soils to retard migrations of these contaminants should be approximately constant."

Comment 8

What efforts have been made to account for secondary permeability due to roots and desiccation cracking of the soils?

Response 8

This is considered to be beyond the scope of this document however, the in situ permeability tests planned for the fall of 1990 are specifically designed to address the influence of macropore features on the hydraulic conductivity of the Ferrelview Formation, clay till unit, and basal till unit. As part of engineering cell design the effect of roots will be studied in detail. A general literature search is being conducted currently for the characterization of trees (roots) which may be present at the disposal cell footprint.

Comment 9

State hazardous waste regulations require that the planning for a land disposal facility include a water balance study. The study is to evaluate the estimated leachate quantities.

Response 9

This is considered to be beyond the scope of this document. However, the WSSRAP plans include efforts to address all of the data requirements as specified in the State Hazardous Waste Management Requirements.

Comment 10

Section (2)(N)2.D. of Chapter 7.264, state hazardous waste regulation, requires a 300 ft buffer between the disposal facility and the property line. The figures in the report indicate less than this distance at some portions of the perimeter. In addition State Hazardous Waste Management Law, RSMo 260.430.2., requires the facility owner to obtain siting authorization from permanent residents located within one-quarter mile of the disposal facility.

Response 10

The conceptual design of the disposal facility has been changed since Revision A of this report was issued. Currently, three designs are under consideration, all of which comply with the 300 ft buffer requirement. Figure 1.2 shows one alternative design. We are also aware of the requirement to obtain siting authorization from all permanent residents within 1/4 mile of the site; DOE will comply with this requirement.

There are no permanent or temporary residents within one-quarter mile of the disposal facility.

Comment 11

Minimum technology requirements of the RCRA regulations specify a double liner system which prevents the migration of leachate into the first liner and through the second liner. The minimum technology guidance recommends a composite (flexible membrane liner as the secondary liner and a flexible membrane liner as the first liner the leachate sees. See EPA publication EPA/625/4-89/022 or OSWER directive number 9487.00-8 for additional details.

Response 11

Comment noted. This information will be passed on to the engineers involved with disposal cell design and will be considered.

ATTACHMENT B

Comments of Ms. Mimi Garstang from the State of Missouri Department of Natural Resources

Comment 1

P. 4, #2 - It should be emphasized that the results from additional basal till and residuum tests need to be incorporated into discussion. Results of these tests will influence disposal cell design and quantify the permeability of the material lying beneath proposed cell area.

Response 1

Agree. The following changes will be made to Section 2 (page 4).

Delete the second sentence of item 2 and replace with the following.

"The basal till and residuum are more heterogeneous, consisting of zones of low hydraulic conductivity gravelly clays ($K < 1x10^{-7}$ cm/sec) and higher permeability, noncohesive gravels."

Comment 2

P. 5, #3 - I do not believe presence of a groundwater divide necessarily means that no active groundwater conduits exist beneath the site. On the contrary, a definable water table is more indicative of diffuse flow.

Response 2

Item 3 on page 5 is a conclusion from the discussion in Section 4.2.1. As this discussion indicates, groundwater flow in carbonate aquifers varies between diffuse-flow and conduit-flow end members. A well developed water table which rises to a substantial elevation above regional base level is a characteristic of diffuse-flow systems. Stated another way, the nature of the water table beneath the WSSRAP indicates a lack of active groundwater conduits. Item 3 on page 5 will be reworded to read "...suggesting that the groundwater flow system is characterized by diffuse flow."

Comment 3

P. 5, #6 - If a bedrock depression or sinkhole is filled with clay-rich glacial material, it would probably be of little concern, even if one existed beneath the site. Only unfilled

subsurface voids or voids filled with permeable, weathered material would be of major concern.

Response 3

Agree. Add to the sentence ", mapping, air survey or visual reconnaissance techniques."

Comment 4

P. 6, #7 - I don't think we should speculate on what happened at the site prior to glacial times. This area was quite different at that time, and we cannot prove recharge was less on uplands prior to till deposition. This is only an opinion. There were large amounts of drilling fluid lost in upper bedrock and/or residuum on uplands indicating recharge and dissolution probably was active prior to deposition of till.

Response 4

The statement is based on studies which prove that streams in upland areas have smaller catchment areas that those further down slope. Add "Numerous studies indicate carbonate terrains are dominated by diffuse flow in the uplands and conduit flow down slope (e.g., Quinlan and Ewers, 1985)." This statement was included to add to general geologic information and to aid the interpretive process.

Comment 5

P. 6 #8 - I believe the last portion of #8 is mostly opinion. Conduits are rapidly recharged where overburden has been removed. Dissolution occurred more rapidly prior to deposition of clay-rich soils; however, it is only opinion that significant dissolution has not occurred since that time. What is significant, anyway?

