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Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Weldon Spring, Missouri, Site

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Acronyms and Abbreviations

AEC	U.S. Atomic Energy Commission
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
ANL	Argonne National Laboratory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 *United States Code* [U.S.C.] 9601, *et seq.*)
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CPOU	Chemical Plant operable unit
CSR	*Code of State Regulations*
CSS	chemical stabilization/solidification
D_{50}	median diameter
DCE	dichloroethylene
DNB	dinitrobenzene
DNT	dinitrotoluene
DOE	U.S. Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	foot or feet
GWOU	Groundwater operable unit
HDPE	high-density polyethylene
IC(s)	institutional control(s)
ICO	in-situ chemical oxidation
IRA	Interim Response Action
LCRS	leachate collection and removal system
LM	Office of Legacy Management
LTS&M Plan	Long-Term Surveillance and Maintenance Plan
m^3	cubic meter

MCE	Maximum Credible Earthquake
MCL	maximum contaminant level
MDC	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MNA	monitored natural attenuation
MOU	Memorandum of Understanding
MoDOT	Missouri Department of Transportation
MSD	Metropolitan St. Louis Sewer District
mg/L	milligram(s) per liter
µg/L	microgram(s) per liter
NARA	U.S. National Archives and Records Administration
NEPA	National Environmental Policy Act (42 U.S.C. 4321, *et seq*.)
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
ORAU	Oak Ridge Associated Universities
ORO	Oak Ridge Operations Office, Oak Ridge, Tennessee
OU	operable unit
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene (or perchloroethylene)
pCi/L	picocurie(s) per liter
PMP	probable maximum precipitation
QROU	Quarry Residuals operable unit
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RAR	Remedial Action Report
RCRA	Resource Conservation and Recovery Act (42 U.S.C. 6901, *et seq.*)
RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROW	right-of-way
TCE	trichloroethylene

TNB	trinitrobenzene
TNT	trinitrotoluene
TSA	temporary storage area
UUUE	unlimited use and unrestricted exposure
VOC	volatile organic compound
WSCC	Weldon Spring Citizens Commission
yd^3	cubic yard(s)

See also definitions in Section 4.0, “Glossary”

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1.0 Basis and Regulatory Requirements

1.1 Purpose and Scope

Consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements, remedial actions either have been or are being completed at the U.S. Department of Energy (DOE) Weldon Spring Site (the Weldon Spring Site or the Site) located near Weldon Spring, Missouri. These remedial actions are protective of the anticipated future land use; however, they do not allow for unlimited use and unrestricted exposure (UUUE) in all areas. This Long-Term Surveillance and Maintenance (LTS&M) Plan explains how the DOE will fulfill its obligation to manage residual hazards at the Site over the long term. Because some of the wastes disposed of at the Site will remain hazardous for several thousand years, this Plan essentially requires management of hazards in perpetuity. As defined by the DOE guidance document, *Long-Term Stewardship Planning Guidance for Closure Sites* (DOE 2002b), long-term stewardship refers to all activities necessary to ensure protection of human health and the environment. These activities include, but are not limited to, "all engineered and institutional controls (ICs) designed to contain or to prevent exposure to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and contained structures, access control, and posting signs." The term "stewardship" has been superseded by the term "surveillance and maintenance" in this document and by DOE policy. The term "surveillance and maintenance" now includes the same activities formerly defined by the term "stewardship" and encompasses the activities of an Operations and Maintenance Plan under CERCLA.

The Site consists of the former Weldon Spring Chemical Plant (which includes an on-site disposal cell), the former Weldon Spring Quarry, and all areas, whether on DOE controlled property or other property, where chemical or radiological contamination is located. This plan does not address aspects of the CERCLA remedial action being conducted by the U.S. Department of the Army (Army) at the adjacent Weldon Spring Ordnance Works.

Objectives for performing long-term surveillance and maintenance at the Site include the following:

- Conducting operation, inspection, and maintenance of the engineered controls.
- Conducting maintenance, inspection, and enforcement of the land and groundwater use restrictions and other ICs necessary for the protectiveness of the remedies.
- Conducting long-term monitoring of air, groundwater, biota, or other media necessary to demonstrate the performance, effectiveness, or protectiveness of the remedies.
- Identifying and implementing actions to optimize remedies and long-term surveillance and maintenance activities.
- Identifying and meeting all regulatory requirements for the post-remedial action site conditions.
- Identifying and meeting all natural, cultural, and historical resource management requirements.

- Ensuring that budgeting, funding, and personnel requirements appropriate to sustain long-term surveillance and maintenance needs are met.
- Ensuring that public involvement, including education, outreach, notice, and informational systems are appropriate to sustain the long-term effectiveness of the remedies.
- Ensuring that information and records management requirements are appropriate and designed to be sustained over the long term.
- Developing all plans, manuals, and reports, including revisions to these documents, which are either required or appropriate to conduct the long-term maintenance and surveillance activities.

Section 1.0, "Basis and Regulatory Requirements," describes the purpose and scope of this document, site activities leading up to long-term surveillance and maintenance, and the legal and regulatory basis for long-term surveillance and maintenance activities. Section 2.0, "Long-Term Surveillance and Maintenance," provides information regarding the surveillance and maintenance implementation program for the Weldon Spring Site, including stakeholder roles, public participation, inspections, reports, 5-year reviews, routine site maintenance, environmental monitoring, IC monitoring, emergencies, permits, and record keeping. Section 3.0 "Institutional Controls Implementation Plan for the Weldon Spring Site," describes the necessary use restrictions on affected federal and state properties, the ICs that are in place and the additional ICs scheduled for implementation. Section 4.0, "Glossary," includes definitions of relevant terms. The Appendixes are listed below:

- Appendix A—Background Information, Remedial Action Histories[This appendix includes background information and monitoring data prepared for 2002, for current updated information see annual site environmental reports]
- Appendix B—Risk Assessment Information
- Appendix C—Disposal Cell Contents
- Appendix D—Legal Descriptions and Ownership Information of Institutional Control Areas
- Appendix E—Institutional Control Documentation
- Appendix F—Official Contact List
- Appendix G—Distribution List
- Appendix H—Annual Inspection Checklist
- Appendix I—Leachate Collection and Removal System Operating Plan
- Appendix J—LCRS/Train 3 Treatment Contingency Plan
- Appendix K—Disposal Cell Groundwater Monitoring Plan
- Appendix L—Well Field Contingency Plan
- Appendix M—Groundwater Operable Unit Contingency Tree
- Appendix N—Example Historical Marker and Plaque

This LTS&M Plan is effective upon approval from the U.S. Environmental Protection Agency (EPA) pursuant to the consultation provisions of the Federal Facilities Agreement (FFA). DOE is responsible for assuring that all LTS&M activities described in this Plan are fully implemented.

1.2 Location and Property Ownership

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles (48 kilometers) west of St. Louis (Figure 1−1). The Site comprises two geographically distinct DOE-owned properties: the Weldon Spring Chemical Plant Area (Chemical Plant Area) and the Weldon Spring Quarry (Quarry). The Chemical Plant Area is located about 2 miles (3.2 kilometers) southwest of the junction of Missouri State Route 94 and U.S. Highway 40/61. The Quarry is about 4 miles southwest of the Chemical Plant. Both sites are accessible from Missouri State Route 94. Directions to the Site from Lambert-St. Louis International Airport are provided in Table 1−1.

Table 1–1. Mileage and Directions from the Lambert-St. Louis International Airport to the Weldon Spring, Missouri, Site

Mileage	Route
0.0	At the Airport exit, take the I-70W on-ramp
11.3	On I-70W, take Exit 228 (Missouri State Route 94 and 1st Capital Drive)
11.9	Turn left on 1st Capital Drive and continue on South 1st Capital Drive (becomes Missouri State Route 94)
24.4	On Missouri State Route 94, turn right at the Interpretive Center entrance

The Chemical Plant Area and Quarry are both located on parts of 17,232 acres (6,974 hectares) of private land acquired by the Army in the early 1940s for construction of the Weldon Spring Ordnance Works facility. The former ordnance works property has since been divided into the following areas:

- The DOE Chemical Plant Area,
- The DOE Quarry,
- The U.S. Army Reserve Weldon Spring Training Area,
- Two conservation areas managed by the Missouri Department of Conservation (MDC),
- A segment of the Katy Trail managed by the Missouri Department Natural Resources-Division of State Parks,
- A Missouri Department of Transportation (MoDOT) maintenance facility,
- The Francis Howell High School,
- The Public Water Supply District #2 (formerly St. Charles County) well field and water treatment facility,
- The St. Charles County law enforcement training center,
- The village of Weldon Spring Heights, and
- A University of Missouri research park.

Title search information regarding ownership interests within areas impacted by the Site is included in Appendix D. These areas are depicted in Figure 1−2.

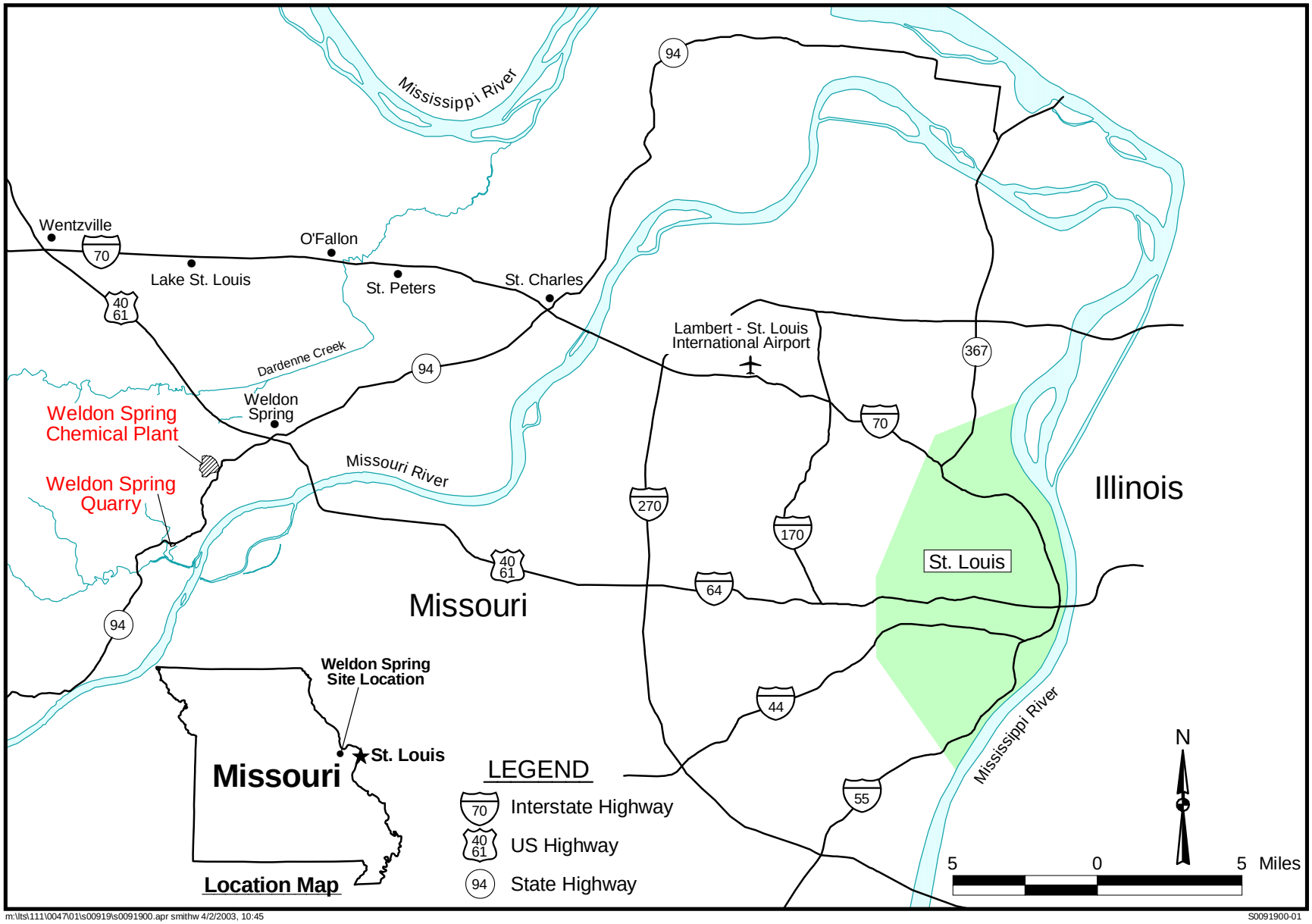

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Figure 1–1. Location of the Weldon Spring, Missouri, Site

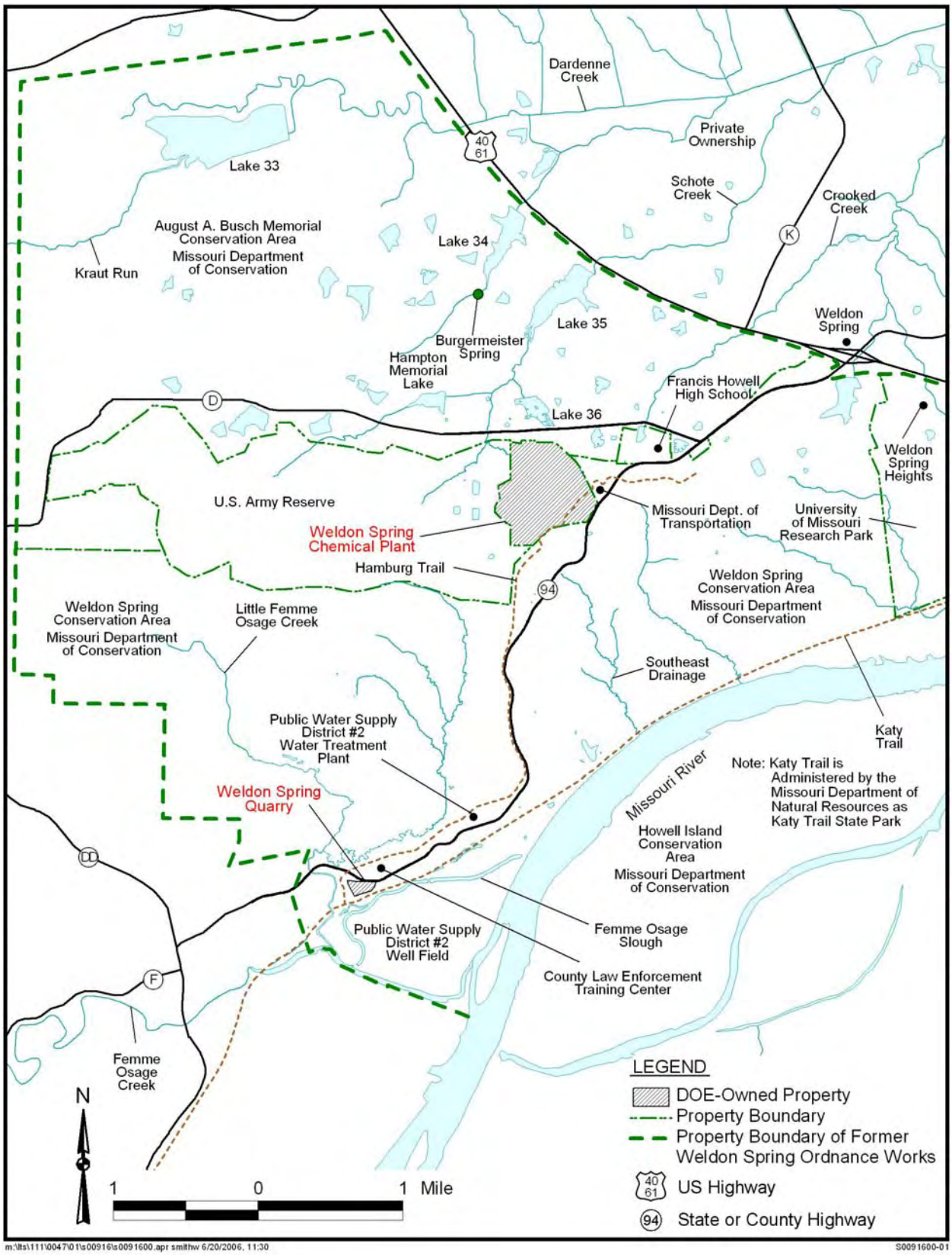

Figure 1–2. Vicinity Map of the Weldon Spring, Missouri, Site

The Chemical Plant and Quarry areas total 228.16 acres (92.33 hectares). The Chemical Plant property is located on 219.50 acres (88.83 hectares); and the Quarry occupies 8.66 acres (3.50 hectares). Legal descriptions of the two parcels are presented in Appendix D. DOE maintains real estate correspondence and instruments at the records repository in Grand Junction, Colorado.

The August A. Busch Memorial Conservation Area, located north of the Chemical Plant, includes about 6,987 acres (2,828 hectares) of actively managed grassland and forest. The Weldon Spring Conservation Area comprises about 7,356 acres (2,977 hectares) of primarily forested land located south and east of the Chemical Plant. The Quarry is located within the Weldon Spring Conservation Area. Both conservation areas are actively managed for fish and wildlife production and are used annually by more than 1,200,000 visitors for fishing, hunting, and hiking (DOE 2002a). MDC currently employs about 50 people in these areas (DOE 2002a).

Katy Trail State Park is a hiking and biking trail built on the former corridor of the Missouri Kansas Texas Railroad (better known as the Katy Trail). The Katy Trail is open for 225 miles from St. Charles to Clinton, Missouri. As estimated by MDNR, approximately 300,000 people use some portion of the trail on an annual basis. The trail runs through the Weldon Spring Conservation Area, over the southern extent of the Southeast Drainage and southeast of the DOE Quarry (see Section 3.0).

The MoDOT facility adjacent to the northeast side of the Chemical Plant is used for storage of materials and equipment for highway maintenance. The facility is approximately 4.3 acres. MoDOT currently employs about 10 workers at this facility.

The Francis Howell High School occupies approximately 61 acres (25 hectares) and is located about 0.6 mile (1.0 kilometer) northeast of the Chemical Plant. The school currently employs approximately 150 faculty and staff, and about 1,600 students attend school.

The two communities closest to the Chemical Plant are Weldon Spring and Weldon Spring Heights, located about 2 miles (3.2 kilometers) to the northeast. The combined population of these two communities is currently approximately 5,000. No private residences are currently located between the Chemical Plant and these two communities; however, two residences owned by MDC are located north of the Chemical Plant. These two residences are connected to the potable water system for the county. The closest private residence to the Quarry is located approximately 1 mile (0.6 kilometer) to the west. Residential and commercial growth is occurring in the communities surrounding the conservation areas, particularly in the city of O'Fallon, an area of growing residential population north of U.S. Highway 40/61.

1.3 Site History

1.3.1 Operations History

In 1941, the U.S. Government acquired 17,232 acres (6,974 hectares) of rural land in St. Charles County to establish the Weldon Spring Ordnance Works. In the process, the towns of Hamburg, Howell, and Toonerville and 576 citizens of the area were displaced (Army undated). From 1941 to 1945, the Army manufactured trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Ordnance Works site. Four TNT production lines were situated on what was to be the Chemical Plant. These operations resulted in nitroaromatic contamination of soil, sediments, and some off-site springs.

Following a considerable amount of explosives decontamination of the facility by the Army and the Atlas Powder Company, 205 acres (83.0 hectares) of the former ordnance works property were transferred to the U.S. Atomic Energy Commission (AEC) in 1956 for construction of the Weldon Spring Uranium Feed Materials Plant, now referred to as the Weldon Spring Chemical Plant. An additional 14.88 acres (6.02 hectares) were transferred to AEC in 1964. The plant converted processed uranium ore concentrates to pure uranium trioxide, intermediate compounds, and uranium metal. A small amount of thorium also was processed. Wastes generated during these operations were stored in four raffinate pits located on the plant property. Uranium processing operations resulted in radiological contamination of the same locations previously contaminated with nitroaromatic compounds by former Army operations.

The Quarry was mined for limestone aggregate used in construction of the Ordnance Works site. The Army also used the Quarry for burning wastes from explosives manufacturing and disposal of TNT-contaminated rubble during operation of the Ordnance Works. These activities resulted in nitroaromatic contamination of the soil and groundwater at the Quarry.

In 1960, the Army transferred the Quarry to AEC, who used it from 1963 to 1969 as a disposal area for uranium and thorium residues from the Chemical Plant (both drummed and uncontained) and for disposal of contaminated building rubble, process equipment, and soils from demolition of a uranium processing facility in St. Louis.

Uranium processing operations ceased in 1966, and on December 31, 1967, AEC returned the facility to the Army for use as a defoliant production plant. In preparation for the defoliant process, the Army removed equipment and materials from some of the buildings and disposed of them principally in Raffinate Pit 4. The defoliant project was canceled before any process equipment was installed, and the Army transferred 50.65 acres (20.50 hectares) of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. AEC and subsequently DOE managed the site, including the Army -owned Chemical Plant, under caretaker status from 1968 through 1985. Caretaker activities included site security, fence maintenance, grass cutting, and other incidental maintenance. In 1984, the Army repaired several of the buildings at the Chemical Plant, decontaminated some of the floors, walls, and ceilings, and isolated some equipment. In 1985, the Army transferred full custody of the Chemical Plant to DOE, at which time DOE designated control and decontamination of the Chemical Plant, raffinate pits, and Quarry as a major project.

1.3.2 Remedial Action History

EPA placed the Quarry and Chemical Plant areas on the National Priorities List (NPL) on July 30, 1987, and March 30, 1989, respectively. A Federal Facility Agreement (FFA) was signed by EPA and DOE in 1986, and it was amended in 1992. A new FFA was signed in 2006 between EPA, DOE, and MDNR. The main purpose of this FFA was to focus more on long-term site management activities. Initial activities at the Chemical Plant, a series of Interim Response Actions (IRAs) undertaken with removal authority, included:

- Removal of electrical transformers, electrical poles and lines, and overhead piping and asbestos that presented an immediate threat to workers and the environment.
- Construction of an isolation dike to divert runoff around the Ash Pond area to reduce the concentration of contaminants going off site in surface water.

- Detailed characterization of on-site debris, separation of radiological and nonradiological debris, and transport of materials to designated staging areas for interim storage.
- Dismantling of 44 Chemical Plant buildings under four separate IRAs.
- Treatment of contaminated water at the Chemical Plant and the Quarry.

Remediation of the Weldon Spring Site was administratively divided into four Operable Units (OUs): Quarry Bulk Waste OU, Quarry Residuals OU (QROU), Chemical Plant area OU (CPOU), and Chemical Plant area Groundwater OU (GWOU). The Southeast Drainage was remediated as a removal action through an Engineering Evaluation/Cost Analysis (EE/CA) report (DOE 1996) as part of the CPOU. The selected remedies are described in the following sections.

1.3.2.1 Quarry Bulk Waste OU

DOE implemented remedial activities for the Quarry Bulk Waste OU set forth in the *Record of Decision for Management of Bulk Wastes at the Weldon Spring Quarry* (DOE 1990).

The selected remedy included:

- Excavation and removal of bulk waste (i.e., structural debris, drummed and unconfined waste, process equipment, sludge, and soil).
- Transportation of the waste along a dedicated haul road to a temporary storage area located at the Chemical Plant.
- Staging of bulk wastes at the temporary storage area.

A detailed description of this remediation is in Section A2.3, "Quarry Bulk Waste OU."

1.3.2.2 Quarry Residuals OU

The QROU remedy was described in the *Record of Decision for the Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1998c). The QROU addressed residual soil contamination in the Quarry proper, surface water and sediments in the Femme Osage slough and nearby creeks, and contaminated groundwater.

The selected remedy included:

- Long-term monitoring and ICs to prevent exposure to contaminated groundwater north of the Femme Osage slough.
- Long-term monitoring and ICs to protect the quality of the public water supply in the Missouri River alluvium, and implementing a well field contingency plan.
- Confirming the model assumptions regarding extraction of contaminated groundwater and establishing controls to protect naturally occurring attenuation processes.
- Restoring the Quarry and establishing ICs.

A detailed description of this remedy is in Appendix A, Section A2.4, "Quarry Residuals OU."

1.3.2.3 Chemical Plant OU

In the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993), DOE established the remedy for controlling contaminant sources at the Chemical Plant and disposing of contaminated materials in an on-site disposal cell.

The selected remedy included:

- Removal of contaminated soils, sludge, and sediment.
- Treatment of wastes, as appropriate, by chemical stabilization/solidification.
- Disposal of wastes removed from the Chemical Plant and stored Quarry bulk wastes in an engineered on-site disposal facility.

The remedy included remediation of 17 off-site vicinity properties affected by Chemical Plant operations. The vicinity properties were remediated in accordance with Chemical Plant Record of Decision (ROD) cleanup criteria. Detailed information regarding the vicinity properties is included in Section A2.1.5, "Vicinity Properties" of Appendix A.

A detailed description of this remediation is in Section A2.1, "Chemical Plant OU."

1.3.2.4 Groundwater OU

DOE implemented an interim ROD to investigate the practicability of remediating trichloroethylene (TCE) contamination in Chemical Plant groundwater, using in situ chemical oxidation (DOE 2000b). DOE issued a final ROD in January 2004, which was signed by EPA in February 2004.

The selected remedy included:

- Collection of monitoring data from wells and springs to verify the effectiveness of monitored natural attenuation (MNA) to reduce COC concentrations over time.
- Institutional controls to limit groundwater use during the remediation period.

A detailed description of this remedy is in Section 2.7.2 and Appendix A, Section A.2.2.

1.3.2.5 Southeast Drainage

Cleanup for the Southeast Drainage was addressed as a removal action under CERCLA. The *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1996) evaluated options for addressing contaminated soils and sediments in the Southeast Drainage. The EE/CA recommended that sediment in accessible areas of the drainage should be removed. The excavated materials would be stored temporarily at an on-site storage area until final disposal in the disposal cell. Soil removal was in two phases: 1997-1998 and 1999. Post-remediation soil sampling was conducted. More details are included in Section A2.1.5.7 and the *Southeast Drainage Closeout Report Vicinity Properties DA-4 and MDC-7* (DOE 1999b).

1.3.2.6 Use Restrictions Needed to Maintain Protectiveness of the Remedial Actions

In addition to the active remedies that have been completed as described in Sections 1.3.2.1 through 1.3.2.5, the RODs also stipulated that use restrictions are needed in order for these remedies to remain protective for the long-term. An Explanation of Significant Differences (ESD) (DOE 2005b) was completed by DOE and approved by EPA to specify use restrictions needed to ensure that remedies in place for the CPOU (including Southeast Drainage), QROU, and the GWOU remain protective for the long term and to restrict land and natural resource uses that are inconsistent with anticipated land uses.

Use restrictions discussed in the ESD are presented in Section 3.0 of this LTS&M Plan. The site areas for which use restrictions were specified include the Chemical Plant disposal cell and buffer area, Southeast Drainage soil and sediment, the Chemical Plant area (including Southeast Drainage) groundwater and springs, the Quarry itself, Quarry area groundwater, and a small reduction zone north of the Femme Osage Slough and south of the Quarry where soil restrictions have been identified. The use restrictions were used as performance objectives for identifying appropriate IC mechanisms for implementation. Implementation of these ICs is part of the scope of this LTS&M Plan.

1.4 Current Site Conditions

Current post-cleanup site conditions are described in Section 3.0. Detailed site background, including remedial action history, is presented in Appendix A. Risk assessment information is presented in Appendix B.

The federal government, through the DOE Office of Legacy Management (LM), is responsible for the radioactive and other hazardous substances released at and from the Weldon Spring Site. The radioactive waste materials generated at the Chemical Plant consisted of radionuclides of the natural uranium and thorium-232 decay series derived from processing uranium and thorium ore concentrates. Contaminated materials disposed of or stored at the Quarry included process wastes from the Chemical Plant and debris from the Mallinckrodt Chemical Company in St. Louis, Missouri.

DOE disposed of the contaminated soils, stabilized sludge, contaminated debris from the Quarry, and the demolished Chemical Plant buildings, and contaminated materials from remediated vicinity properties in the disposal cell. Regulated nonradiological hazardous materials that were encountered during remedial action were treated and disposed of either in the disposal cell or at off-site EPA-approved disposal facilities. A comprehensive list of wastes disposed of in the cell is provided in Appendix C. Contamination remains at the Weldon Spring Site at the following locations:

- The disposal cell contains approximately 1.48 million cubic yards of contaminated materials.
- Residual groundwater contamination remains in the shallow aquifer beneath the Chemical Plant Area, at the Quarry, and at some surrounding areas.
- Several springs near the Chemical Plant Area discharge contaminated groundwater.
- Residual soil and sediment contamination remains in the Southeast Drainage Area.
- Residual soil contamination remains at inaccessible locations within the Quarry.

1.5 Current Regulatory Requirements

This section discusses applicable and relevant and appropriate requirements (ARARs) which apply to the post-remediation aspect of the project.

Because contamination remains at the Site at levels above those that allow UUUE, CERCLA requires that the remedial actions be reviewed at least every 5 years. These reviews are commonly called 5-year reviews. DOE has implemented some ICs and will implement additional ICs to meet use restrictions that are necessary to protect the remedies until contaminant levels allow UUUE.

The disposal cell contents are not regulated under the Resource Conservation and Recovery Act (RCRA), but RCRA postclosure disposal cell monitoring and maintenance requirements are ARARs. The RCRA groundwater protection standard (40 CFR 264 Subpart F) sets forth the general groundwater monitoring requirements for the disposal cell. Generally, the disposal cell groundwater monitoring program must provide representative samples of background water quality, as well as groundwater passing the point of compliance. For a more complete description, see the Disposal Cell Groundwater Monitoring Plan (Appendix K) which was developed to address these requirements. Additional postclosure requirements for the cell are identified in 40 CFR 264 Subpart N and include action leakage rate and leachate collection and removal requirements. These requirements are addressed in Sections 2.7.4, 2.9.2, and Appendixes I and J. Subpart N also includes requirements to maintain the integrity of the final cover, including making repairs as necessary, which is addressed in Section 2.6.

The principal ARARs for the impacted groundwater at the chemical plant are the drinking water standards known as Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act and Missouri water quality standards. These standards, which are established in the Chemical Plant GWOU ROD, are shown in Table 1−2.

Table 1–2. Federal and State Water Quality Standards for the Chemical Plant GWOU

Constituent	Standard	Citation
Nitrate (as N)	10 mg/L	40 CFR 141.62
Total Uranium	20 pCi/L	40 CFR 141
1,3-DNB	1.0 µg/L	10 CSR 20-7[a]
2,4-DNT	0.11 µg/L	10 CSR 20-7[a]
NB	17 µg/L	10 CSR 20-7[a]
TCE	5 µg/L	40 CFR 141.61
2,6-DNT	1.3 µg/L	Risk Based[b]
2,4,6-TNT	2.8 µg/L	Risk Based[c]

[a]Missouri Groundwater Quality Standard.
[b]Risk-based concentration equivalent to 10^{-5} for a resident scenario.
[c]Risk-based concentration equivalent to 10^{-6} for a resident scenario.
Key: DNB = dinitrobenzene; NB = nitrobenzene; DNT = dinitrotoluene; mg/L = milligram(s) per liter; pCi/L = picocurie(s) per liter; µg/L = microgram(s) per liter

The Missouri requirements for well construction (10 CSR 23-4.050) will be an ARAR for any newly installed wells or for the abandonment of any wells.

The 30 µg/L standard for uranium in groundwater outlined in 40 CFR 192.02 was considered as a potential ARAR for the quarry groundwater during development of the Feasibility Study (DOE 1998a) and Proposed Plan (DOE 1998b). The groundwater north of the slough is impacted; however, it is not considered to be a usable groundwater source. Conversely, the Missouri River alluvium south of the slough is currently not impacted and is presently being used as a potable water source. Because groundwater north of the slough is not a useable source, 40 CFR 192.02 is not considered an ARAR for that groundwater. However, 40 CFR 192.02 would likely be an ARAR for any remedial action considered for the useable groundwater source south of the slough in the unlikely event of contaminant migration from north of the slough. The Missouri Water Quality Standard for 2,4-DNT (0.11 µg/L) is also a chemical-specific ARAR for quarry groundwater.

2.0 Long-Term Surveillance and Maintenance

2.1 Surveillance and Maintenance Implementation

This LTS&M Plan implements long-term components of remedies selected for the Weldon Spring Site. The purpose of long-term surveillance and maintenance is to meet the general objectives listed in Section 1.1, "Purpose and Scope." This LTS&M Plan includes the requirements for long-term surveillance and maintenance specified in the *Long-Term Surveillance and Maintenance Program Plan* (DOE 1999a).

DOE will maintain protectiveness at the Weldon Spring Site through a combination of activities, including conducting regular inspections; conducting environmental monitoring, sampling, and other site operation and maintenance activities; maintaining ICs and regulatory compliance; and working with stakeholders and regulators to perpetuate awareness and knowledge of site conditions. Current Site responsibilities are provided in Table 2–1 and described in the following subsections.

Table 2–1. Current Weldon Spring Site Responsibilities

Organization	Function
DOE Office of Legacy Management	Formulate policy and provide resources and support. Site LTS&M management; conduct inspections, monitoring, and maintenance; maintain public interpretive center and information repository; provide opportunities for public participation; resolve stakeholder issues, ensure compliance with DOE orders and ARARs, provide records management, implement and maintain ICs.
EPA Region VII	Lead regulatory agency. Provide regulatory oversight to assess DOE's compliance with the requirements of this Plan. Review and comment on, and as appropriate approve, documents relating to long-term LTS&M activities, including, but not limited to, LTS&M Plan changes, annual and five-year review reports.
Missouri Department of Natural Resources	Provide regulatory review of DOE's compliance with the requirements of this Plan. Review and comment on documents relating to LTS&M activities, including, but not limited to, LTS&M Plan changes, annual and five-year review reports.
St. Charles County (Division of Environmental Services, Register of Deeds, Regional Planning Commission, Water Department)	Local Government representative. Compliance with applicable county regulations; preservation of deeds, easements, parcel maps; master planning and zoning.
Missouri Department of Health and Senior Services	Public health issues.
General Public	Public meeting input, review of LTS&M Plan changes, document review.

2.1.1 Role of DOE

DOE will conduct surveillance and maintenance activities at the Weldon Spring Site in accordance with this Plan to protect human health and the environment and to comply with applicable legal requirements. DOE is responsible for the radiological and other hazardous substances released at or from the Site. Because of the long-lived nature of the contaminants remaining on site, the DOE will provide surveillance and maintenance services at the Weldon Spring Site in perpetuity. DOE is responsible for the preparation, revision, and implementation of this LTS&M Plan, which includes procedures for inspection, monitoring, and maintenance of

the Site, and for managing remaining contamination. Surveillance and maintenance activities also include complying with reporting requirements and maintaining records pertaining to this Site.

2.1.2 Role of Regulators

EPA Region VII, currently located in Kansas City, Kansas, is the lead regulatory agency for Weldon Spring Site activities conducted under this Plan. EPA will provide regulatory oversight to assess DOE's compliance with the requirements of this Plan. EPA will review and comment on, and as appropriate approve, documents relating to long-term surveillance and maintenance activities including, but not limited to, LTS&M Plan changes and annual and 5-year review reports.

MDNR in Jefferson City, Missouri, also will provide regulatory review of DOE's compliance with the requirements of this Plan, including review and comment on documents relating to long-term surveillance and maintenance activities, such as LTS&M Plan changes and annual and 5-year review reports.

2.1.3 Role of Stakeholders

DOE considers the persons, agencies, and others listed in Appendix G to be stakeholders for the Site. Stakeholders may comment on LTS&M Plan changes, provide review of DOE activities by reviewing documents and attending public meetings, informally monitor the Site and the site surveillance and maintenance program, and report concerns to DOE or regulators. See Section 2.2, "Public Participation" for more details regarding stakeholder involvement.

2.1.4 LTS&M Plan Revisions

Revisions to the LTS&M Plan are categorized as either minor changes or major changes. Minor changes are the routine or ministerial sorts of changes necessary to effectively administer the LTS&M Plan and will not result in immediate preparation of a revised LTS&M Plan. Minor changes will be made available to EPA, the State, and stakeholders in an annual summary. All cumulative minor changes will be formally incorporated into the LTS&M Plan at the time it is revised to address a major change.

Examples of minor changes include, but are not limited to, changes to the contact list, changes to the distribution list, modification to the leachate handling procedures, subordinate modifications to the inspection checklist, and generally accepted changes to sampling methods or quality assurance procedures.

Major changes are the revisions necessary to address changed site conditions or other significant new information. If DOE is notified regarding a need for a major change to the LTS&M Plan, DOE will formally submit a revised LTS&M Plan for review and approval pursuant to the consultation provisions of the FFA. The need for the revision, as well as any timeframe for submittal, shall be mutually agreeable or subject to dispute resolution. In the event that DOE determines on its own that a major change is appropriate, DOE will formally submit a revised LTS&M Plan as a primary document or for review and approval, as appropriate, pursuant to the consultation provisions of the FFA. In either case, following EPA approval of the LTS&M Plan, DOE will solicit public comment on any proposed revisions to the Plan. Following public

comment, DOE, EPA, and MDNR will evaluate the comments and determine whether the document should be modified.

Examples of major changes include, but are not limited to, changes to ICs, remedy changes, remedy optimizations, fundamental changes to monitoring programs or objectives, and the closure of the interpretive center.

This procedure applies to the LTS&M Plan and all related site plans incorporated by reference or by inclusion in the appendixes. The related site plans include the following:

- Well Field Contingency Plan
- Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit
- Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit of the Weldon Spring Site
- Annual Inspection Checklist
- Leachate Collection and Removal System Operating Plan
- LCRS/Train 3 Treatment Contingency Plan
- Disposal Cell Groundwater Monitoring Plan

2.2 Public Participation

One of the goals of the surveillance and maintenance program is to promote and facilitate public involvement. Active public involvement helps DOE address citizens' concerns as well as provides additional surveillance input to DOE. DOE will encourage public participation through operating the interpretive center, providing notice when documents are available, eliciting public comment, holding public meetings, hosting educational programs, and through other means. Formal process steps involving public input are shown on Figure 2−1.

2.2.1 Regulator, Stakeholder, and Responder Contacts

The purpose of the contact effort is to ensure that the public and key community leaders, including federal, state, and local government officials, are kept informed of Site activities and status changes. Contact information is maintained, including

- Legislative and executive branch officials (federal, state, and local).
- U.S. Environmental Protection Agency, Region VII.
- U.S. Department of the Army.
- State of Missouri (Departments of Natural Resources, Conservation, Health, and Transportation).
- St. Charles County.
- Francis Howell School District.
- Interested citizens.
- Media (print and electronic).

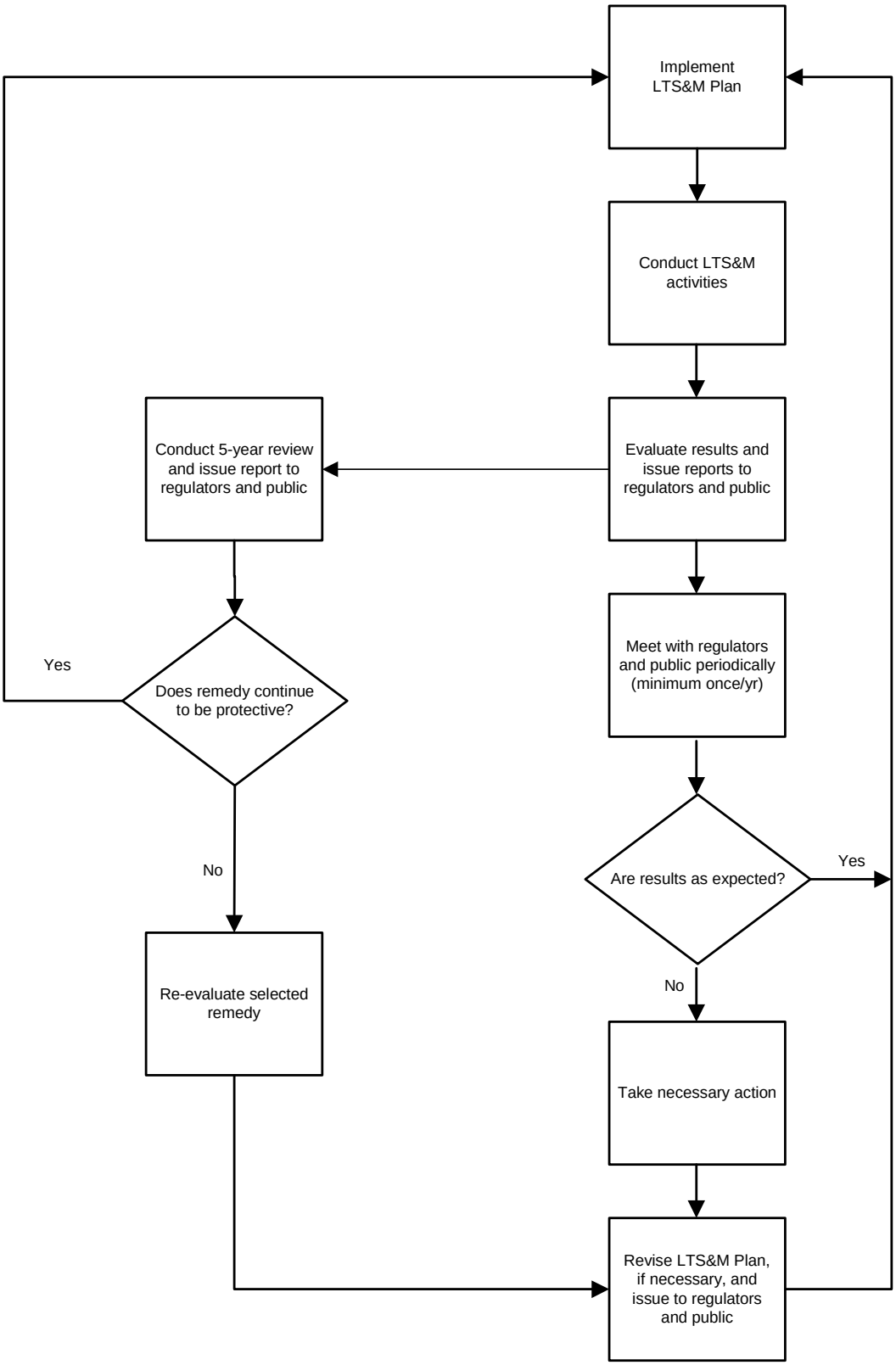

Figure 2–1. Long-Term Surveillance and Maintenance Implementation Flow Chart for the Weldon Spring, Missouri, Site

The Official Contact List (Appendix F) and the Distribution List (Appendix G) will be reviewed and updated on at least an annual basis, in conjunction with the annual inspections, as part of the 5-year reviews, and in conjunction with other significant site announcements and notifications.

2.2.2 DOE Contacts

Contact information for the DOE staff responsible for implementing the Weldon Spring Site surveillance and maintenance program will be posted at the Interpretive Center and made available via the DOE–LM website. These communications will encourage the public to actively participate with DOE in the surveillance and maintenance process by reporting sightings or concerns such as visible changes to the cell cover, erosion, suspicious land use, damaged monitoring wells, or vandalism.

The DOE contact list will also serve an informational purpose by providing a mechanism for the public to submit questions or requests for information if or when there is no continuous on-site DOE presence. The following contact list will be maintained and revised on an annual basis, as necessary, to reflect the most current contact information. Changes to this list will not cause the issuance of a revision to the LTS&M Plan. At times when the LTS&M Plan is reissued to address a major change, these changes will be included within the revision.

- Tom Pauling, Environmental Team Leader
  U.S. Department of Energy/LM-20
  2597 B 3/4 Road, Grand Junction, CO 81503
  (970) 248-6048
- Jane Powell, DOE/LM-20
  Weldon Spring Site Manager
  11003 Hamilton-Cleves Hwy.
  Harrison, OH 45030
  (513) 648-3148
- Yvonne Deyo, Site Manager
  S.M. Stoller Corporation
  7295 Hwy 94 South, St. Charles, MO 63304
  (636) 300-0012
- Grand Junction 24-Hour Monitored Security Telephone Numbers
  (877) 695-5322
  (970) 248-6070
- Website for the Weldon Spring Site
  http://www.lm.doe.gov/land/sites/mo/weldon/weldon.htm

2.2.3 Document Review and Public Meetings

Interested stakeholders as discussed in Section 2.2.1, "Regulator, Stakeholder, and Responder Contacts," will be notified of the availability of both annual and each CERCLA 5-year review reports available to the public at the Interpretive Center, the Middendorf-Kredell branch of the St. Charles City-County Library System, and on the DOE website for the Weldon Spring Site. This notification will ensure that the public is aware of site activities and changes. Comments and/or questions can be directed to the DOE contacts listed in Section 2.2.2, "DOE Contacts."

To ensure a mechanism whereby the public can be briefed on and participate in periodic site reviews, a schedule for a public meeting will be included in the notification letter sent with each annual site inspection report and posted on the website. The annual meeting will include discussions of site surveillance and maintenance activities and observations during the previous year, proposed changes to the LTS&M Plan, and public comments and concerns.

2.2.4 Interpretive Center Operation

DOE will maintain and operate the Weldon Spring Site Interpretive Center at the Site. The purpose of the Interpretive Center is to inform the public of Site history, remedial action activities, and final conditions. The Interpretive Center also will provide information about the long-term surveillance and maintenance program for the Site, provide access to surveillance and maintenance information, and support community involvement activities. It will serve to communicate the historical legacy of the Site, provide educational and research opportunities for current and future generations, and make available information about contamination present at the Site to guide people in making decisions about appropriate activities at the Site.

Current exhibits in the Interpretive Center present:

- The history of the towns that once occupied this area.
- A timeline of significant events at the Weldon Spring Site from 1900 to the present.
- The legacy of the Weldon Spring Ordnance Plant and Uranium Feed Material Plant and the manufacturing wastes.
- The events and community efforts to cleanup the Site and the people that made it happen.
- The multi-faceted phases of the Weldon Spring Site Remedial Action Project.

These exhibits may be changed as appropriate to changing conditions or emerging issues at and near the Site. The hours of operation of the Interpretative Center are posted at the Site. The current hours of operation are Monday through Friday: 9:00 a.m. to 5:00 p.m., Saturday: 10:00 a.m. to 4:00 p.m. (10:00 a.m. to 2:00 p.m. November 1 through March 31) and Sunday: 12:00 p.m. to 4:00 p.m. The Interpretative Center is closed on holidays. These hours are subject to change and current hours will be posted on the website.

DOE will provide staff and funding needed to operate the Interpretive Center. DOE will monitor center usage and public perception of its value, and may discontinue operations, with the approval of EPA in consultation with the State (per the LTS&M Plan revision procedures), if the Interpretive Center is not utilized in a manner that enhances the purposes discussed above. If and when DOE proposes closing the Interpretive Center, it will propose other activities to serve these purposes, as appropriate. DOE will also consult with the community on this decision through the revision process for this Plan.

2.2.5 Howell Prairie and Native Plant Educational Garden

The 150 acres surrounding the disposal cell has been planted with over 80 species of native prairie grasses and wildflowers. Plants such as Prairie Blazing Star, Little Bluestem, and Wild Bergamot will once again dominate this area which was a large native prairie prior to European settlement. Howell Prairie is one of the largest plantings of its kind in the St. Louis metropolitan area.

A garden that consists entirely of plants native to the state of Missouri has been designed and planted in front of the Interpretive Center. The Native Plant Educational Garden consists of an extensive planting of species from Howell Prairie as well as other perennials, shrubs, and trees. Walking paths, benches, and markers to identify the various plants are located throughout the 5 acre garden.

The Howell Prairie, Native Plant Educational Garden, and Interpretive Center were designed to attract visitors to the Weldon Spring Site, thus ensuring long-term community education about the remediation project and enhancing the overall educational mission of the site.

2.3 Routine Site Inspections

2.3.1 Frequency of Inspections

DOE will inspect the Weldon Spring Site at least annually to confirm that remedial action components, including associated ICs, remain in place and effective, and to determine if maintenance or additional monitoring is needed. DOE will notify EPA and MDNR of the inspection at least 30 days before the scheduled inspection date. DOE may reassess the inspection process and frequency based on experience and propose modifications as appropriate. Proposed modifications will be submitted as part of the 5-year review report or in a formal revision to the LTS&M Plan.

2.3.2 Inspection Procedure

For the purposes of inspection, the Weldon Spring Site will be divided into specific areas (Table 2−2). Each area will be inspected individually. The annual inspection will be comprehensive and will be conducted within a set period of time, usually a 2-day period. This does not preclude the possibility that additional inspections or observations could contribute to the annual inspection. A single annual inspection report will be prepared for all areas.

Inspectors will physically inspect the cell top and side slopes, side slope toe, cell and site drainage structures, and the leachate collection and removal system (LCRS). Inspectors will look for modifying processes or threats to disposal cell integrity such as creep, bulging, differential settlement, erosion, or rock degradation. Inspectors also will look for physical evidence of uses that are inconsistent with the use restrictions. Previous maintenance work will be inspected and maintenance needs will be compiled.

Table 2–2. Inspection Areas for the Weldon Spring, Missouri, Site

Area	Description
	Chemical Plant
Disposal Facility and 300-foot (ft) Buffer Zone	Disposal cell, apron, and 300-ft buffer area, ramp and platform, guard rail, LCRS, leachate treatment building and appurtenances, access and perimeter roads, cell performance monitoring wells, and site markers.
Chemical Plant Site Boundary	Area between the 300-ft buffer zone and the Chemical Plant property boundary, including access roads, survey monuments, information signage, and groundwater monitoring wells.
Chemical Plant Outlying Area	Groundwater use restriction area, additional area beyond property boundary where development may affect site integrity, selected off-site areas where erosion might eventually threaten the Chemical Plant, areas overlying contaminated groundwater plumes, culverts at Missouri State Route 94 and Highway D, groundwater monitoring wells, Springs 6301, 6303, 5303, and 5304, and the Southeast Drainage.
	Quarry
Quarry and Quarry Outlying Area	Quarry property, area of groundwater use restrictions, area beyond property boundary where development may affect site integrity, survey monuments, and groundwater monitoring wells.

Inspecting the cell cover, clean fill dike cover, and toe apron for settlement or rock degradation will consist of walking 10 transects across the cell and walking along the cell perimeter. Inspectors will look for and map depressions, shifts of cell plane vertices, or other indications of settlement. At least five test plot areas will be designated and mapped to inspect for rock degradation based on comparison of previous year's photographs. A global positioning system or other method with equivalent accuracy will be used for mapping.

Inspectors will compare results with previous survey results to determine if features are construction artifacts or if additional degradation has occurred. If inspectors identify settlement, or if the percentage of degraded rock appears significant or is noticeably greater than on the remainder of the cover, DOE will determine a course of monitoring and evaluation as described in Section 2.9.2.

Inspectors will note changes to the area surrounding the Chemical Plant and Quarry sites. Significant changes within these areas could include new development or expansion of existing development, erosion, or road building. Near the Quarry, inspectors will note evidence of development that may result in changes to the surface grading, groundwater system, disturbance of the reduction zone, and evidence of inappropriate groundwater extraction. At the Quarry, inspectors also will look for evidence of settling, ponding water, backfill erosion, and highwall instability.

Within each area, the condition of specific site-surveillance features (Section 2.3.5, "Specific Site-Surveillance Features"), such as site markers and monitoring wells, will be inspected for change, deterioration, and functionality.

Some observations will be documented with photographs. Such observations may be evidence of vandalism, changed conditions, or maintenance needs. Inspectors will record photograph

information on a Field Photograph Log, which becomes part of the site record maintained at the DOE office in Grand Junction.

Inspectors will verify that the DOE contact phone numbers remain displayed at the Chemical Plant and Quarry and are listed in local telephone directories.

Following inspections, DOE will perform any necessary maintenance actions, take corrective measures to address any activities inconsistent with the use restrictions, and correct any other problems identified. A description of the findings and the actions taken or scheduled to be taken to address the problems will be included in the annual report.

2.3.3 Inspection Checklist and Map

Site inspections are guided by checklists that address the performance of each inspection. The initial annual inspection checklist for the Weldon Spring Site and the 5-year inspection checklist for the cell cover are presented in Appendix H. Initial site inspection maps are shown on Figures 2–2 and 2–3. The maps are used to record field notes, photograph locations, and other annotations of inspection findings. The field maps become a part of the permanent site record.

At the conclusion of a site inspection, inspectors will note revisions to the applicable checklist in anticipation of the next site inspection. The checklists are again reviewed and revised as necessary before each inspection. Revisions to the checklists may include inspection instructions addressing new observations, notes about maintenance conducted since the previous inspection, or progressive changes in site conditions. These revisions will generally be minor changes to the LTS&M Plan unless it is necessary to address changed site conditions or significant new information as described in Section 2.1.4.

DOE believes that the implementation of the inspection through the use of the inspection checklist will provide a means to estimate protocols and procedures necessary to satisfy the requirements of this plan.

Concurrent with each annual inspection, inspectors will review the *Comprehensive Five-Year Review Guidance* (EPA 2001).

2.3.4 Institutional Controls Inspection

During routine sampling of wells, DOE contractor sampling personnel will inspect for any evidence of land use changes or significant land disturbance. The contractor will also verify that all information signage on the monitoring wells at the Quarry area reduction zone is intact and legible. The samplers will promptly report any changed conditions to DOE for follow-up action.

DOE will conduct a formal annual inspection of the physical locations addressed by ICs. DOE also will evaluate whether the ICs remain effective in protecting human health and the environment and, in coordination with EPA and MDNR, will take appropriate action if evidence indicates the controls are not effective.

DOE will contact property owners annually to ensure they remain aware of ICs on their property. IC contact information will be maintained in the inspection checklist (Appendix H). The contact

will consist of a documented phone conversation to confirm agency contact information. Similarly, DOE also will check county records to verify that deed notices, easements and other recorded instruments remain in place. A list of the agencies and stakeholders to be contacted for the annual inspection is included in Appendix F.

Groundwater and Surface Water—During annual site inspections, inspectors will look for indications of groundwater or surface water withdrawal or use in restricted use areas (see Section 3.2). Indications may include new wells, well points, pumps set on wells or on well points, or new residential or commercial development with no apparent connection to a municipal water supply. Observations and corrective actions will be recorded in the annual report and summarized in the 5-year review report. In preparation for the 5-year review, DOE will contact MDNR to determine if well registrations were issued for the area affected by contaminated groundwater.

Chemical Plant and Quarry—During annual inspections, inspectors will look for indications of excavation into soils and bedrock at the DOE-owned property, or in the geochemical reduction zone south of the Quarry (see Section 3.2). If any party has been granted use of portions of the Chemical Plant or Quarry, inspections will ensure that such use is in accordance with terms of use agreements and that surface drainage has not been modified.

Southeast Drainage—During the annual inspections, inspectors will look for indications of residential use or construction in the Southeast Drainage, or other activity that would signify residential use of the area. Also during the annual inspection, DOE will ensure that MDC remains aware of land use restrictions imposed in the affected area of the Southeast Drainage.

Institutional Controls Enforcement—DOE will notify EPA and MDNR if ICs have been violated or if enforcement action is necessary. DOE will present the results of IC monitoring and maintenance in the annual report.

2.3.5 Specific Site-Surveillance Features

Specific site-surveillance features at the Weldon Spring Site are shown on Figure 2–2 and Figure 2–3.

2.3.6 Access Controls

Information Signs—A sign is posted at the Interpretive Center and at various historical marker locations in the area providing the DOE 24-hour and local contact phone numbers. Signs are posted on the LCRS fence to inform the public that trespassing is forbidden, and that persons may call the DOE 24-hour security telephone number (970-248-6070 or 877-695-5322) or the local DOE representatives (636-300-0012) for information.

Disposal Cell Guard Rail—A guard rail surrounds the cell at the toe of the side slope. The barricade is designed to prevent vehicular access to the cell.

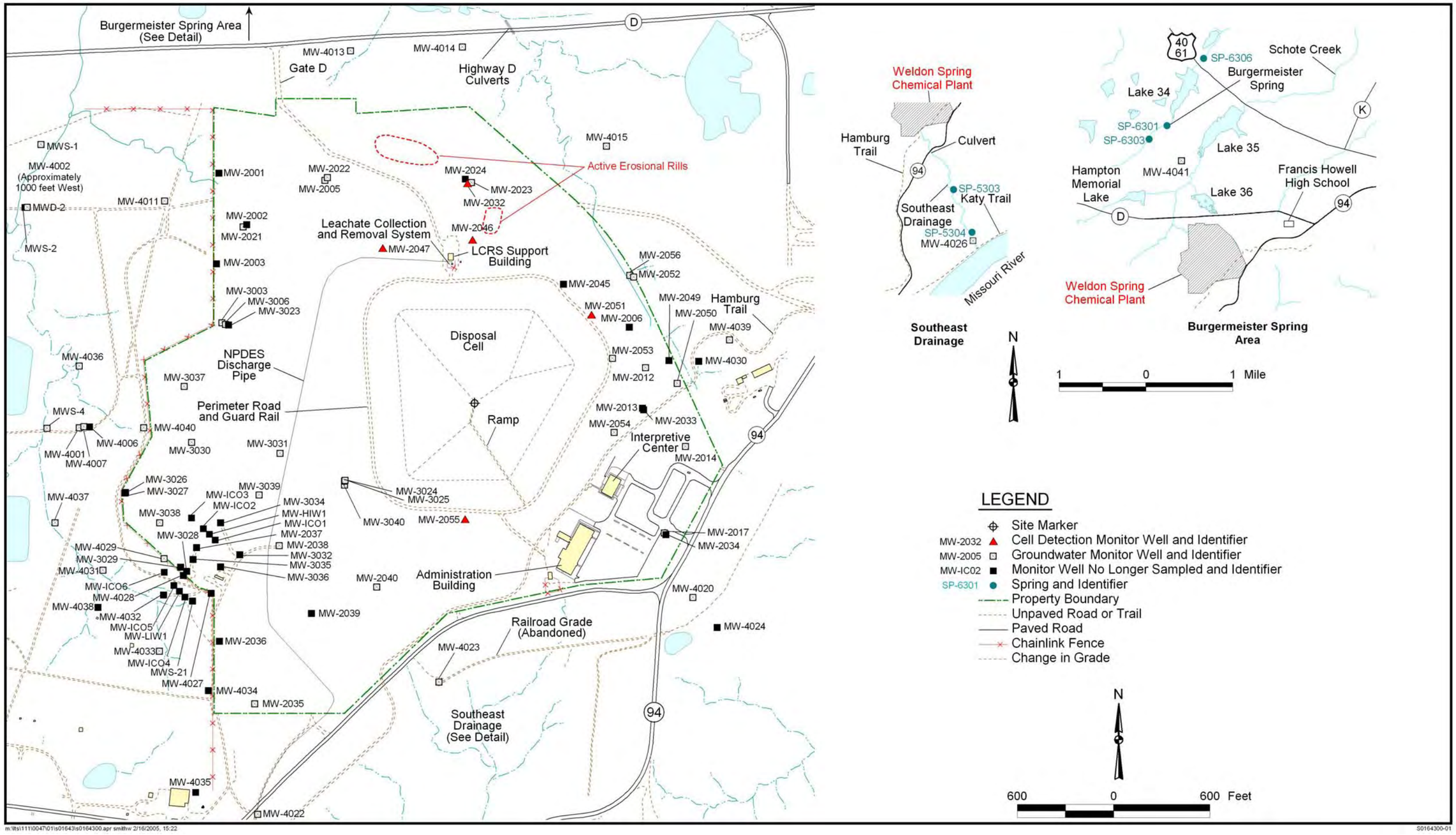

Figure 2–2. Inspection Base Map for the Chemical Plant Area of the Weldon Spring, Missouri, Site

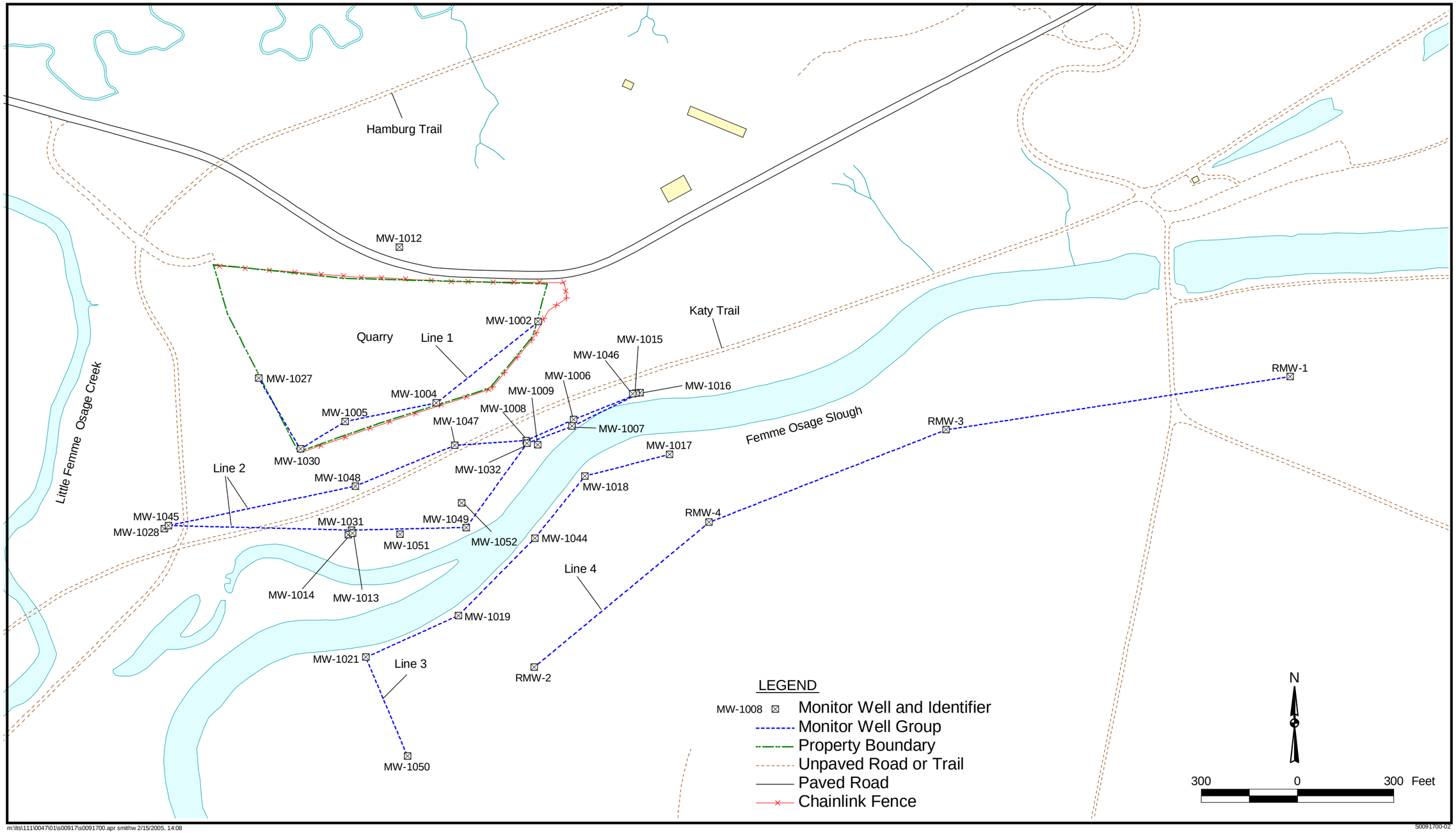

Figure 2–3. Inspection Base Map for the Quarry Area of the Weldon Spring, Missouri, Site

Fencing—A chain-link security fence encloses the LCRS sump to prevent unauthorized entry. The reconstructed security fence, located one foot on the Army's side of the common boundary, is owned and maintained by the Army for its security purposes. Historical fencing remains around a portion of the DOE Quarry.

2.3.7 Site Markers

Four permanent site markers are installed on concrete pylons on top of the disposal cell. These include general information about the cell cover. The coordinates and elevation for the north monument benchmark are as follows: North: 1,043,145.709; East: 755,063.602; Elevation 734.2267 ft above mean sea level.

2.3.8 Monitoring Wells

Chemical Plant—The groundwater monitoring well network has been defined from existing or new monitoring wells located inside or adjacent to the Weldon Spring Site property to reflect long-term surveillance and maintenance requirements specified in the RODs for the GWOU and the CPOU. These wells are completed in the Burlington-Keokuk Limestone. Construction details and lithologic logs for the wells will be archived in the Weldon Spring Site records at the DOE office in Grand Junction.

Quarry—The groundwater monitoring well network consists of approximately 30 monitoring wells located primarily downgradient of the Quarry property (Figure 2–3). These wells are completed in the alluvial aquifer or the underlying bedrock units (Kimmswick Limestone, Decorah Group, or Plattin Limestone). Construction details and lithologic logs for the wells are archived in the Weldon Spring Site records at the DOE office in Grand Junction.

2.3.9 Personnel

Typically, two inspectors will perform annual inspections. Inspectors will be experienced engineers or scientists who have the required knowledge, skills, and abilities to evaluate site conditions and recognize potential or actual problems.

Inspectors will be assigned for a given inspection of the Weldon Spring Site on the basis of site conditions and inspector expertise. Areas of expertise include civil, geotechnical, and geological engineering; geology, hydrology, biology, and environmental science (e.g., ecology, soils, or range management). If conditions warrant, more than two inspectors may be assigned to the inspection to evaluate serious or unusual problems and make appropriate recommendations.

2.3.10 Annual Reports

Results of annual site inspections will be reported to EPA and MDNR. DOE will post the final report on the DOE website for the Weldon Spring Site and place it in the Weldon Spring Site Interpretive Center, and other local information repositories, and send it to interested stakeholders. In the report, DOE also will address maintenance and monitoring results for the previous 12 months and will include descriptions of the cause and outcome of events that require notification of local, state, or federal officials.

2.4 Follow-up Inspections

Follow-up inspections are unscheduled inspections that are conducted in response to threatening or unusual site conditions.

2.4.1 Criteria

DOE may conduct follow-up inspections if the following occurs:

- A condition is identified during the routine site inspection, or other site visit, that requires personnel with specific expertise to return to the site to evaluate the condition.
- DOE is notified by a citizen, employee, or federal, state, or local agency that conditions at the site are substantially changed. Notification may be made to the DOE office in Grand Junction using the toll-free phone number posted at the Interpretive Center, to on-site personnel, or to local law enforcement agencies.

Once a condition or concern is identified at the site, DOE personnel will evaluate the information and decide whether to respond with a follow-up inspection. At any time, DOE may request the assistance of local authorities to confirm the seriousness of a condition at the site before scheduling a follow-up inspection. DOE will notify EPA and MDNR of a follow-up inspection upon identifying the need to conduct such an inspection.

Specific conditions that may necessitate a follow-up inspection include intrusion, violation of ICs, vandalism, or the need to revisit the site to evaluate, define, or conduct maintenance tasks. Conditions that may require a more immediate follow-up inspection include extreme weather, seismic events, and disclosure of deliberate human activity that threatens the integrity of waste containment. DOE will evaluate risk when scheduling follow-up inspections. Urgency of the follow-up inspection will be in proportion to the seriousness of the condition.

In the event of an incident or activity that threatens or compromises ICs or poses a risk of exposure to or release of known contaminants, DOE will follow the procedures in Section 2.9, "Emergencies, Contingency Planning, and Corrective Action."

2.4.2 Personnel

Inspectors assigned to follow-up inspections will be selected on the same basis as for routine site inspection, described in Section 2.3.9, taking into account any additional specific expertise necessary to address the circumstance.

2.4.3 Reports of Follow-up Inspections

Results of follow-up inspections will be included in the next annual inspection report. Separate reports will be prepared if DOE determines it advisable to notify EPA, MDNR, or another outside agency of a situation at the site that remains uncorrected.

If follow-up inspections are required for more serious reasons, DOE will submit to EPA, MDNR, and St. Charles County a preliminary report of the follow-up inspection within 60 days of the inspection. More serious reasons may include situations that could result in a compromise or failure of cell containment or situations that could result in unacceptable risk to the public or the

environment. The public will be notified of the availability of the follow-up report via posting on the Internet. Copies of the report will be available to the public upon request.

2.5 5-Year Review

DOE will conduct CERCLA 5-year reviews, including preparing a 5-year review report, in accordance with the National Contingency Plan and EPA guidance for 5-year reviews in effect at the time the review is to be conducted. The purpose of the CERCLA 5-year review is to ensure that the remedies remain protective of human health and the environment. The Weldon Spring Site 5-year review report also will serve as the principal mechanism for monitoring, evaluating, improving, and reporting on all long-term management activities, including operations and maintenance; long-term monitoring; IC monitoring and enforcement; community involvement; information system; contingency actions; and post-ROD changes. Consideration of new science and technology will be addressed during the 5-year review process. The 5-year review report will also include the results of the previous five annual inspections and environmental monitoring results.

In the 5-year review report, DOE will present an evaluation of remedy performance and make any appropriate recommendations for modifying the surveillance and maintenance program, implementing corrective action, optimizing the selected remedies, or making changes to the selected remedies (if necessary).

DOE will consult then current EPA guidance for 5-year reviews and will add essential elements to the inspection that precedes preparation of the 5-year review report to ensure capture of necessary field observations. Additional evaluation of site monitoring data for the review period will be conducted.

During the 5-year review, in addition to annual visual inspections, general or differential settlement of the cell cover will be monitored through the use of terrestrial and/or aerial surveys. Rock gradation changes in the cell cover, clean fill dike cover, and toe apron will be visually assessed and evaluated (Appendix H).

In accordance with EPA guidance, DOE will prepare a single 5-year review report that addresses the four OUs of the Weldon Spring Site, with the Southeast Drainage Area being included in the Chemical Plant Area OUs. The most recent 5-year review was completed in 2006 (DOE 2006). The next 5-year review report is planned for 2011; therefore, the 2010 inspection will be structured to support the 5-year review.

2.6 Routine Site Maintenance and Operations

Roads and Walkways—Inspectors will evaluate the condition of the access road, perimeter road, and disposal cell ramp and platform for maintenance needs. Needs may include vegetation control, grading, or adding aggregate. DOE will promptly complete any needed maintenance or repairs. Unless affected by Site activities, DOE will not conduct any maintenance of the Hamburg Trail.

Wells—During the routine site inspections, DOE will inspect the disposal cell wells, more than 10 percent of Chemical Plant and Quarry monitoring wells, and arrange for needed maintenance

or repairs. Groundwater samplers also will note maintenance needs and ensure the wells are kept secured and in good repair. Monitoring personnel will maintain access to sample locations, which may include maintenance of access routes and vegetation control. Maintenance at off-site locations will be conducted in accordance with access agreements. All maintenance activities will be documented in the site maintenance log.

LCRS—Modeling results predict that the production rate of leachate from the disposal cell will decrease steadily over the 10 years following cap completion until it becomes insignificant. On-site personnel will monitor fluid volume in the LCRS sump and arrange for sampling and disposal in accordance with the *Leachate Collection and Removal System Operating Plan* (Appendix I). DOE will decrease on-site monitoring frequency to reflect diminishing leachate production. A decrease in leachate production automatically will lead to less leachate monitoring frequency, since there will be fewer shipments for treatment and disposal. Ultimately, the system may be monitored from a remote location, with system inspections coinciding with routine site inspections or conducted in response to concerns about remote monitoring information.

The LCRS sump is a confined space, and methane is generated by peat in the liner system. Workers must follow confined space entry procedures before entering the sump, which includes checking the sump atmosphere for oxygen and explosive concentrations of gases.

Interpretive Center, Administration Building, Sanitary Wastewater Treatment System, and Associated Grounds—DOE intends to offer use of these structures and associated landscaped areas to another primary building user. DOE will use office space and the laboratory in the administrative building. The primary building user will assume responsibility for building and grounds maintenance and capital improvements within the region shown on the final agreement. DOE will retain responsibility for maintenance of and capital improvements of the Interpretive Center. DOE and the primary building user will enter into a long-term use permit that specifies provisions for shared occupation. Currently this arrangement has been entered into with Lindenwood University for an indefinite term.

Vegetation—DOE will control vegetation on the disposal cell and in other rock-armored areas to prevent damage to the cell cover and maintain the proper function of drainage structures. Vegetation control may include cutting trees and shrubs and applying herbicides to their stems. The primary building user will maintain vegetation around the administration building and Interpretive Center.

DOE is establishing a demonstration prairie on the remainder of the Chemical Plant (see Section 2.2). The prairie provides high quality erosion protection and a low maintenance cover. Maintenance activities may include periodic cutting, burning, fertilizing, erosion control, and weed control. Prairie maintenance is conducted by a subcontractor and supervised by a prairie ecosystem consultant, who will direct maintenance activities on the basis of site conditions. A consortium of conservation groups helps DOE manage the prairie.

DOE is also establishing a native plant educational garden that surrounds the Interpretive Center. Maintenance activities may include periodic irrigation, mowing, burning, and weed control. Garden maintenance is conducted by a subcontractor and volunteer labor. Maintenance activities are supervised by the Interpretive Center manager. The intent of the garden is to assist in attracting and then educating the public about the Weldon Spring Site. Routine maintenance

completed during the previous 12 months will be summarized in the next annual inspection report.

2.7 Environmental Monitoring

The Remedial Design/Remedial Action (RD/RA) work plans for the Weldon Spring Site specify environmental monitoring requirements for specific OUs, which are implemented through this plan. Results will be reported in the annual site environmental report and summarized in the 5-year review report. Environmental data results are available on the Internet (http:/www.lm.doe.gov/land/sites/mo/weldon/weldon.htm or www.wssrap.com). In accordance with current laboratory turnaround times and review protocol, the data will be available on the website approximately 90 days after sampling.

DOE may conduct additional site environmental monitoring that is not required as part of an approved remedy but is required under DOE Order 450.1, *Environmental Protection Program*. DOE will report the results of the additional monitoring in the annual site environmental report.

Separate groundwater monitoring programs have been established for the Chemical Plant and Quarry because of geographic separation and differences in the hydrogeologic features that influence groundwater flow. Groundwater monitoring locations will include local springs where groundwater emerges from conduit flow paths (DOE 2003).

Monitoring results are compared to EPA and State of Missouri groundwater quality standards that are identified as ARARs in Table 1−2. Results may also be compared to trigger values (where applicable) that indicate unacceptable changes in contaminant concentrations.

2.7.1 Disposal Cell Detection Monitoring

Disposal cell detection monitoring is summarized in Table 2−3. Specific procedures for evaluation of monitoring results and required responses are presented in the Detection Monitoring section of the "Disposal Cell Groundwater Monitoring Plan" (Appendix K). The cell detection monitoring locations are shown on Figure 2–2.

DOE will monitor groundwater upgradient and downgradient of the disposal cell and also will monitor Burgermeister Spring (SP–6301) under base flow conditions as part of the disposal cell monitoring program. Burgermeister Spring is a primary localized resurgence point of groundwater from the Chemical Plant and represents surface water hydraulically connected to the Chemical Plant.

Table 2–3. Detection Monitoring Program for the Disposal Cell at the Weldon Spring, Missouri, Site

Sample Locations	Hydrologic Relationship	Sampling Frequency	Analytes (all locations)
MW–2032	Downgradient	Semiannual	Total uranium, radium-226, radium-228, thorium-228, thorium-230, thorium-232, arsenic, barium, chromium, lead, manganese, nickel, selenium, thallium 1,3,5-TNB, 1,3-DNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, polychlorinated biphenyl, polycyclic aromatic hydrocarbon, field parameters (pH, temperature, and conductivity).
MW–2046	Downgradient		
MW–2047	Downgradient		
MW–2051	Downgradient		
MW–2055	Upgradient		
SP–6301	Downgradient		

Note: DNB = dinitrobenzene; DNT = dinitrotoluene; TNB = trinitrobenzene; TNT = trinitrotoluene

2.7.2 Groundwater OU

In July 2004, DOE implemented the selected remedy of monitored natural attenuation (MNA) as outlined in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004b). The monitoring network was modified as described in the GWOU interim remedial action report (DOE 2005a). A revision to the Baseline Concentrations of the Chemical Plant Groundwater Operable Unit Monitored Natural Attenuation Network was prepared in December 2007 to evaluate the monitoring data collected from July 2004 through May 2006 (baseline period) and assess the long term monitoring program. The rationale and methodology for the review and evaluation of future MNA are presented in the report.

The objectives specified in the ROD (DOE 2004b) for the GWOU MNA monitoring network are:

- Objective 1 is to monitor the unimpacted water quality at upgradient locations in order to maintain a baseline of naturally occurring constituents from which to evaluate changes in downgradient locations. This objective will be met by using wells located upgradient of the contaminant plume.
- Objective 2 is to verify contaminant concentrations are declining with time at a rate and in a manner that cleanup standards will be met in approximately 100 years as established by predictive modeling. This objective will be met using wells at or near the locations with the highest concentrations of contaminants, both near the former source areas and along expected migration pathways. The objective will be to evaluate the most contaminated zones. Long-term trend analysis will be performed to confirm downward trends in contaminant concentration over time. Performance will be gauged against long-term trends. It is anticipated that some locations could show temporary upward trends due to the recent source control remediation, ongoing dispersion, seasonal fluctuations, analytical variability, or other factors. However, concentrations are not expected to exceed historical maximums.
- Objective 3 is to ensure that lateral migration remains confined to the current area of impact. Contaminants are expected to continue to disperse within known preferential flowpaths associated with bedrock lows (paleochannels) in the upper Burlington-Keokuck Limestone and become more dilute over time as rain events continue to recharge the area. This objective will be met by monitoring various downgradient fringe locations that either

are not impacted or minimally impacted. Contaminant impacts in these locations are expected to remain minimal or non-existent.

- Objective 4 is to monitor locations underlying the impacted groundwater system to confirm that there is no significant vertical migration of contaminants. This will be evaluated using deeper wells screened and influenced by the unweathered zone. No significant impacts at these locations should be observed.
- Objective 5 is to monitor contaminant levels at the impacted springs that are the only potential points of exposure under current land use conditions. The springs discharge groundwater that includes contaminated groundwater originating at the Chemical Plant area. Presently, contaminant concentrations at these locations are protective of human health and the environment under current recreational land uses. Continued improvement of the water quality in the affected springs should be observed.
- Objective 6 is to monitor for hydrologic conditions at the site over time in order to identify any changes in groundwater flow that might affect the protectiveness of the selected remedy. The static groundwater elevation of the monitoring network will be measured to establish that groundwater flow is not changing significantly and resulting in changes in contaminant migration.

The monitoring network consists of 50 wells, four springs, and one surface water location. The locations and the objectives they satisfy are summarized in Table 2−4 and are depicted on Figure 2−4.

The monitoring network is designed to collect data to show that either natural attenuation processes are acting as predicted or to trigger the implementation of contingencies when these processes are not acting as predicted (i.e., unexpected expansion of the plume or sustained increases in concentrations within the area of impact). The data analysis and interpretation will satisfy the following:

- Baseline conditions (Objective 1) have remained unchanged.
- Performance monitoring locations (Objective 2) indicate that concentrations within the area of impact are decreasing as expected.
- Detection monitoring locations (Objective 3, 4, and 5) indicate when a trigger has been exceeded.

The guidance documents *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tanks Sites* (EPA 1999) and the *Technical Guidance for the Long-Term Monitoring of Natural Attenuation Remedies at Department of Energy Sites* (DOE 1999c) were used during the development of this monitoring program.

Contaminants of concern (COCs) for groundwater and springs at the Chemical Plant area are TCE, nitrate, uranium, and nitroaromatic compounds. The set of COCs measured for each of the monitoring locations presented in Table 2−4 depends on the proximity of the particular well or spring to the contaminant plumes.

Table 2–4. Monitoring Program for GWOU MNA Remedy

Location	Objective	Unit	Sampling Frequency	TCE	Nitrate (as N)	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-2012	Objective 2	Weathered	S				✓	✓	✓	✓	✓
MW-2014	Objective 2	Weathered	S						✓	✓	
MW-2017	Objective 1	Weathered	A				✓	✓	✓	✓	✓
MW-2021	Objective 4	Unweathered	A		✓						
MW-2022	Objective 4	Unweathered	A		✓		✓	✓			
MW-2023	Objective 4	Unweathered	A				✓	✓	✓	✓	✓
MW-2032	Objective 3	Weathered	A				✓	✓	✓	✓	✓
MW-2035	Objective 1	Weathered	A	✓	✓	✓			✓		
MW-2038	Objective 2	Weathered	S		✓				✓		
MW-2040	Objective 2	Weathered	S		✓						
MW-2046	Objective 2	Weathered	S					✓			
MW-2050	Objective 2	Weathered	S						✓	✓	
MW-2051	Objective 3	Weathered	A				✓	✓	✓	✓	✓
MW-2052	Objective 2	Weathered	S						✓	✓	
MW-2053	Objective 2	Weathered	S					✓	✓	✓	
MW-2054	Objective 2	Weathered	S						✓	✓	
MW-2056	Objective 4	Unweathered	A				✓	✓	✓	✓	✓
MW-3003	Objective 2	Weathered	S		✓	✓					
MW-3006	Objective 4	Unweathered	A	✓	✓	✓			✓		
MW-3024	Objective 2	Weathered	S								
MW-3030	Objective 2	Weathered	S	✓		✓			✓		
MW-3031	Objective 3	Weathered	A	✓		✓					
MW-3034	Objective 2	Weathered	S	✓	✓				✓		
MW-3037	Objective 3	Weathered	A	✓		✓			✓		
MW-3039	Objective 2	Weathered	S						✓		
MW-3040	Objective 2	Unweathered	Q		✓	✓					
MW-4007	Objective 4	Unweathered	A	✓	✓						
MW-4013	Objective 2	Weathered	S		✓						
	Objective 3		A						✓	✓	✓

Table 2−4 (continued).Monitoring Program for GWOU MNA Remedy

Location	Objective	Unit	Sampling Frequency	TCE	Nitrate (as N)	Uranium	1,3-DNB	2,4,6-TNT	2,4-DNT	2,6-DNT	NB
MW-4014	Objective 3	Weathered	A		✓		✓	✓	✓	✓	✓
MW-4015	Objective 3	Weathered	A						✓	✓	✓
MW-4022	Objective 1	Unweathered	A		✓	✓					
MW-4023	Objective 1	Weathered	A		✓	✓					
MW-4026	Objective 3	Alluvium/SED	A			✓					
MW-4029	Objective 2	Weathered	S	✓	✓						
MW-4031	Objective 2	Weathered	S		✓						
MW-4036	Objective 3	Weathered	A	✓	✓	✓			✓		
MW-4039	Objective 3	Weathered	A				✓	✓	✓	✓	✓
MW-4040	Objective 2	Unweathered	Q		✓	✓					
	Objective 4		A	✓					✓		
MW-4041	Objective 3	Weathered	A	✓	✓	✓	✓	✓	✓	✓	✓
MW-4042	Objective 4	Unweathered	Q		✓	✓					
MWS-1	Objective 3	Weathered	A	✓	✓	✓			✓		
MWS-4	Objective 3	Weathered	A	✓	✓	✓					
MWD-2	Objective 4	Unweathered	A		✓	✓					
SP-5303	Objective 5	Spring	Q			✓					
SP-5304	Objective 5	Spring	Q			✓					
SP-6301	Objective 5	Spring	Q	✓	✓	✓	✓	✓	✓	✓	✓
SP-6303	Objective 5	Spring	Q	✓	✓	✓	✓	✓	✓	✓	✓
SW-2007	Objective 5	Stream	A			✓					

Objective 1 – Upgradient Locations
Objective 2 – Contaminant Plume
Objective 3 – Downgradient and Lateral Locations
Objective 4 – Locations beneath the area of impact
Objective 5 – Springs
SED – Southeast Drainage
A – Annual S – Semiannual Q - Quarterly

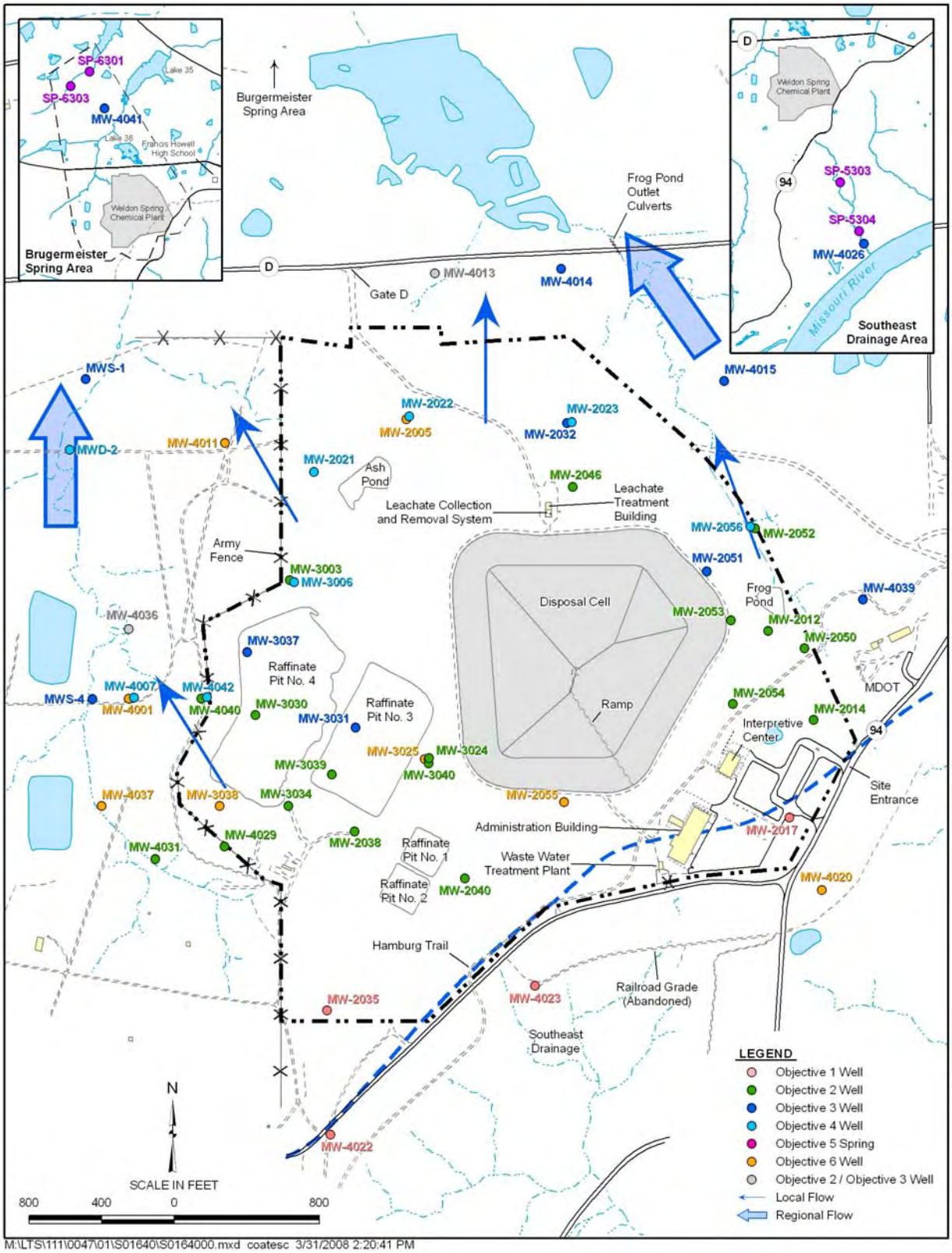

Figure 2–4. MNA Groundwater Monitoring Locations

2.7.2.1 Upgradient Monitoring Data Evaluation

Groundwater data from the upgradient locations will be compared with the previously collected data from each respective location. If a statistically significant increase (defined as a concentration that exceeds the mean plus three standard deviations for the previous eight data points) is measured, then an investigation of the data point's validity will be initiated. For those locations that are "nondetect," a statistically significant increase is considered to be the respective cleanup standard measured for two consecutive sampling periods.