Response 5

The statement that the overburden has low permeability is based on numerous laboratory triaxial permeability tests. The statement regarding pH buffering capacity of the overburden soils is based on geochemical modeling of lysimeter sample analyses.

The conclusion that no significant dissolution of limestone bedrock has occurred beneath the glacial cover is indeed interpretative; however, this conclusion is necessary to support the argument that the site is suitable for location of a disposal facility. If significant dissolution of the bedrock is

currently occurring beneath the overburden, the longevity of a disposal facility could be threatened.

Comment 6

P. 6, #10 - "Large voids" should be defined. Specifically in drilling GT-44, which is within the disposal cell area, a 0.5 ft and 2.0 ft void or washout existed in the upper 20 feet of bedrock. These may be considered small voids; however, the statement may be misleading. Maybe say "no voids larger than ...."

Response 6

Agree. Item 10 on page 6 will be modified to read as follows. "No voids have been detected in the overburden and no voids larger than 1.8 ft in vertical extent have been detected in the bedrock in the disposal cell study area."

Comment 7

P. 7 - A modified description of the residuum should be inserted in paragraph 2 after complete testing is finished. The residuum matrix may only be "tight" at certain moisture contents to be identified by tests. The unit weight (wet and dry) of the residuum is lighter than any other unit.

Response 7

Agree. The description will be modified as follows. In the second paragraph of Section 3.1 (page 7), the third sentence will be changed to read: "Interstitial clay is typically red, highly plastic, and at the moisture contents encountered during sampling, forms a tight matrix within the gravel. Of the five samples successfully recovered from the residuum, three consisted of noncohesive gravels."

Comment 8

P. 7 - I feel more discussion on basal till with inclusion of new test results on additional basal till sampling would be appropriate. Table 3-1 refers to gravel portions and inability to sample these gravel areas. It would be beneficial to explain this in light of new sampling.

Response 8

Agree. The description will be modified as follows. In the third paragraph of Section 3.1 (page 7), the following text will be inserted after the first sentence.

"As with the residuum, sampling of the basal till proved difficult. Of the four samples successfully recovered, one consisted of noncohesive chert gravel." See also response to Comment 10.

Comment 9

P. 9 - The last paragraph is a discussion of engineering properties but it does not identify the unit that it is describing. I believe the discussion is on residuum; however, it is not stated in the paragraph.

Response 9

Agree. The first sentence of the second paragraph of Section 3.2 will be revised as follows. "Less than 50% by weight of residuum samples passed through a No. 200 sieve."

Comment 10

P. 13 - Again, incomplete test results make basal till and residuum unit descriptions vague and meaningless.

Response 10

Agree. The following changes will be made on page 13 (Section 3.3).

Transpose paragraphs two and three. Add the following qualifier to the first sentence of the second paragraph. "Permeability testing under...clayey soils from the site (Ferrelview Formation and clay till) generally have..."

Replace the fourth and fifth paragraph with the following.

"The gravelly soils from the site (basal till and residuum) were difficult to sample. Of the four samples successfully recovered from the basal till, one consisted of noncohesive gravel which cannot be tested for permeability. Of the five samples recovered from the residuum, three consisted of noncohesive gravel. The samples from these units which were tested had very low hydraulic conductivities (Table 3-3). These measurements represent the lower end of the range of hydraulic conductivity values in these units. The residuum in particular is extremely heterogeneous and the values in Table 3-3 should not be considered representative of the entire unit.'

Update Table 3-3 with the following information. Asterisk (*) indicates new data.

MKF AND JEG (1989)				
GT-50	ST 02	Loess	2.0E-05	
GT-55	ST 06	Loess	1.9E-06	
* GT-58P	ST 01	Loess	3.0E-08	1.0E-06
GT-43	ST 04	Ferrelview Fm	7.0E-08	
GT-46	ST 03	Ferrelview Fm	3.2E-06	
GT-48	ST 05	Ferrelview Fm	1.0E-08	
GT-55	ST 04	Ferrelview Fm	2.9E-08	
* GT-58P	ST 03	Ferrelview Fm	No Flow	
* GT-59	ST 02	Ferrelview Fm	5.0E-08	
* GT-62	ST 07	Ferrelview Fm	No Flow	
* GT 63P	ST 01	Ferrelview Fm	4.0E-09	4.8E-08
GT-43	SB 17	Clay Till	3.8E-08	
GT-45	ST 07	Clay Till	1.7E-08	
GT-50	SB 08	Clay Till	6.5E-08	
GT-51	SB 07	Clay Till	1.7E-08	
* GT-58P	ST 09	Clay Till	1.0E-08	
* GT-60P	ST 10	Clay Till	No Flow	
* GT-59	ST 06	Clay Till	No Flow	
* GT-63P	ST 09	Clay Till	3.2E-09	
* GT-67P	ST 08	Clay Till	4.1E-08	1.9E-08
* GT-60P	SB 15	Basal Till	2.0E-08	
* GT-60P	SB 17	Basal Till	2.0E-08	
* GT-62	SB 13	Basal Till	8.0E-09	1.5E-08
* GT-51	SB 09	Residuum	5.0E-08	
* GT-65	SB 16	Residuum	3.0E-08	3.9E-08