2.7.2.2 Performance Monitoring Data Evaluation

Concentrations of COCs are expected to decrease to cleanup standards within a reasonable timeframe (i.e., 100 years). A long-term trend analysis will be performed to confirm downward trends in COCs over time. Performance will be gauged against these trends. Some locations are expected to show temporary upward trends due to ongoing dispersion, analytical variability, or other factors; however, concentrations are not expected to exceed historical maximums.

Concentration (annual averages)-versus-time graphs at each well would then serve as visual indicators of MNA progress. Given the variations in COC concentrations that have been observed in recent years at some monitoring locations, it is possible that multiple years may pass before clear indications of this local natural attenuation become obvious.

Though data from individual wells may not immediately provide conclusive evidence of natural attenuation, metrics based on average concentrations in specific contaminated areas would provide evidence of downward trends in contaminant mass. With this approach, the arithmetic weighted mean concentrations of a COC at all Objective 2 wells within a specific contaminated area and from a single sampling event could be graphed over time. As with individual wells, the respective measures of average concentrations would be expected to decrease as time passed.

The complex nature of groundwater flow and transport in the Chemical Plant area suggests that contaminant concentrations during the next few years will likely fluctuate in response to the temporally and spatially variable processes upon which MNA depends. For these reasons, it will be important to identify potential causes of data variability rather than prematurely concluding that natural attenuation is progressing rapidly or not progressing at all. To that end, knowledge of the numerous fate and transport processes that affect contaminant levels at the site will be crucial.

Examples of phenomena that have, in the past, caused relatively large fluctuations in COC concentrations include the subsurface disturbances resulting from pilot testing of enhanced remediation methods. In addition, anomalously large decreases in the concentration of nitroaromatic compounds during recent years at well MW-2012 in the Frog Pond area appear to be related to local land subsidence rather than the product of natural attenuation induced by dilution and dispersion. Similarly, the appearance of chemically reducing conditions in a well located north of the disposal cell (DOE 2005b) a few years ago, which resulted from the biodegradation of dead organic matter in the well, was determined to be a transient and anomalous phenomenon. Such occurrences and other occasional stresses on the groundwater

system, such as episodic recharges from large storms and the changes in aquifer chemical conditions that may result, should be anticipated.

2.7.2.3 Detection Monitoring Data Evaluation

Contaminants are expected to continue to disperse within known preferential flow paths associated with bedrock lows (paleochannels) in the upper Burlington-Keokuk Limestone and become more diluted over time. If a statistically significant increase (defined as a concentration that exceeds the mean plus three standard deviations for the previous eight data points) is measured, then an investigation of the data point's validity will be initiated. For those locations that are "nondetect," a statistically significant increase is considered to be the respective cleanup standard measured for two consecutive sampling periods.

Corresponding concentration (annual averages)-versus-time graphs at each well would then serve as visual indicators of MNA progress on a local scale. Given the variations in COC concentration that have been observed in recent years at some monitoring locations, it is possible that multiple years may pass before clear indications of this local natural attenuation become obvious.

2.7.2.4 Hydrologic Data Evaluation

Site hydrological conditions over time are being monitored using all the wells included in the MNA network (Objective 1 through 4 wells in addition to those well listed for Objective 6) in order to identify any changes in groundwater flow that might affect the protectiveness of the selected remedy. The static groundwater elevations of the monitoring network will be measured to establish that groundwater flow is not changing significantly and resulting in shifts in contaminant migration.

Groundwater elevations will be calculated and evaluated to verify that the groundwater flow directions and rates are sufficient to support the attenuation of the contaminants in the predicted timeframes. Also, groundwater flow direction will be evaluated against the IC boundary to verify that the restricted-use area is adequate.

2.7.2.5 Trigger Levels

Trigger levels were set for each contaminant in the performance and detection monitoring locations in the event that increases occur unexpectedly. There are two triggers for each COC. The first trigger is set at what would be a statistically significant increase in a contaminant concentration at a location. ("Statistically significant" has previously been defined as a concentration that exceeds the mean plus three standard deviations for the previous eight data points.) If this occurs, then an investigation of the data point's validity will be initiated.

The second trigger has been established as a fixed concentration that indicates unacceptable increases in contaminant concentrations either within the area of impact (Objective 2), outside the area of impact (Objectives 3 and 4), or at discharge points (Objective 5). The trigger levels are summarized in Table 2–5. The justification for the development of these triggers is summarized in the RD/RA work plan (DOE 2004b). Concentrations that exceed the second trigger level will invoke a more vigorous response.

Table 2–5. Trigger Levels for Performance and Detection Monitoring at the GWOU

Parameter	Objective 1[a]	Objective 2	Objective 3 (near)	Objective 3 (far)	Objective 4	Objective 5
Nitrate	Mean + 3sd	1,350 mg/L	30 mg/L	10 mg/L	20 mg/L	20 mg/L
Uranium	Mean + 3sd	100 pCi/L	50 pCi/L	20 pCi/L	40 pCi/L	150 pCi/L
TCE	Mean + 3sd	1,000 µg/L	15 µg/L	5 µg/L	10 µg/L	5 µg/L
2,4-DNT						
East Plume	Mean + 3sd	2,300 µg/L	1.1 µg/L	0.11 µg/L	0.22 µg/L	0.22 µg/L
West Plume	Mean + 3sd	5 µg/L	0.55 µg/L	0.11 µg/L	0.22 µg/L	0.22 µg/L
2,6-DNT	Mean + 3sd	2,000 µg/L	13 µg/L	1.3 µg/L	2.6 µg/L	1.3 µg/L
2,4,6-TNT	Mean + 3sd	500 µg/L	11.2 µg/L	2.8 µg/L	5.6 µg/L	2.8 µg/L
1,3-DNB	Mean + 3sd	20 µg/L	4 µg/L	1 µg/L	2 µg/L	1 µg/L
NB	Mean + 3sd	50 µg/L	34 µg/L	17 µg/L	17 µg/L	17 µg/L

[a]Mean + 3sd = mean of previous eight measured concentrations plus three standard deviations

2.7.2.6 Long-Term Data Evaluation

Every 5 years, the progress of the MNA remedy will be reviewed and documented. This review should be performed in conjunction with the CERCLA 5-Year Review for the Weldon Spring Site. This review should include trending analysis for the past 5 years of data.

As outlined in the RD/RA work plan (DOE 2004b), trend analysis will be performed on Objective 2 and 5 locations to confirm downward trends in contaminant concentrations over time. This review will also contain an assessment of the monitoring program, including locations and sampling frequency. In future years, the behavior of the contaminant concentrations will become more predictable. At that time, the monitoring frequency can be decreased. Also, as the natural attenuation progresses, some wells and springs will exhibit concentrations that fall below the cleanup level. As this happens, the continued monitoring of these wells will not be necessary. A justification for decreasing monitoring frequencies and deleting monitoring locations will be summarized in a report documenting the last 5 years of data.

2.7.3 Quarry Residuals OU

DOE implemented long-term monitoring at the quarry in October 2002. Monitoring is conducted in accordance with the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000a).

2.7.3.1 Monitoring Strategy

The major source of groundwater contamination was removed under the ROD for the Quarry Bulk Waste OU by removal of contaminated soil, debris, and surface water from the Quarry. The follow-on QROU ROD stipulated long-term groundwater monitoring with institutional controls (ICs). COCs in Quarry groundwater are uranium and the nitroaromatic compound 2,4-DNT. The QROU monitoring program has two primary objectives:

- Monitor uranium levels in groundwater south of Femme Osage Slough to verify that the groundwater is not impacted.

- Monitor contaminant levels within the area of groundwater impact north of the slough until they attain target levels, indicating negligible potential to degrade groundwater south of the slough.

ICs are also being implemented to prevent groundwater use in the quarry area north of the slough and to prevent disturbance of a naturally occurring reduction zone. The rationale and the design for long-term monitoring for the QROU are described in the *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit* (DOE 2000a). Inspection of institutional controls is outlined in Section 2.3.4.

Groundwater north of the slough contains elevated levels of uranium. Uranium levels south of the slough and in the area of production wells in the Missouri River Alluvium remain within the observed natural variation within the aquifer, ranging from 0.1 pCi/L to 14.3 pCi/L; an average background is 2.77 pCi/L (See Appendix A). DOE detected a maximum uranium level of 2,740 pCi/L north of the slough in 1999 and set an administrative target level of 300 pCi/L (representing a 90 percent reduction) as the remediation goal for the groundwater in the plume north of the slough. Uranium is attenuated through either precipitation as the groundwater passes through a geochemical reduction zone or adsorption onto aquifer materials. Modeling indicates that recharge from the area of impact north of the slough accounts for less than 1 percent of the total flow through the Missouri River Alluvium (DOE 2000a). Based on this, if the natural attenuation processes were to become ineffective and the uranium level north of the slough is at 300 pCi/L (the administrative target level), the potential increase of uranium levels in the well field would not be greater than 3 pCi/L. For groundwater south of the slough, if monitoring indicates uranium concentrations to exceed the maximum contaminant level of 20 pCi/L, DOE will evaluate risk and take appropriate action (see Section 2.9.1.3, "Quarry Residuals OU").

North of the slough, 2,4-DNT has been detected consistently at one location in concentrations exceeding the Missouri State Water Quality standard of 0.11 µg/L. Sporadic detects less then 0.11 µg/L have been detected at five other locations since 2002. Concentrations have generally decreased since completion of bulk waste removal activities from the Quarry. The target level for 2,4-DNT has been set at the Missouri State Water Quality standard.

2.7.3.2 Monitoring Locations

The Quarry groundwater monitoring well network consists of wells arrayed in four "lines" between the Quarry and the production wells in the Missouri River Alluvium (Figure 2−3). The first and second lines are established to monitor the effect of residual Quarry contaminants on groundwater quality within the alluvium and shallow bedrock north of Femme Osage Slough. The third line, consisting of wells completed in the alluvial aquifer south of the slough, is monitored to provide early warning of contaminant migration across the reduction zone and toward the well field. The fourth line of wells is completed in the same portion of the aquifer from which the production wells withdraw water. The purpose of the fourth line wells is to monitor water quality in the alluvial aquifer and monitor for occurrence of uranium at concentrations outside the range of natural variation.

Starting in 2007, a limited number of wells were monitored for 2,4-DNT. It was determined that only three locations had detectable concentrations since 2005. During the CERCLA Five-year Review (DOE 2006), it was recommended that these three locations continue to be monitored to

fulfill the required monitoring for 2,4-DNT. In conjunction with these three locations, five other locations will be included.

2.7.3.3 Monitoring Program

Parameters to be monitored include uranium and six nitroaromatic compounds at identified locations (primarily 2,4-DNT) (Table 2−6) Geochemical parameters are also being measured (Eh [oxidation-reduction potential], sulfate, total dissolved iron, and iron oxidation state) to monitor the geochemical properties for the reduction zone and confirm that the reduction zone is capable of ongoing attenuation of uranium in groundwater. These results should correlate with observed uranium concentrations upgradient and downgradient of the reduction zone.

Monitoring frequencies were established to (1) provide adequate warning of contaminant migration, taking into account travel times from known plume locations to critical locations immediately upgradient of the well field; and (2) provide data adequate for valid statistical analysis of groundwater conditions. Aquifer hydraulic characterization results indicate that groundwater travel time from north of the slough to immediately south of the slough is approximately 1 year. Travel time between Lines 3 and 4 is slower because of a lower hydraulic gradient (DOE 2000a).

2.7.3.4 Data Analysis and Interpretation

North of the slough, data from wells in Lines 1 and 2 will be analyzed to demonstrate that the target levels for uranium and 2,4-DNT are attained. Data analysis will be conducted in accordance with methods described in *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Groundwater* (EPA 1992). Monitoring objectives are met when the target levels of 300 pCi/L and 0.11 µg/L for uranium and 2,4-DNT, respectively, are not exceeded at the 90th percentile in a 12-month monitoring period, and trend analysis indicates that contaminant levels are decreasing. If either contaminant meets these criteria, monitoring of that contaminant can be discontinued.

South of the slough, uranium levels will be compared to the EPA maximum contaminant level of 20 pCi/L. If elevated uranium levels are detected, DOE will implement the contingency actions presented in Section 2.9.1.3, “Quarry Residuals OU.”

2.7.4 Other Environmental Monitoring

DOE has decided to implement sampling at areas that have historically shown impact from site operations or source areas. This additional monitoring is not required under any of the remedies for the GWOU or QROU.

Table 2–6. Groundwater Monitoring Program for the Quarry at the Weldon Spring, Missouri, Site

Line	Wells	Analytes			Frequency
		Uranium	2,4-DNT	Geochemical Parameters	
1	MW−1002	➨	➨	➨	S
	MW−1004	➨	➨	➨	
	MW−1005	➨	➨	➨	
	MW−1012[a]	➨		➨	
	MW−1027	➨	➨	➨	
	MW−1030	➨		➨	
2	MW−1006	➨	➨	➨	Q
	MW−1007	➨		➨	
	MW−1008	➨		➨	
	MW−1009	➨		➨	
	MW−1013	➨		➨	
	MW−1014	➨		➨	
	MW−1015	➨		➨	
	MW−1016	➨		➨	
	MW−1028	➨		➨	
	MW−1031	➨		➨	
	MW−1032	➨	➨	➨	
	MW−1045	➨	➨	➨	
	MW−1046	➨		➨	
	MW−1047	➨		➨	
	MW−1048	➨		➨	
	MW−1049	➨	➨	➨	
	MW−1051	➨		➨	
	MW−1052	➨		➨	
3	MW−1017	➨		➨	S
	MW−1018	➨		➨	
	MW−1019	➨		➨	
	MW−1021	➨		➨	
	MW−1044	➨		➨	
	MW−1050	➨		➨	
4	RMW−1	➨		➨	A
	RMW−2	➨		➨	
	RMW−3	➨		➨	
	RMW−4	➨		➨	

Geochemical parameters: sulfate, total iron (filtered), iron (2+), and Eh
S = semiannual Q = quarterly A = annual
[a]Upgradient location (filtered)

2.7.4.1 Femme Osage Slough Monitoring

DOE backfilled the Quarry and graded the surface to create positive drainage. Therefore, surface water will not accumulate within the Quarry. Surface water monitoring is not required as part of remedy for the QROU; however, DOE will monitor surface water for uranium at four locations along Femme Osage Slough, as shown on Figure 2–5. These locations are sampled semiannually. During high groundwater levels, this portion of the slough is recharged by groundwater from north of the slough.

2.7.4.2 Busch Lake and Creek Monitoring

Busch Lakes 34, 35, and 36, Schote Creek, and Dardenne Creek are sampled annually for uranium. This monitoring is not part of the Chemical Plant or Groundwater Operable Unit remedies. These locations are monitored to measure the effects of groundwater and surface water discharges from the site on the downstream water quality.

2.7.5 Disposal Cell LCRS Monitoring and Operation

The LCRS requires periodic monitoring to ensure the system is functioning as designed and sump capacity is not exceeded. Monitoring will indicate if the secondary leachate collection system is collecting leachate, either as a result of primary liner leakage or from another source. Liquid levels in the secondary sump containment must be monitored. DOE will remove and dispose of leachate at a frequency sufficient to prevent leachate volume from reaching the maximum capacity of the sump. Section 303(c) of 40 CFR 264 (which is relevant and appropriate to this activity) requires that after the final cover is installed, the amount of liquids removed from the sump be recorded at least monthly. If the liquid level in the sump stays below the pump operating level for two consecutive months, the amount of liquids in the sump must be recorded at least quarterly. If the liquid level in the sump stays below the pump operating level for two consecutive quarters, the amount of liquids in the sump must be recorded at least semiannually. If at any time during the postclosure care period the pump operating level is exceeded on quarterly or semiannual recording schedules, the recording of amount of liquids must return to monthly until the liquid level again stays below the pump operating level for two consecutive months. “Pump operating level” for the Weldon Spring Site is defined as the maximum amount of liquid in the sump, which equals 11,200 gallons. Leachate production rates, analytical results, and disposal records will be summarized in the annual report. Monitoring and operating procedures are specified in Appendix I.

Leachate level and flow rates will be monitored and recorded weekly at the outset. As a reliable database is generated, DOE may modify the sump level monitoring frequency in accordance with regulations in 40 CFR 264.303(c) which requires only monthly and then quarterly flow recording. Flow rates will be reported in units of gallons per day and compared to the action leakage rate of 100 gallons/acre/day established for the leachate collection system. See Section 2.9.2.2, “Action Leakage Rate” for more information regarding the action leakage rate.

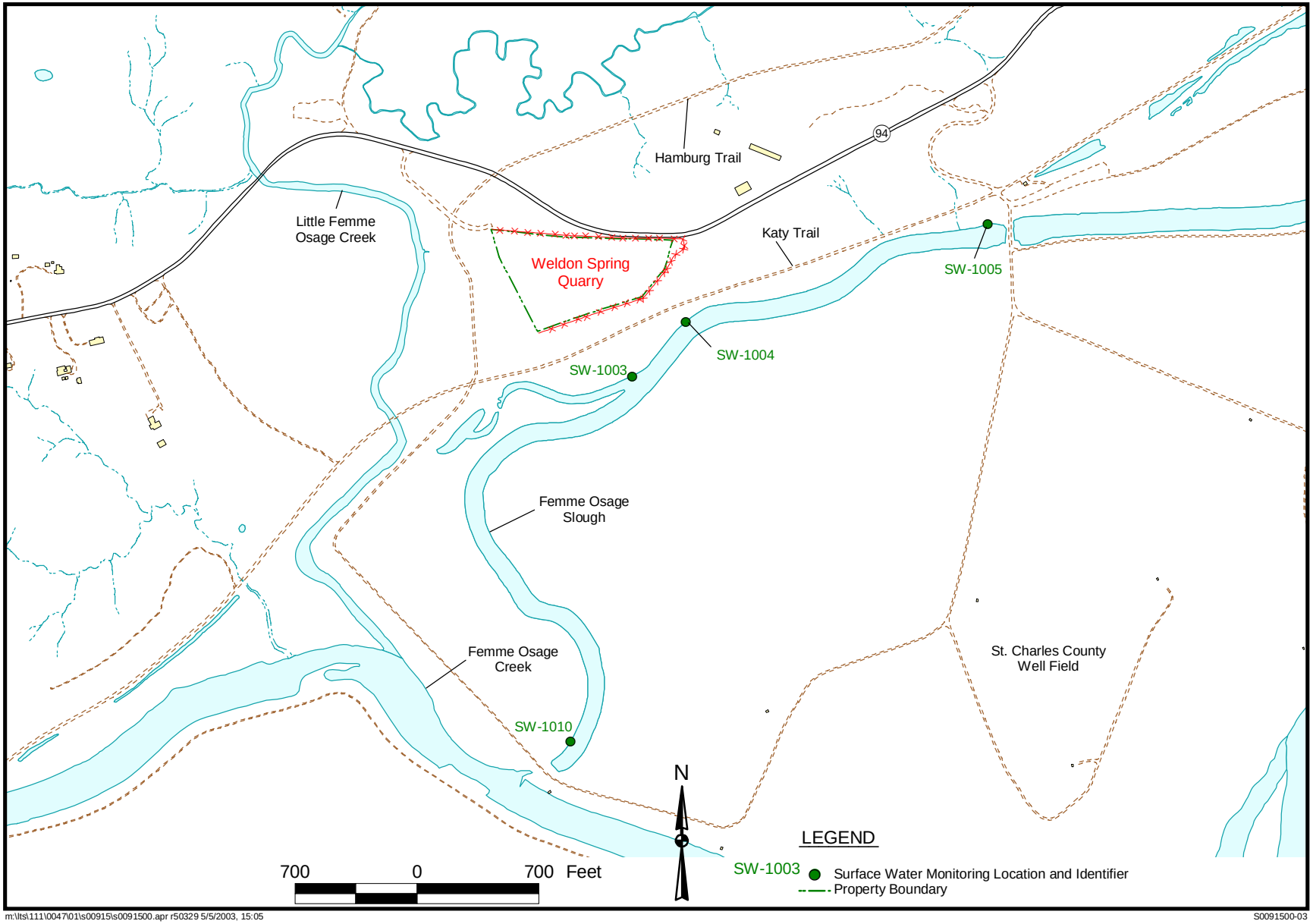

Figure 2–5. Surface Water Monitoring Locations at the Quarry Area of the Weldon Spring, Missouri, Site

During 2006 and 2007, discharge from the primary leachate collection system has generated approximately 135 gallons per day and 119 gallons per day, respectively. The combined leachate from the secondary leachate collection system has averaged approximately 12 gallons per day for 2006 and 10.8 gallons per day for 2007. The average leak rate for the secondary leachate collection system for 2006 and 2007 has been approximately 0.48 gallon/acre/day, significantly less than 1 percent of the action leakage rate (100 gallons/acre/day). This is a result of superior design and construction, as well as operational controls that optimized the moisture content of the compacted soil waste.

2.7.5.1 Leachate Chemistry Monitoring and Disposal

The leachate has been sampled quarterly since generation for an extensive list of chemical and radiological constituents. Beginning in calendar year 2003, the leachate has been sampled semiannually in accordance with Appendix K "Disposal Cell Groundwater Monitoring Plan." The list of analytes is included in the plan. As needed, the leachate is pumped from the sump and transported to the Metropolitan St. Louis Sewer District (MSD) for treatment in their Bissell Point wastewater treatment facility. The approval letter from MSD and subsequent amendments to that letter are included in Appendix I. A sample of leachate is collected and analyzed in accordance with MSD requirements for each hauling event (Appendix I). DOE has an allocation of 0.15 millicuries per year of radioactivity and 25,000 gallons per month (gpm). Leachate uranium activity during 2002 typically was 50 pCi/L, which is equivalent to an annual radioactivity of approximately 0.02 millicuries. The 2004 through 2007 uranium data have shown variable levels between 13 and 26 pCi/L.

DOE received notification in April 2004 that the leachate must meet the radiological drinking water standard of 30 µg/L (20 pCi/L) prior to acceptance. The disposal cell leachate was very close to this limit in 2004; therefore DOE exercised a pretreatment contingency process and began treating the leachate through a system of cartridge filters and ion exchange media that is selective for uranium. The leachate was sampled after treatment and found to be significantly below the 30 µg/L limits for uranium. DOE requested and received approval to raise the allocation of 15,000 gpm to 25,000 gpm. The disposal cell is not generating any additional leachate, but the increased volume limit provides added operational flexibility related to the pretreatment options and hauling.

2.7.6 Air Monitoring

Because radioactive and asbestos waste handling operations were complete, and waste was encapsulated in the disposal cell, DOE halted air monitoring at the site perimeter and at off-site locations for radon-222, thoron (radon-220), and particulates in 2000. Radon flux measurements collected on the first foot of the 3-foot-thick layer of the radon barrier averaged less than 5 percent of the regulatory limit of 20 pCi per square meter per second (DOE 2001a). Therefore, no postclosure radon monitoring is required.

2.8 Regulatory Compliance Monitoring

At the time of the routine site inspection, DOE will evaluate the degree of compliance with regulations governing surveillance and maintenance activities at the Weldon Spring Site. Those regulations are specified in Section 1.5, “Current Regulatory Requirements.”

An evaluation of regulatory compliance may be required at other times as well, in response to unusual or nonroutine occurrences. The results of this monitoring will be presented in the annual report. However, if DOE identifies instances of noncompliance that necessitate corrective action, DOE will inform EPA and MDNR of site conditions as soon as they are assessed.

2.9 Emergencies, Contingency Planning, and Corrective Action

Emergency measures are the actions DOE will take in response to "unusual damage or disruption" that threatens or compromises site safety or security, such as exposure or release of cell contents. DOE will contain and manage radioactive or hazardous materials that are the responsibility of DOE in the unlikely event such materials are discovered or released. Certain circumstances may arise during the surveillance and maintenance phase of the Weldon Spring Site that require implementation of contingency actions. To the extent these actions can be anticipated and planned for (e.g., the Quarry well field contingency plan), they have been incorporated into RODs and RD/RA workplans. Unanticipated contingency actions will be subject to CERCLA processes prior to implementation. Certain options under CERCLA, which will be evaluated, include emergency or time-critical actions, IRAs, and changes or amendments to the RODs. DOE is responsible for any future hazards posed by releases from or at the Site and to revise the LTS&M Plan appropriately in light of any additional or revised cleanup required under the terms of the FFA.

Site inspections, monitoring, and maintenance activities are designed to identify potential problems before they develop into a need for corrective action. However, in the unlikely case that extreme natural events, vandalism, or unanticipated events threaten the integrity and operation of the disposal cell, corrective actions that could include temporary emergency measures will be carried out to mitigate the problem. In addition, DOE will evaluate the factors that caused the problem and ensure that the possibility of recurrence is minimized or avoided.

DOE will notify EPA, MDNR, and St. Charles County as soon as an emergency situation is known to exist. The Missouri Department of Health and Senior Services will be notified, if appropriate. Emergency contact information will be maintained in Appendix F of this plan. DOE also will maintain a listing for local DOE contact phone numbers in the local telephone directories.

As soon as practical after initial emergency response notifications have been made and appropriate measures have been initiated, the following stakeholders will be notified of the situation: MoDOT (local), MDC (local), Francis Howell High School, and Francis Howell School District. A listing of these emergency notification contacts also will be maintained in Appendix F.

The St. Charles County Sheriff’s office will be contacted annually as part of the annual inspection to maintain contact and to determine if they have any concerns or issues regarding the

Site. It also will be verified that they have an updated emergency contact list and phone numbers for the Site.

A procedure is in place that requires the U.S. Geological Survey National Earthquake Center to provide email notification to DOE when an earthquake of magnitude 3.0 or greater occurs within 20 miles of the Site.

The public may use the 24-hour security telephone numbers monitored at the DOE office in Grand Junction (970-248-6070 or 877-695-5322), or the telephone number for local site support personnel (636-300-0012) to notify DOE of site concerns.

For the purposes of this plan, corrective action refers to specific occurrences listed below. Minor problems, such as filling potholes, repairing drainage structures, and repairing monitoring equipment, are completed under normal site maintenance procedures. Occurrences that require corrective action generally will be those that indicate a potential release of contamination from the disposal cell or otherwise threaten the health and safety of the public or the environment.

Occurrences that may require corrective action include, but are not limited to:

- Concentration limits exceeded or sustained upward trends at monitoring locations.
- Damage to the disposal cell that could potentially allow release of contamination and/or threaten the health and safety of the public or the environment.
- Excessive leachate production in the disposal cell.
- Rapid headward erosion of nearby drainages.

2.9.1 Groundwater Contingency Actions

2.9.1.1 Disposal Cell Groundwater Corrective Action

If it is determined that leakage from the disposal cell has resulted in deterioration of the groundwater at the Chemical Plant, a review of the remedy will be necessary. This is based on the condition that the remedy is not behaving as expected and may no longer be protective of human health and the environment. Modifications or actions would be documented under CERCLA and would be consistent with RCRA 40 CFR 264.100. At this time, a modification of this program would be documented in collaboration with EPA and MDNR.

2.9.1.2 Groundwater OU

The monitoring program has been developed to recognize any of the following observations that could lead to reconsideration of the remedy:

- A sustained upward trend in contaminant concentration in groundwater or springwater, indicating that undiscovered sources may be present;
- Trends in contaminant concentrations that are inconsistent with meeting cleanup goals within a reasonable timeframe; or
- Significant increases in the areal or vertical extent of contamination, resulting in new impacts to adjacent (both horizontal and vertical) unimpacted groundwater systems.

Trigger concentrations (see Table 2−5) have been assigned at appropriate locations as indicators of changed conditions or of having a potential for impact outside those areas where migration is expected to occur (i.e., paleofeatures). Responses will range from data verification and increased monitoring to reevaluation of MNA timeframes. Decision trees have been developed for each monitoring program (Appendix M) that outline courses of action for exceeding trigger levels.

In the event that recalculation of the MNA timeframes is required, the methodology to be used is presented in the *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004b). The original calculations were based on a larger set of wells than the set used to monitor MNA. Collection of data from nearby existing wells will be necessary to complete this task; therefore, it is not expected that recalculation will be performed routinely as a performance measure of MNA.

Should an alternative to MNA be needed, it will be implemented in accordance with the CERCLA process for post-ROD changes. If the remedy requires immediate action, a time-critical removal will be considered. Alternatives other than MNA will be reevaluated and will include in-situ chemical oxidation (ICO) as well as other treatment or containment technologies that may be available in the future.

2.9.1.3 Quarry Residuals OU

Groundwater from the Public Water Supply District #2 (formerly St. Charles County) well field located in the Missouri River Alluvium south of the Slough is used for residential purposes. Monitoring data indicate that uranium concentrations in this area are within the range of background concentrations for the Missouri River alluvium. Because removal of major sources of contamination has been completed, no significant amounts of additional contaminants should be introduced into the groundwater system. However, because of the presence of uranium in groundwater north of the slough, contingency actions have been considered in the event that uranium concentrations increase or uranium from the Quarry is observed in groundwater south of the slough.

During bulk waste removal activities, a well field contingency plan (DOE 1992) was prepared to address concerns about the protection of the well field in the event contaminants were mobilized due to remedial actions. The monitoring and contingency action portions of the contingency plan have been incorporated into this LTS&M Plan. If an alternate source of drinking water is required, engineering design and construction will proceed based on the design criteria that was presented in the contingency plan (Appendix L). The contingency plan also outlined the preliminary planning and preparation that will be necessary to implement the construction of new wells in the existing well field or a partial or full replacement well field.

If a consistently upward trend in uranium or 2,4-DNT concentrations is observed for three consecutive sampling events in the groundwater north or south of the slough, DOE will investigate the contaminant source and transport mechanism. This may include conducting hydrogeologic and geochemical investigations, installing additional monitoring wells, or increasing sampling frequency of the monitoring network.

If uranium concentrations in groundwater south of the slough exceed the trigger level of 20 pCi/L, DOE will notify EPA Region VII, MDNR, and Public Water Supply District #2

(formerly St. Charles County) as soon as the condition is confirmed. Confirmation may include reanalyzing samples, if possible, or resampling the locations in question and other potentially affected locations and submitting the samples to analytical laboratories for expedited analysis.

If the elevated uranium concentration is valid, DOE will reevaluate the potential for impacts to the well field and the alluvial aquifer. This evaluation may include

- Increasing the frequency of sample collection.
- Performing hydrogeologic and/or contaminant transport investigations to identify migration pathways.
- Installing additional monitoring wells.
- Conducting groundwater modeling to predict long-term impacts.
- Conducting a risk evaluation consistent with methods outlined under CERCLA.
- Determining the need for and feasibility of groundwater remediation.
- Installing new production wells in the existing well field, or partial or full replacement of the well field in an alternate location.

2.9.2 Disposal Cell Contingency Actions

2.9.2.1 Leachate Contingency Treatment

Prior to obtaining approval to dispose of leachate at an offsite regional water treatment system, DOE designed a dedicated water treatment plant (referred to as Train 3) to decrease manganese and uranium levels. DOE constructed a treatment building and installed some of the required equipment. The plant was not completed as an automated system, but DOE will modify the equipment to function as a manually operated treatment system, if the current LCRS operation (see Section 2.7.5) is changed. The circumstances that could lead to the use of the contingency treatment system include changes to the MSD discharge agreement or analysis of the operating system demonstrates a need for change. As discussed in Section 2.7.5.1, the current system uses ion exchange resin columns to reduce uranium.

If the contingency plan is implemented the treated leachate will be sampled before discharge. Leachate will be pumped into a dedicated pipeline and discharged to the Missouri River at National Pollutant Discharge Elimination System (NPDES) Outfall 007 in accordance with DOE's NPDES permit (Appendix I). DOE will maintain the NPDES permit for the discharge point (outfall) of the discharge line, for possible future use.

The *LCRS/Train 3 Treatment Contingency Plan* is included as Appendix J (see also the *Leachate Collection and Removal System Operating Plan* in Appendix I).

2.9.2.2 Action Leakage Rate

As outlined in the Notice of Final Rulemaking, *Federal Register* Volume 57, Number 19, dated January 29, 1992, EPA recommends 100 gallons/acre/day for land disposal units meeting the minimum required design specifications. However, the final rule allows the owner/operator to calculate an action leakage rate based on site-specific design of the unit. The calculated action leakage rate should be based on calculations of the maximum flow capacity of the leak

detection system so as not to exceed one foot head on the bottom liner. Based on the site specific design, the calculated action leakage rate for the Weldon Spring Site disposal cell is 2,640 gallons/acre/day. For the 26.5-acre waste footprint within the disposal cell, this converts to 69,960 gallons per day. As a more practical number, DOE agreed to use the recommended 100 gallons/acre/day as the action leakage rate for the disposal cell. The actual combined secondary flow rates recorded at the end of December 2002 were less than 1 gallon/acre/day (100 times less than the action leakage rate). The average flow rates for 2003 were approximately 0.6 gallon per acre per day and reduced to approximately 0.5 gallon/acre/day in 2006 and 2007.

In accordance with EPA regulations (40 CFR 264.304), if the action leakage rate is exceeded, DOE will notify EPA and MDNR within 7 days of the determination. A preliminary written assessment of the determination will be submitted within 14 days and will include amount of liquids, likely sources of liquids, and possible location, size, and cause of any leaks, and short-term actions taken and planned. Other actions to be taken will be to:

- Determine any other short-term and longer-term actions to be taken to mitigate or stop any leaks.
- Submit to EPA and MDNR, within 30 days after the original notification, results of the above actions taken and the actions planned. DOE will continue to submit this report monthly to EPA and MDNR as long as the flow rate exceeds the action leakage rate.

To make the above determinations DOE will

- Assess the source of liquids and amounts of liquids by source.
- Conduct a fingerprint, hazardous constituent, or other analysis of the liquids in the leak detection system to identify the source of liquids, possible location of any leaks, and the hazard and mobility of the liquid.
- Assess the seriousness of any leaks in terms of potential for escaping into the environment.

DOE has considered possible events involving the disposal cell that may require response actions. A summary of event scenarios and corresponding response actions is provided in Table 2−7. If a trigger is met, DOE will notify authorities in accordance with Section 2.9, “Emergencies, Contingency Planning, and Corrective Action.”

Table 2–7. Potential Disposal Cell Event Scenarios for the Weldon Spring, Missouri, Site

Event Scenario	Response Action
Biointrusion**,** consisting of unwanted, deep-rooted plants invading the cover, or burrowing animals that could compromise proper functioning of the rock cover, drain layer, or radon/infiltration barrier. The riprap rock cover acts as a biointrusion barrier to discourage these occurrences. If the biointrusion accelerates a breakdown of the rock cover, it may not provide sufficient protection against erosion. If the drain layer becomes clogged with plant roots, it may not function properly (drain laterally) and may cause a head buildup with a resulting greater infiltration through the radon/infiltration barrier. Full penetration of the radon/infiltration barrier could result in potential radon emissions or an overall increased infiltration rate through the cover.	Annual maintenance will include spot application of an approved herbicide to kill observed vegetation on all rock-covered surfaces of the cell and the cell perimeter road. Dead vegetation will not require removal. Burrowing animals within the cell footprint will be removed in accordance with an approved method. If penetration of the composite liner (geomembrane) has occurred, the damage to the cover material will be evaluated. If necessary, the liner will be repaired using similar materials and construction practices, provided an assessment of the problem does not indicate a design flaw. If the radon/infiltration barrier has been fully penetrated, the barrier will be repaired. Air monitoring for radon emissions may be used to evaluate the effect of biointrusion on the radon barrier. Monitoring stations will be established on the disposal cell and at the project boundaries. If a repair is made, air-monitoring stations will be added in the work zone. Monitoring will continue through the response action period until it is determined that the potential for radon exposure is controlled. Monitoring frequency for leachate production rate and chemistry may be increased following discovery of the problem.
Degradation of Radon/Infiltration Barrier performance could result from rupture due to differential settlement caused by unexpected deterioration in the waste or cracking from drying of the medium- to high-plasticity clays. The possibility of these scenarios occurring is remote because controlled waste placement limits differential settlement, and the thick layer of rock cover materials over the radon/infiltration barrier reduces the potential for drying. Some desiccation cracking is expected in the radon/infiltration barrier in the bentonite in the geomembrane, but this should be limited to near the surface of the barrier. In addition, the ability of the clayey radon/infiltration barrier to deform plastically allows the disposal cell to accommodate some settlement beyond design- predicted values.	If settlement is observed during an inspection or indicated in evaluation of aerial topographic maps, and the observed settlement might result in ponding or degraded radon/infiltration barrier performance, a professional engineer will perform an analysis to evaluate the potential for reduced performance of the barrier with regard to radon attenuation and resistance to infiltration. If the engineering evaluation indicates that the observed settlement has the potential to degrade performance of the radon barrier, monitoring for radon emissions will begin at the suspected areas, and leachate production rates and monitoring results will be evaluated. An evaluation of these data will determine if repair of the radon/infiltration barrier is necessary.
Erosion of the Rock-Covered Areas may be caused by slope failure, disruption of the riprap rock armor, or concentrated flows leading to headward cutting and gully formation. If allowed to continue, subsequent erosion of the radon/infiltration barrier may occur.	Should the area of erosion-altered riprap cover exceed 30 ft in length and 3 inches deep, and evaluation indicates a threat to containment integrity, DOE will repair the cover by replacing materials. Repairs of smaller erosional features may be deferred; however, monitoring frequency will double. The root cause of the erosion (e.g., storm, snowfall, extreme temperatures, earthquake event, human intervention) will be analyzed, and appropriate measures will be taken to mitigate the mechanism causing the erosion.

Table 2−7 (continued). Potential Disposal Cell Event Scenarios for the Weldon Spring, Missouri, Site

Event Scenario	Response Action
Erosion of the Site Outside the Disposal Cell may occur as rilling or gullying in areas constructed for sheet flow drainage. Rilling is the development of numerous, minute, closely spaced channels resulting from uneven removal of surface soil by streamlets of sufficient discharge and velocity to generate cutting power. If concentrated flows continue, rilling can progress into gullying with associated headward (upstream) cutting. Gullying can occur in areas of concentrated flow such as drainage channels. To prevent this, the final site grading minimizes any concentrated flows and promotes sheet flow. In addition, vegetation and rock armor are used to reduce surface erosion.	Should observed erosional damage threaten cell system integrity or create off-site sediment transport, a repair to the surface will be made. Repairs of smaller erosional features may be deferred; however, monitoring frequency will double. Erosion features oriented toward the disposal cell will require prompt repairs. Methods and materials used in the repair may include regrading, revegetating, erosion mats, rock armor, etc. The cause of the erosion (e.g., storm, snowfall, vegetative growth, human intervention) will be analyzed, and appropriate measures will be taken to mitigate the mechanism causing the erosion.
Rock Cover Deterioration may occur over time as a result of physical and chemical weathering of the limestone cobbles and boulders. Accelerated chemical weathering of the rock can occur if slightly acidic rainwater reacts with the limestone and dissolves the rock. Accelerated physical weathering can occur if the rock has abundant fractures that, after becoming saturated, are exposed to freezing conditions. This causes the water in the fractures to expand and mechanically break the rock apart.	If the percentage of degraded rock appears to increase between two consecutive inspections, DOE may initiate controlled monitoring by point count, photography, gradations, or other method. If controlled monitoring indicates that the median diameter (D_{50}) of the rock may be approaching the threshold levels (see below), DOE will conduct an engineering evaluation to determine if rock degradation has or is expected to reduce erosion protection to less than one half of a 24-hour probable maximum precipitation event. If the gradation for the area is still within initial specifications, the area will continue to be monitored as recommended by a professional engineer. Degraded rock may be replaced under the following conditions: • The D_{50} of the cell cover rock inside the parietal line halfway between the cell apex and the slope break equals 3 inches. • The D_{50} of the remaining cell cover rock inside the slope break line equals 4 inches. • The D_{50} of the rock in the clean fill dike slopes, except the north slope, equals 4 inches. • The D_{50} of the rock in the north clean fill dike slope equals 6 inches. • The D_{50} of the toe apron rock equals 6 inches.
Abnormal Functioning of the LCRS may be potentially caused by the following factors: • *Cover damage or reduced lateral drainage in the cover drainage layer*. Damage to the cover from biointrusion or settlement is discussed above. Reduced lateral drainage in the cover drainage layer may increase the head above the radon/infiltration barrier and result in increased infiltration through the barrier. • *Clogging and reduced flow capacity in the drain piping system.* In the event of clogging of the LCRS drains, a secondary gravel drainage channel is available to prevent leachate buildup in the waste. • *Increase in the permeability of the supporting liners.* Progressive failure due to deterioration of the liners is accounted for in the normal operation during the long and very long term by designing the cell to function as if no synthetic liner is present. A 3-foot-thick compacted clay liner and at least 20 ft of unsaturated low-permeability soils below the LCRS will severely limit vertical migration of any seepage resulting from failure of the LCRS and will function as a geochemical barrier.	If the leachate collection rate increases significantly in the primary system, an evaluation of the cover (including lateral drainage in the drainage layer similar to biointrusion or settlement scenarios) will be implemented. If clogging of the LCRS piping is suspected, measured steps will be taken to isolate and clean out the affected area. If the action leakage rate is exceeded in the secondary system, actions will be taken in accordance with 40 CFR 264.304. These actions are discussed in Section 2.9.2.2, “Action Leakage Rate.”

2.10 Permit and Agreement Administration

Certain permits and agreements will be required for DOE to carry out its surveillance and maintenance activities at the Weldon Spring Site. These instruments are summarized in Table 2−8. DOE will keep these current, comply with their conditions, and terminate them when they are no longer needed. Other agreements that are part of a selected remedy are discussed as ICs. When implemented, ICs such as easements, may supercede access agreements.

Table 2–8. Permits and Agreements for the Weldon Spring, Missouri, Site

Type	Party	Description
Approval Authority	MSD	Approval to allow hauling and discharge of the leachate and monitoring well purge water to the Metropolitan St. Louis Sewer District.
NPDES Permit (MO-0107701)	MDNR	Allows surface discharge of treated leachate and well purge water as a contingency.
Federal Facility Agreement (CERCLA-07-2006-0161)	EPA, MDNR	Enforceable agreement with EPA and MDNR focusing on long-term management activities at the site.
Consent Agreement (95-HW-000)	MDNR	Site Treatment Plan for the treatment of Mixed Waste that is stored for longer than one year.
Access Agreement	MDNR	To allow vehicles access on the Katy Trail.
Monitoring Well Registrations	MDNR	Required for existing monitoring wells.

MDNR = Missouri Department of Natural Resources
MSD = Metropolitan St. Louis Sewer District
NPDES = National Pollutant Discharge Elimination System

2.11 Budget and Funding

DOE will request adequate funds to maintain the remedies specified in the RODs for the site. DOE will be appropriated funds to conduct long-term surveillance and maintenance at the Weldon Spring Site as part of an annual Congressional appropriation.

The fundamental performance criteria for the Weldon Spring disposal facility were reliable controls on the waste, including redundant cap, bottom liner, and leachate removal systems, which were to be effective for 1,000 years, to the extent reasonably achievable, but for at least 200 years. Some component systems, such as the synthetic materials, were believed to degrade more quickly than the natural materials.

Designing for longevity of the disposal cell was accomplished be relying on redundant synthetic and natural materials. The bottom liners consist of a recompacted 3-ft-thick clay liner, underlain by at least 20 ft of extremely low permeability clay. The LCRS is composed of a double synthetic liner system, a highly transmissive synthetic drainage net, and highly transmissive sand materials. The LCRS drains by gravity through synthetic pipes to a synthetic sump, but these systems have redundant natural drainage materials surrounding them so that in the event of failure of the synthetics, the disposal cell leachate will continue to have a natural drainage flowpath out of the cell. Similarly, the cap systems integrate both synthetic liners and natural materials including compacted clay, drainage sands and gravel, and oversized riprap. Due to the long lifecycles of these natural materials, it is not necessary to include replacement costs in the annual budget estimate.

Groundwater monitoring wells are estimated to last 30 years or longer and, due to the staggered dates of installation, an annual amount for repairs and replacement of one well per year has been included in the annual budget. Whether a well requires replacement in a given year is subject to an evaluation triggered initially by its age or performance issues indicative of problems (e.g., poor recovery, high turbidity, changes in water elevations). Actual well replacement may occur in groups rather than individually for cost efficiency, but the criteria is to maintain, replace, and optimize the well network to support the long-term nature of the remedies.

Approximate total funding to implement the surveillance and maintenance program described in the LTS&M Plan is estimated in 2005 dollars (Table 2−9). Additional funds are available to complete site restoration and implement the final GWOU ROD and the 2005 Explanation of Significant Differences. Costs for prairie maintenance and leachate disposal should decrease over the next 10 years. Contingency funds, if needed, will be drawn from Congressionally appropriated funds.

2.12 Records and Data Management

Site surveillance and maintenance records are maintained at the DOE office in Grand Junction. These records have been selected because they contain critical information needed to ensure the continued management and the follow-on actions and controls (including property management) required to protect public health and the environment and to demonstrate compliance with applicable legal requirements. This surveillance and maintenance record collection does not include information pertaining to employee or public health and safety issues with respect to former site operations. It is planned to review and revise records and data management procedures on a regular basis to make sure current procedures and technologies are employed. The record preservation practices described in this section do not necessarily describe all of DOE's obligations under CERCLA and the FFA, which includes the archiving of historical site records.

Table 2–9. Estimated Annual Funding Requirements for Long-Term Surveillance and Maintenance of the Weldon Spring, Missouri, Site—Base Year Fiscal Year 2005

Item	Estimated cost
Labor and Travel	$759,000
Staff Interpretive Center Prepare routine and annual reports Review/validate environmental data Manage leachate Overall site management	
Supplies, Services and Equipment	$550,000
Sample collection Sample analysis Maintenance for monitoring wells, roads, erosion repairs, prairie	
Other Participants	$125,000
Grantees and other direct-to-DOE technical assistance	
Total (FY 2005)	$1,434,000

Note: All contractor costs are fully burdened with project support overhead, General and Administrative (G&A) expenses and fee. Costs of government employee labor and travel are not included. Monitoring well replacement will be scheduled periodically rather than annually and budgeted accordingly.

Access and Retrieval—The records at the DOE office in Grand Junction are available to the site custodian as well as all stakeholders. Key site documents (e.g., closure reports, environmental assessments, fact sheets, RODs, inspections, and long-term surveillance plans) and site mapping/environmental data (e.g., boundaries, structures, and wells) are viewable on the Internet at http://www.lm.doe.gov/land/sites/mo/weldon/weldon.htm.

In addition, DOE will maintain local access at the Weldon Spring Site Interpretive Center and at the Middendorf-Kredell branch of the St. Charles City-County Library System to selected site documents.

The local surveillance and maintenance documents available at the Interpretive Center will include the following (only those documents marked with an asterisk will be maintained at the library):

- The Administrative Record (includes documents supporting site remedy selection).
- *The Administrative Record indices.
- *RODs for the Chemical Plant OU, Groundwater OU, Quarry Bulk Waste OU, and Quarry Residuals OU.
- The Explanation of Significant Differences
- Closure reports documenting final site conditions.
- Site atlas (vicinity, topographic, and base maps).
- *The LTS&M Plan (this document).
- DOE real property records, including legal descriptions for DOE-owned property.
- Baseline and aerial photographs.
- Groundwater monitoring reports.
- *Annual reports.
- *5-Year review reports.
- Follow-up or contingency inspection preliminary assessments and reports.
- Site maintenance or repair reports.
- Corrective action plans and reports.

These documents will be available either electronically or as printed material. In either case, DOE will attempt to provide a means for users to obtain a printed copy of the information.

Pre-Surveillance and Maintenance Record Collection—The Regional Records Center is the federal records repository in Kansas City, Missouri, and is the designated archive facility for Weldon Spring records created during the operation and remediation of the site. To facilitate retrieval of records after site operations cease, and because the greatest repository of site knowledge will reside with the site steward, DOE will obtain copies of box and file indices and Records Transmittal and Receipt forms (SF 135) for the site. These indices and SF 135s will be retained with the surveillance and maintenance collection.

In addition, DOE will have custody of site documents residing in the federal records center and will be notified prior to the destruction of any temporary records.

Regulatory Requirements—Weldon Spring Site records are maintained in full compliance with DOE requirements:

- 36 CFR Parts 1220–1238, "National Archives and Records Administration"
- Title 44, *United States Code* (U.S.C.), Chapter 29, "Records Management by the Archivist of the United States and by the Administrator of General Services," Chapter 31, "Records Management by Federal Agencies," and Chapter 33, "Disposal of Records."

DOE has established a Records Disposition Schedule that provides the authority for the transfer, or disposal of records created and maintained by DOE. The complete discussion of the DOE Record Disposition System is found at the DOE Office of Chief Information Officer, http://cio.energy.gov. The Weldon Spring Site records are subject to the DOE Programmatic Records Schedule for unique and site specific records. Utilizing the category of Environmental Records, the primary focus of the schedule is retention and disposition of records of those activities that may affect the physical environment. The records covered by this schedule document the results of sampling and analysis, monitoring, permitting and disposal and cleanup activities affecting the physical environment. Environmental records include, but are not limited to, the administrative record, permits, reports, studies, evaluations, characterizations, logbooks of various kinds, as well as more obvious burial or storage records, closure plans, and waste management documentation. Other issues such as, medical, health and safety concerns emanating from these activities, but not specifically required by environmental regulations are dispositioned using the Epidemiological Records category. These records are under a moratorium from ever being destroyed (found under the Records Moratoria), so that these records are available for health researchers and other pertinent activities. The site Environmental and Epidemiological Records are maintained at the U.S. National Archives and Records Administration (NARA) facility. All records require written authorization from DOE prior to destruction by NARA.

2.12.1 Site Drawings and Photographs

Weldon Spring Site conditions were documented with as-built drawings and maps. Aerial photographs of the Weldon Spring Site were taken regularly. These drawings and photographs will be maintained in the permanent site record at the DOE office in Grand Junction.

2.12.2 Site Maps

The maps for the Chemical Plant and Quarry (Figure 2−2 and Figure 2−3) show the locations of the property boundaries, structures, roads inside and near the property boundaries, and monitoring wells. Map data are maintained in a geographical information system database.

The site map data will be used to generate maps for site inspections. After each inspection, new inspection maps will be prepared that show the locations of items of interest noted during previous inspections. Each site inspection map will indicate the year of the inspection and inspection purpose.

2.12.3 Site Record Drawings and Maps

Site record drawings and maps represent final site conditions and configurations of the cell, structures, monitoring wells, and other site features. These drawings and maps are included in the Remedial Action Reports for each OU, and will be managed in the permanent Weldon Spring Site records file at the DOE office in Grand Junction.

2.12.4 Site Baseline Photographs

Photographs taken during various phases of Weldon Spring Site remediation and a photographic record of final site conditions are maintained in the Weldon Spring Site permanent site file. These photographs provide a visual record to complement the as-built drawings and maps.

Initial site features will be photographed by DOE. This initial set of photographs will serve as site baseline photographs.

2.12.5 Site Inspection Photographs

Photographs also will be taken during subsequent site inspections to document current conditions, especially new or changed conditions, at the site. Comparison of current photographs with the baseline set of photographs will be useful to document steady or changing conditions at the site over time.

2.12.6 Site Aerial Photographs

Aerial photographs of the Weldon Spring Site (in black and white or color) have been taken numerous times during operation and reclamation of the site. The photographs provide a record for monitoring changing conditions (e.g., erosion, vegetation, and land use) over time and are preserved in the permanent site file.

2.13 Quality Assurance

Quality assurance for environmental monitoring activities at the Weldon Spring site is divided into two separate categories. The first is programmatic or overall project quality assurance, and relates to the incorporation and documentation of the quality of all site activities. This approach is discussed in Section 2.13.1. The second category is specific to the environmental monitoring activities presented in this plan and is discussed in Section 2.13.2.

2.13.1 Programmatic Quality Assurance

The Weldon Spring Site is obligated to comply with DOE Order 414.1C (*Quality Assurance*) and 10 CFR 830.120 ("Quality Assurance"). These requirements are documented utilizing DOE plans to ensure that work performed at facilities handling, processing, or utilizing radioactive materials is of documented quality. These requirements include: project organization, a quality assurance program, a document control system, the identification and control of items, inspections, the control of measuring and test equipment, handling, storage, and shipping of quality-affecting items, a program for implementing and verifying corrective action, a program for maintaining quality assurance records, and a routine assessment program.

2.13.2 Environmental Monitoring Program Quality Assurance

The quality of the environmental monitoring program is maintained and documented through a number of measures described in the following subsections. The measures include: the use of standard operating procedures; the collection, analysis, and evaluation of quality control samples and performance evaluation samples; the use of standardized analytical methods; data management activities and data quality evaluations (data validation); maintaining quality assurance records; and evaluating analytical laboratory data, sample collection activities, and programmatic procedures. Each of these items will be discussed in the following subsections.

2.13.3 Standard Operating Procedures

Standard operating procedures have been developed for routine activities associated with environmental monitoring at the Weldon Spring site under DOE documents. These procedures have been developed from EPA and DOE guidance and from standard industry practices. Controlled copies of procedures are maintained in accordance with the document control requirements of DOE Order 414.1A and 10 CFR 830.120.

2.13.4 Quality Control Samples

Numerous quality control samples are collected in support of environmental monitoring activities. Quality control samples were developed in accordance with the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351). These include: field duplicate samples, blank samples, and equipment blank samples. Samples also are provided to the laboratory for internal laboratory quality control evaluations specific to sample media (matrix spikes, matrix spike duplicate, and matrix duplicate samples). Table 2−10 presents a summary of the various quality control samples that will be collected to support environmental monitoring activities.

Table 2–10. Field Quality Control Sample Summary

QC Sample Type	Frequency	Purpose
Matrix Spike/Matrix Spike Duplicate or Matrix Duplicate	1 per 20	Assess matrix and possible intralaboratory variability
Field Duplicate	1 per 20	Assess matrix, intralaboratory, and field operations variability
Equipment Blank (non-dedicated equipment only)	1 per 20	Assess effectiveness of decontamination
Trip Blank	1 pair per cooler containing VOC samples	Assess potential volatile organic compound (VOC) cross-contamination during shipping

2.13.5 Analytical Methods

Standardized analytical methods, procedures, and protocols used to analyze samples collected for the environmental monitoring plan are contained in *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. These standardized analytical methods, procedures, and protocols will be used whenever possible, or variations will be approved prior to analysis. Variations to methods, procedures, or protocols are documented in

the controlled standard operating procedures received from contracted laboratories or by revisions to the DOE standard operating procedures.

2.13.6 Data Management Activities and Data Quality Evaluations

Environmental data management activities performed for the Weldon Spring Site are detailed in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*. The plan directs data management activities and data validation requirements. This plan and the associated data validation requirements have been adopted for the monitoring program at the Weldon Spring site. The primary activities associated with data management and data quality are field documentation, sample management, data validation, data review, and database maintenance. These programs ensure that analytical data generated by laboratories for samples collected at the Weldon Spring site are reviewed and qualified prior to release for general usage.

Data validation is the process of reviewing the sampling documentation and analytical data to ensure that adequate documentation was maintained and that results are qualified in compliance with established reporting requirements. Data generated during sampling activities and by analytical laboratories for the Weldon Spring site monitoring programs are validated.

The validation process consists of reviewing data for transcription errors, reviewing sampling documentation and chain-of-custody documentation, and comparing actual holding times to the method specified holding times. During validation, personnel determine whether the laboratory records document the established quality control criteria for the analytical procedures were followed, quality control samples were within their respective acceptance limits, and that adequate documentation is available to support the validity of the data.

Also, during the validation process, the data are reviewed and qualified by the data reviewer for comparability with historical results and for statistical and compliance evaluations.

Upon completion of data validation, data are flagged with appropriate final data qualifiers and are then available for general use. All databases containing final validated data are backed up regularly. To maintain the integrity of the computer files, access to edit the database is extensively restricted.

2.13.7 Quality Assurance Records

Records generated as a result of environmental monitoring are maintained as quality assurance records. Field sampling forms, analytical data, equipment calibration records, and validation documentation records are all considered quality assurance records and are maintained in accordance with the requirements of DOE procedures.

2.14 Health and Safety

The Health and Safety Program that applies to LTS&M activities is based on 10 CFR 851, “Worker Safety and Health Program,” and 10 CFR 8935, “Occupational Radiation Protection,” and other requirements as specified in the Legacy Management Support (LMS) contract. The Health and Safety Program is described in the *Health and Safety Manual*, (LMS/POL/S04321), which identifies the policies and requirements that apply to all work performed within the scope

of the LMS contract. In addition to the requirements specified in these high tier programmatic documents, LTSM activities at the Weldon Site will be conducted in accordance with the Job Safety Analysis (JSA) prepared for each non-routine activity and/or task.

3.0 Institutional Controls Implementation Plan for the Weldon Spring Site

This section summarizes information pertinent to the implementation of institutional controls (ICs) to meet objectives of the use restrictions described in the Explanation of Significant Differences (ESD) issued in February 2005 (DOE 2005b). The ESD clarified use restrictions necessary for the remedial actions specified in the Chemical Plant Operable Unit (CPOU), Chemical Plant area Groundwater OU (GWOU), and the Quarry Residuals Operable Unit (QROU) Records of Decision (RODs) to remain protective over the long-term.

Current site conditions (reflecting post-remedial action conditions) for the Chemical Plant and Quarry areas and the risk-basis for why use restrictions are needed are discussed in Section 3.1. The objectives of, or performance expectations for, the use restrictions are summarized in Section 3.2. Specific ICs already in place and additional mechanisms identified for implementation are presented in Section 3.3. The schedule for implementing additional ICs is discussed in Section 3.4. Section 3.5 presents the procedures for maintaining the ICs and for conducting periodic inspections. Section 3.6 presents the general provisions for the implementation of ICs for the site. Actual agreements or documentation of ICs that are in place to date are reproduced in Appendix E. Additional documents relating to ICs will be added to Appendix E as part of future revisions to the plan.

3.1 Current Site Conditions and Risk-Basis for Use Restrictions

The discussion in this section is presented by the two primary site areas: the Chemical Plant area and the Quarry area, with the information from the two OUs (CPOU and GWOU) for the Chemical Plant area presented first. The discussion for the Southeast Drainage is included with that for the CPOU. The areas requiring use restrictions are summarized in Table 3–1 and are shown in Figure 3–1 and Figure 3–2.

3.1.1 Chemical Plant Area

Remedial action for the Chemical Plant soils and structures was addressed in the CPOU; removal of contaminated soils and sediments at the Southeast Drainage was addressed via an Engineering Evaluation/Cost Analysis (EE/CA) as part of the CPOU. Chemical Plant area (including Southeast Drainage) groundwater and springs was addressed in the Chemical Plant area GWOU.

3.1.1.1 Chemical Plant OU

The contaminated soil and other wastes generated from the CPOU cleanup are now permanently disposed of at an engineered disposal cell constructed at the Chemical Plant. Wastes generated from cleanup of the Quarry area have likewise been disposed of in the disposal cell. At the time of its closure, the cell contained approximately 1.13 million cubic meters (1.48 million cubic yards) of waste.

Table 3–1. Properties Requiring Institutional Controls At The Weldon Spring Site

Property	Figure No. and Key[a]	Pertinent OU	Property Owner	Approx. Acreage	Existing Rights of Way (ROW)[b]
Chemical Plant disposal cell and buffer area	3−1, C1	CPOU	DOE	90	None
Southeast Drainage (200-ft corridor along the entire drainage)	3−1, C2	CPOU	MDC, MDNR-Parks[c]	37	Explorer Pipeline, Union Electric, Missouri American Water Co., MoDOT State Route 94
Chemical Plant groundwater	3−1, G1	GWOU	DOE	219	St. Charles County Water Department, Union Electric, Missouri American Water Co., Southwestern Bell Telephone, Explorer Pipeline, Public Water District No. 2, MoDOT State Route 94.
August A. Busch Memorial Conservation Area and Weldon Spring Conservation Area groundwater and springs (i.e., SP-6301, SP-6303, SP-5303, SP-5304)	3−1, G2	GWOU	MDC	734	Explorer Pipeline, Union Electric, Southwestern Bell Telephone, Public Water District No. 2, MoDOT State Route 94 and Highway D
Weldon Spring Training Area groundwater	3−1, G3	GWOU	U.S. Army	183	St. Charles County Water Department, Public Water District No. 2; Union Electric, Southwestern Bell Telephone
Highway Maintenance Facility groundwater	3−1, G4	GWOU	MoDOT	4.3	Union Electric, Missouri American Water Co.
Quarry soil	3−2, Q1	QROU	DOE	9	MoDOT State Route 94
Quarry area groundwater north and south of Femme Osage Slough	3−2, Q2 and Q3	QROU	DOE, MDC, MDNR-Parks	202 (includes Quarry and peapod area)	Explorer Pipeline, St. Charles County Water Department
Peapod-shaped soil area south of the Katy Trail and north of Slough	3−2, Q4	QROU	MDC	4.7	None

[a]The figure key is intended to facilitate identification of the properties discussed in this section. The first letter designates whether the area is being restricted as part of the CPOU (designated as C), the QROU (designated as Q), or the GWOU (designated as G). Numbers have been assigned to each of the various parcels of property within the boundaries of the restricted area for each of the operable units.
[b]The existing ROWs listed do not invalidate or interfere with the use restrictions and ICs implemented for the Weldon Spring site.
[c]The Katy Trail ownership interest held by MDNR-Parks is subject to conditions set forth in the Certificate of Interim Trail Use, issued by the Federal Surface Transportation Board under the Rails to Trails Act.

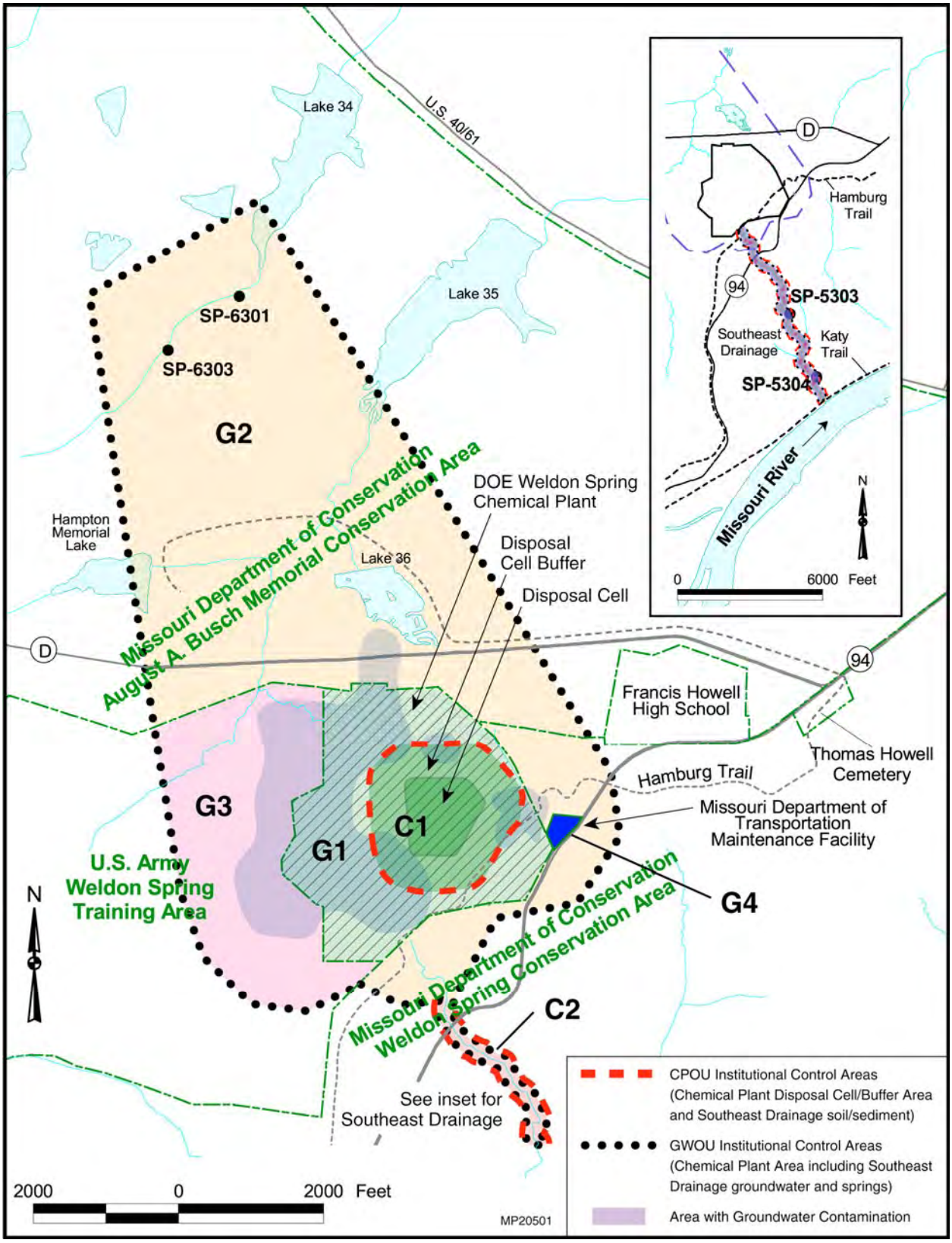

Figure 3–1. Institutional Control Areas for the Chemical Plant and Groundwater Operable Units

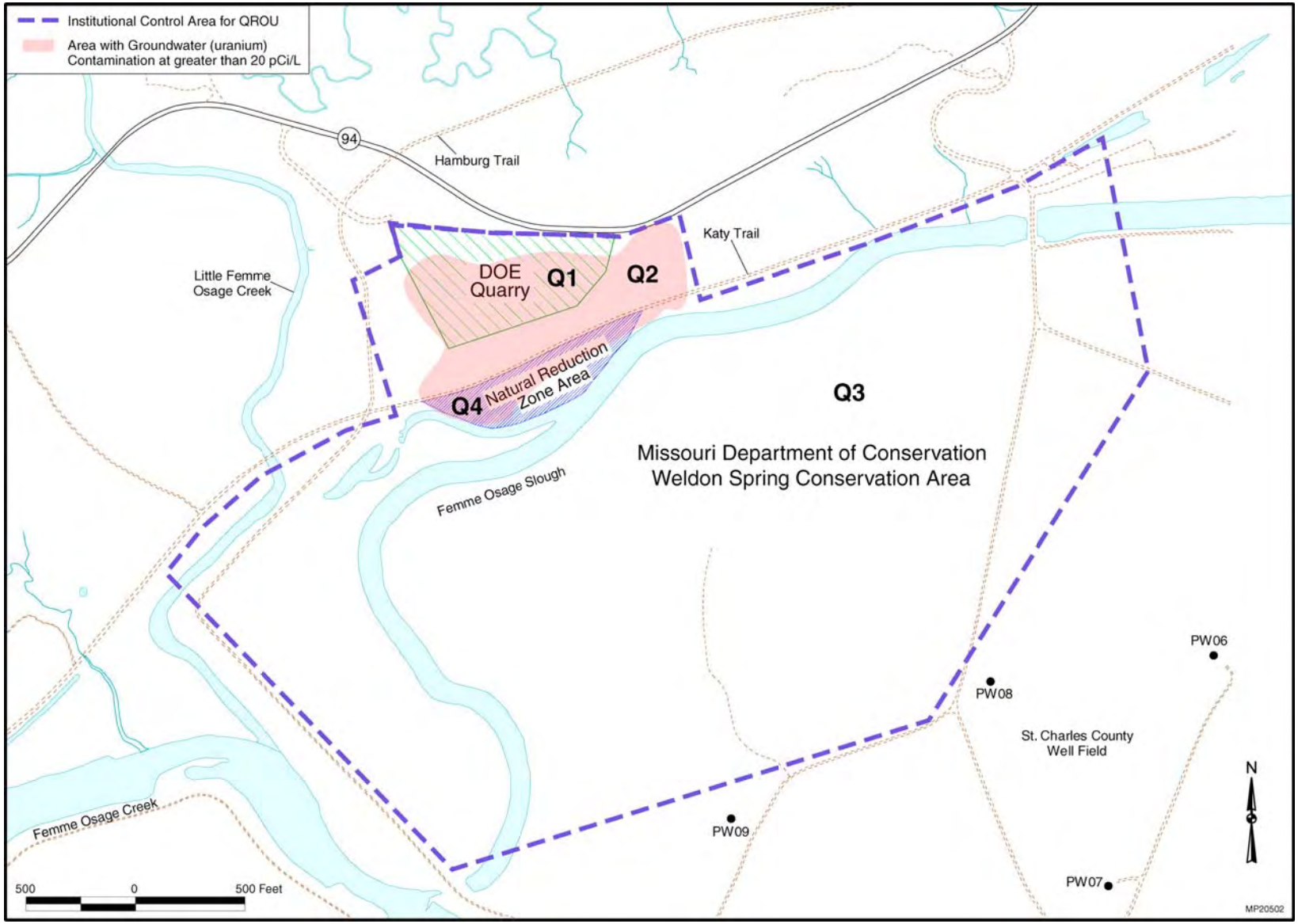

Figure 3–2. Institutional Control Areas for the Quarry Residuals Operable Unit

The CPOU ROD specified that "perpetual care be taken of the committed land within the disposal cell footprint because waste would retain its toxicity for thousands of years." It stipulated that the cell cover be inspected and that the groundwater be monitored. The CPOU ROD also specifies that "following completion of the site cleanup activities, an assessment of the residual risks based on actual site conditions will be performed to determine the need for any future land use restrictions. This assessment would consider the presence of the on-site disposal cell, the buffer zone, the adjacent U.S. Department of the Army (Army) site, and any other relevant factors necessary to ensure that appropriate measures are taken to protect human health and the environment for the long term."

It was decided at the time of the CPOU ROD that the final decision regarding land use for the Chemical Plant outside of the disposal cell and its buffer area should be determined after post-cleanup information was evaluated so that a final decision on the need for any future land use restrictions would be based on the actual residual condition. Hence, the ROD specified that a post-remediation risk assessment would be performed following cleanup to determine the need for any future land use restrictions. Soil cleanup goals were established in the CPOU ROD that were intended to be as low as reasonably achievable given the design limitations pertaining to safe field excavation techniques and field survey capabilities. Recreational use was considered to be the reasonably anticipated future land use. A standard conservative recreational visitor scenario as defined in the CPOU Baseline Risk Assessment was considered to be representative of recreational use. The exposure assumptions used were consistent with those recommended for a recreational scenario in EPA Risk Assessment Guidance for Superfund (RAGS) (EPA 1989a). Risk calculations based on the soil cleanup goals showed cumulative risk to the recreational visitor was within the acceptable risk range.

The soil excavations were conservatively designed to remove contamination to depth to achieve the established cleanup goals or better. The post-remediation risk assessment used post-cleanup confirmation data to evaluate the cumulative risk posed by exposure to soils from all contaminants. The assessment is believed to overestimate risks because it did not take into consideration the backfilling and reworking of the soils following excavation. The assessment confirmed that the potential risks to recreational visitors are within the acceptable risk range.

The post-remediation risk assessment also evaluated the risk to a suburban resident. A standard conservative suburban residential scenario as defined in the CPOU Baseline Risk Assessment was used. Following recommendations in EPA guidance (RAGS, Exposure Factors Handbook) (EPA 1989a,b; EPA 1997), the exposure assumptions (e.g., contact rate, exposure frequency and duration variables) used as input data to the evaluation were conservatively based on the 95th or, if not available, the 90th percentile statistical value for these variables. This approach provides risk estimates for reasonable maximum exposure to a resident receptor. The calculated risk to the suburban resident was generally greater than 1×10^{-4} but less than 1×10^{-3} and, therefore, slightly exceeds the acceptable risk range. However, the risk to the suburban resident from exposure to naturally occurring background concentrations of radionuclides in soils is 5.3×10^{-4}, or essentially the same risk posed by residual concentrations in the remediated areas. In other words, there is no significant incremental increase in risk from exposure to the remediated areas for a suburban resident. For purposes of this site and the ESD, the standard conservative suburban residential scenario was considered representative of unlimited use and unrestricted exposure (UUUE), the EPA policy threshold for determining whether ICs are appropriate.

These calculated risks are cumulative of all contaminants; however, the risks are primarily due to the radionuclides associated with the uranium ores. The CPOU ROD considered the standards for residual radium-226 found in 40 CFR 192, Subpart B to be relevant and appropriate to the cleanup of these radionuclides. The ROD was issued in 1993 prior to the issuance of EPA Directive 9200.4-25, Use of Soil Cleanup Criteria 40 CFR 192 as Remediation Goals for CERCLA Sites. A review of the expectations set forth by EPA in this guidance confirms 1) these standards would still be considered relevant and appropriate if the decision were made today, i.e., the contamination and its distribution was consistent with the outlined expectations; and 2) the actual residual concentrations for radium and thorium combined are much less than the concentrations identified in the guidance as meeting the health-based standard.

For the above reasons, DOE concludes that there is no need to restrict land use in the Chemical Plant area based solely on exposure to soils with residual contamination. The groundwater pathway and the appropriate use restrictions for groundwater are addressed in Section 3.1.1.2, "Chemical Plant Area Groundwater OU". This assessment does not apply to the soils and sediments in the Southeast Drainage, which are addressed below.

Although there is no reason to restrict land use in the Chemical Plant area to prevent exposure to soils, it is necessary to restrict land use in the buffer area to protect the long-term effectiveness of the remedy. Missouri Regulation 10 CSR 25-7.264(2)(N)2.D, providing for a 300-ft buffer zone between the property line and the actual landfill, was identified as relevant and appropriate in the CPOU ROD. This is the basis for the 300-ft buffer zone around the disposal cell. The buffer is intended to provide an area that would only be used for monitoring and maintenance activities. It also provides an area of erosion protection for the cell. Use restrictions are needed to ensure that the buffer zone remains effective for these purposes.

The EE/CA and decision document for the Southeast Drainage specified removal of radioactively contaminated soil and sediment from accessible areas of the drainage, with the removed soil and sediment to be transported to the Chemical Plant for temporary storage and ultimate disposal in the disposal cell. The removal action was completed in 1999 and the removed soils and sediment were placed in the on-site disposal cell.

The Southeast Drainage is narrow and wooded with limited access, and one of the objectives of this cleanup was to limit ecological damage to the drainage. It was determined that the soil cleanup goals developed for the CPOU described above were not appropriate for cleanup of this area. Risk-based cleanup goals were developed for the drainage that were designed to be protective for recreational use and for a modified residential scenario involving a child living near the drainage and using it periodically for play activities. Post-cleanup soil and sediment sampling was conducted, and a post-cleanup risk assessment was performed to confirm that the drainage is protective for these uses and, therefore, protective for any reasonably anticipated land use. However, residual soil and sediment contamination remains in some locations within the drainage at levels exceeding those that would support UUUE as represented in this case by a standard conservative suburban residential exposure scenario described above. Therefore, land use restrictions are needed in the drainage to prevent residential use or other uses inconsistent with recreational use. The Southeast Drainage is located on property owned by state entities.

The length of time it may take soils and sediments to attenuate to levels that support UUUE cannot be accurately estimated, and achieving UUUE conditions was not the goal of the removal

action. Also, there are no effective means to monitor or verify attenuation of the soils and sediments at this time. Therefore, land use restrictions will need to remain in place for the long term. The width for the restricted area for the Southeast Drainage is 200 ft. The width of the restricted area is based on the average width of the drainage used in the modified residential scenario and represents a practical boundary outside which a future resident would not routinely access the drainage.

3.1.1.2 Chemical Plant Area Groundwater OU

The selected remedy in the GWOU Final ROD is monitored natural attenuation of the contaminants of concern (COCs) with ICs to limit the use of groundwater and spring water as a drinking water source during the period of remediation (or attenuation). This ROD also stipulates that ICs "be implemented to restrict use of contaminated groundwater and spring water to prevent human-induced impacts on groundwater flow."

The reasonably expected future land use at the Chemical Plant area is recreational use, which would not make use of groundwater. Also, low groundwater yields and the availability of a municipal drinking water source reduce the likelihood of groundwater being used for residential purposes. Nevertheless, the potential future risk from residential use of the water was evaluated. This evaluation included an assessment of the risk from ingesting the groundwater at quantities typical for a resident scenario. The assessment indicated unacceptable cancer and noncancer risks for a resident from ingesting the contaminated groundwater. Hence, use restrictions are needed to ensure that groundwater is not used as a residential drinking water source until cleanup standards for groundwater are met. The cleanup standards are set at levels that allow for UUUE. The use restrictions should also apply to the contaminated springs identified on Figure 3–1 as SP-6301, SP-6303, SP-5303, and SP-5304. It is estimated that it would take approximately 100 years for contaminants in groundwater and spring water to naturally attenuate to UUUE cleanup standards.

The buffer area necessary to prevent hydraulic impacts to the area of contamination was defined as extending 1,000 ft from the outer edge of where contaminated groundwater exceeds cleanup standards. The size of the buffer area was conservatively determined by considering the area that would be covered by the hydraulic capture of a well installed in the most transmissive location at the site (the location where the highest water yield could be obtained). The Chemical Plant area affected by the groundwater contamination is on property under the jurisdictional control of DOE and the Army and on property owned by state entities.

3.1.2 Quarry Area

The 1998 QROU ROD was intended to address the residual contamination remaining at the Quarry Area following removal of the waste material from the Quarry proper. The bulk waste was removed and transported to the Chemical Plant area for permanent disposal in the onsite disposal cell under the 1990 Quarry Bulk Waste Operable Unit ROD.

3.1.2.1 Quarry Residuals OU

The primary residual concern is the uranium contaminated groundwater beneath the Quarry and its immediate surrounding area north of the Femme Osage Slough. The conditions at the Quarry

area were determined to be protective for its current and reasonably anticipated future land use (recreational) because exposure to contaminated groundwater is not a concern for these uses. The ROD determined that "ICs will be necessary to prevent uses inconsistent with recreational use, or uses that would adversely affect contaminant migration." A long-term groundwater monitoring network was implemented.

Residual soil contamination in the Quarry area was remediated to the cleanup goals established by the CPOU ROD described above, except for some inaccessible soils that remain in the cracks and fissures of the Quarry walls and floor. As part of the Quarry restoration, the cracks and fissures were grouted and the Quarry was backfilled with clean borrow soil to an elevation at or above where the waste material had been present. The area is now fully vegetated. Under these conditions, DOE could not identify a plausible exposure scenario that would result in an unacceptable risk. The main purpose for backfilling the Quarry was to address physical safety concerns (e.g., to minimize the risk of someone falling into an open pit), stabilize the north and south highwalls, and to minimize infiltration to groundwater through the Quarry cracks and fissures. To sustain these conditions the backfill material must remain in place over the long term with a surface grade that promotes surface runoff. Therefore, DOE will monitor the Quarry fill and restrict activities that could result in the removal of the fill (e.g., use as a borrow source).

The contaminated groundwater in the Quarry area is confined to the shallow system beneath the Quarry and the marginal alluvium north of the slough (Figure 3–2). The impacted groundwater system was determined not to be a potential source of drinking water because of insufficient yields; however, uranium concentrations exceed the drinking water standard and the system is located adjacent to the Missouri River Alluvial aquifer which is currently used as a drinking water source. A 2-year study was conducted to investigate the potential effectiveness of installing a groundwater removal and treatment system. This study confirmed the validity of model projections reported in the feasibility study, which had indicated that a groundwater removal and treatment system would not be effective in significantly reducing uranium mass or concentrations in the Quarry area groundwater.

Uranium concentrations in the groundwater in the marginal alluvium north of the slough decrease rapidly in the direction of the slough, and uranium concentrations south of the slough are consistent with background. This indicates the geochemical conditions in this zone north of the slough are favorable for reducing the amount of dissolved uranium in groundwater. Geochemical investigations were performed confirming that processes, including sorption to the soil matrix and precipitation, are acting to reduce uranium and limit uranium migration south of the slough. This area is referred to as the Quarry natural reduction zone area. Natural processes in the reduction zone should continue to mitigate migration of uranium toward the well field over the long term. This zone is approximately 4.7 acres in size and is shown in Figure 3–2. Drilling, digging, or other construction activities that result in the large-scale removal or exposure of soils in the reduction zone should be restricted so that the natural characteristics, (e.g., oxidation potential) are not changed. The geochemical investigation established that this reduction zone begins at a depth of approximately 5 ft.

Installation of pumping wells in the proximity of the contaminated area should be restricted to limit the potential for contaminant migration to be artificially induced or increased. The approximately 202-acre IC boundary shown in Figure 3–2 is expected to provide a sufficient hydraulic buffer. The size of the area was determined based on the estimated maximum

hydraulic capture zone of a pumping well. With the exception of the 9-acre Quarry, which is under DOE jurisdictional control, the remainder of the restricted area is owned by state entities. The time frame for groundwater north of the slough to reach levels that no longer pose a concern for the adjacent alluvial aquifer is expected to be greater than 100 years considering the hydrogeologic characteristics present in this location. It was estimated in the remedial design phase that a uranium concentration of 300 pCi/L or lower in groundwater north of the slough would not cause levels south of the slough to exceed the drinking water standard, on the basis of conservative assumptions postulating the migration of the contaminated groundwater. The evaluation indicated that recharge to the impacted area (Quarry area north of the slough) accounts for less than 1 percent of the total flow to the St. Charles County well field (i.e., at 300 pCi/L, it is expected that no more than 3 pCi/L, or much less than the drinking water standard of 20 pCi/L, would be contributed to the well field if it is conservatively assumed that all attenuation mechanisms failed, including the attenuation from the reduction zone discussed above).

3.2 Use Restrictions and IC Objectives

The ESD (DOE 2005b) prepared for the Weldon Spring site presents use restrictions for specific areas. The areas are on either Federal or state owned properties (see Table 3–1). No privately owned property is affected by the use restrictions. These use restrictions or IC objectives (as listed in Sections 3.2.1 to 3.2.2 below) will be implemented through this LTS&M Plan.

3.2.1 Chemical Plant Area

3.2.1.1 Chemical Plant OU

Disposal Cell and Buffer Area: The use restrictions listed below must be met throughout the disposal cell area, including its surrounding 300-ft buffer zone as identified in Figure 3–1. This area is under federal DOE jurisdictional control. The use restrictions listed below shall be maintained until the remaining hazardous substances are at levels allowing for UUUE. Due to the extremely long-lived nature of the radioactive constituents in the disposal cell, these restrictions are expected to be necessary for essentially as long as the disposal cell remains in place. The objectives of the controls or restrictions are as follows:

1. Prevent activities on the disposal cell, such as the use of recreational vehicles that could compromise the integrity of the cell cover (e.g., result in the removal or disturbance of the riprap).

2. Prevent activities in the buffer zone such as drilling, boring, or digging that could disturb the vegetation, disrupt the grading pattern, or cause erosion.

3. Retain access to the buffer area for continued maintenance, monitoring, and routine inspections of the cell and buffer area.

4. Prevent construction of any type of residential dwelling or facility for human occupancy on the disposal cell and buffer area, other than facilities to be occupied for activities associated with performing environmental investigation and/or restoration and expansion of the existing Interpretive Center.

5. Maintain the integrity of any current or future remedies or monitoring systems.

Southeast Drainage Soil or Sediment: The use restrictions listed below must be met at the approximately 37-acre area shown in Figure 3–1 covering the 200-ft corridor along the length of the Southeast Drainage. The restricted area is located on property that is owned by state entities. These restrictions will need to be maintained until the remaining hazardous substances are at levels allowing for UUUE, which is anticipated to be a period of decades or longer.

1. Prevent the development and use of the Southeast Drainage property for residential housing, schools, child care facilities and playgrounds.

3.2.1.2 Groundwater OU

Chemical Plant Area Groundwater and Springs: The use restrictions listed below must be met in the entire area of approximately 1,140 acres shown on Figure 3–1 where groundwater use needs to be restricted until concentrations of the COCs meet drinking water or risk-based standards that allow for UUUE. The period of time necessary for contaminants to attenuate to these levels has been estimated at approximately 100 years. The size of the restricted area includes a 1,000-ft buffer area that accounts for the groundwater gradient and flow conditions at the site. The restricted area includes properties under Federal jurisdictional control (DOE and the Army) as well as properties owned by state entities. The objectives of the controls or restrictions are as follows:

1. Prevent the use of the contaminated shallow groundwater and spring water for drinking water purposes. The contaminated shallow groundwater occurs in the weathered and unweathered portions of the upper limestone unit (Burlington-Keokuk). The contaminated groundwater and spring water system occurs within the limits of the hydraulic buffer zone identified on Figure 3–1. The springs are identified on the figure as SP−6301, SP−6303, SP−5303, and SP−5304. This restriction will need to be maintained over a period of decades or longer.

2. Limit the use of all groundwater within the outlined restricted area to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. This restriction will need to be maintained over a period of decades or longer.

3. Retain access to the area for continued monitoring and maintenance of groundwater wells and springs.

4. Maintain the integrity of any current or future remedies or monitoring systems.

3.2.2 Quarry Area

The use restrictions listed below must be met at the specific areas shown in Figure 3–2. The use restrictions must be maintained until the remaining hazardous substances are at levels allowing for UUUE.