Comment 11

P. 15 - The statement by Freeze and Cherry, 1979, should be viewed with skepticism. It was possibly misapplied in this case. Many times in red structured clays, permeability increases with decreasing moisture content due to cracking, etc. The proposed additional study examining macropore features is an excellent idea.

Response 11

Change last paragraph Section 3.3 page 15 to read. "Additional studies have been proposed to investigate the in situ permeability of the Ferrelview Formation, clay till unit, and basal till unit. These studies focus on determination of in situ permeability testing with particular attention paid to the influence of macropore features on hydraulic conductivity."

ATTACHMENT B

Comments of Ms. Mimi Garstang from the State of Missouri Department of Natural Resources

Comment 1

P. 4, #2 - It should be emphasized that the results from additional basal till and residuum tests need to be incorporated into discussion. Results of these tests will influence disposal cell design and quantify the permeability of the material lying beneath proposed cell area.

Response 1

Agree. The following changes will be made to Section 2 (page 4).

Delete the second sentence of item 2 and replace with the following.

"The basal till and residuum are more heterogeneous, consisting of zones of low hydraulic conductivity gravelly clays ($K < 1x10^{-7}$ cm/sec) and higher permeability, noncohesive gravels."

Comment 2

P. 5, #3 - I do not believe presence of a groundwater divide necessarily means that no active groundwater conduits exist beneath the site. On the contrary, a definable water table is more indicative of diffuse flow.

Response 2

Item 3 on page 5 is a conclusion from the discussion in Section 4.2.1. As this discussion indicates, groundwater flow in carbonate aquifers varies between diffuse-flow and conduit-flow end members. A well developed water table which rises to a substantial elevation above regional base level is a characteristic of diffuse-flow systems. Stated another way, the nature of the water table beneath the WSSRAP indicates a lack of active groundwater conduits. Item 3 on page 5 will be reworded to read "...suggesting that the groundwater flow system is characterized by diffuse flow."

Comment 3

P. 5, #6 - If a bedrock depression or sinkhole is filled with clay-rich glacial material, it would probably be of little concern, even if one existed beneath the site. Only unfilled

subsurface voids or voids filled with permeable, weathered material would be of major concern.

Response 3

Agree. Add to the sentence ", mapping, air survey or visual reconnaissance techniques."

Comment 4

P. 6, #7 - I don't think we should speculate on what happened at the site prior to glacial times. This area was quite different at that time, and we cannot prove recharge was less on uplands prior to till deposition. This is only an opinion. There were large amounts of drilling fluid lost in upper bedrock and/or residuum on uplands indicating recharge and dissolution probably was active prior to deposition of till.

Response 4

The statement is based on studies which prove that streams in upland areas have smaller catchment areas that those further down slope. Add "Numerous studies indicate carbonate terrains are dominated by diffuse flow in the uplands and conduit flow down slope (e.g., Quinlan and Ewers, 1985)." This statement was included to add to general geologic information and to aid the interpretive process.

Comment 5

P. 6 #8 - I believe the last portion of #8 is mostly opinion. Conduits are rapidly recharged where overburden has been removed. Dissolution occurred more rapidly prior to deposition of clay-rich soils; however, it is only opinion that significant dissolution has not occurred since that time. What is significant, anyway?

Response 5

The statement that the overburden has low permeability is based on numerous laboratory triaxial permeability tests. The statement regarding pH buffering capacity of the overburden soils is based on geochemical modeling of lysimeter sample analyses.

The conclusion that no significant dissolution of limestone bedrock has occurred beneath the glacial cover is indeed interpretative; however, this conclusion is necessary to support the argument that the site is suitable for location of a disposal facility. If significant dissolution of the bedrock is

currently occurring beneath the overburden, the longevity of a disposal facility could be threatened.

Comment 6

P. 6, #10 - "Large voids" should be defined. Specifically in drilling GT-44, which is within the disposal cell area, a 0.5 ft and 2.0 ft void or washout existed in the upper 20 feet of bedrock. These may be considered small voids; however, the statement may be misleading. Maybe say "no voids larger than ...."

Response 6

Agree. Item 10 on page 6 will be modified to read as follows. "No voids have been detected in the overburden and no voids larger than 1.8 ft in vertical extent have been detected in the bedrock in the disposal cell study area."

Comment 7

P. 7 - A modified description of the residuum should be inserted in paragraph 2 after complete testing is finished. The residuum matrix may only be "tight" at certain moisture contents to be identified by tests. The unit weight (wet and dry) of the residuum is lighter than any other unit.

Response 7

Agree. The description will be modified as follows. In the second paragraph of Section 3.1 (page 7), the third sentence will be changed to read: "Interstitial clay is typically red, highly plastic, and at the moisture contents encountered during sampling, forms a tight matrix within the gravel. Of the five samples successfully recovered from the residuum, three consisted of noncohesive gravels."

Comment 8

P. 7 - I feel more discussion on basal till with inclusion of new test results on additional basal till sampling would be appropriate. Table 3-1 refers to gravel portions and inability to sample these gravel areas. It would be beneficial to explain this in light of new sampling.

Response 8

Agree. The description will be modified as follows. In the third paragraph of Section 3.1 (page 7), the following text will be inserted after the first sentence.

"As with the residuum, sampling of the basal till proved difficult. Of the four samples successfully recovered, one consisted of noncohesive chert gravel." See also response to Comment 10.

Comment 9

P. 9 - The last paragraph is a discussion of engineering properties but it does not identify the unit that it is describing. I believe the discussion is on residuum; however, it is not stated in the paragraph.

Response 9

Agree. The first sentence of the second paragraph of Section 3.2 will be revised as follows. "Less than 50% by weight of residuum samples passed through a No. 200 sieve."

Comment 10

P. 13 - Again, incomplete test results make basal till and residuum unit descriptions vague and meaningless.

Response 10

Agree. The following changes will be made on page 13 (Section 3.3).

Transpose paragraphs two and three. Add the following qualifier to the first sentence of the second paragraph. "Permeability testing under...clayey soils from the site (Ferrelview Formation and clay till) generally have..."

Replace the fourth and fifth paragraph with the following.

"The gravelly soils from the site (basal till and residuum) were difficult to sample. Of the four samples successfully recovered from the basal till, one consisted of noncohesive gravel which cannot be tested for permeability. Of the five samples recovered from the residuum, three consisted of noncohesive gravel. The samples from these units which were tested had very low hydraulic conductivities (Table 3-3). These measurements represent the lower end of the range of hydraulic conductivity values in these units. The residuum in particular is extremely heterogeneous and the values in Table 3-3 should not be considered representative of the entire unit.'

Update Table 3-3 with the following information. Asterisk (*) indicates new data.

MKF AND JEG (1989)				
GT-50	ST 02	Loess	2.0E-05	
GT-55	ST 06	Loess	1.9E-06	
* GT-58P	ST 01	Loess	3.0E-08	1.0E-06
GT-43	ST 04	Ferrelview Fm	7.0E-08	
GT-46	ST 03	Ferrelview Fm	3.2E-06	
GT-48	ST 05	Ferrelview Fm	1.0E-08	
GT-55	ST 04	Ferrelview Fm	2.9E-08	
* GT-58P	ST 03	Ferrelview Fm	No Flow	
* GT-59	ST 02	Ferrelview Fm	5.0E-08	
* GT-62	ST 07	Ferrelview Fm	No Flow	
* GT 63P	ST 01	Ferrelview Fm	4.0E-09	4.8E-08
GT-43	SB 17	Clay Till	3.8E-08	
GT-45	ST 07	Clay Till	1.7E-08	
GT-50	SB 08	Clay Till	6.5E-08	
GT-51	SB 07	Clay Till	1.7E-08	
* GT-58P	ST 09	Clay Till	1.0E-08	
* GT-60P	ST 10	Clay Till	No Flow	
* GT-59	ST 06	Clay Till	No Flow	
* GT-63P	ST 09	Clay Till	3.2E-09	
* GT-67P	ST 08	Clay Till	4.1E-08	1.9E-08
* GT-60P	SB 15	Basal Till	2.0E-08	
* GT-60P	SB 17	Basal Till	2.0E-08	
* GT-62	SB 13	Basal Till	8.0E-09	1.5E-08
* GT-51	SB 09	Residuum	5.0E-08	
* GT-65	SB 16	Residuum	3.0E-08	3.9E-08

Comment 11

P. 15 - The statement by Freeze and Cherry, 1979, should be viewed with skepticism. It was possibly misapplied in this case. Many times in red structured clays, permeability increases with decreasing moisture content due to cracking, etc. The proposed additional study examining macropore features is an excellent idea.

Response 11

Change last paragraph Section 3.3 page 15 to read. "Additional studies have been proposed to investigate the in situ permeability of the Ferrelview Formation, clay till unit, and basal till unit. These studies focus on determination of in situ permeability testing with particular attention paid to the influence of macropore features on hydraulic conductivity."