1. Prevent the development and use of the Quarry for residential housing, schools, child care facilities and playgrounds. Prevent drilling, boring, digging, or other activities in the Quarry proper that disturb the vegetation, disrupt the grade, expose the Quarry walls, or cause

erosion of the clean fill that was used to restore the Quarry. This restriction should be maintained for the long-term. The 9-acre Quarry is under DOE jurisdictional control.

2. Prevent the use of the contaminated shallow groundwater for drinking water purposes. The contaminated shallow groundwater underlies the Quarry and extends to the marginal alluvium north of the slough as indicated on Figure 3–2. This restriction will need to be maintained over a period of decades or longer.

3. Limit the use of all groundwater within the outlined restricted area shown on Figure 3–2 to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. This restriction will need to be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are at 300 pCi/L or lower. With the exception of the 9-acre Quarry, this restricted area is owned by state entities. This area covers approximately 202 acres.

4. Prevent drilling, boring, digging, construction, earth moving or other activities in the location identified as the Quarry natural reduction zone area that could result in disturbing the soils at this location or exposing subsurface soils (i.e., soils deeper than [about] 5 ft below the surface). The soil in this area at a depth of 5 ft or greater contains geochemical properties that allow reduction processes to naturally occur, resulting in the precipitation of uranium from Quarry groundwater north of the Femme Osage Slough and thereby minimizing uranium migration to the well field. The restrictions must be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are 300 pCi/L or lower. This area is located on property owned by a state entity and is approximately 4.7 acres in size.

5. Retain access to the area for continued monitoring and maintenance of groundwater wells.

6. Maintain the integrity of any current or future remedies or monitoring systems.

3.3 Specific Institutional Controls for the Weldon Spring Site

Specific IC mechanisms have been identified to implement the use restrictions presented in Section 3.2. The ICs generally fall into one of the four categories identified by EPA guidance (EPA 2000). Multiple mechanisms are being used to provide “layering” for additional durability. The EPA IC categories are as follows.

- Proprietary controls—such as easements and covenants are based in real property law and generally create legal property interests
- Governmental controls—are generally implemented and enforced by state or local governments and can include zoning restrictions, well drilling regulations, building permits, ordinances, or similar mechanisms that restrict land or resource use

- Enforcement and permit tools with ICs components—CERCLA Federal Facility Agreements, CERCLA Unilateral Administrative Orders, and Administrative Orders on Consent can be used to enforce or restrict site activities as can RCRA permits and orders
- Informational devices—such as state registries, deed notices, information centers, markers and advisories provide information that a site contains residual or capped contamination

At the completion of all easements, DOE will record them with the St. Charles County Recorder of Deeds. At the completion of all easements and the new MOU, DOE will revise the LTS&M Plan Appendix E to include copies of these agreements.

3.3.1 Summary of Institutional Controls Currently In Place

The following institutional controls are in place for the Weldon Spring site:

1. DOE has exclusive jurisdictional control over the Chemical Plant and the Quarry. Federal ownership provides inherent authority for DOE to control land use based on its legislative jurisdiction and take action against unapproved uses but also entails statutory and regulatory obligations. Numerous requirements are placed on federal agencies that manage land to ensure the protection of human health and the environment. Per DOE Order 430.1B, *Real Property Asset Management*, DOE is required to provide an inventory of the specific ICs implemented to restrict use of the property in DOE's Facilities Information Management System (FIMS). The maintenance of a real property asset inventory system is designed to communicate the presence of land use restrictions to current federal management personnel and to assure this information is readily available to possible future users of the land. As part of the protocol for maintaining this database, FIMS data must be (a) maintained as complete and current throughout the life cycle of real property assets, including real property related institutional controls; and (b) archived after disposal of real property assets with those necessary for long-term maintenance and surveillance identified, reviewed, and retained accordingly.

   CERCLA Section 120(h) (3) requires for property transfers to be accompanied by a covenant warranting that "all remedial action necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of transfer" and that "any additional remedial action found to be necessary after the date of transfer shall be conducted by the United States." Upon transfer, the deed or other agreement governing the transfer must contain clauses that indicate the following information: (a) necessary restrictions on the use of the property to ensure protection of human health and the environment (e.g., maintenance of ICs); and (b) restrictions on the use necessary to ensure the required remedial investigations, response actions (e.g., monitoring, implementation of ICs), and oversight activities (e.g., long-term surveillance and maintenance activities) will not be disrupted.

2. DOE has committed to perpetual care of the disposal cell and buffer zone as specified in the Chemical Plant Record of Decision (ROD), which is enforceable under the FFA.

3. A notation has been entered on the ownership record filed at the St. Charles County Recorder's Office (deed notice). The notation explains the restrictions on groundwater use

and residential development of the Chemical Plant and Quarry areas. The notice acts as an informational device in the event ownership is transferred at some point in the future.

4. The Interpretive Center serves as a community information resource, which depicts the history of the area and details the progression of the cleanup process. Information is available on the construction of the engineered disposal cell and the residual groundwater contamination.

5. Placement of historical markers along the Hamburg Trail and information plaques accessible at the top of the engineered disposal cell. The historical markers depict significant events and locations along the trail related to the displacement of the population during the early 1940s to accommodate the federal government's World War II efforts. The markers also note significant events at their respective locations related to DOE cleanup efforts and encourages the reader to learn more by visiting the DOE Interpretive Center. Similarly, the plaques at the top of the disposal cell contain information regarding the surroundings and the history of St. Charles, as well as information regarding the cleanup and waste materials buried within the disposal cell. See Appendix N for a sample historical marker and disposal cell plaque.

6. Missouri regulates the construction of wells pursuant to 10 CSR Chapter 3 Well Construction Code. 10 CSR 3.010(1)(A)4 states that "A well shall be constructed so as to maintain existing natural protection against pollution of water-bearing formations and to exclude all known sources of contamination from the well including sources of contamination from adjacent property." 10 CSR 3.030(2) says "Minimum Protective Depths of Well Casing. All wells shall be watertight to such depths as may be necessary to exclude contaminants. A well shall be constructed so as to seal off formations that are likely to pose a threat to the aquifer or human health." 10 CSR 3.090(1)(A) says "All persons engaged in drilling domestic wells in Area 1, a limestone or dolomite area shall set no less than eighty feet (80') of casing, extending not less than thirty feet (30') into bedrock. Example: if sixty feet (60') of residual (weathered rock) material is encountered in drilling before bedrock, then ninety feet (90') of casing must be set." These regulations combine to have the effect of preventing the construction of wells that would allow for consumption of contaminated groundwater by preventing the well from drawing water from groundwater from a depth less than 80 feet which includes the surficial contaminated zone.

7. DOE has real estate licenses with the Missouri Department of Conservation (MDC) that allow access for the purpose of monitoring and maintaining groundwater wells, drilling and plugging wells, usage of the effluent water pipeline, and a physical entrance at the north gate.

8. The existing Southeast Drainage easement on MDC property providing DOE rights to use the drainage for overland discharge of sewerage; this easement does not directly prohibit development of the Southeast Drainage, but providing notice in the title records that the property is subject to overland sewage flow may help deter residential development in this area until a more effective IC can be put in place.

9. DOE has real estate licenses with the Missouri Department of Natural Resources (MDNR) that allow access along portions of the Katy trail for the purpose of monitoring and maintaining groundwater wells, drilling and plugging wells, usage of the effluent water pipeline, and sampling access along portions of the Katy Trail.

10. Memorandum of Understanding (MOU) with Department of Army regarding cooperation with DOE remedy implementation. The MOU gives DOE permission to access Army property for the purpose of implementing remedial actions, which includes monitoring and maintaining groundwater wells, and drilling and plugging wells.

11. Special Area Designation Under the State Well Drillers' Act. The "Special Use Area" under the Missouri well code was finalized in the Missouri regulations and became effective August 2007 (10 CSR 23-3. 100(8). This is a special regulation that was pursued by DOE and Army and designated DOE and Army's groundwater restricted areas as special areas that require additional drilling protocols and construction specifications to be imposed by MDNR on any future domestic wells.

12. The use restrictions and the ICs identified in this LTS&M Plan are enforceable under the FFA.

Copies of existing IC agreements are included in Appendix E.

3.3.2 Implementation of Additional Institutional Controls

In addition to ICs that are already in place as discussed above, DOE is in the process of implementing the additional ICs identified in the subsections below and in Table 3−2 (at end of Section 3.0). These ICs were identified based on research findings and positions developed by EPA and DOE (EPA 2005a,b; DOE 2005c,d). These are: (1) easements with state entities and (2) updated MOU with the Army. DOE was successful in obtaining the Special Area Designation under the Missouri Well Drillers' Act. This special rule was finalized in the Missouri Register in July 2007. It is possible that some overlap may occur in the implementation of groundwater use restrictions by the Army and DOE on Federal and State owned properties. To the extent practical, DOE will coordinate with the Army to make sure that the actions undertaken are compatible and avoid unnecessary duplications.

If DOE is unable to secure one or more of the easements on property owned by the state of Missouri or by an agency of the state of Missouri by negotiation, using DOE's standard real property acquisition procedures, DOE may submit an alternative plan for review and approval. The plan will outline the alternative approach DOE proposes to use to achieve an equivalent level of control as would have been provided by the easement. The plan shall describe the alternative institutional controls, the procedures necessary to implement the alternative institutional controls, the level of control the alternative institutional controls would provide in meeting the relevant institutional control objectives, and a schedule for implementing the alternative institutional controls. If EPA does not approve the alternative plan, EPA may direct DOE to initiate and pursue condemnation to acquire the easement.

3.3.2.1 Easements

DOE is in the process of negotiating easements with surrounding affected State agency landowners for implementing the use restrictions required on state properties. An easement is a real property interest that conveys certain rights from the grantor (fee simple land owner) to the grantee. In the case of the Weldon Spring site, DOE will seek easements for the purpose of

restricting use of the contaminated groundwater and the hydraulic buffer zone, and also to restrict land use in the Southeast Drainage and at the Quarry reduction zone. See Section 3.2 for a full description of the restrictions. The easements will also assure DOE access to monitoring locations for sampling and maintenance and, where applicable, provide that DOE is notified of use inconsistent with the terms of the easements. When put into effect, these easements will supersede and replace the current real estate licenses described in 3.3.1.

DOE possesses delegated acquisition authority to acquire real property interests, including easements to implement institutional controls, through the authority of the Atomic Energy Act of 1954 and the Energy Organizational Act of 1974, combined with Congressional appropriation authority. For the Weldon Spring site, budget authorization for establishing ICs is part of the authorization for the remedial action under CERCLA. In addition, congressional authorization is not needed for less than "fee simple" acquisitions, which will be the case for the Weldon Spring site.

DOE will acquire easements in accordance with DOE policy and procedures. The completed easements would be appropriate for recordation with St. Charles County and effective in the state of Missouri.

DOE has completed the following activities towards acquiring the easements:

1. Obtained legal descriptions and surveyed the affected properties: The legal descriptions of the properties affected by the use restrictions are presented in Appendix D of this report.

2. Conducted a title search for the affected properties: DOE conducted a title search (Investors Title Search Company 2004) to identify "less than fee simple" owners within the wider area originally comprising the Weldon Spring Ordnance Works to investigate real property interests, easements, or rights-of-way (ROWs) in these areas.

3. Obtained preliminary title commitment: A follow-on title search was conducted (Investors Title Search Company March 2005) to provide sufficient ownership information to proceed with negotiations. The information obtained from these title searches are summarized in Table 3–1. All of the "less than fee simple" ownership in the properties identified for use restrictions are expected to be unaffected by the restrictions, that is utility rights-of-way would not be impaired by the implementation of DOE's use restrictions. Conversely, DOE has examined the existing ROWs and concluded that none of these interfere with or invalidate any of the use restrictions, including any of the prospective easements.

4. DOE issued initial letters, dated October 12, 2005, to the surrounding state agency property owners in order to initiate discussions regarding the proposed easements. DOE through its realty section and its interagency agreement with the U.S. Army Corps of Engineers (Omaha Office) sent a draft easement and offer letter to MDC in May 2006. The letters were issued to MDNR-Parks and MoDOT in September 2006. DOE received a response from MDNR-Parks dated May 10, 2007. DOE issued additional letters to the three state agencies in August 2007. These letters included copies of the original offer letters and draft easements. The purpose of these letters was to attempt to revitalize the easement negotiations. DOE met with MDNR-Parks on October 22, 2007, and prepared meeting minutes from the meeting and are working towards resolution of issues. Appendix E, *Institutional Control Documentation*,

included language that was agreed upon between DOE and MDNR-Parks for contamination questions that may arise during any construction in the MDNR-Parks easement areas along the Katy Trail. DOE issued additional letters to MDC and MoDOT in December 2007, in another attempt to revitalize negotiations. DOE received a response from MoDOT in January 2008, which stated that they are working on the issue with the other State agencies.

3.3.2.2 MOU for the Army Property

Use restrictions have been identified for a portion of the Army Training area (shown as G3 in Figure 3–1) as part of DOE's GWOU remedy. An existing MOU is currently in effect that commits the Army to support the remedial actions implemented by DOE. DOE will seek to modify or update this MOU to specify the use restrictions identified in Section 3.2. The new or revised MOU will be specific with respect to the necessary groundwater use restrictions for property under Army control. The MOU will also allow DOE access to the property for the purposes of collecting groundwater samples from both DOE and Army wells, drilling or plugging wells as needed, conducting remedial actions (if necessary), and inspecting for consequential land or resource use changes.

The Army also will be pursuing appropriate IC mechanisms as part of the CERCLA groundwater remedy they have implemented for their area. The MOU will also address other coordination issues relative to the Army institutional controls, as needed and as compatible with the Army IC implementation schedule.

DOE met with Army representatives on September 15, 2005, to discuss the updated MOU. DOE delivered a draft of the new MOU to the Army in January 2006, and copied MDNR and EPA. Minor changes were suggested by MDNR and were made by DOE. The Army had several changes to the U.S. Army Corps of engineers project manager during 2006. Since the new MOU contains both "access" and "restrictive use" provisions, it must be approved by both the land owner, the 89th Regional Readiness Command, and the U.S. Army Corps of Engineers, as the remedial action controlling agency.

3.4 Maintenance and Inspection Procedures for Institutional Controls

Maintenance and inspection activities associated with existing ICs are described in Section 2.3.4 and Appendix H. Implementation of the additional ICs will result in the need to review additional recorded instruments during the annual inspection and appropriate modifications will be made to future revisions of the plan.

DOE shall employ DOE administrative procedures to track all site modification, development, maintenance, and remedial activities which would entail excavation or disturbance of contaminated soil, waste, or withdrawal of groundwater to ensure that no project violates use restrictions of DOE described in Section 3.2. DOE shall require coordination with and prior approval by environmental personnel if any such activities will be located on or near contaminated media. DOE will ensure that all such site activities will be conducted in such a manner to ensure that they do not compromise the integrity or function of subsurface or surface remedial systems or result in uncontrolled releases of, or exposures to, subsurface or surface contamination.

DOE has internal procedures governing DOE work which will help maintain the use restrictions and assure protection of the integrity of the institutional controls. These procedures derive from DOE Orders, Policy and Guidance. DOE environmental protection Orders are included in all DOE contracts and these requirements also flow down to subcontractor work at DOE sites. These requirements are formalized in contractor manuals including the *Health and Safety Manual,* the *Health and Safety Procedures Manual* (LMS/PRO/S04337) and the *Environmental Protection Manual* (LMS/POL/S04329). These documents include evaluation processes and checklists, such as the Project/Activity Evaluation form and the Job Safety Analysis form, to assure that work is done safely and in an environmentally protective manner. The process requires advance evaluation of the work done for DOE to assure that it is done in a safe and environmentally protective manner. To undertake any work, including drilling or excavating, the evaluation forms require authorizing signatures from appropriate disciplines, including environmental management.

For property not controlled by DOE, routine surveillance will be used to inspect for any evidence of land use changes or disturbances as described in Section 2.3.4. Also, immediate follow-up inspections will be conducted any time DOE is notified of a changed condition consistent with Section 2.4.1. Site information is available at the interpretive center and at the MDC visitor center.

Information signage and contact numbers will be posted on monitoring wells at the Quarry area reduction zone, the only area not controlled by DOE where there is a restriction on digging. Signs indicating the prohibition on digging in the quarry reduction zone will be developed and placed at each of the monitoring well clusters in that area. The size and placement of these signs will be such that they are visible from the Katy Trail and will contain information describing the extent of the digging restrictions, DOE and MDC contact information for reporting any digging activities observed, and any restrictions on activities to protect the monitoring well. The signs will be placed within 120 days following approval of the LTS&M Plan. All signs, markers, and plaques will be inspected and maintained on a regular basis.

3.5 General Provisions for Institutional Controls Implemented for the Weldon Spring Site

The provisions listed below set out the general requirements for addressing changed conditions.

1. DOE shall maintain the land and resource use restrictions developed pursuant to the LTS&M Plan until such time as the concentrations of the hazardous substances are at such levels to allow for UUUE.

2. DOE shall initiate a response to all activities which are inconsistent with the use restrictions, IC objectives or ICs, or any other action that may interfere with the effectiveness of the ICs described in the LTS&M Plan as soon as practicable, but in no event later than 20 days, after DOE becomes aware of the activity.

3. DOE shall notify EPA and MDNR as soon as practicable, but in no event later than 20 days, after discovery of any activity that is inconsistent with the use restrictions, IC objectives or ICs, or any other action that may interfere with the effectiveness of the ICs described in the

LTS&M Plan. DOE shall provide a written description of the action(s) it has taken or is planning to take to address the problem within 60 days following discovery of the activity.

4. DOE shall notify EPA and MDNR as soon as practicable, but in no event later than 20 days, after any proposal to change land or resource use on property that is under DOE jurisdictional control and subject to the use restrictions or ICs developed pursuant to the LTS&M Plan.

5. DOE shall notify EPA and MDNR as soon as practicable, but in no event later than 20 days, after discovery of any proposed, planned, or actual land or resource use changes on property that is not under DOE jurisdictional control but is subject to the use restrictions or ICs developed pursuant to the LTS&M Plan.

6. DOE shall notify EPA and MDNR at least 6 months prior to any transfer, sale, lease, or agreement for use of any property under its jurisdictional control (Chemical Plant and Quarry) that is subject to the use restrictions or ICs developed pursuant to the LTS&M Plan. This will ensure that EPA and MDNR will have the option to be involved in decisions as to the appropriate provisions to include in the conveyance documents. DOE shall provide a copy of executed deed or transfer documents to EPA and Missouri. In advance of a transfer of ownership or control of property, DOE shall take action within the limitations of its authority to ensure that the controls and restrictions will continue after transfer and any successive transfers pursuant to agreement among DOE, EPA, and MDNR. If it is not possible for DOE to notify EPA and MDNR at least 6 months prior to any transfer, sale, or lease, DOE shall notify EPA and MDNR as soon as practicable but no later than 60 days prior to the transfer, sale, or lease of property under its jurisdictional control. In addition to the land transfer notice and discussion provisions above, DOE further agrees to provide EPA and Missouri with similar notice, within the same time frames, as to federal-to-federal transfer of property. This notice to EPA and MDNR also applies to any real property interest (e.g., easement) that DOE may transfer, vacate, or otherwise modify.

7. DOE shall notify EPA and MDNR as soon as practicable, but in no event later than 20 days, after discovery of any proposed, planned or actual transfer, sale, or lease of property subject to the use restrictions or ICs developed pursuant to the LTS&M Plan but not under DOE jurisdictional control.

8. DOE shall not modify or terminate the use restrictions or ICs developed pursuant to the LTS&M Plan without EPA approval. DOE shall seek EPA approval before undertaking any action that may disrupt the effectiveness of the ICs or any action that may alter or negate the need for the ICs. Approval will be sought pursuant to Section 2.1.4.

9. DOE will monitor land and resource use and the ICs and report the results to EPA and MDNR as provided in Section 2.3.4 and Appendix H of the LTS&M Plan. The annual inspection report submitted to EPA and MDNR will evaluate the status of the ICs, describe any deficiencies, and describe any actions taken or planned to address any deficiencies. The results of the monitoring and evaluation will be used in the 5-Year Review process to evaluate the effectiveness of the remedy.

10. DOE is responsible for implementing, maintaining, reporting on, and enforcing the ICs identified and implemented pursuant to the LTS&M Plan and ESD. In the event DOE transfers these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity.

Table 3–2. IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Disposal Cell and Buffer Area	CPOU	1. Prevent activities on the disposal cell, such as the use of recreational vehicles that could compromise the integrity of the cell cover (e.g., result in the removal or disturbance of the riprap). Duration: Until UUUE conditions are achieved, which means as long as the disposal cell remains in place.	DOE has jurisdictional control of this property. The CPOU ROD commits to perpetual care of the committed land (disposal cell and buffer area) because the waste would retain its toxicity for thousands of years. A notation on the ownership record has been recorded with the St. Charles County recorder of deeds. To date, additional layers have also been established in the operation of the Interpretive Center, placement of historical markers and the ramp and platform leading to the information plaques. ICs on the DOE-controlled Chemical Plant are enforceable through the provisions of the existing FFA. The ICs are specified in the LTS&M Plan, which is a principal document under the new FFA.	Routine sampling of wells—DOE contractors will inspect for any evidence of land use changes or significant land disturbance. Annual physical inspections of ICs and annual review of recorded title information—DOE will adhere to maintenance and inspection requirements per the LTS&M Plan. Assess the on-going protectiveness of the ICs as part of the required remedy review under CERCLA.	None.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Disposal Cell and Buffer Area (cont.)	CPOU	2. Prevent activities in the buffer zone such as drilling, boring, or digging that could disturb the vegetation, disrupt the grading pattern, or cause erosion. Duration: same as CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	None
		3. Retain access to the buffer area for continued maintenance, monitoring, and routine inspections of the cell and buffer area. Duration: same as CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	None
		4. Prevent construction of any type of residential dwelling or facility for human occupancy on the disposal cell and buffer area, other than facilities to be occupied for activities associated with performing environmental investigation and/or restoration and expansion of the existing Interpretive Center. Duration: same as CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	None
		5. Maintain the integrity of any current or future remedies or monitoring systems. Duration: same as CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1.	None

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Southeast Drainage	CPOU	1. Prevent the development and use of the Southeast Drainage property for residential housing, schools, child-care facilities and playgrounds. Duration: Until UUUE conditions are achieved, decades or longer.	State ownership; Well Driller's Act (request special designation; addresses groundwater only); existing easement giving DOE the right to use for overland discharge of sewage does not prohibit development but could help deter development until a more effective IC is put in place.	Same as for CPOU Disposal Cell and Buffer Area use restriction #1. DOE will incorporate into the maintenance and inspection procedures new requirements indicated by the additional ICs to be implemented, as appropriate.	The following mechanism will be added for implementation: Easement.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Chemical Plant Area Groundwater and Springs	GWOU	1. Prevent the use of the contaminated shallow groundwater and spring water for drinking water purposes. The contaminated shallow groundwater occurs in the weathered and unweathered portions of the upper limestone unit (Burlington-Keokuk). The contaminated groundwater and spring water system occurs within the limits of the hydraulic buffer zone identified on Figure 3−1. The springs are identified on the figure as SP-6301, SP-6303, SP-5303, and SP-5304. Duration: This restriction will need to be maintained over a period of decades or longer.	For the Chemical Plant itself, DOE has jurisdictional control of this property. A notation on the ownership record has been recorded with the St. Charles County recorder of deeds. To date, additional layers have also been established in the operation of the Interpretive Center, placement of historical markers and the ramp and platform leading to the information plaques. ICs on the DOE controlled Chemical Plant are enforceable through the provisions of the existing FFA. The ICs are specified in the LTS&M Plan, which is a principal document under the new FFA. The existing MOU between Army & DOE allows for access to Army property for activities consistent with conducting and maintaining the groundwater remedy, e.g., well drilling, plugging, and sampling. For the state-owned areas, current state ownership and minimum eighty feet casing required by 10 CSR 23-3.090. A real estate license with the MDC exists that allows well drilling, plugging, and sampling; Well Driller's Act (request special designation; addresses groundwater only);	Routine sampling of wells—DOE contractors will inspect for any evidence of land use changes or significant land disturbance. Annual physical inspections of ICs and annual review of recorded title information—DOE will adhere to maintenance and inspection requirements per LTS&M Plan. Assess on-going protectiveness of ICs as part of required remedy review under CERCLA.	None for the DOE Chemical Plant. The MOU between Army and DOE will be updated to clarify restrictions and access for monitoring. For state-owned properties, mechanism to be added is: Easement.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Chemical Plant Area Groundwater and Springs (cont.)	GWOU	2. Limit the use of all groundwater within the outlined restricted area to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. Duration: This restriction will need to be maintained over a period of decades or longer.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.
		3. Retain access to the area for continued monitoring and maintenance of groundwater wells and springs. Duration: same as GWOU use restriction #1.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.
		4. Maintain the integrity of any current or future remedies or monitoring systems. Duration: same as GWOU use restriction #1.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.	Same as for GWOU use restriction #1.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Quarry Area	QROU	1. Prevent the development and use of the Quarry for residential housing, schools, child care facilities and playgrounds. Prevent drilling, boring, digging, or other activities in the Quarry proper that disturb the vegetation, disrupt the grade, expose the Quarry walls, or cause erosion of the clean fill that was used to restore the Quarry. This restriction should be maintained for the long-term. The 9-acre Quarry is under DOE jurisdictional control. Duration: The use restriction must be maintained until Quarry area conditions allow for UUUE, a period of decades or longer.	DOE has jurisdictional control of this property. A notation on the ownership record has been recorded with the St. Charles County recorder of deeds. To date, additional layers have also been established in the operation of the interpretive center, placement of historical markers and the ramp and platform leading to the information plaques. ICs on the DOE-controlled Quarry are enforceable through the provisions of the FFA. The ICs are specified in the LTS&M Plan, which is a principal document under the new FFA.	Routine sampling of wells—DOE contractors will inspect for any evidence of land use changes or significant land disturbance. Annual physical inspections of ICs and annual review of recorded title information—DOE will adhere to maintenance and inspection requirements per LTS&M Plan. Assess on-going protectiveness of ICs as part of required remedy review under CERCLA.	None.
		2. Prevent the use of the contaminated shallow groundwater for drinking water purposes. The contaminated shallow groundwater underlies the Quarry and extends to the marginal alluvium north of the slough as indicated on Figure 3−2. Duration: This restriction will need to be maintained until UUUE conditions are achieved, a period of decades or longer.	For the DOE Quarry, same as for QROU use restriction #1. For the state-owned areas, current state ownership, existing real estate licenses with the MDC and MDNR-Parks that allow well drilling, plugging, and sampling, and minimum 80 feet of casing as required by 10 CSR 23-3.090; Well Driller's Act (request special designation; addresses groundwater only);.	Same as for QROU use restriction #1 for both DOE quarry and state-owned properties.	For the DOE Quarry, same as for QROU use restriction #1. For state-owned properties, mechanism to be added is: Easement.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Quarry Area (cont.)	QROU	3. Limit the use of all groundwater within the outlined restricted area shown on Figure 3−2 to investigative monitoring only. The boundary of the restricted area extends beyond the area of contamination and is intended to provide a buffer against potential hydraulic influences on the area of contamination by preventing such things as pumping wells being located in the proximity of the contaminated area. This restriction includes the shallow groundwater system and also extends vertically to all groundwater systems that underlie the contaminated groundwater. Duration: This restriction will need to be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are at 300 pCi/L or lower. With the exception of the 9-acre Quarry, this restricted area is owned by state entities.	Same as for QROU use restriction #2.	Same as for QROU use restriction #2.	Same as for QROU use restriction #2.

Table 3–2 (continued). IC Design for the Weldon Spring Site

Area	OU	Use Restrictions and Duration	Existing ICs	Monitoring Frequency and Responsibility	Additional IC Mechanisms
Quarry Area (cont.)	QROU	4. Prevent drilling, boring, digging, construction, earth moving or other activities in the location identified as the Quarry natural reduction zone area that could result in disturbing the soils at this location or exposing subsurface soils (i.e., soils deeper than [about] 5 ft below the surface). This restriction will need to be maintained over a period of decades or longer. The soil in this area at a depth of 5 ft or greater contains geochemical properties that allow reduction processes to naturally occur, resulting in the precipitation of uranium from Quarry groundwater north of the Femme Osage Slough and thereby minimizing uranium migration to the well field. Duration: The restrictions must be maintained over a period of decades or longer, until uranium concentrations in Quarry groundwater north of the slough are at 300 pCi/L or lower. This area is located on property owned by a state entity.	Same as for QROU use restriction #2 for state-owned properties.	Same as for QROU use restriction #1. During routine well sampling, DOE contractors will also verify that all information signage on the monitoring wells is intact and legible.	Same as for QROU use restriction #2 for state-owned properties.
		5. Retain access to the area for continued monitoring and maintenance of groundwater wells. Duration: the use restriction must be maintained until conditions allow for UUUE.	Same as for QROU use restriction #2.	Same as for QROU use restriction #1.	Same as for QROU use restriction #2.
		6. Maintain the integrity of any current or future remedies or monitoring systems. Duration: The use restriction must be maintained until conditions allow for UUUE.	Same as for QROU use restrictions #1 and #2.	Same as for QROU use restrictions #1 and #2.	Same as for QROU use restrictions #1 and #2.

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4.0 Glossary

Alluvium: Sediments generally composed of clay, silt, sand, gravel, or similar unconsolidated material deposited by flowing rivers.

Aquifer: Rock or sediment that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Background level: 1. The concentration of a substance in an environmental medium (air, water, or soil) that occurs naturally or is not the result of human activities. 2. In exposure assessment the concentration of a substance in a defined control area, during a fixed period of time before, during, or after a data-gathering operation.

Confining unit: A layer of material of low hydraulic conductivity immediately above or below an aquifer that prevents the upward or downward movement of groundwater.

Contamination: Introduction into water, air, and soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use. Also applies to surfaces of objects, buildings, and various household and agricultural use products.

Exposure pathway: The course a contaminant takes from its source to the exposed individual. A complete exposure pathway generally requires four elements: (1) a source and mechanism of release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminant (referred to as the exposure point), and (4) an exposure route (e.g., external gamma irradiation, ingestion, inhalation, dermal absorption). If any of these elements is missing, the exposure pathway is considered incomplete.

Exposure scenario: A series of assumptions based on factors such as land use and human activities at a site. The major assumptions inherent to a scenario aside from land use, are the frequency and duration of exposure to a contaminant. These exposure assumptions are assigned numerical values along with assumptions regarding exposure pathways and estimate of exposure point concentrations to calculate potential intakes of a contaminant by a receptor. Typical exposure scenarios are residential, commercial/industrial, and recreational.

Feasibility Study (FS): 1. Analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site such as one on the NPL. The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the RI/FS. 2. A small-scale investigation of a problem to ascertain whether a proposed research approach is likely to provide useful data.

Groundwater: The supply of water found beneath the Earth's surface, usually in aquifers, which supply wells and springs.

Headward erosion: Occurs when the upper end of a drainage is cut back (lengthened in the upstream direction) by water as it flows in at its head.

Institutional controls: Controls such as deed restrictions, use restrictions, and permitting requirements that prohibit or limit activities that may result in exposure to contamination. Effective ICs must remain in effect for the duration of the hazard, survive a change in property ownership, and be enforceable. ICs also include those which preserve knowledge and facilitate public education regarding hazards at a site in order to enhance protectiveness into the future.

Leachate: Water that collects contaminants as it percolates through wastes, pesticides or fertilizers.

Leaky confining unit: A layer or zone of relatively lower permeability material immediately above or below an aquifer that allows some upward or downward movement of groundwater.

Maximum Credible Earthquake (MCE): A measure of the greatest seismic load that can be expected at a given location. The Weldon Spring disposal cell was designed to withstand a maximum credible earthquake.

Operable Unit (OU): Term for each of a number of separate activities undertaken as part of a Superfund site cleanup.

Probable Maximum Precipitation (PMP): The greatest amount of precipitation for a given duration that is theoretically possible from a storm event at a particular geographical area at a certain time of year. PMP is derived by adjusting the results of depth-area-duration analyses of precipitation in major storms that have occurred or could have occurred in the area of interest for maximum moisture charge and rate of moisture flow. The Weldon Spring disposal cell was designed and built to withstand 38.4 inches of rainfall in 6 hours.

Protectiveness: Maintaining risks to human health and the environment to within approved limits.

Radioactivity: The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays, from the nucleus of an unstable atom.

Radon: A colorless, naturally occurring, radioactive, inert gas formed by radioactive decay of radium atoms in soil and rocks.

Radon/infiltration barrier: A layer of compacted low-permeability clayey soil in the disposal cell cover that slows the movement of radon enough for the radon to decay before it escapes, and prevents precipitation water from entering the disposal cell.

Raffinate: A waste product from a refining process.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at NPL sites under CERCLA.

Reduction zone: A subsurface zone with characteristics of a reducing environment, such as gray to black soils, presence of organic materials, and absence of iron oxides. Reducing indicates a chemical condition that will change the solubility of most metals (e.g., uranium is typically precipitated in a reducing environment).

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Design (RD): A phase of remedial action that follows the remedial investigation/feasibility study and includes development of engineering drawings and specifications for a site cleanup.

RD/RA Work Plan: A plan implementing the requirements of a ROD consisting of a combination of the remedial design and remedial action phases.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action, and support technical and cost analyses of alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the RI/FS.

Remediation: Removal of contamination at a site to levels that do not exceed pre-established goals, such as federal or state standards or alternate concentration limits that are protective of human health and the environment.

Risk: A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Risk assessment: A process for organizing and analyzing information to determine if an environmental chemical might cause harm to exposed persons or the ecosystem. Risk assessments for the Weldon Spring Site conform to the procedures established by EPA. For human health, the EPA risk assessment process analyzes the possibility of cancer and noncancer effects caused by site contamination. EPA considers it acceptable if a person's chances of developing cancer (from site contaminants) are increased by only 1 chance in 1 million to 1 chance in 10,000 in addition to the chances of a person developing cancer from other causes. For noncancer effects, EPA compares the potential intake amount to the toxicity of the site contaminant. This ratio is called the hazard quotient; if one or more chemicals are present, the ratios are added to get a hazard index. EPA considers it not acceptable if the hazard quotient or hazard index is greater than 1.

Risk factor: Characteristics (e.g., race, sex, age, obesity) or variables (e.g., smoking, occupational exposure level) associated with increased probability of a toxic effect.

Route of exposure: The avenue by which a chemical comes into contact with an organism, (e.g., inhalation, ingestion, dermal contact, injection).

Select soil waste: A silty-clayey soil, with at least 50 percent passing the No. 200 sieve and maximum particle size limited to 6 inches. For construction of the Weldon Spring disposal cell, the material for this layer was selectively retrieved from the available contaminated soils present on site. The material was free of debris that could damage the high-density polyethylene (HDPE) liner.

Stakeholders: Any organization, government entity, or individual who has a stake in or may be affected by an approach to environmental regulation, pollution prevention, energy conservation, and other activities.

Surveillance and Maintenance: All activities necessary to ensure protection of human health and the environment following completion of cleanup, disposal, or stabilization at a site or portion of a site. Long-term surveillance and maintenance includes all engineered and ICs designed to contain or prevent exposure to residual contamination and waste, such as surveillance activities, record-keeping activities, inspections, groundwater monitoring, ongoing pump and treat activities, cap repair, maintenance of entombed buildings or facilities, maintenance of other barriers and contained structures, access control, and posting signs.

Stratigraphic unit: A stratum or collection of adjacent strata recognized as a unit in the classification of a rock sequence with respect to any of the many properties and attributes that rocks may possess, for purposes such as description, mapping, and correlation. Rocks may be classified stratigraphically on the basis of features such as color, properties (e.g., mineral content, radioactivity, chemical composition), age, and fossil content.

Superfund: The program operated under the legislative authority of CERCLA and the Superfund Amendments and Reauthorization Act of 1986 that funds and carries out EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the NPL, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Surface water: All water naturally open to the atmosphere (e.g., rivers, lakes, reservoirs, ponds, streams, impoundments, seas, and estuaries).

Transient drainage: Gravity drainage of water expelled from the pore spaces of soil encapsulated in the disposal cell. Water is introduced into the cell during construction as water added for compaction and dust control, as moisture in waste materials, and from precipitation. The weight of overlying material squeezes water from pore space, which drains out the bottom of the waste material. In the Weldon Spring disposal cell, this water is captured on the bottom liner system and conveyed to the LCRS. “Transient” refers to the fact that the cell cover prevents recharge of water into the cell, and drainage is an artifact of construction that will eventually reach zero flow.

Vicinity property: A discrete and off-site property or structure contaminated with hazardous materials that were derived from a processing site.

5.0 References

36 CFR 1220–1238. "National Archives and Records Administration," *Code of Federal Regulations.*

40 CFR 141. U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations," *Code of Federal Regulations,* July 1, 2001.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations,* July 1, 2001.

40 CFR 264. U.S. Environmental Protection Agency, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations,* July 1, 2001.

10 CSR 20-7.031. Missouri *Code of State Regulations,* Title 10, "Department of Natural Resources," Division 20, "Clean Water Commission," Chapter 7.031, "Water Quality Standards."

10 CSR 23. Missouri *Code of State Regulations,* Title 10, "Department of Natural Resources," Division 23, "Division of Geology and Land Survey."

10 CSR 25-7.264. Missouri *Code of State Regulations,* Title 10, "Department of Natural Resources," Division 25, "Hazardous Waste Management Commission," Chapter 7.264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities."

Army (U.S. Department of the Army), undated. *Histories of Ordnance Installations and Activities, 1940-45*, Entry 646, Records of the Office of the Chief of Ordnance (Record Group 156), Executive Branch, Historical Branch.

DOE Orders: 414.1A, *Quality Assurance*
450.1, *Environmental Protection Program*

DOE (U.S. Department of Energy), 1990. *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry,* DOE/OR/21548-317, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1992. *Well Field Contingency Plan,* DOE/OR/21548–340, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, November.

DOE (U.S. Department of Energy), 1993. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site,* OE/OR/21548-376, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1996. *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-584, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, August.

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

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

DOE (U.S. Department of Energy), 1998c. *Record of Decision for the Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548–725, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1999a. *Long-Term Surveillance and Maintenance Program Plan,* GJO-99-93-TAR, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, June.

DOE (U.S. Department of Energy), 1999b. *Southeast Drainage Closeout Report Vicinity Properties DA4 and MD7,* Rev. 0, DOE/OR/21548-772, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1999c. *Technical Guidance for the Long-Term Monitoring of Natural Attenuation Remedies at Department of Energy Sites*, October.

DOE (U.S. Department of Energy), 2000a. *Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit*, DOE/OR/21548-787, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 2000b. *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site,* DOE/OR/21548-798, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 2001a. *Completion Report for Radon Flux Monitoring of the WSSRAP Disposal Facility,* DOE/OR/21548-876, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 2001b. *Weldon Spring Site Remedial Action Project Second Five-Year Review*, DOE/OR/21548-891, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, August.

DOE (U.S. Department of Energy), 2002a. *Weldon Spring Site Environmental Report for Calendar Year 2001*, DOE/OR/21548-917, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 2002b. *Long-term Stewardship Planning Guidance for Closure Sites*, August.

DOE (U.S. Department of Energy), 2004a. *Weldon Spring Site Project Safety Plan*, DOE–LM/GJ630–2004, U.S. Department of Energy Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2004b. *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site*, DOE/GJ/79491−943, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 2005a. *Interim Remedial Action Report for the Groundwater Operable Unit of the Weldon Spring Site*, DOE/GJ/79491-952, U.S. Department of Energy Office of Legacy Management, March.

DOE (U.S. Department of Energy), 2005b. *Explanation of Significant Differences, Weldon Spring Site*, U.S. Department of Energy Office of Legacy Management, February.

DOE (U.S. Department of Energy), 2005c. Electronic Mail from U.S. Department of Energy, Office of Legacy Management to U.S. Environmental Protection Agency, Superfund Division (transmitting research paper on legalities and enforceability of various institutional control mechanisms in Missouri), April 15.

DOE (U.S. Department of Energy), 2005d. Transmittal Letter from U.S. Department of Energy, Office of Legacy Management to U.S. Environmental Protection Agency, Superfund Division (transmitting DOE's Position Paper on Institutional Control for the Weldon Spring site), April 22.

DOE (U.S. Department of Energy), 2006. *Weldon Spring Site Five-Year Review*, DOE-LM/GJ1158-2006, U.S. Department of Energy Office of Legacy Management, September.

DOE (U.S. Department of Energy), 2007. *Baseline Concentrations of the Chemical Plant Groundwater Operable Unit Monitored Natural Attenuation Network at the Weldon Spring, Missouri, Site*, DOE-LM/1539-2007, U.S. Department of Energy Office of Legacy Management, December.

EPA (U.S. Environmental Protection Agency), 1989a. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, 9 Part A*, EPA/549/1-89/002. Interim Final, Office of Emergency and Remedial Response, Washington, D.C., December.

EPA (U.S. Environmental Protection Agency), 1989b. *Exposure Factors Handbook*, EPA/600/8-89/043. Office of Health and Environmental Assessment, Washington, D.C., July.

EPA (U.S. Environmental Protection Agency), 1992. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Groundwater*, EPA 230–R–92–014; Office of Policy, Planning, and Evaluation; Environmental Statistics and Information Division, July.

EPA (U.S. Environmental Protection Agency), 1997. *Exposure Factors Handbook*, EPA/600/P-95/002F (Volumes 1 to 3). Office of Research and Development, National Center for Environmental Assessment, U.S. EPA, Washington, DC, August.

EPA (U.S. Environmental Protection Agency), 1999. *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*, OSWER 9200.4-178, April.

EPA (U.S. Environmental Protection Agency), 2000. *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanups*, EPA 540-F-00-005, September.

EPA (U.S. Environmental Protection Agency), 2001. *Comprehensive Five-Year Review Guidance*, OSWER 9355.7–03B–P, October.

EPA (U.S. Environmental Protection Agency), 2005a. *Institutional Controls Research−Missouri*. Prepared for U.S. Environmental Protection Agency Region VII, Superfund Division, and Office of Regional Counsel by DPRA Incorporated, Manhattan, Kansas, April 8.

EPA (U.S. Environmental Protection Agency), 2005b. Transmittal Letter from U.S. Environmental Protection Agency Region VII, Superfund Division to U.S. Department of Energy, Office of Legacy Management (transmitting attachment with recommendations for institutional controls for the Weldon Spring site), April 22.

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PLN/S04351, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

Appendix A

Background Information, Remedial Action Histories, Present Site Conditions

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A1.0 Weldon Spring Site Description and History

A1.1 Location and Property Ownership

The Weldon Spring Site is located in St. Charles County, Missouri, about 30 miles (48 kilometers) west of St. Louis (Figure A−1). The site comprises two geographically distinct U.S. Department of Energy (DOE)-owned properties: the Weldon Spring Chemical Plant and Raffinate Pit sites (Chemical Plant) and the Weldon Spring Quarry (Quarry). The Chemical Plant is located about 2 miles (2.3 kilometers) southwest of the junction of Missouri State Route 94 and U.S. Highway 40/61. The Quarry is about 4 miles southwest of the Chemical Plant. Both sites are accessible from Missouri State Route 94. Directions to the site from Lambert-St. Louis International Airport are provided in Table A−1.

Table A−1. Mileage and Directions from the Lambert-St. Louis International Airport to the Weldon Spring, Missouri, Site

Mileage	Route
0.0	At the Airport exit, take the I-70W on-ramp
11.3	On I-70W, take Exit 228 (Missouri State Route 94 and 1st Capital Drive)
11.9	Turn left on 1st Capital Drive and continue on South 1st Capital Drive (becomes Missouri State Route 94)
24.4	On Missouri State Route 94, turn right at the Interpretive Center entrance

During the early 1940s, the Department of the Army (DA) acquired 17,232 acres (6,974 hectares) of private land in St. Charles County for construction of the Weldon Spring Ordnance Works facility. The former ordnance works site has since been divided into several contiguous areas under different ownership as depicted in Figure A−2. Current land use of the former ordnance works area includes the DOE Weldon Spring Chemical Plant and Weldon Spring Quarry, the U.S. Army Reserve Weldon Spring Training area, lands managed by the Missouri Department of Conservation (MDC) and Missouri Department Natural Resources (MDNR)-Division of State Parks, the Francis Howell High School, a Missouri Department of Transportation (MoDOT) maintenance facility, the St. Charles County water treatment facility and law enforcement training center, the village of Weldon Spring Heights, and a University of Missouri research park.

The Chemical Plant and Quarry areas total 228.16 acres (92.33 hectares). The Chemical Plant property is located on 219.50 acres (88.83 hectares), and the Quarry occupies 8.66 acres (3.50 hectares). Legal descriptions of the two parcels are presented in Appendix D. DOE maintains real estate correspondence and instruments as part of the Long-Term Surveillance and Maintenance (LTSM) Program records at the DOE Grand Junction Office.

Most of the land consists of two state conservation areas managed by the MDC, which employs about 50 people at their facilities (DOE 2003c). The August A. Busch Memorial Conservation Area, located north of the Chemical Plant, includes about 6,987 acres (2,828 hectares) of actively managed grassland and forest. The Weldon Spring Conservation Area comprises about 7,356 acres (2,977 hectares) of primarily forested land located south and east of the Chemical Plant.

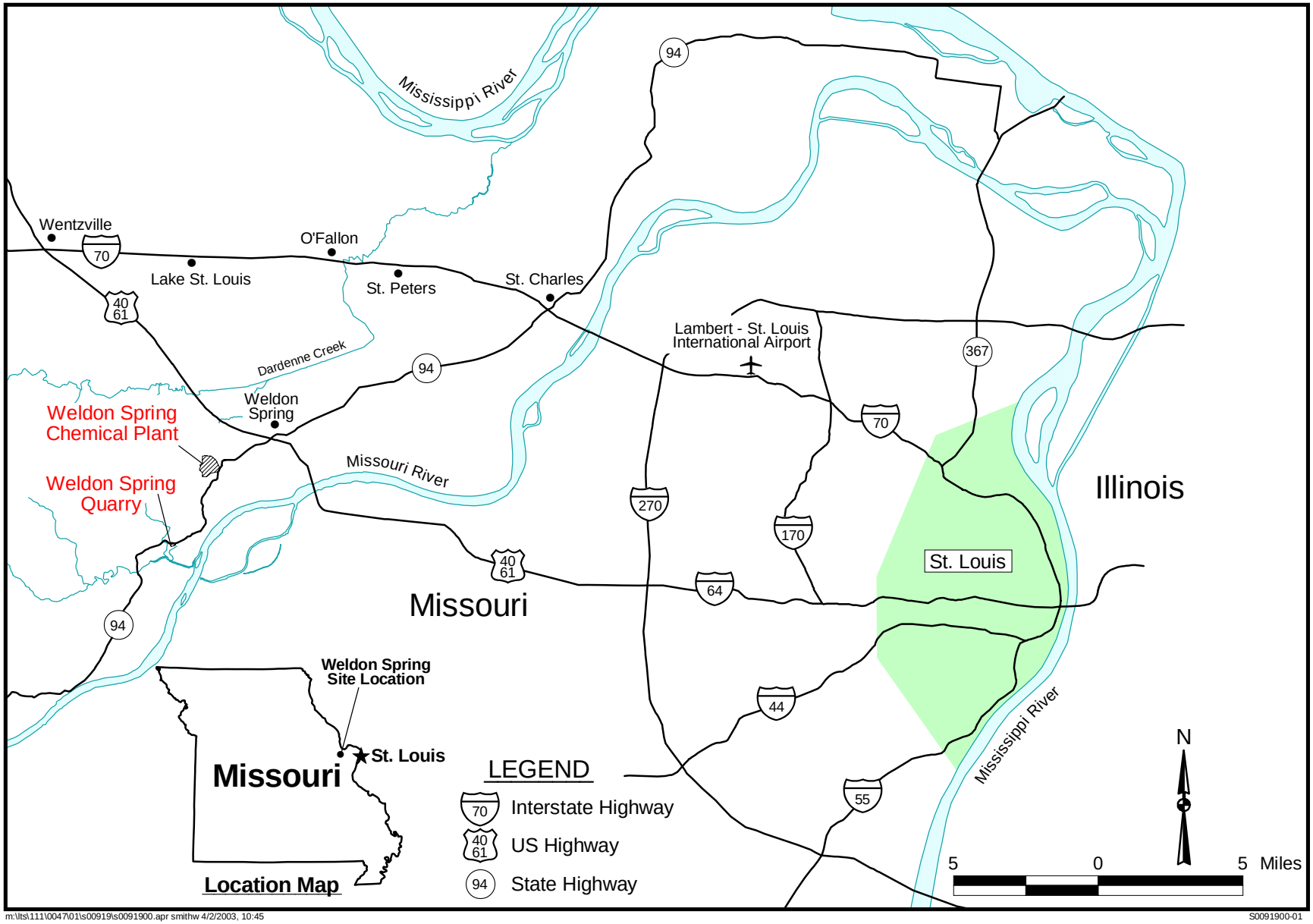


Figure A−1. Location of the Weldon Spring, Missouri, Site

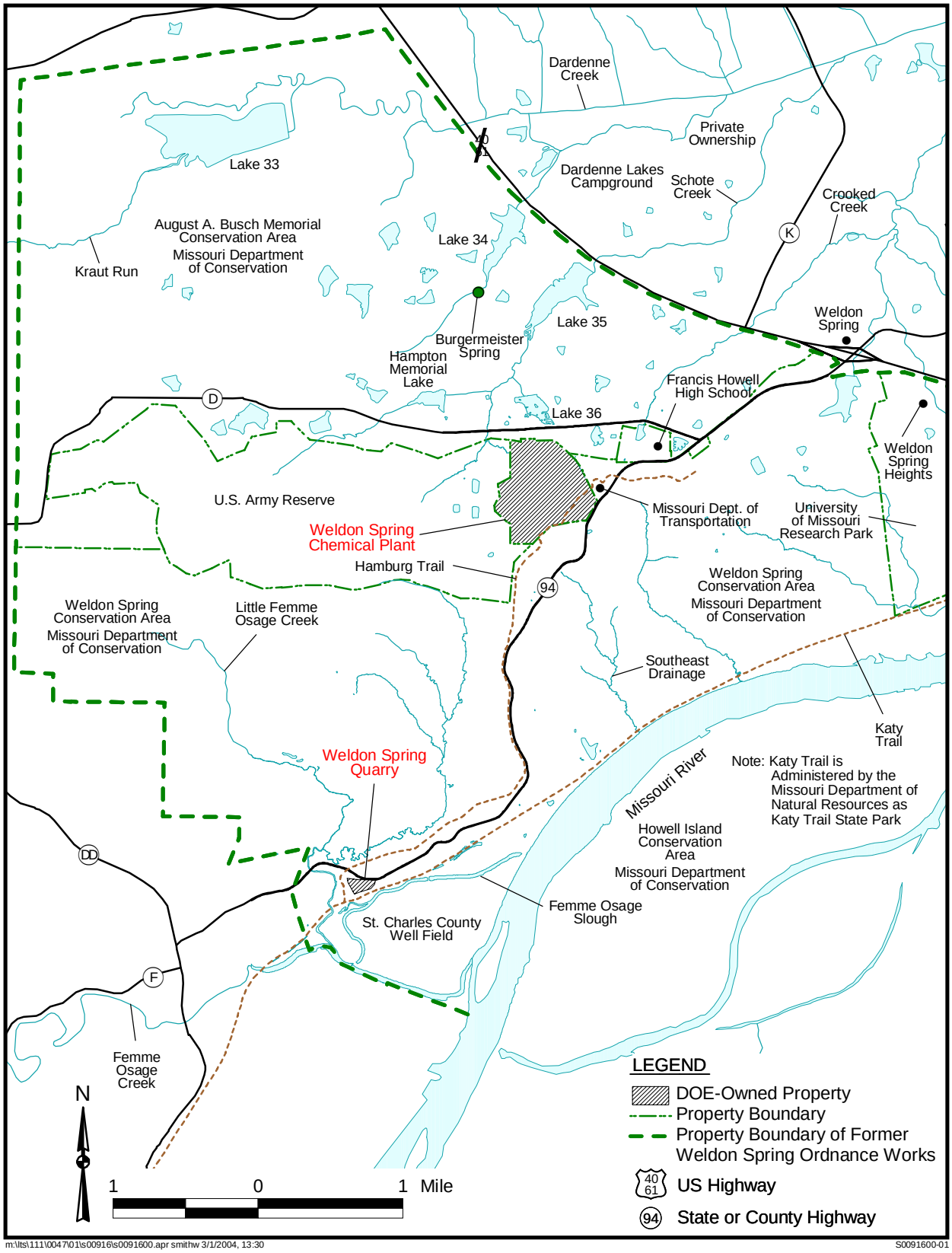


Figure A−2. Vicinity Map of the Weldon Spring, Missouri, Site

The Quarry is located within this conservation area. Both conservation areas are actively managed for fish and wildlife production and are used annually by more than 1,200,000 visitors for fishing, hunting, and hiking (DOE 2003c).

The Francis Howell High School occupies approximately 61 acres (25 hectares) and is located about 0.6 mile (1.0 kilometer) northeast of the Chemical Plant. The school employs approximately 150 faculty and staff, and about 1,600 students attend school. The MoDOT facility, located adjacent to the northeast side of the Chemical Plant, employs about 10 workers (DOE 2003c).

The two communities closest to the Chemical Plant are Weldon Spring and Weldon Spring Heights, located about 2 miles (3.2 kilometers) to the northeast. The combined population of these two communities is about 5,000 (DOE 2003c). No private residences are located between the Chemical Plant and these two communities; however, two residences owned by the MDC are located north of the Chemical Plant. These two residences are connected to the potable water system for the county. The closest private residence to the Quarry is located approximately 1 mile (0.6 kilometer) to the west. Residential and commercial growth is occurring in the communities surrounding the conservation areas, particularly in the city of O'Fallon, an area of growing residential population north of U.S. Highway 40/61.

A1.2 Physiography and Topography

The Weldon Spring Site, situated between the Mississippi and Missouri Rivers, is near the boundary between the Dissected Till Plains of the Central Lowland physiographic province to the north and the Salem Plateau of the Ozark Plateau physiographic province to the south. This boundary nearly coincides with the southern edge of Pleistocene glaciation that covered the northern half of Missouri more than 10,000 years ago.

The Chemical Plant is located on the east-west Missouri-Mississippi River surface drainage divide. Elevations at the site range from approximately 610 feet (186 meters) above mean sea level near the northern edge of the site to 650 feet (198 meters) above mean sea level near the southern edge. The topography of the site is gently undulating and generally slopes northward to the Mississippi River and, more steeply, southward to the Missouri River.

No natural drainage channels traverse the Chemical Plant, but because the site is topographically higher than surrounding areas, drainageways originate on the property and convey storm water off the site. Drainage from the southeastern portion of the site generally flows southward to a tributary referred to as the Southeast Drainage, which flows to the Missouri River. The northern and western portions of the site drain to tributaries to the Busch Lakes and Schote Creek, which in turn enter Dardenne Creek and, ultimately, the Mississippi River. Surface water can be lost to the subsurface through losing stream segments and discharges to Burgermeister Spring. These tributaries are shown on Figure A–2. Surface water from these watersheds is not used as a public drinking water supply. Dardenne Creek is used for irrigation purposes.

The Quarry is situated on a bluff of the Missouri River valley approximately 1 mile (1.6 kilometers) northwest of the Missouri River. Elevations in the Quarry area range from approximately 450 to 570 feet (149 to 174 meters) above mean sea level. Most surface runoff in the area is captured by Little Femme Osage Creek and Femme Osage Creek (Figure A–2). Below their confluence, Femme Osage Creek flows east to the Missouri River, which flows in a

northeasterly direction approximately 1 mile south of the Quarry. The average surface elevation of the Missouri River near the St. Charles County well field is 450 feet (137 meters). No direct surface water runoff enters the Quarry due to the topography of the area. The Quarry has been partially backfilled with low-permeability soils and has been graded to direct storm water off the area to prevent ponding and limit recharge to the contaminated limestone aquifer. Femme Osage Slough, approximately 700 feet (213 meters) south of the Quarry, is a 1.5-mile (2.4-kilometer) -long section of the original Femme Osage Creek and Little Femme Osage Creek and is currently used for recreational fishing.

A1.3 Hydrogeology

A1.3.1 Regional

In the Weldon Spring area, Quaternary alluvium and glacial deposits of varying thickness overlie a sequence of Mississippian through Cambrian formations consisting primarily of limestone and dolomite. The aquifers in these carbonate strata are separated by confining units that include layers of limestone, sandstone, siltstone, and shale. General stratigraphy and associated hydrology of the Weldon Spring area are summarized in Table A–2.

Aquifers in Quaternary alluvium are present near the Missouri River. Three bedrock aquifers are present in the region (Table A–2). The shallow bedrock aquifer system consists of limestones of the Mississippian Burlington-Keokuk and Fern Glen Formations. Regionally, the total thickness of these formations ranges from 145 to 270 feet (44 to 82 meters). The middle aquifer system is present in the Ordovician Kimmswick Limestone, which is 70 to 100 feet (21 to 30 meters) thick. The shallow and middle aquifers are separated by 60 to 135 feet (18 to 41 meters) of fine-grained limestone, shaley sandstone, and shale, which form a leaky confining unit over the middle bedrock aquifer. The deep aquifer system comprises eight formations ranging from the top of the Ordovician St. Peter Sandstone to the base of the Cambrian Potosi Dolomite. It is separated from the middle aquifer by 210 to 295 feet (64 to 90 meters) of shale and fine-grained limestone that form a confining unit between the two aquifers.

A1.3.2 Chemical Plant

Two major geologic units are present beneath the Chemical Plant: unconsolidated surface materials and underlying carbonate bedrock (Figure A–3). Unconsolidated surficial materials as much as 60 feet (18 meters) thick are clay-rich and mostly of glacial origin. The uppermost bedrock unit in the area, the Burlington-Keokuk Limestone, has been separated into two zones with different physical characteristics: a shallow, weathered zone underlain by an unweathered zone. The weathered portion of this formation consists of highly fractured limestone and has solution voids and enlarged fractures. These features are also present on a limited scale in the unweathered zone, which consists of thinly to massively bedded limestone.

The three regional bedrock aquifers are present beneath the Chemical Plant and are separated by the upper leaky and lower confining units above and below the middle aquifer system. The shallow unconfined bedrock aquifer, which occurs in the Burlington-Keokuk Limestone, is the only aquifer affected by site-related contamination (DOE 1997d) and is therefore of primary interest for groundwater monitoring. Localized aquifer properties are controlled by fracture spacing and solution voids in the weathered zone of the formation.

Table A−2. Generalized Stratigraphy and Hydrostratigraphy of the Weldon Spring, Missouri, Site

System	Series	Stratigraphic Unit	Typical Thickness (feet)[a]	Physical Characteristics	Hydrostratigraphic Unit
Quaternary	Holocene	Alluvium	0–120	Gravelly, silty loam	Alluvial aquifer
	Pleistocene	Loess and glacial drift[b]	10–60	Silty clay, gravelly clay, silty loam, or loam over residuum from weathered bedrock	Locally a leaky confining unit[c]
Mississippian	Meramecian	Salem Formation[c]	0–15	Limestone, limey dolomite, finely to coarsely crystalline, massively bedded, and thin bedded shale	
		Warsaw Formation[c]	0–80	Shale and thin to medium bedded finely crystalline limestone with interbedded chert	
	Osagean	Burlington-Keokuk Limestone	100–200	Cherty limestone, very fine to very coarsely crystalline, fossiliferous, thickly bedded to massive	Shallow aquifer system
		Fern Glen Limestone	45–70	Cherty limestone, dolomitic in part, very fine to very coarsely crystalline, medium to thickly bedded	
	Kinderhookian	Chouteau Limestone	20–50	Dolomitic argillaceous limestone, finely crystalline, thin to medium bedded	Upper leaky confining unit
Devonian	Upper	Sulphur Springs Group Bushberg Sandstone[d]	40–55	Quartz arenite, fine to medium grained, friable	
		Lower part of Sulphur Springs Group undifferentiated		Calcareous siltstone, sandstone, oolitic limestone, and hard carbonaceous shale	
Ordovician	Cincinnatian	Maquoketa Shale[e]	0–30	Calcareous to dolomitic silty shale and mudstone, thinly laminated to massive	
	Champlainian	Kimmswick Limestone	70–100	Limestone, coarsely crystalline, medium to thickly bedded, fossiliferous and cherty near base	Middle aquifer system
		Decorah Group	30–60	Shale with thin interbeds of very finely crystalline limestone	Lower confining unit
		Plattin Limestone	100–130	Dolomitic limestone, very finely crystalline, fossiliferous, thinly bedded	
		Joachim Dolomite	80–105	Interbedded very finely cystalline, thinly bedded dolomite, limestone, and shale; sandy at base	
		St. Peter Sandstone	120–150	Quartz arenite, fine to medium grained, massive	Deep aquifer system
	Canadian	Powell Dolomite	50–60	Sandy dolomite, medium to finely crystalline, minor chert and shale	
		Cotter Dolomite	200–250	Argillaceous, cherty dolomite, fine to medium crystalline, interbedded with shale	
		Jefferson City Dolomite	160–180	Dolomite, fine to medium crystalline	
		Roubidoux Formation	150–170	Dolomitic sandstone	
		Gasconade Dolomite	250	Cherty dolomite and arenaceous dolomite (Gunter Member)	
Cambrian	Upper	Eminence Dolomite	200	Dolomite, medium to coarsely crystalline, medium bedded to massive	
		Potosi Dolomite	100	Dolomite, fine to medium crystalline, thickly bedded to massive; drusy quartz common	

[a]Thickness data sources vary.
[b]Glacial drift unit includes the Ferrelview Formation and is saturated in the northern portion of the Ordnance Works where this unit behaves locally as a leaky confining unit.
[c]The Warsaw and Salem Formations are not present in the Weldon Spring area.
[d]The Sulphur Springs Group also includes the Bachelor Sandstone and the Glen Park Limestone.
[e]The Maquoketa Shale is not present in the Weldon Spring Area.

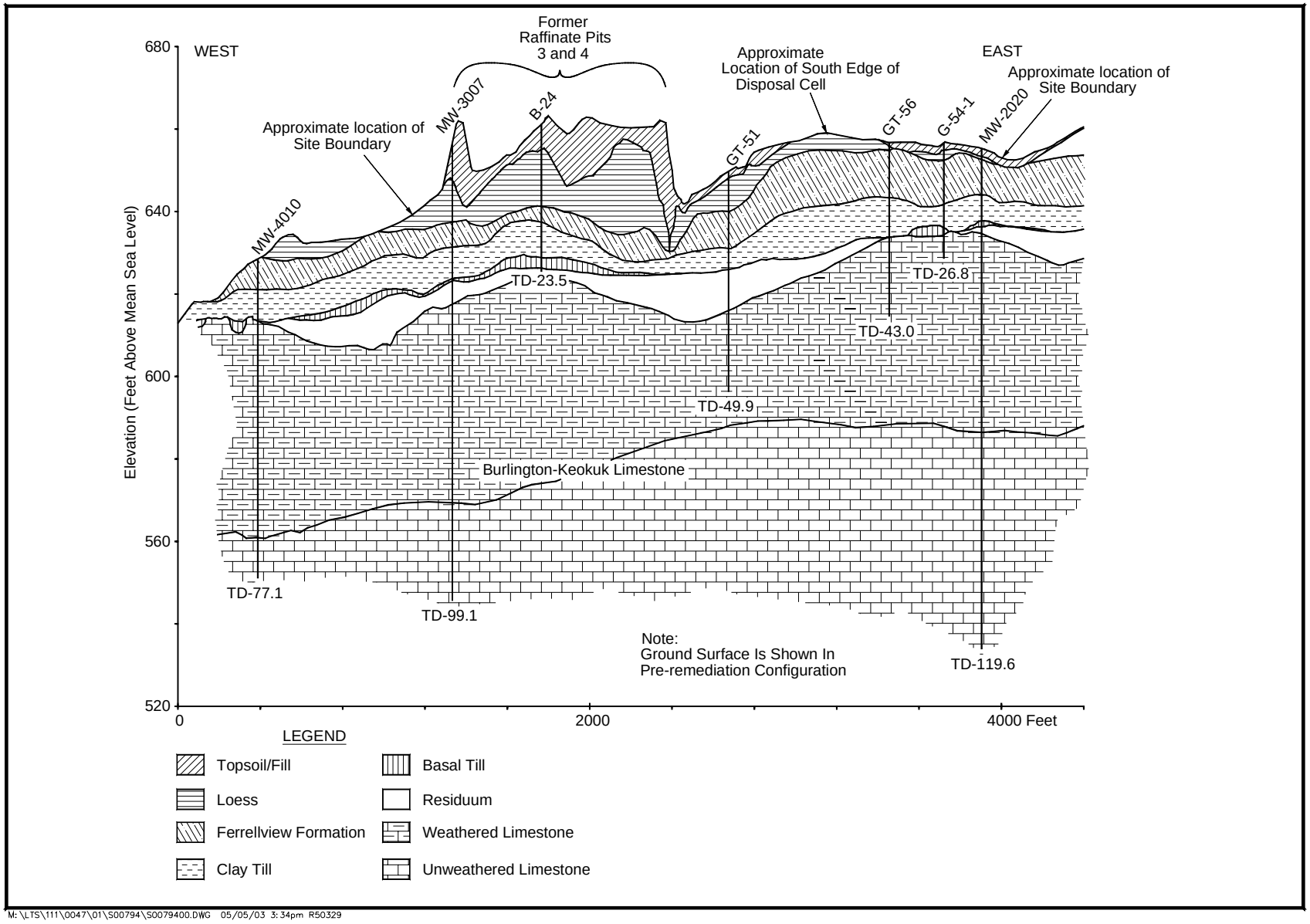


Figure A−3. Geologic Cross Section of the Weldon Spring, Missouri, Site Chemical Plant Area

Groundwater movement is controlled primarily by horizontal bedding planes, fractures, and solution features, resulting in limited downward movement into deeper formations. The underlying unweathered zone has decreased secondary porosity and lower hydraulic conductivity. Recharge to this aquifer is mainly through infiltration of precipitation from overburden and from streams where they cross limestone fractures and solution voids (i.e., "losing streams"). The water table at the Chemical Plant remains within the bedrock.

Regional groundwater flow for St. Charles County is toward the east. However, an east-west-trending groundwater divide, which coincides with the topographic high located immediately south of the Chemical Plant, separates two distinct local drainage systems. North of the divide groundwater flows north and west toward Burgermeister Spring and eventually toward Dardenne Creek. South of the divide groundwater flows southeast toward the Missouri River. Localized flow is controlled largely by bedrock structure and by surface water drainages. The potentiometric surface of the shallow unconfined aquifer is shown on Figure A–4. Groundwater movement is generally by diffuse flow with localized zones of discrete flow controlled by solution conduits or paleochannels. Springs, a common feature in the vicinity of the Chemical Plant site, are located where groundwater emerges through solution channels or at topographic low points (i.e., "gaining streams"). The springs in the Southeast Drainage, which is located south of the groundwater divide, contribute to intermittent flow in the drainage.

A1.3.3 Quarry

The Quarry is located in low limestone hills near the northern bank of the Missouri River. Mississippian through Upper Ordovician formations, present in the Chemical Plant, are absent in the Quarry (Figure A–5). Limestone was quarried from the Ordovician Kimmswick Limestone, which is exposed in the Quarry walls. Before the Quarry was backfilled and regraded, the bedrock floor of the Quarry exposed the underlying shale and thinly bedded limestone of the Decorah Group. Unconsolidated deposits of windblown glacial materials overlie the Kimmswick Limestone in the upland areas near the Quarry, and substantial deposits of Quaternary Missouri River alluvium cover the Plattin Limestone to the south and east of the Quarry.

Two of the regional bedrock aquifers are present in the vicinity of the Quarry. The shallow aquifers of interest occur in the Kimmswick Limestone and in the alluvium of the Missouri River. The Kimmswick Limestone aquifer has low yield and is not used as a drinking water source in the Quarry vicinity. Recharge to the limestone bedrock is from infiltration of precipitation through overburden and upland recharge. Groundwater generally flows from north to south in the vicinity of the Quarry, toward the alluvium the Missouri River. Some Quarry groundwater flows westward from the Quarry to Little Femme Osage Creek. The potentiometric surface of the shallow aquifer is shown on Figure A–6.

The predominant aquifer system in the Quarry area is the Missouri River alluvium, which is a source of drinking water for residents of St. Charles County. The alluvial aquifer is recharged by infiltration of surface water (principally from the Missouri River) and precipitation, and by discharge from the Plattin Limestone where it contacts the alluvium south and east of the Quarry.

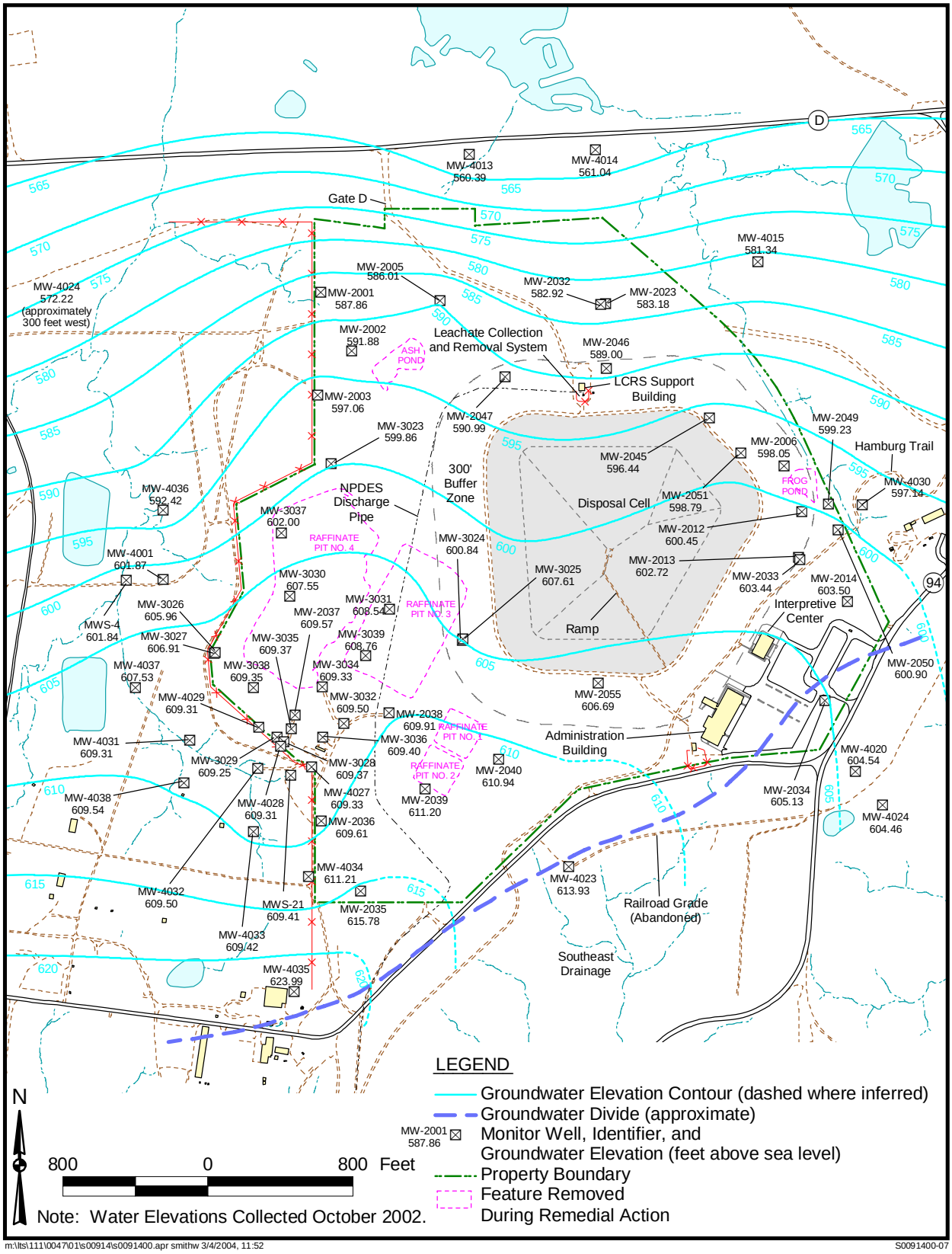
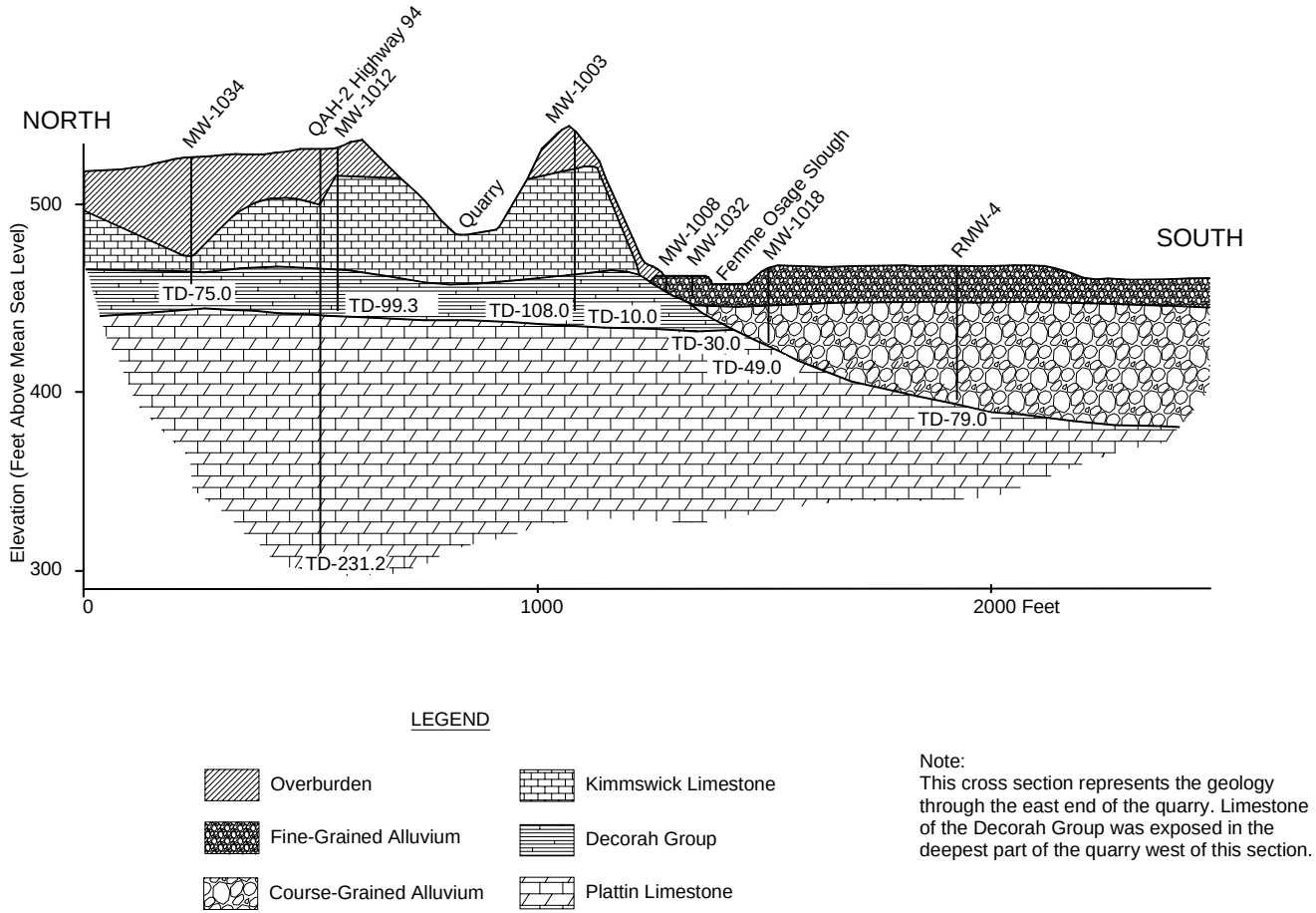


Figure A−4. Groundwater Contour Map of the Weldon Spring, Missouri, Site Chemical Plant Area



Note:
This cross section represents the geology through the east end of the quarry. Limestone of the Decorah Group was exposed in the deepest part of the quarry west of this section.

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Figure A−5. Geologic Cross Section of the Weldon Spring, Missouri, Site Quarry Area

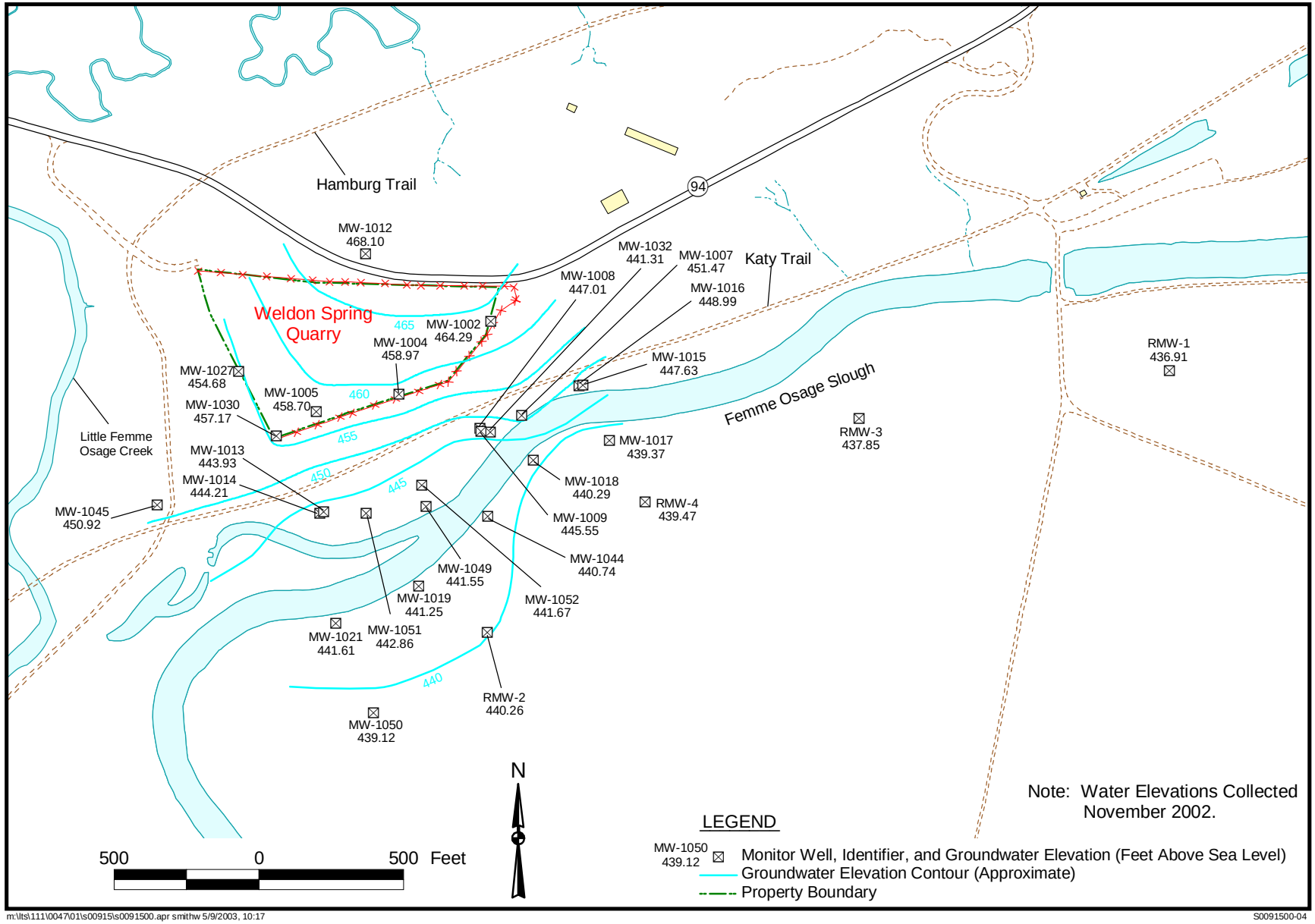


Figure A−6. Groundwater Contour Map of the Weldon Spring, Missouri, Site Quarry Area

Groundwater flow in the area of the St. Charles County well field, which is located between Femme Osage Slough and the Missouri River, generally is in an eastward direction. The flow is influenced by the Missouri River and by pumping from the eight production wells in the well field.

A1.4 Climate and Vegetation

A continental climate with warm to hot summers and moderately cold winters prevails in the Weldon Spring area. Average daily maximum and minimum temperatures are 65.4°F (18.6°C) and 46.7°F (8.2°C), respectively. Mean annual precipitation is 37.5 inches (95.0 centimeters). Winds measured at the site flow predominantly from the south and southwest at an average velocity of 6.3 miles per hour (2.8 meters per second).

State conservation areas surround most of the Chemical Plant (Figure A–2). These areas are managed for multiple uses, including timber, fish and wildlife habitat, and recreation. Open fields in these areas are leased to sharecroppers for agricultural production; portions of the crops are left for wildlife use. The main agricultural products are corn, soybeans, milo, winter wheat, and legumes.

The Quarry is surrounded by the Weldon Spring Conservation Area, which consists primarily of deciduous forest with some old field habitat of grasses, herbs, and scattered wooded areas. Slope and upland forest, including cottonwood, sycamore, and oak, is present along the rim and upper portions of the Quarry.

A1.5 Site History

A1.5.1 Operations History

In 1941, the U.S. Government acquired 17,232 acres (6,974 hectares) of rural land in St. Charles County to establish the Weldon Spring Ordnance Works. In the process, the towns of Hamburg, Howell, and Toonerville and 576 citizens of the area were displaced (U.S. Department of the Army undated). From 1941 to 1945, the DA manufactured trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Ordnance Works site. Four TNT production lines were situated on what was to be the Chemical Plant. These operations resulted in nitroaromatic contamination of soil, sediments, and some off-site springs.

Following a considerable amount of explosives decontamination of the facility by the Army and the Atlas Powder Company, 205 acres (83.0 hectares) of the former ordnance works property were transferred to the U.S. Atomic Energy Commission (AEC) in 1956 for construction of the Weldon Spring Uranium Feed Materials Plant, now referred to as the Weldon Spring Chemical Plant. An additional 14.88 acres (6.02 hectares) were transferred to the AEC in 1964. The plant converted processed uranium ore concentrates to pure uranium trioxide, intermediate compounds, and uranium metal. A small amount of thorium was also processed. Wastes generated during these operations were stored in four raffinate pits located on the plant property. Uranium processing operations resulted in radioactive contamination of the same locations previously contaminated by former Army operations.

The Weldon Spring Quarry was mined for limestone aggregate used in construction of the ordnance works. The Army also used the Quarry for burning wastes from explosives

manufacturing and disposal of TNT-contaminated rubble during the operation of the ordnance works. These activities resulted in nitroaromatic contamination of the soil and groundwater at the Quarry.

In 1960, the Army transferred the Quarry to AEC, who used it from 1963 to 1969 as a disposal area for uranium and thorium residues from the Chemical Plant (both drummed and uncontained), and for disposal of contaminated building rubble, process equipment, and soils from demolition of a uranium processing facility in St. Louis. Radiological contamination occurred in the same locations as the nitroaromatic contamination.

Uranium processing operations ceased in 1966, and on December 31, 1967, AEC returned the facility to the Army for use as a defoliant production plant. In preparation for the defoliant process, the Army removed equipment and materials from some of the buildings and disposed of them principally in Raffinate Pit 4. The defoliant project was canceled before any process equipment was installed, and the Army transferred 50.65 acres (20.50 hectares) of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. AEC and subsequently DOE managed the site, including the Army-owned Chemical Plant, under caretaker status from 1968 through 1985. Caretaker activities included site security oversight, fence maintenance, grass cutting, and other incidental maintenance. In 1984, the Army repaired several of the buildings at the Chemical Plant, decontaminated some of the floors, walls, and ceilings, and isolated some equipment. In 1985, the Army transferred full custody of the Chemical Plant to DOE, at which time DOE designated control and decontamination of the Chemical Plant, raffinate pits, and Quarry as a major project.

A1.5.2 Remedial Action History

DOE established an on-site project office in 1986, and the Quarry and Chemical Plant were placed on the National Priorities List in 1987 and 1989, respectively. Initial remedial activities at the Chemical Plant site consisted of a series of Interim Response Actions (IRAs) authorized through the use of Engineering Evaluation/Cost Analysis (EE/CA) reports. Electrical transformers, electrical poles and lines, and overhead piping and asbestos were removed by IRAs because they presented an immediate threat to workers and the environment. An isolation dike was built to divert runoff around the Ash Pond area to reduce the concentration of contaminants going off site in surface water. The Debris Consolidation IRA consisted of detailed characterization of on-site debris, separation of radioactive and nonradioactive debris, and transport of materials to designated staging areas for interim storage. Four separate IRAs authorized the dismantling of 44 Chemical Plant buildings.

The treatment of water was another major activity addressed by IRAs. Separate EE/CAs were prepared for the site and Quarry water treatment plants. The first batch of water from the Quarry water treatment plant was discharged in January 1993. The first batch of water from the site water treatment plant was discharged in May of the same year. Water was treated at both sites to remove chemical and radiological contaminants. The water was tested prior to batch discharge. Two hundred seventy-six million gallons of water meeting the National Pollutant Discharge Elimination System discharge criteria were treated and released. Dewatering of the four raffinate pits was completed in September 1999. Demolition of the site water treatment plant was completed on July 6, 2000, and the Quarry water treatment plant demolition was completed in May 2001. Both plants were disposed of in the on-site disposal cell.

Remediation of the Weldon Spring Site was administratively divided into four Operable Units (OUs): Quarry Bulk Waste OU, Quarry Residuals OU, Chemical Plant OU, and Groundwater OU. The Southeast Drainage was remediated as a separate action through an EE/CA report (DOE 1996).

A2.0 Remedial Action Descriptions

A2.1 Chemical Plant OU

In September 1993, DOE finalized the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (DOE 1993) for managing contaminated materials (except groundwater) at the Chemical Plant. The Chemical Plant OU addressed the various sources of contamination in the Chemical Plant including soils, sludge, sediment, and materials placed in short-term storage as a result of previous response actions. The remedial action included in the Chemical Plant Record of Decision (ROD) was the major component of site cleanup and addressed comprehensive disposal options for the project. The primary focus was the contaminated material in the Chemical Plant, including that generated as a result of previous response actions, but it also addressed disposal of materials generated by the other OUs in order to facilitate a disposal decision that would integrate all the OUs. The three key components of the remedy were:

- Remove the contaminated materials.
- Treat the wastes as appropriate by chemical stabilization/solidification (CSS).
- Dispose of the wastes in an engineered disposal facility constructed on site.

The remedy included remediation of 17 off-site vicinity properties affected by Chemical Plant operations. The vicinity properties were remediated in accordance with Chemical Plant ROD cleanup criteria. Detailed information regarding the vicinity properties is included in Section A2.1.5, “Vicinity Properties” of this Appendix.

A2.1.1 Present Conditions

The Chemical Plant property will remain under DOE jurisdiction. The disposal cell and a 300-foot (91-meter) buffer zone around the cell will be controlled by the U.S. government in perpetuity with no change in land use. The 300-foot buffer zone is a MDNR regulation under Title 10 *Code of State Regulations,* Division 25 (10 CSR 25-7.264). Any agreement to use DOE-controlled land between the buffer zone and the property boundary will invoke land use restrictions to prevent excavation or construction activities, preserve the site grading pattern that is designed to protect the cell, and protect long-term monitoring wells located on the Chemical Plant property.

Contaminated groundwater remains in the shallow aquifer beneath the Chemical Plant, primarily in the western and northeastern portions of the site and beneath portions of adjacent property. Contaminants include uranium, nitrate, trichloroethylene (TCE), and nitroaromatic compounds, including TNT and 2,4-DNT. Burgermeister Spring (SP–6301), located approximately 1 mile (1.6 kilometers) northwest of the Chemical Plant, has elevated concentrations of contaminants of

concern related to Chemical Plant activities (uranium and nitrate). DOE will acquire the necessary restrictive rights with the landowner to ensure land use remains restricted.

Soil and sediment containing elevated concentrations of radium-226, thorium-230, and uranium-238 remain in the Southeast Drainage. Radionuclide concentrations in the soil, sediment, and spring water are below protective levels calculated using a hypothetical child-resident scenario. Exposure scenarios used for the risk assessment do not represent unrestricted use. Therefore, DOE will obtain a restrictive easement or will obtain an indefinite term license with the MDC to ensure that future land use remains consistent with the selected remedy provisions. Springs in the Southeast Drainage (i.e., the 5300 drainage) will be encompassed in the area of institutional control for the Southeast Drainage.

A corrugated metal culvert underneath Missouri State Route 94 at the Southeast Drainage (see the inspection base map, Figure 2–2) contains fixed residual radioactivity on its inner surfaces in excess of DOE Order 5400.5*, Radiation Protection of the Public and the Environment* generic surface contamination guidelines for natural uranium, uranium-238, and associated decay products. The maximum beta-gamma activity, measured inside the culvert, was 11,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2). A supplemental limit of 15,000 dpm/100 cm^2 was approved by the DOE Oak Ridge Operations Office, Oak Ridge, Tennessee (DOE–ORO) on the basis that the upper bounds potential dose to workers and the general public from the residual radioactivity is very low (more than an order of magnitude below the DOE guideline of 100 millirem per year), and additional remedial action would not be cost effective (DOE 2001b and DOE 2001c). Should future Missouri State Route 94 roadway modifications or other disturbance result in access to the culvert, DOE will remove the culvert and provide for its final disposal at an U.S. Environmental Protection Agency (EPA)-approved radioactive waste disposal site.

Soil containing elevated concentrations of uranium-238 was left under twin culverts in the Highway D right-of-way within the Frog Pond Outlet located north of the Chemical Plant (see the inspection base map, Figure 2–2). A summary of the risk assessment for these culverts is provided in Appendix B. DOE will provide long-term surveillance and maintenance oversight to manage this soil. The inside surfaces of the corrugated metal culverts contain fixed residual radioactivity in excess of DOE Order 5400.5 generic surface contamination guidelines for natural uranium, uranium-238, and associated decay products. The maximum beta-gamma activity was 10,800 dpm/100 cm^2. DOE–ORO approved a supplemental limit of 15,000 dpm/100 cm^2 because the maximum potential dose to workers and the general public from the residual radioactivity is very low (more than an order of magnitude below the DOE guideline of 100 millirem per year), and additional remedial action would not be cost effective (DOE 2001b and DOE 2001c). Should future Highway D roadway modifications result in access to the drainage culverts, DOE will remove both culverts and provide for their final disposal at an EPA-approved radioactive waste disposal site.

Institutional controls for management of the remaining contaminated groundwater, Burgermeister Spring and Southeast Drainage spring water, soil, sediment, and culverts are addressed in Section 3.0, “Institutional Controls” of this Long-Term Surveillance and Maintenance Plan.

Dedicated haul roads between the Chemical Plant and the Quarry and a borrow area have been reclaimed as a hiking and bike trail (the Hamburg Trail). DOE converted a metal building into an interpretive center for the public and installed a ramp and platform on the disposal cell for public access. An administration building and wastewater treatment plant also remain on the site.

A2.1.2 Soil Confirmation

Cleanup criteria for the contaminants of concern in site soil were developed from environmental regulations and guidelines in combination with the results of site-specific risk assessments. As part of the latter, a site-specific analysis was conducted to address the reduction of residual risks to within a range from As Low As Reasonable Achievable (ALARA) levels for a residential scenario to an incremental increased risk of 1×10^{-6} for carcinogens and a hazard index of 1 for noncarcinogens. Table A−3 lists the cleanup criteria established in the Chemical Plant ROD. Following excavation of an area, the dimensions of which were based on extensive characterization data, DOE used several approaches to confirm that the cleanup criteria had been met. The area was walk-scanned using radiation detection monitors and was sampled using a grid established for the site. The data were then evaluated against specific not-to-exceed target levels, hot-spot evaluation procedures, average data target levels, and cumulative data goals based on all data collected to date. Additional details concerning how confirmation was conducted are presented in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (DOE 1995).

Table A−3. Weldon Spring, Missouri, Site Chemical Plant ROD Cleanup Criteria for Soils

	Surface		Subsurface	
Radionuclides (pCi/g)	ALARA	Criteria	ALARA	Criteria
Radium-226	5.0	6.2	5.0	16.2
Radium-228	5.0	6.2	5.0	16.2
Thorium-230	5.0	6.2	5.0	16.2
Thorium-232	5.0	6.2	5.0	16.2
Uranium-238	30	120	30	120
Chemicals (mg/kg)	ALARA	Criteria	ALARA	Criteria
Arsenic	45	75	75	750
Chromium	90	110	110	1,110
Lead	240	450	450	4,500
PAHs	0.44	5.6	5.6	56
PCBs	0.65	8.0	8.0	80
2,4,6-TNT	14	140	140	1,400

Key: mg/kg = milligram(s) per kilogram; PCBs = polychlorinated biphenyls; pCi/g = picocurie(s) per gram; TNT = trinitrotoluene; ALARA = As Low As Reasonably Achievable; PAHs = polycyclic aromatic hydrocarbons

Values listed for surface soils apply to contamination within the upper 15 centimeters (6 inches) of the soil column. Values for subsurface apply to contamination in soils below 15 centimeters (6 inches) unless otherwise noted.

Between 1995 and 2001, approximately 200 acres (81 hectares) were confirmed. Confirmation activities were conducted as detailed in the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (DOE 1995). This plan presents the protocol to determine whether remediation efforts at the Chemical Plant of the Weldon Spring Site have been completed as

required by the Chemical Plant ROD, including cleanup standards, sampling methods, sample frequency, analytical parameters, and the statistical evaluation to be performed to accomplish this determination.

In general, the confirmation process can be described as follows: Excavations were designed to remove contaminated soil where concentrations exceeded the ALARA cleanup goals. Once the contaminated soil was excavated to the design depths, walkover surveys were conducted to determine if soil samples could be collected. Walkover surveys were conducted using 2-inch by 2-inch (5-centimeter by 5-centimeter) sodium iodide scintillation detectors. During the walkovers, areas with gamma activity exceeding 1.5 times background received additional excavation. Once gamma activity in the areas being surveyed was less than 1.5 times background, confirmation soil samples were collected. Soil sample results were then compared against the cleanup standards in the Chemical Plant ROD.

Table A−4 provides a summary of cumulative confirmation results collected under the *Chemical Plant Area Cleanup Attainment Confirmation Plan* (DOE 1995). The table was generated using the final data sets compiled from all samples that represented soils left in place.

Table A−4. Final Soil Confirmation Statistics for the Weldon Spring, Missouri, Site Chemical Plant

Parameter	Number of Samples	Average Concentration	Background Concentration	ALARA Cleanup Goal	Percentage of Results below ALARA
Arsenic (mg/kg)	2,782	8.19	26	45	99.96%
Chromium (mg/kg)	3,090	17.37	36	90	100.00%
Lead (mg/kg)	2,687	18.22	34	240	99.70%
Thallium (mg/kg)	1,082	1.78	16	16	99.82%
Polycyclic aromatic hydrocarbons (mg/kg)	2,716	0.10	N/A	0.44	94.48%
PCBs (mg/kg)	3,111	0.04	N/A	0.65	98.46%
2,4,6-TNT (mg/kg)	1,514	0.17	N/A	14	99.80%
Uranium-238 (pCi/g)	9,193	2.91	1.2	30	99.13%
Radium-226 (pCi/g)	6,909	1.04	1.2	5	99.93%
Radium-228 (pCi/g)	6,731	1.04	1.2	5	99.96%
Thorium-230 (pCi/g)	6,183	1.56	1.2	5	97.99%
Thorium-232 (pCi/g)	6,731	1.04	1.2	5	99.93%

N/A - No background concentration is listed for the organic compounds because they are not naturally present in soil.
Key: mg/kg = milligram(s) per kilogram; PCBs = polychlorinated biphenyls; pCi/g = picocurie(s) per gram; TNT = trinitrotoluene

A2.1.3 Disposal Cell

Construction of an engineered disposal cell on the Chemical Plant property began in 1997. Approximately 1.48 million cubic yards (1.13 million cubic meters) of waste materials, including building debris, asbestos-containing materials, treated raffinate sludge, contaminated soils, drums, process equipment, and the Quarry bulk wastes, were disposed of in the cell. To form a structurally stable material, raffinate sludge was mixed with portland cement and fly ash in the engineered and constructed on-site chemical stabilization/solidification (CSS) plant to create

grout that was pumped to the disposal cell. Disposal activities were completed in 2001. A detailed description of construction and waste disposal activities are included in the Chemical Plant Remedial Action Report.

The disposal cell is located on the northeastern portion of the Chemical Plant property, and the outer perimeter protection system encompasses an area of approximately 41 acres (16.6 hectares). The 5-sided cell has 4:1 side slopes over the clean-fill dike, and cover slopes of approximately 13:1 over the waste. The maximum width of the cell footprint, including the rock-covered apron, is approximately 1,500 feet (457 meters), and the maximum height above grade is approximately 91 feet (28 meters). The cell contains approximately 1.48 million cubic yards (1.13 million cubic meters) of contaminated waste, with a total activity of 6,570 curies. The waste column has a maximum thickness of 63 feet (19 meters), and the waste footprint, including the lower interior dike slopes, is approximately 24 acres (9.7 hectares).

Six primary systems were incorporated into the cell design: the cover, the waste, a surrounding clean-fill dike, a geochemical barrier, a basal liner system, and a leachate collection and removal system (LCRS) (Figure A–7).

The cell cover system is approximately 8.5 feet (2.6 meters) thick; the upper 3.5 feet (1.1 meters) of the top slope consists of limestone riprap with an average diameter of 8 inches (20 centimeters); the riprap is 2 feet thick on the side slopes (Figure A–8). The riprap layer protects the cover from erosion and restricts penetration of the cover by plant roots and burrowing animals. This riprap layer overlies a sequence of aggregate bedding and drainage layers. Beneath these layers is a high-density polyethylene (HDPE) liner with an attached layer of bentonite. The principal radon/infiltration barrier consists of a 3-foot (0.9-meter)-thick layer of compacted low-permeability clayey soil beneath the HDPE liner.

Three drainage bays were created at the cell bottom sloping toward two low points on the north side of the cell floor to facilitate leachate flow. The west bay includes a monolith of debris cemented with grout containing raffinate sludges.

The cell bottom liner incorporates two HDPE layers separated by a synthetic drainage layer consisting of geotextile and geonet (Figure A–9). The upper HDPE liner system is covered with drainage aggregate and a layer of peat mixed with low-radioactivity soil that will adsorb some leachate contaminants. The lower HDPE liner system was placed on a bentonite mat-covered 3-foot (0.9-meter)-thick layer of compacted clay. The mat and clay layer provide an additional low-permeability liner and geochemical barrier that will adsorb uranium and other constituents in leachate that potentially could leak through the HDPE liner system. The cell foundation complies with a siting requirement included in the Missouri regulations for the equivalent of a 30-foot thickness of clay with a permeability of 10^{-7} centimeters per second under the contained waste.

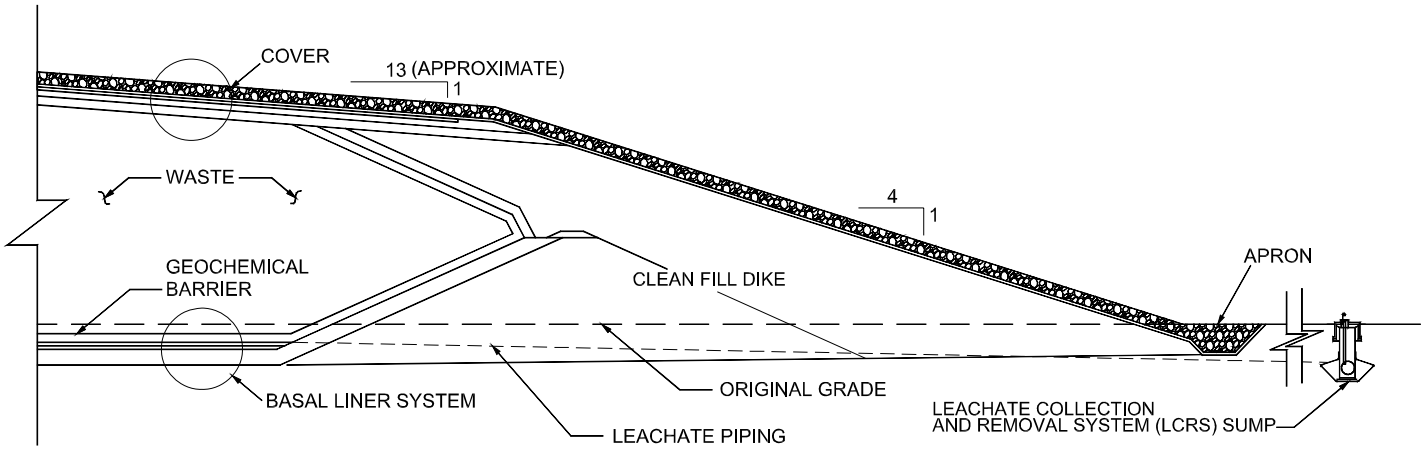
Specific performance and design criteria for the cell include:

- Seismic resistance: sustain a Maximum Credible Earthquake defined as:

  −Peak Ground Acceleration = 0.26 g (gravitation constant)

  −Period of the Design Ground Motion = 0.3 second

  −Duration of the Design Ground Motion = 24 to 30 seconds



CELL CONFIGURATION

AREA INCLUDING APRON = 41 ACRES
MAXIMUM WIDTH = 1,500 FEET
MAXIMUM HEIGHT = 91 FEET
WASTE VOLUME = 1.48 MILLION CUBIC YARDS

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Figure A−7. Primary Systems of the Weldon Spring, Missouri, Site Disposal Cell

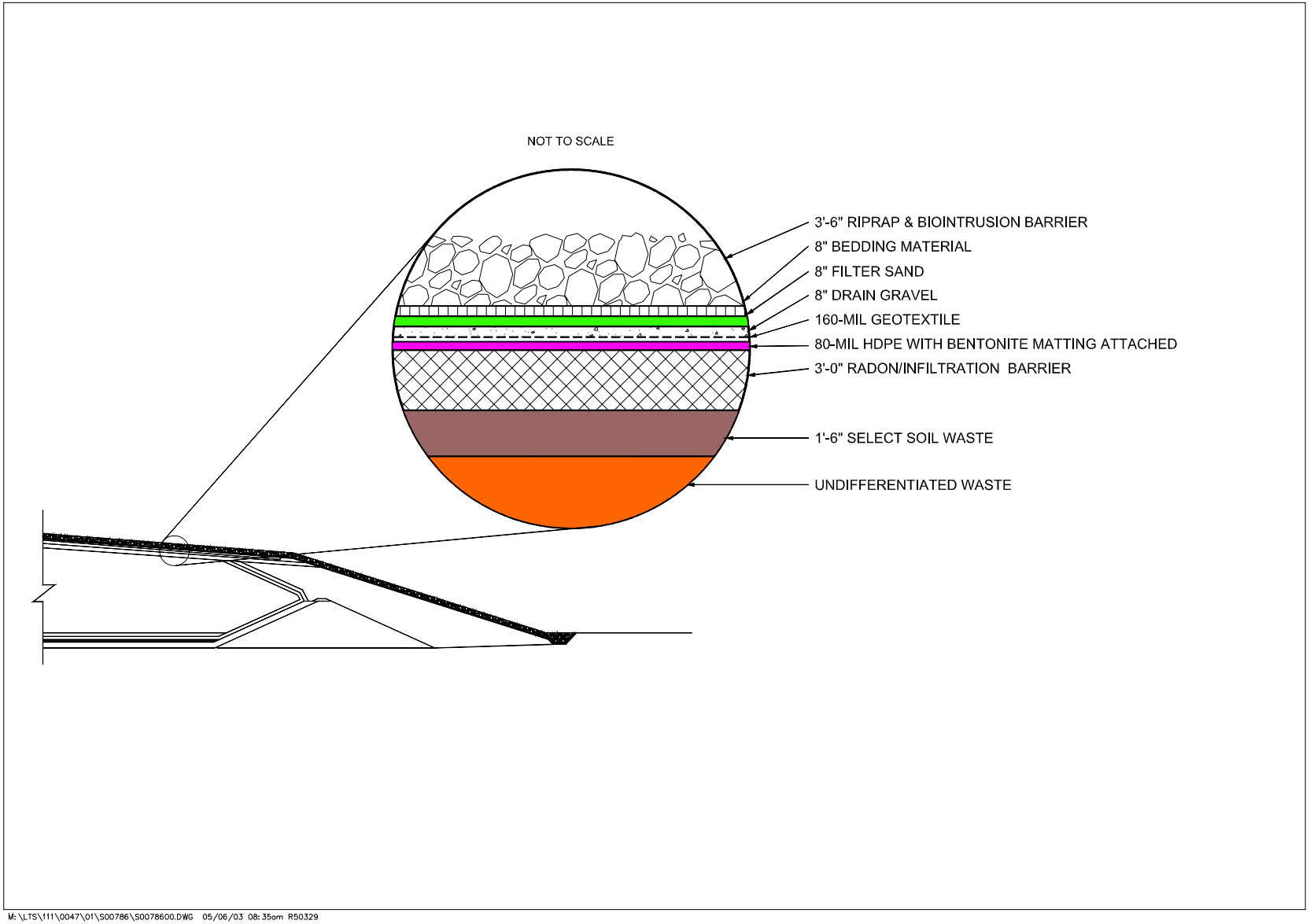

Figure A−8. Cover System of the Weldon Spring, Missouri, Site Disposal Cell

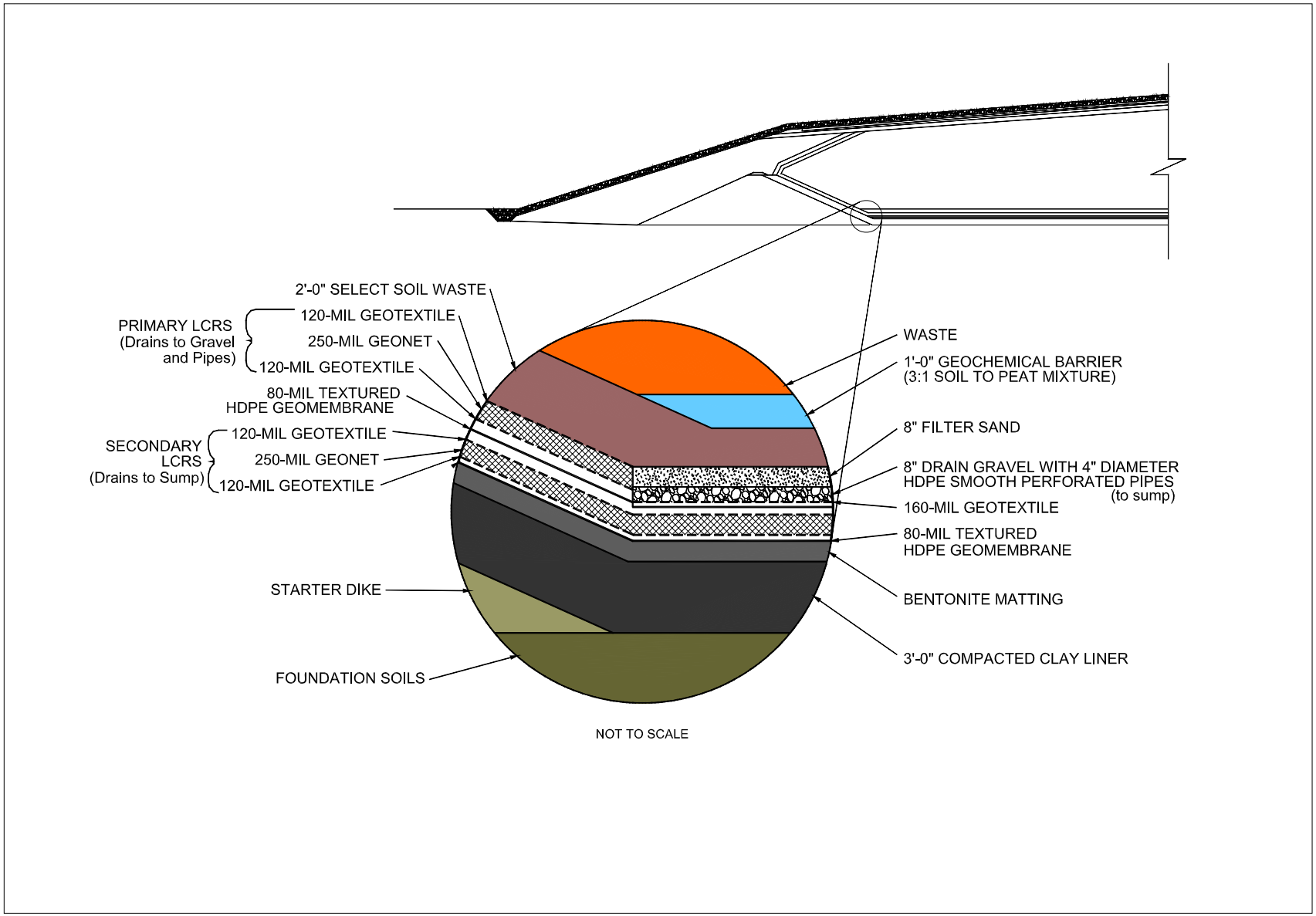

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Figure A−9. Basal Liner System of the Weldon Spring, Missouri, Site Disposal Cell

−Horizontal Seismic Acceleration Coefficient (long term) = 0.17

−Horizontal Seismic Acceleration Coefficient (short term) = 0.13

- Sustain a Probable Maximum Precipitation (PMP) event defined as 38.4 inches in 24 hours.

Leachate from the cell is collected in a primary collection system under the cell consisting of 4-inch (10-centimeter)-diameter perforated HDPE pipes placed in the drainage material on top of the primary liner (Figure A–9). The pipes convey leachate by gravity to a sump located north of the disposal cell (Figure A–10). The sump consists of a 200-foot (61-meter)-long, 42-inch (107-centimeter)-diameter HDPE pipe for storage and a 60-inch (152-centimeter)-diameter HDPE manhole for access. A zone of drain gravel in an annulus enclosed by an 80-mil (2-millimeter)-thick HDPE geomembrane liner was placed around the leachate piping between the cell liner and the sump and also around the sump itself to provide secondary containment. Within the cell, the primary collection pipes are configured to overflow into the drain gravel if they become clogged or if water levels exceed 12 inches (30 centimeters), to be conveyed inside the annulus to the secondary containment around the sump. A monitoring well was installed adjacent to the sump manhole to detect leakage from the sump or overflow of the primary collection pipes into the secondary containment system. Primary collection system pipes converge at the sump.

A secondary collection system consists of an HDPE geonet placed between layers of geotextile (high-tensile strength filter fabric), which is placed between the primary and secondary bottom liners (Figure A–9). This system collects leakage through the primary liner. Fluids flow through the secondary collection system to two gravel-filled sumps, one for each basin, located along the north edge of the cell (Figure A–10). The fluids are then conveyed by HDPE pipe through the gravel-filled annulus to the HDPE sump north of the cell. Flows in secondary collection system pipes can be monitored individually at the sump.

Instrumentation sensors installed in the LCRS sump will be used to monitor the combined (primary and secondary) leachate volume. The east and west secondary leachate collection system flow is discretely monitored prior to being combined with the primary leachate through a system of volumetrically calibrated containers. These containers are equipped with level switches and dump valves. The container fills with secondary leachate to a predetermined level, and a valve is actuated that dumps the contents. The number of dumps is recorded electronically and displayed at the LCRS monitoring cabinet. The flow rates will be calculated from these data. The LCRS monitoring cabinet is installed in the LCRS Support Building and displays the combined sump level and the discrete secondary collection system number of dumps. The operational capacity of the combined sump is approximately 11,200 gallons, and the sump secondary containment is approximately the same. The operation and maintenance plan for the LCRS is provided in Appendix I.

A summary of analytical results for leachate samples collected between January 2002 and January 2003 is provided as an attachment to Appendix I. These data will be reported in the annual environmental report.

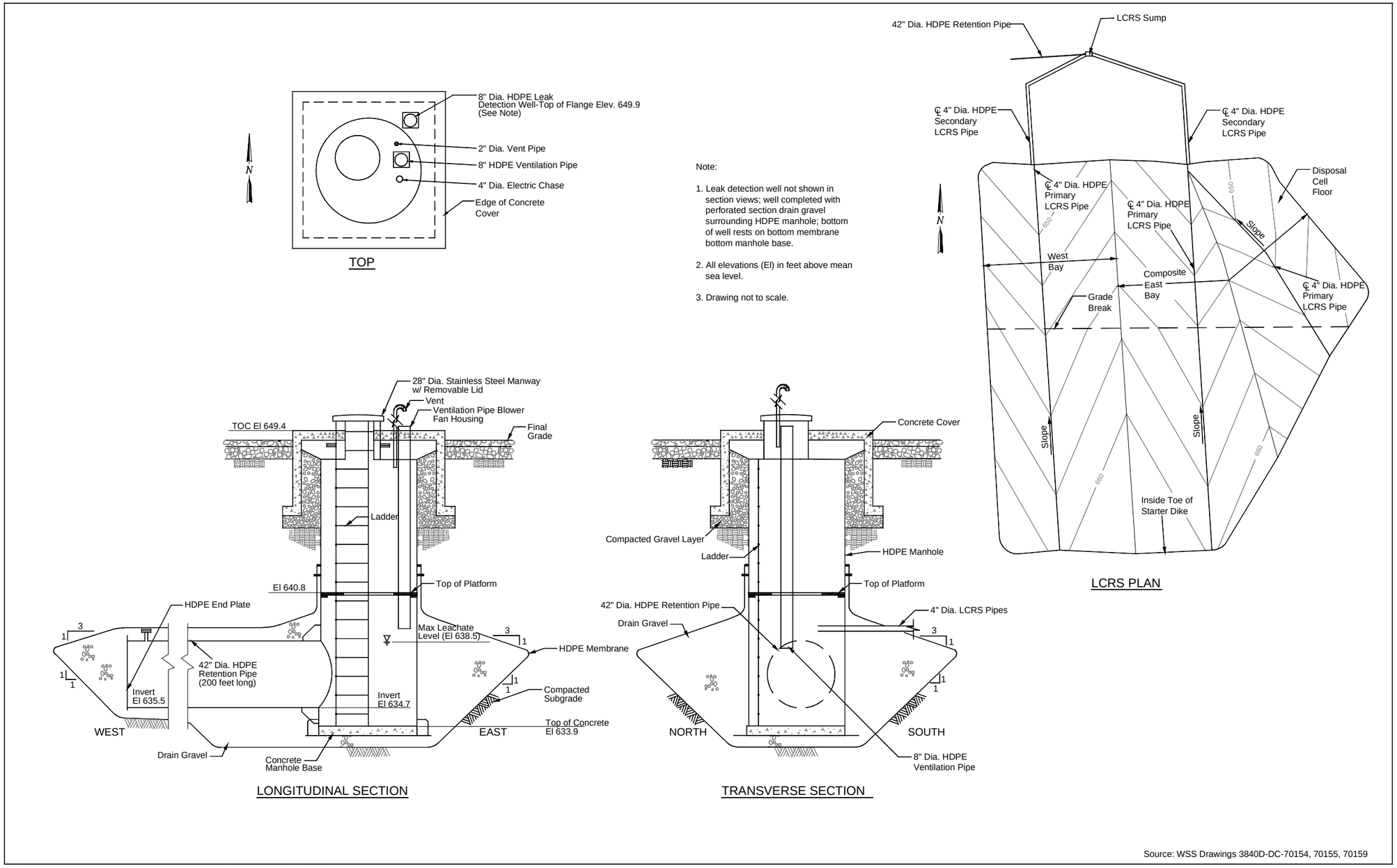

Figure A−10. Leachate Collection and Removal System of the Weldon Spring, Missouri, Site Disposal Cell

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A rock apron at the toe of the side slope is 16 feet wide and 4 feet deep and filled with rock with a median diameter of 8 inches. The apron protects the cell from gullying or erosion progressing upslope (headward erosion) toward the cell. It also dissipates energy and redistributes flow off the cell. Positive grading directs runoff from the disposal cell and the immediate surrounding area away from the cell. Final grading of the Chemical Plant incorporates the natural drainage patterns to the greatest extent practical to promote drainage and prevent scouring and erosion. Beyond the cell, surface water is controlled using V-shaped surface swales designed to accommodate runoff from a PMP 24-hour storm event.

DOE established a detection-monitoring network (Figure A−11) around the cell to monitor cell performance, as required under Title 40 *Code of Federal Regulations* Part 264 (40 CFR 264) Subpart F and 10 CSR 25–7.264(2)(F). The network originally consisted of five wells and Burgermeister Spring. All wells are completed in the weathered portion of the Burlington-Keokuk Limestone. In 2001, monitoring well MW–2048 was damaged and replaced with MW−2055. Also, MW–2051 was installed to replace MW−2045, where anomalous, elevated metal concentrations were attributed to poor hydraulic performance. Burgermeister Spring (SP−6301) is a perennial downgradient point of emergence for groundwater from the Chemical Plant area.

A2.1.4 Surface Water

Streams do not run through the property, but because the site is topographically higher than the surrounding areas, drainageways originate on the property and convey storm water off site. Prior to remediation, surface drainage from the western portion of the site, which included Ash Pond, the south and north dump areas, and the raffinate pits, drained to tributaries of Busch Lake 35 and then to Schote Creek and Dardenne Creek (Figure A–12). In this watershed during 1999, Ash Pond, Raffinate Pits 3 and 4, the chipped wood storage area, and the south end of the temporary storage area (TSA) were remediated and confirmed to meet Chemical Plant ROD cleanup criteria. The remainder of this watershed was remediated and confirmed to meet cleanup criteria during 2000. Final grading was completed during 2001, and the area was seeded.

Surface water drainage from the northeast portion of the Chemical Plant, which included the administration building and subcontractor parking lots, Frog Pond, the material staging area, and part of the disposal cell, discharged to Dardenne Creek from Schote Creek after first flowing through Busch Lakes 36 and 35 (Figure A–12). During cell construction, storm water runoff from open portions of the cell was collected in Retention Basin 2 for treatment before discharge by pipeline to the Missouri River. The cell was closed during 2001 and the basin was removed.

In 2002, average uranium levels at the off-site surface water locations were lower than the 2000 annual averages at three of five locations and slightly higher at two locations. Average annual uranium concentrations for surface water are provided in Table A–5, along with the historical high concentrations for each location. The historical concentrations for the background location, SW–2007, are also shown. Uranium levels at the Busch Lake Outlets have shown an overall decline since remediation started. The Schote Creek and Dardenne Creek locations are downstream of the lakes and have always shown relatively low concentrations because the Chemical Plant portion of the watershed is much smaller than the total watershed area. The slightly higher levels reported for these two creeks in 2001 are within the range reported at the background location. Surface water bodies downstream of the Chemical Plant continue to show declining uranium levels.

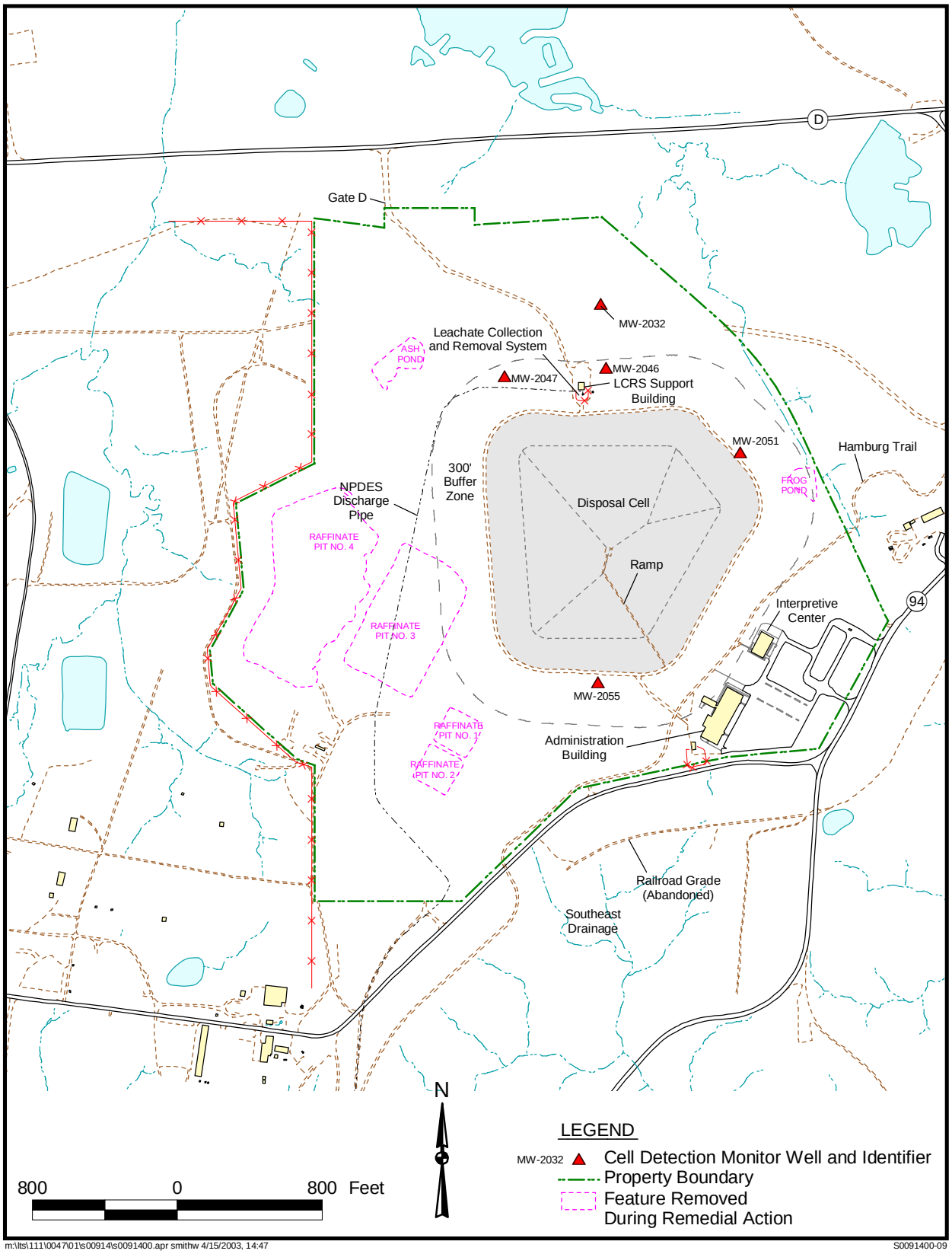

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Figure A−11. Cell Performance Well Locations at the Weldon Spring, Missouri, Site

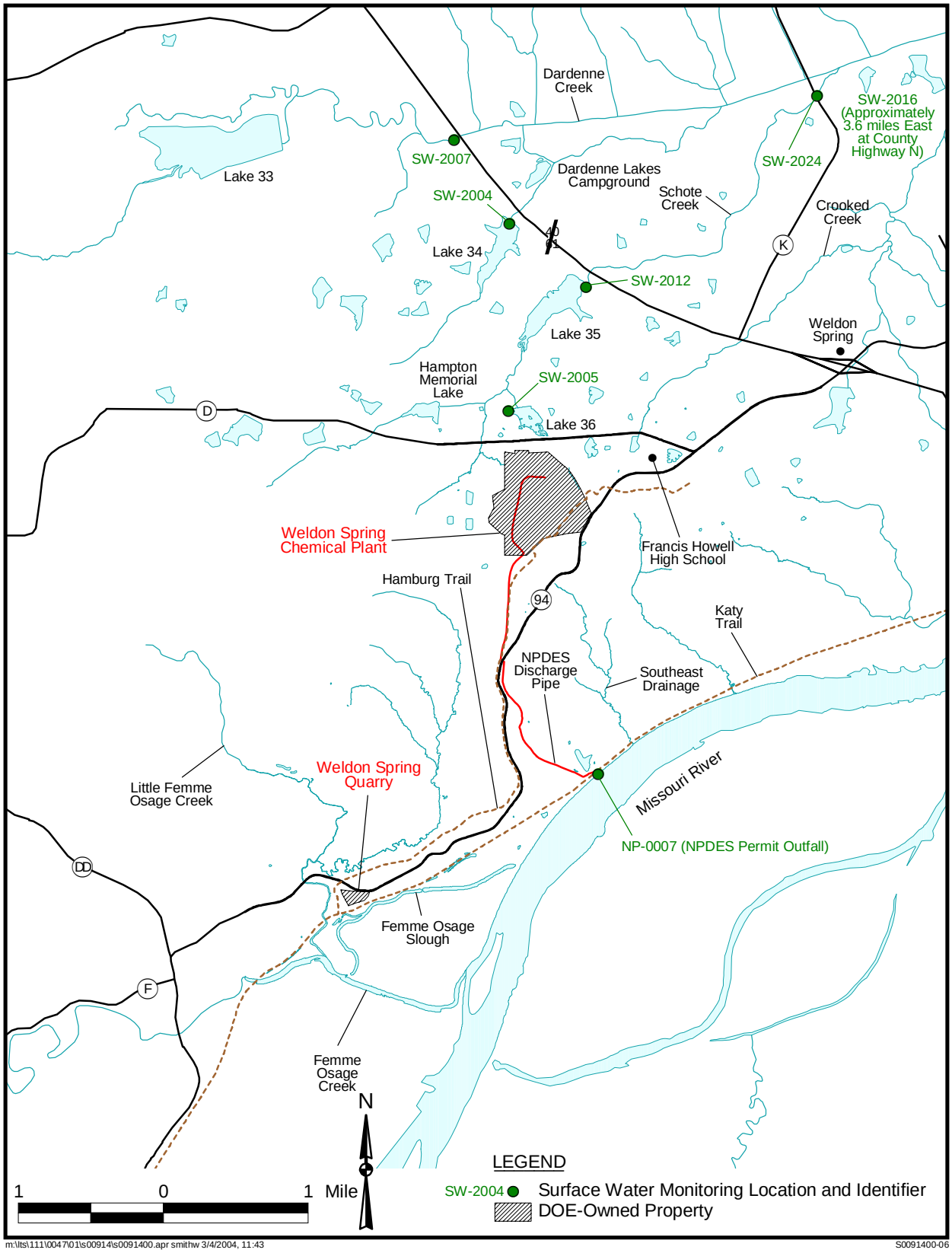

Figure A−12. Surface Water Monitoring Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site

Table A−5. 2002 Annual Averages for Total Uranium Concentrations at Chemical Plant Area Surface Water Locations at the Weldon Spring, Missouri, Site

Identifier	Location	Average[a]	Maximum[a]	Minimum[a]	Historical Maximum[a] (year)
SW–2004	Lake 34	4.3	6.7	2.6	39.0 (1989)
SW–2005	Lake 36	3.1	4.1	2.5	53.7 (1996)
SW–2012	Lake 35	2.4	4.5	1.0	326.0 (1991)[b]
SW–2016	Dardenne Creek	0.9	1.4	0.3	7.8 (1994)
SW–2024	Schote Creek	1.9	2.8	0.8	5.3 (1999)
SW–2007[c]	Background		8.2	0.1	8.2 (1990)

[a]All concentrations in picocurie(s) per liter (pCi/L).
[b]Result considered an outlier.
[c]Location was not sampled in 2001.

Runoff from the southern portion of the Chemical Plant (Figure A–12), which historically included the site water treatment plant, Building 434 (where legacy process chemicals were stored), and parking and equipment areas for the former CSS facility, flows southeast to the Missouri River via the Southeast Drainage. Prior to remedial action, overflow from Raffinate Pits 1, 2, and 3 and the Chemical Plant process sewer line discharged to the Southeast Drainage. Raffinate Pit 3 was removed in 1999. The site water treatment plant, effluent basins, equalization basin, Raffinate Pits 1 and 2, and Building 434 were removed, and the area was remediated and confirmed to meet Chemical Plant ROD cleanup criteria during 2000. By the end of 2001, final grade was established and the area was seeded.

A2.1.5 Vicinity Properties

In 1985, Oak Ridge Associated Universities (ORAU) conducted a comprehensive radiological survey of all areas outside the Chemical Plant boundary and within the ordnance works area (Boerner 1986). The purpose of the study was to assess the extent and levels of off-site radioactive contamination resulting from operation of the uranium feed materials plant. Radiologically contaminated areas outside the boundaries of the Chemical Plant and Quarry were defined by ORAU as vicinity properties. Vicinity properties that required remedial action are shown in Figure A−13. The radiological surveys included surface and subsurface soils, water, and sediment on the properties surrounding the Chemical Plant. Background levels and baseline concentrations were established for each medium in the vicinity of the area. These concentrations were used to determine the extent of radioactive contamination within a surveyed area. ORAU used the following threshold concentrations to determine radioactively contaminated soil: radium-226 and thorium-232 concentrations of 5 picocuries per gram (pCi/g) averaged over the first 6 inches (15 centimeters) of soil depth and 15 pCi/g for soil more than 6 inches (15 centimeters) deep; uranium-238 concentration of 60 pCi/g averaged over the area of interest. Results of the study indicated that soils in small areas in the Chemical Plant area and the MDC conservation areas had generally low levels of radioactivity as a result of previous site activities. In total, ORAU identified 17 vicinity properties, of which seven were in the DA Weldon Spring Training Area (DA−1 through DA−7), and 10 were in the MDC wildlife areas (MDC−1 through MDC−10). The properties and descriptions are listed in Table A−6.

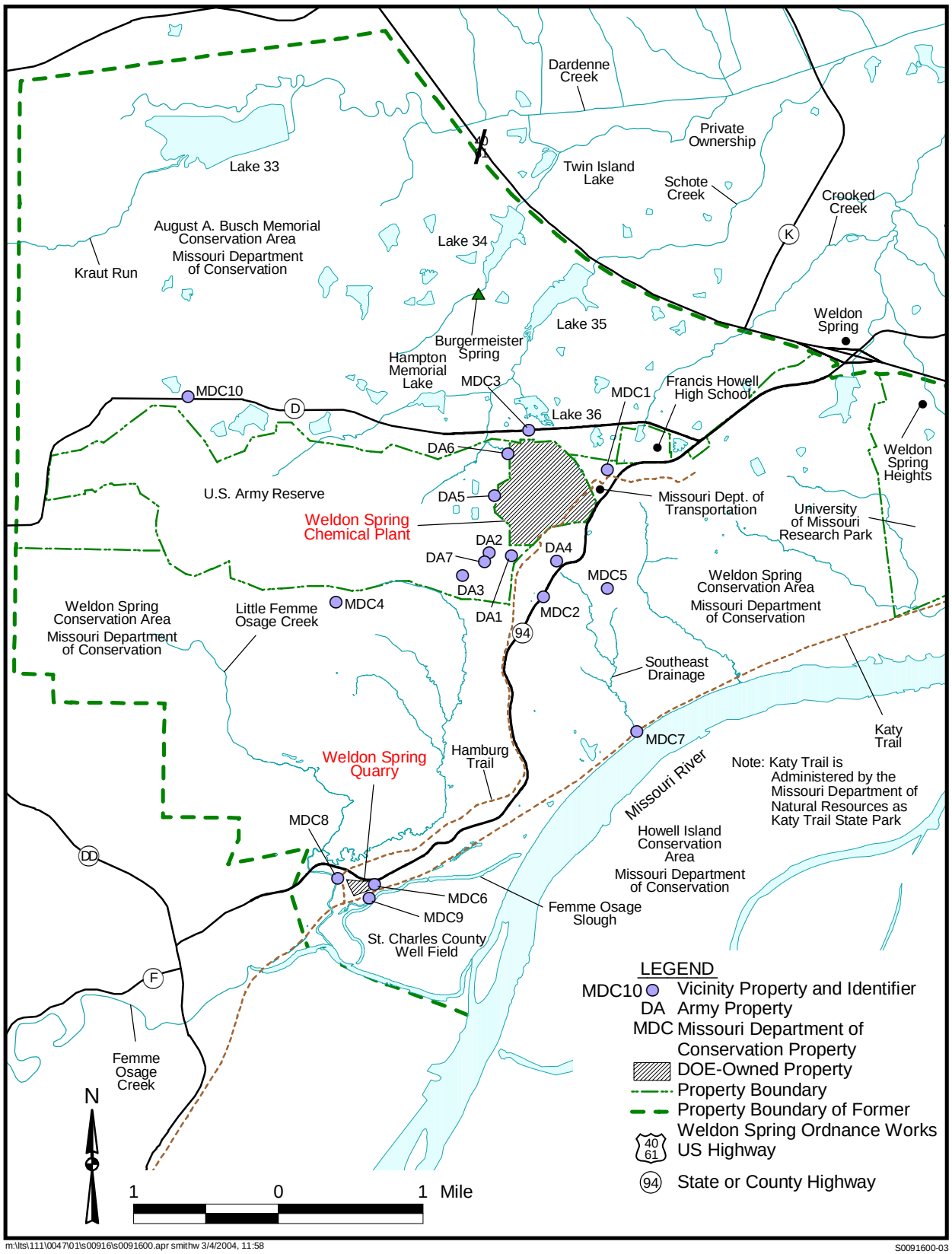

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Figure A−13. Vicinity Property Location Map of the Weldon Spring, Missouri, Site

The Chemical Plant ROD is the remedial action decision document for most of the vicinity properties. Specific cleanup decisions for DA−7, MDC−8, and the Southeast Drainage (DA−4 and MDC−7) were addressed either before or after the ROD was signed under the following documentation:

- DA−7: Interim Response Action 4 (IRA−4) Army Property No. 7
- MDC−8: *Engineering Evaluation/Cost Analysis for the Proposed Management of Contaminated Water in the Weldon Spring Quarry* (DOE 1989)
- DA−4/MDC−7: *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1996)

Table A−6. Vicinity Properties Associated with the Weldon Spring, Missouri, Site

Vicinity Property	ROD Designation	Description
DA−1	A1	Located on approximately 7 acres (3 hectares) of wooded field, the contaminated area consisted of a soil-covered mound and surrounding area, an approximately 4-foot (1.2-meter)-wide ditch adjacent to a railroad track east of the wooded field and a drainage ditch flowing northwest.
DA−2	A2	Located adjacent to a railroad track in a grass field approximately 400 feet (122 meters) north of the Weldon Spring Training Area entrance road and about 3,802 feet (1,159 meters) from the entrance off Missouri State Route 94. The area was rectangular, measuring 70 feet (21.4 meters) by 260 feet (79.3 meters).
DA−3	A3	Wooden loading dock, approximately 246 feet (75 meters) to the south of the Weldon Spring Training Area entrance road and 4,528 feet (1,380 meters) from the entrance off Missouri State Route 94. The dock rose approximately 15 feet (4.6 meters) above an abandoned railroad track.
DA−4	A4	Short segment of Southeast Drainage running from the Imhoff Tanks within the Weldon Spring Chemical Plant to the Missouri River.
DA−5	A5	Surface drainage ditch leading west from raffinate pits across a part of the Weldon Spring Training Area.
DA−6	A6	About 660 feet (201 meters) of a drainage ditch beginning at Ash Pond, which crosses a portion of the Weldon Spring Training Area.
DA−7	A7	Isolated area about 3 feet (1 meter) north of the Weldon Spring Training Area entrance road about 3,793 feet (1,156 meters) from the entrance off Missouri State Route 94. The area was rectangular, measuring roughly 6.9 feet (2.1 meters) by 4.9 feet (1.5 meters).
MDC−1	B1	An area of soil approximately 1,798 square feet (167 square meters) on the west side of Missouri State Route 94 just north of the entrance to the Missouri Highway Department property.
MDC−2	B2	Small piece of pipe on the surface approximately 3 feet (1 meter) off Missouri State Route 94 to the east and about 11,478 feet (3,498.4 meters) from U.S. Highway 40/61.
MDC−3	B3	Two small isolated areas of contamination south of Highway D at the 24,482 feet (7,462.1 meters) reference marker.
MDC−4	B4	Situated near an access road to the radio tower (Road C) and the DA property perimeter fence. Consisted of mounds of soil and miscellaneous wood, metal, and other debris.
MDC−5	B5	Located 1,545 feet (471 meters) from the intersection of Highway D and Missouri State Route 94 and was in a drainageway along an eroded gravel road. Consisted of abandoned drums and adjacent soil.

Table A−6 (continued). Vicinity Properties Associated with the Weldon Spring, Missouri, Site

Vicinity Property	ROD Designation	Description
MDC−6	B6	An isolated spot of contamination adjacent to the Quarry perimeter fence. Consisted of an area of soil approximately 10.8 square feet (1 square meter).
MDC−7	B7	The main Southeast Drainage area running from the MDC perimeter fence through the Weldon Spring Wildlife Area to the Missouri River.
MDC−8	B8	Three isolated spots near a railroad bridge spanning the Little Femme Osage Creek. One measuring 5.4 square feet (0.5 square meter), two measuring 10.8 square feet (1 square meter).
MDC−9	B9	Located between the abandoned Missouri-Kansas-Texas Railroad and Femme Osage Slough, south of the Weldon Spring Quarry.
MDC−10	B10	Old DA disposal area along Highway D adjacent to an access road. Isolated area of soil estimated to be 1.6 square feet (0.15 square meter).

MDC−1 was remediated in accordance with DOE Formerly Utilized Sites Remedial Action Program protocols prior to ROD signature. MDC−2 was remediated prior to ROD signature by ORAU during the initial identification campaign.

A2.1.5.1 DA−1, DA−2, DA−3, and DA−5

Remediation of DA−1, DA−2, DA−3, and DA−5 began on December 16, 1997, and was completed on July 9, 1998. Contaminated soil, root balls, and miscellaneous materials were excavated and transported to the Ash Pond storage area, the chipped wood storage area, and the material staging area, respectively, and were eventually placed in the disposal cell. Quantities were estimated as follows: DA−1: 1,715 cubic yards (1,311 cubic meters), DA−2: 731 cubic yards (559 cubic meters), DA−3: 65 cubic yards (50 cubic meters), and DA−5: 1,250 cubic yards (956 cubic meters). After contaminated soil within the vicinity property had been excavated, confirmation sampling was conducted to verify that the contaminant concentrations were less than Chemical Plant ROD cleanup criteria. Cleanup criteria are included in Section A2.1.2, "Soil Confirmation." Compete details of the remediation are in the *Closeout Report for Vicinity Properties DA−1, DA−2, DA−3, DA−5, and DA−7* (DOE 1999c).

A2.1.5.2 DA−6

Vicinity Property DA−6 consists of a losing-stream reach of the Ash Pond drainage extending 1,132 feet (345 meters) west of the DOE fence line. The extent of this drainage was initially characterized to provide data regarding potential contamination of surface and shallow subsurface sediments and soils. Results of the soil sampling indicated the presence of uranium-238 above ALARA goals at the westernmost sampling location. On the basis of these data, walkover/hotspot sampling was conducted along the length of the drainage extending northward to the Busch Lake 35 inlet, as well as south to the previously remediated portion of Vicinity Property DA−5. Walkover surveys and hotspot sampling were also performed in DA−6 proper to verify uranium-238 levels. Both DOE and the Oak Ridge Institute for Science and Education (formerly ORAU) conducted these surveys.

Data results indicated that all uranium-238 concentrations within the extended drainage were at or below the surface ALARA goal of 30 pCi/g. Uranium-238 concentrations within the DA−6 drainage proper were below or at the surface criterion of 120 pCi/g. Thorium-230 was analyzed

in sediment samples obtained after a contaminated surface water discharge into the drainage. Results showed that levels of thorium-230 were below the surface ALARA goal of 5.0 pCi/g.

No remediation was required for DA−6 based on the additional characterization performed on the vicinity property. The analytical results are documented in *Analytical Data Results for Engineering Characterization of Vicinity Property DA−6; Ash Pond Drainage* (DOE 2001a).

A2.1.5.3 MDC−3, MDC−4, MDC−5, and MDC−10

Remediation of MDC−3, MDC−4, MDC−5, and MDC−10 began on October 26, 1997, and was completed on June 22, 1998. Contaminated soils were transported to the Ash Pond storage area, root balls were taken to the chipped wood storage area, and miscellaneous materials were taken to the material staging area. These wastes were eventually placed in the disposal cell. The quantities were estimated as follows: MDC−3: 13 cubic yards (10 cubic meters), MDC−4: 534 cubic yards (408 cubic meters), MDC−5: 137 cubic yards (105 cubic meters), and MDC−10: 74 cubic yards (57 cubic meters). After contaminated soil within the vicinity property had been excavated, confirmation sampling was conducted to verify that the contaminants with concentrations exceeding Chemical Plant ROD cleanup levels had been removed. Complete details of the remediation are in the *Closeout Report for Vicinity Properties MDC−3, MDC−4, MDC−5, and MDC−10* (DOE 1999d).

A2.1.5.4 MDC−6

Remediation of MDC−6 was conducted in November 1993 as part of bulk waste removal from the Quarry. The soil volume removed was 219 cubic yards (167 cubic meters), and it was staged within the Quarry and disposed of according to the *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (DOE 1990). The soil was removed at a later date and transported to the TSA to await final disposal in the cell.

A2.1.5.5 MDC−9

Remediation of MDC−9 began on January 4, 1996, and was completed on February 29, 1996. Contaminated soil (approximately 4,450 cubic yards [3,402 cubic meters]) and root balls were staged at the Ash Pond storage area or chipped wood storage area and eventually placed in the disposal cell.

Complete details of the remediation of MDC−6 and MDC−9 are in the *Closeout Report for Vicinity Properties MDC−6 and MDC−9* (DOE 1999b).

A2.1.5.6 MDC−8

The Quarry construction staging area, including vicinity property MDC−8, was remediated on August 8, 1990. The excavated soil (approximately 2 cubic yards [1.5 cubic meters]) was staged within the Quarry area for removal with Quarry bulk waste, temporary storage at the TSA, and eventual disposal within the disposal cell. After soil removal, the area was confirmed clean. Complete details of the remediation of MDC−8 are included in the *Vicinity Property DOC−8 Close-Out Report* (DOE 1997a).

A2.1.5.7 Southeast Drainage

The Southeast Drainage is a natural drainage area with intermittent flow that traverses both the Army property and the Weldon Spring Conservation Area from the Chemical Plant site to the Missouri River (Figure A−2). Both the Army and AEC used the drainage to discharge water from sanitary and process sewers to the Missouri River. Also, contaminated liquids in the raffinate pits were decanted to the plant process sewer and subsequently discharged to the Southeast Drainage; overflow from the raffinate pits continued to discharge into the drainage after plant operations ceased. As a result, sediments and soils in the Southeast Drainage were contaminated. Radioactive contaminants of concern were uranium-238, radium-226, thorium-232, and thorium-230. Spring water in the Southeast Drainage (springs SP−5303 and SP−5304) was contaminated with uranium and low concentrations of nitroaromatic compounds from the contaminated sediment.

Remedial action for the Southeast Drainage was addressed as a separate action under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri* (DOE 1996) was prepared in August 1996 to evaluate the human and ecological health risks within the drainage. The EE/CA recommended that selected sediment in accessible areas of the drainage should be removed with track-mounted equipment and transported by off-road haul trucks to the Chemical Plant. The excavated materials would be stored temporarily at an on-site storage area until final disposal in the disposal cell.

Soil removal was in two phases: 1997−98 and again in 1999. A total of 1,931 cubic yards (1,476 cubic meters) was excavated in the first phase, and about 22.5 cubic yards (17.2 cubic meters) was excavated in the second phase.

Post-remediation soil sampling was conducted at Southeast Drainage locations after the soil was excavated. The purpose of this sampling was to determine the remaining concentrations of radionuclides within the soil and sediment and to calculate the risk reduction achieved from soil removal. Sampling was conducted in accordance with the *Post-Remediation Sampling Plan for the Southeast Drainage* (DOE 1997c). All post-remediation data results were used by Argonne National Laboratory to calculate risk reduction achieved by the removal action.

Complete details of the remediation as well as the post-cleanup risk assessment of the Southeast Drainage are in the *Southeast Drainage Closeout Report Vicinity Properties DA−4 and MDC−7* (DOE 1999g).

A2.1.5.8 Busch Lakes

Busch Lakes 34, 35, and 36 are man-made bodies in the eastern portion of the August A. Busch Memorial Conservation Area and were constructed in the 1960s when the feed materials plant was in operation.

Lakes 35 and 36 are part of the Schote Creek surface water drainage, which collects storm water runoff from the Chemical Plant. Water flows to Lake 36 via a natural drainage from the Chemical Plant. From Lake 36, the water flows through an overflow structure into another drainage that flows into Lake 35. Lake 34 is in a surface water drainage that receives no direct

runoff from the Chemical Plant, but does receive groundwater that flows beneath the Chemical Plant and discharges from Burgermeister Spring.

When the sediments in these lakes were characterized in 1989, it was determined that the radioactive contamination in them was limited to uranium-238. Lake 36 sediments were sampled again in 1997 after it had been drained by the MDC for scheduled restoration. Lakes 34 and 35 were sampled again in 1998 using a floating drill rig.

None of the samples obtained from Lakes 34 and 35 had uranium-238 concentrations greater than the cleanup criterion of 120 pCi/g. The data indicated that remediation of the sediments in these lakes was not warranted; therefore, no further action was required. Additional details are presented in the *Completion Report for Sediment Sampling at Busch Lakes 34 and 35* (DOE 1999a).

Characterization results from Lake 36 indicated that approximately 10,000 cubic yards (7,600 cubic meters) of sediment within the lake bed had uranium concentrations exceeding the ALARA goal of 30 pCi/g but below the cleanup criterion of 120 pCi/g. Because these sediments were accessible due to the lake drainage, DOE agreed to excavate this volume and place it on the Chemical Plant property. Although not required, DOE subsequently placed these sediments in the disposal cell. Details of characterization results are provided in the *Busch Lake 36 Summary Closeout Report* (DOE 1997e).

A2.1.5.9 Frog Pond Drainage Area

The following information was incorporated from the *Closeout Report for the Frog Pond Drainage* (DOE 2000c). The Frog Pond drainage begins at the north boundary of the Chemical Plant site and ends at Busch Lake 36.

ORAU sampled the Frog Pond areas during the vicinity property study conducted in 1985. Elevated levels of uranium-238 were identified within the Frog Pond drainage; however, the levels did not exceed DOE residual contamination criteria for classification as a contaminated MDC vicinity property. Therefore, they were not included in the Chemical Plant ROD as a vicinity property. In 1997 and 1998, additional sampling in the Frog Pond drainage area indicated that concentrations of uranium at locations in the drainage north of Highway D at the inlet area of Busch Lake 36 exceeded the ROD uranium-238 cleanup criterion of 120 pCi/g (DOE 1999f). This area was designated the Frog Pond Outlet vicinity property.

Remediation of the Frog Pond Outlet began on July 7, 1999, and was completed on October 7, 1999. Approximately 2,864 cubic yards (2,190 cubic meters) of contaminated soil and root balls were excavated and transported directly to the disposal cell. Analytical results of post-cleanup confirmation samples in the excavated areas averaged less than ALARA and no results exceeded criteria.

Excavation at the Frog Pond Outlet included removing approximately 20 feet (6 meters) of both 60-inch (152-centimeter)-diameter Highway D culverts and underlying soil from the eastern end of the outlet. Measurements of radioactivity indicated that soils remaining under the culverts still had elevated beta-gamma activity (500 to 800 counts per minute). Additional excavation would have been close to the MoDOT right-of-way and the utility corridor, which included a fiber optics line. Therefore, excavation ceased at the eastern end of the Frog Pond Outlet. Soil samples

were collected under both culverts, and the edge of the excavation was surveyed for future reference. After the samples had been collected, 70-inch (178-centimeter)-diameter extensions were fit over the 60-inch (152-centimeter)-diameter culverts and encased in concrete at the culvert joints. The area was then backfilled to the original grade. Analytical results of the samples indicated that soil under the easternmost culvert had a uranium-238 concentration of 310 pCi/g, which is above the ROD cleanup criterion; uranium concentration in soil under the westernmost culvert was below the cleanup criterion. Further details of this sampling are presented in the *Closure Report for Soil Sampling at the Frog Pond Outlet, Addendum 6 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties* (DOE 2000a). Residual contamination associated with these two culverts is the subject of an institutional control (see Appendix E).

A2.2 Groundwater OU

The Groundwater OU is the second of two OUs established for the Chemical Plant area of the Weldon Spring Site. The Groundwater OU addresses contaminated groundwater and springs in the Chemical Plant area.

A2.2.1 Present Conditions

A2.2.1.1 Groundwater

Contaminated groundwater remains beneath the Chemical Plant, primarily in the western and southwestern portions of the site and beneath portions of adjacent Army property (Figure A–14 through Figure A–19). Contaminants include uranium, TCE, nitrate, and nitroaromatic compounds. Nitroaromatic compounds also occur in groundwater in the east and northeast portion of the site. Contamination in groundwater is generally confined to the shallow, weathered portion of the Burlington-Keokuk Limestone. Some contamination occurs in the unweathered portion of the Burlington-Keokuk Limestone beneath the former raffinate pits. Groundwater from the Chemical Plant also discharges to springs in the August A. Busch Memorial Area.

Since the Groundwater OU project began in 1987, more than 100 wells and 15 springs have been used for groundwater monitoring and sampling. A total of 68 wells and 5 springs (SP−6301, SP−6303, SP−6306, SP−5303, and SP−5304) were sampled in 2002 to monitor the affects from historical Chemical Plant operation, recent remedial activities, and groundwater field studies. Monitoring well locations are shown on Figure A–20. Spring monitoring locations are shown on Figure A−21.

Monitoring wells at the Chemical Plant are completed in the Burlington-Keokuk Limestone. Most of the wells are completed in the weathered unit of the bedrock where most contaminated groundwater has been found. Some wells are screened in the unweathered zone of the Burlington-Keokuk Limestone and are used to assess the downward migration of contaminants. Where possible, monitoring wells within the boundaries of the Chemical Plant are located near historical contaminant sources and preferential flow paths to assess migration into the groundwater system. Additional wells are located outside the Chemical Plant boundary to detect and evaluate potential off-site migration of contaminants (Figure A–20).

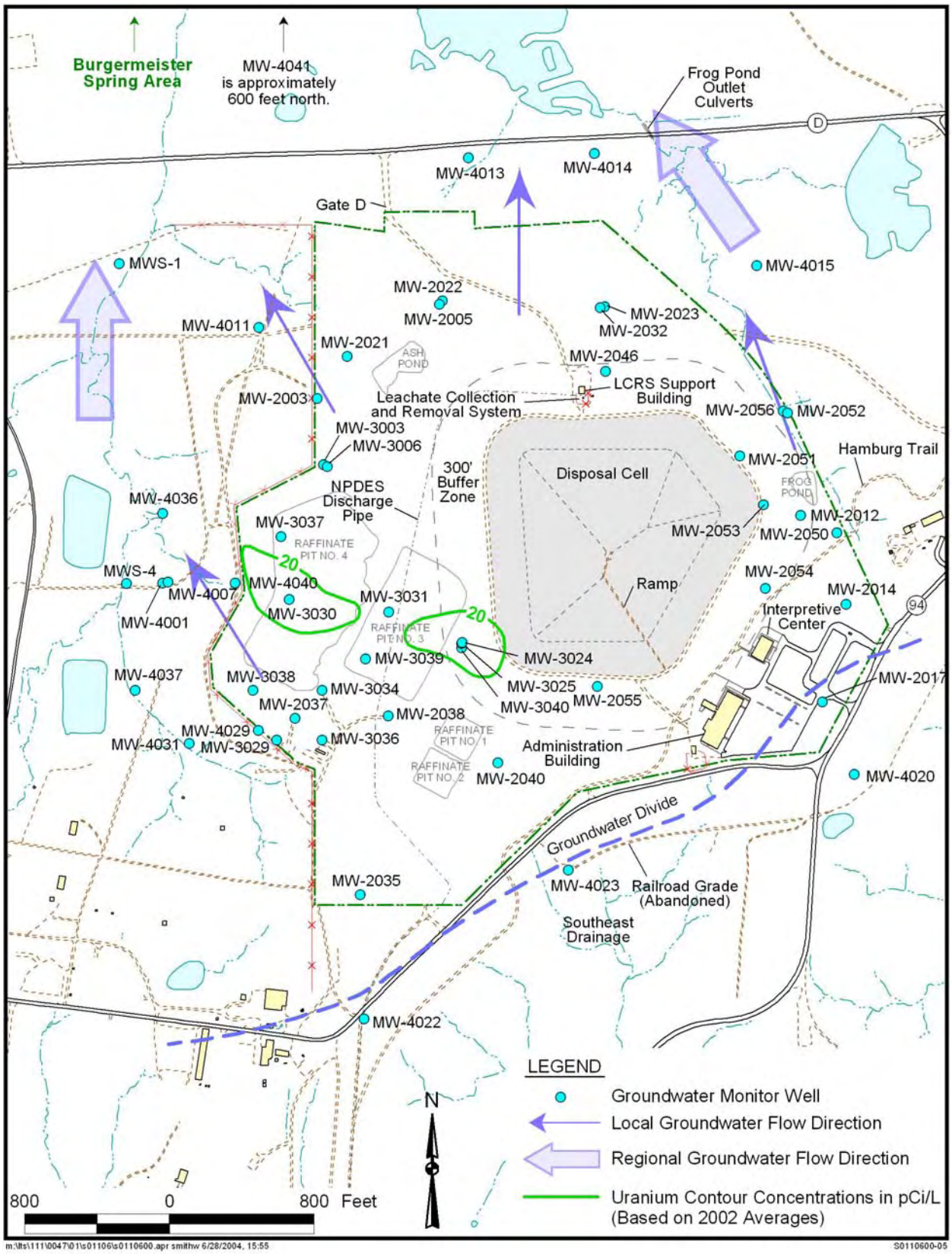

Figure A−14. Uranium Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

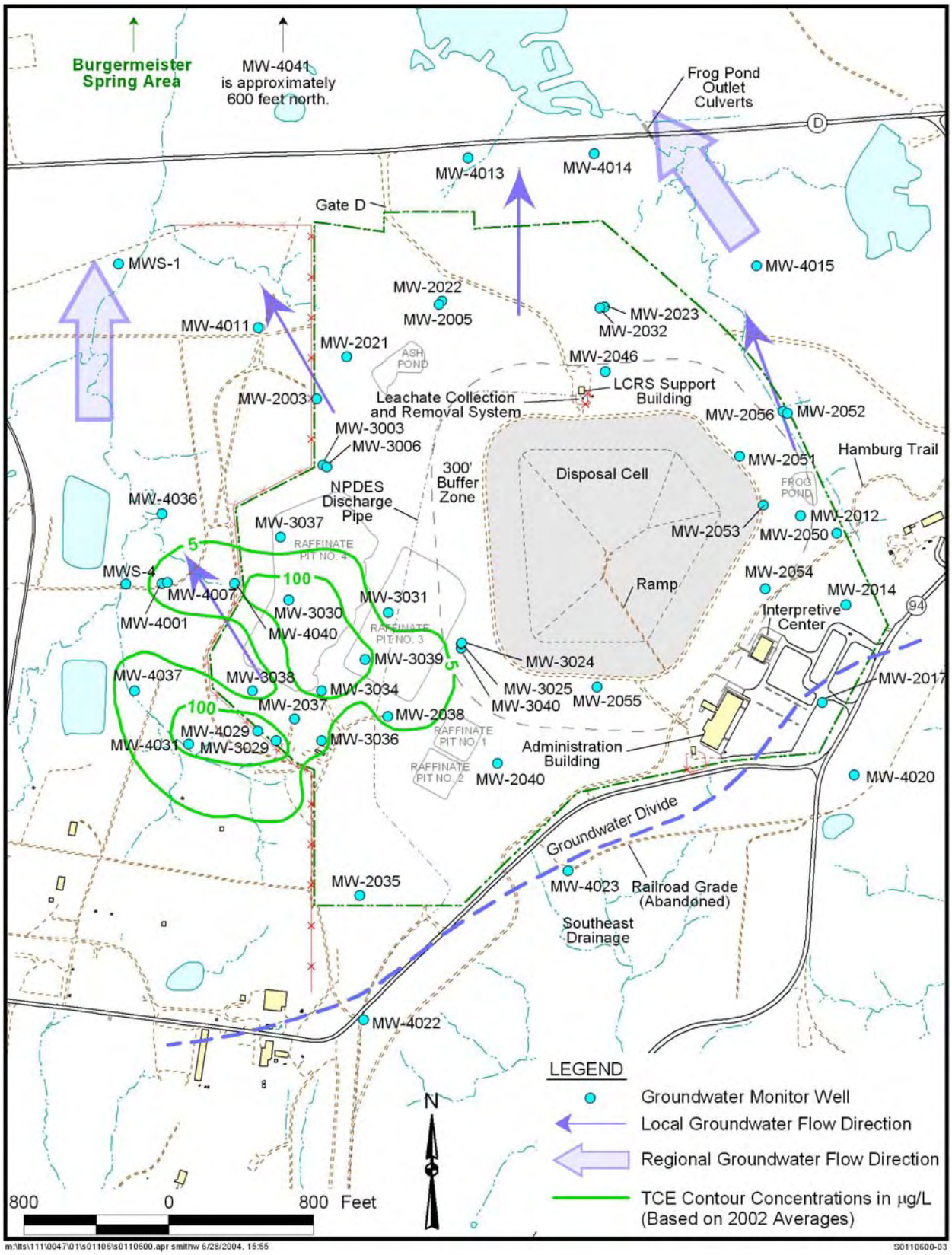

Figure A−15. TCE Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

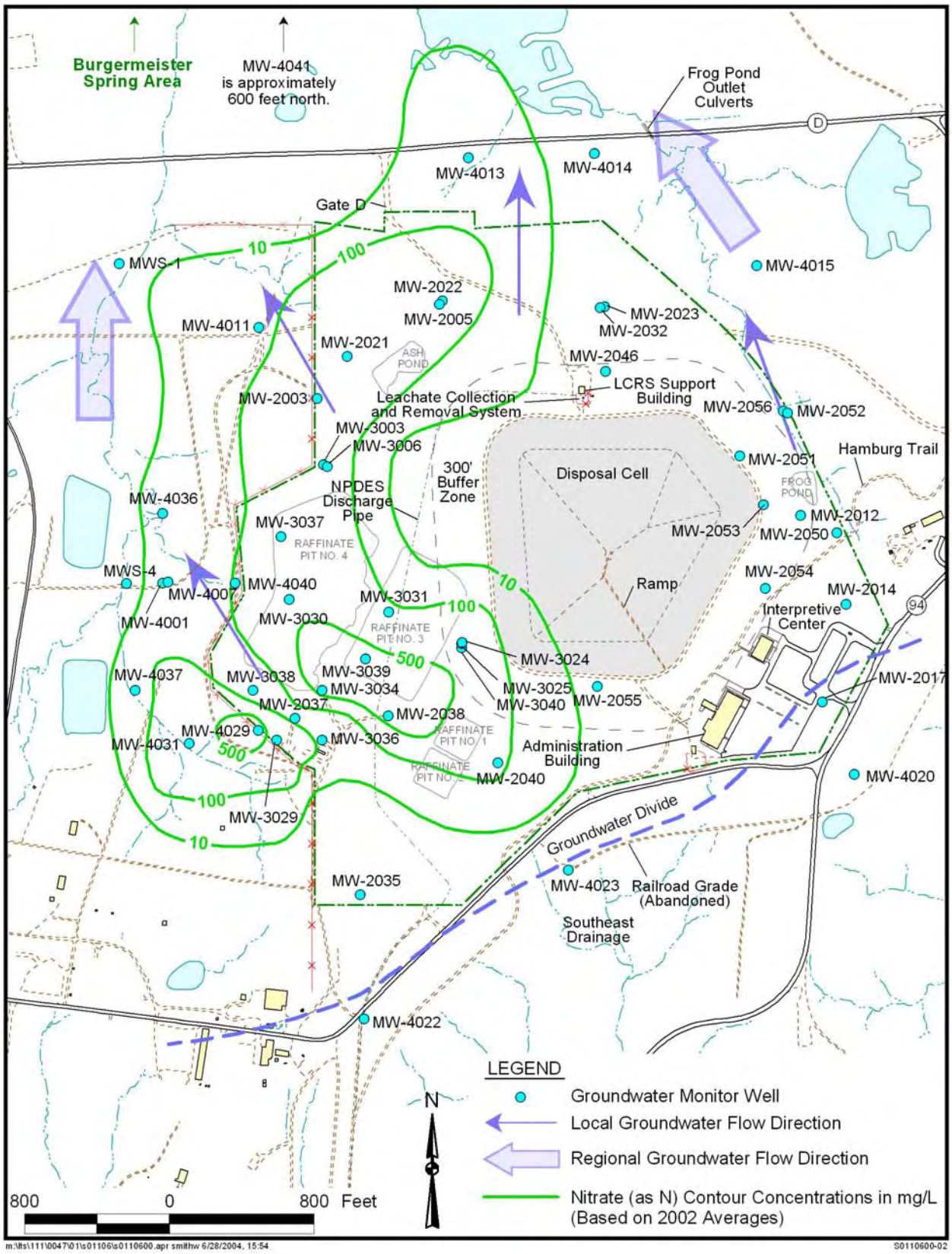

Figure A−16. Nitrate Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

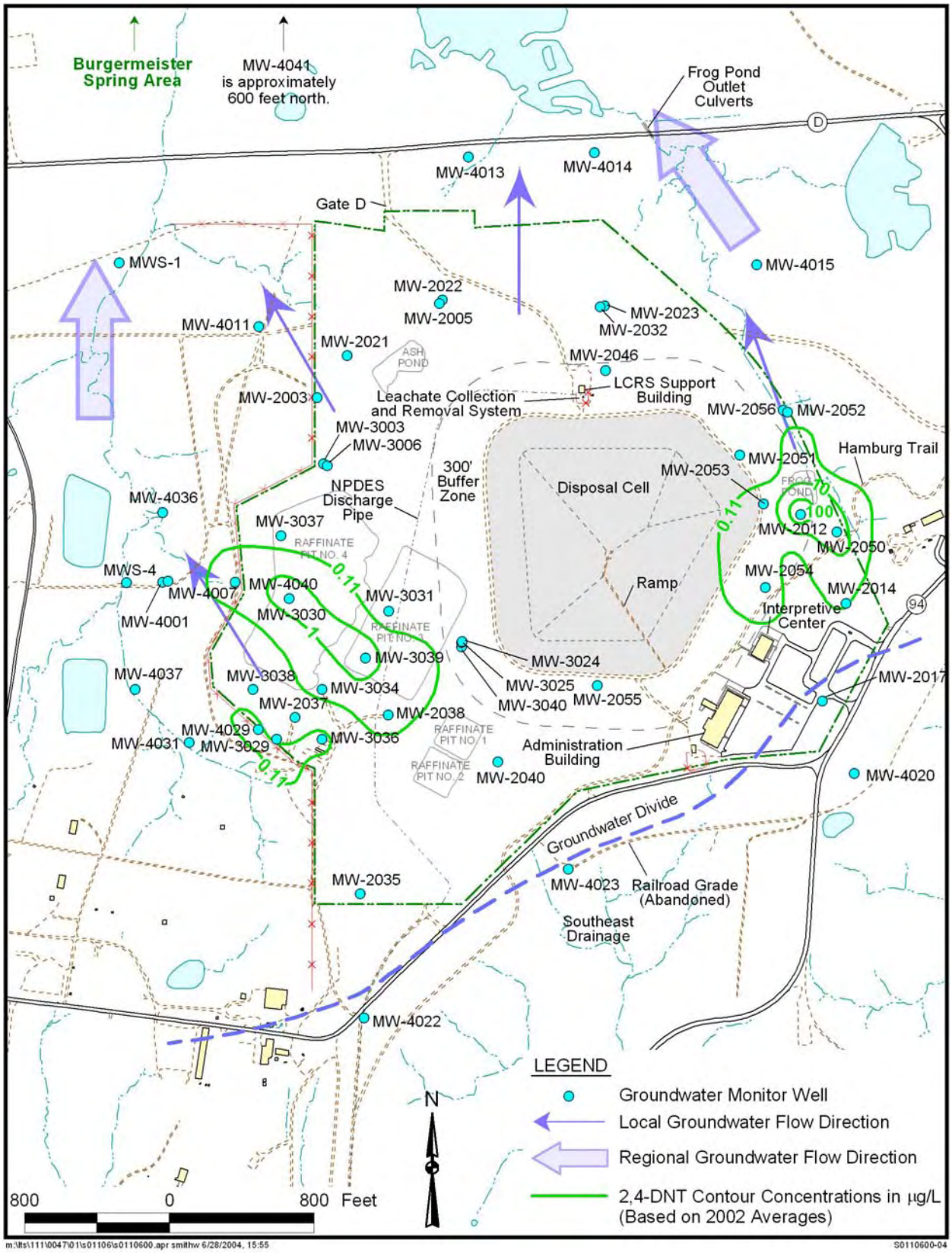

Figure A−17. 2,4-DNT Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

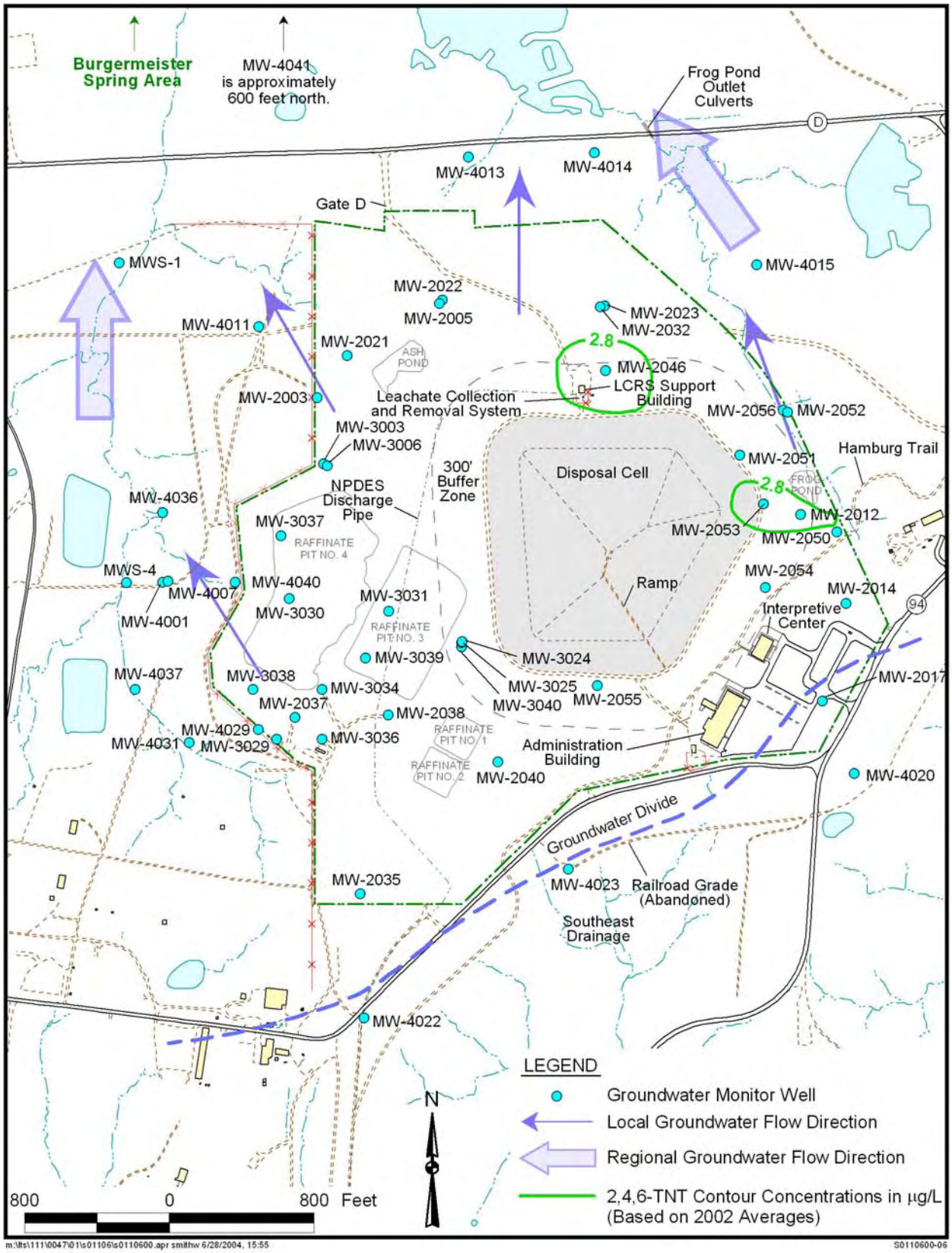

Figure A−18. 2,4,6-TNT Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

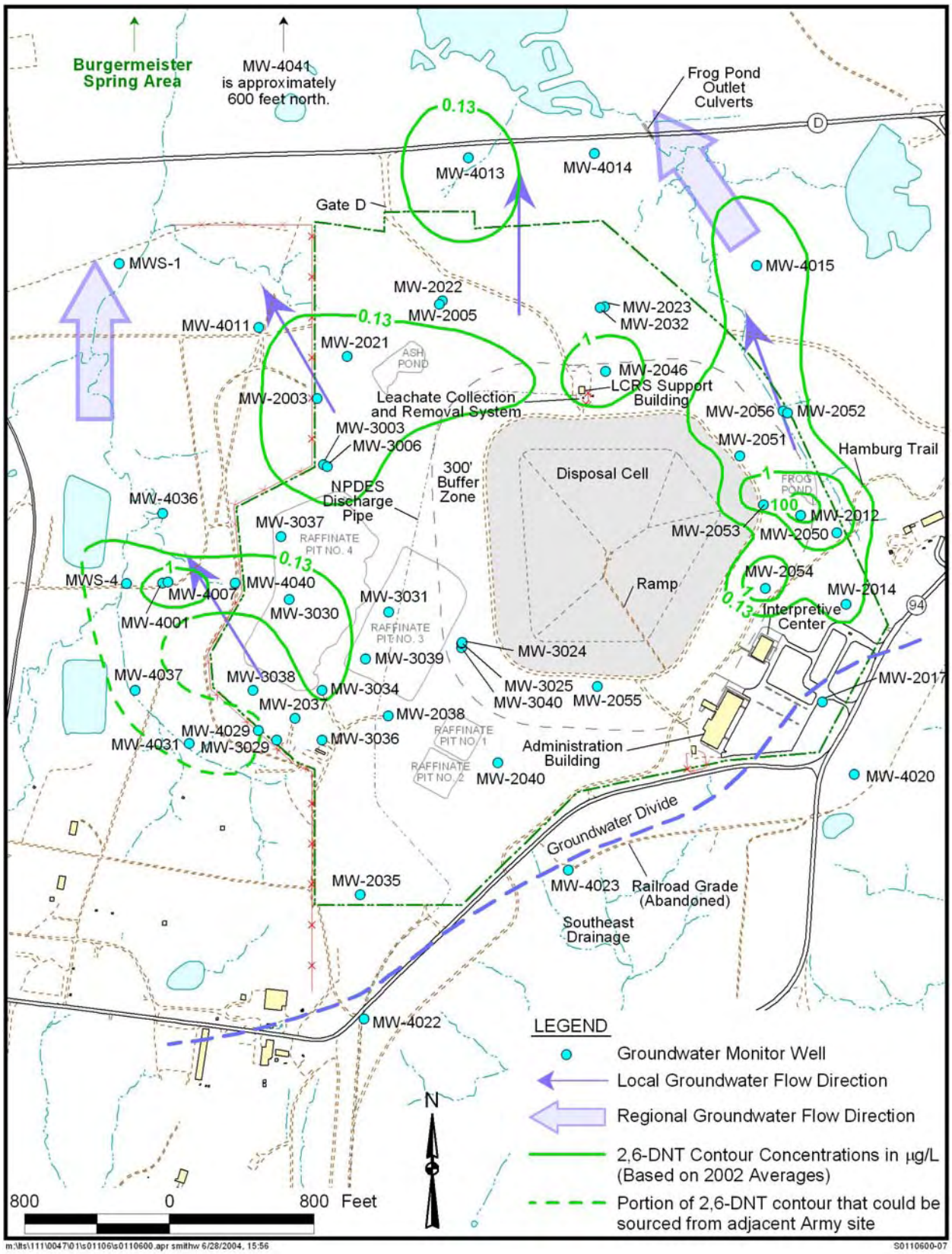

Figure A−19. 2,6-DNT Distribution in the Shallow Aquifer at the Weldon Spring, Missouri, Site Chemical Plant Area

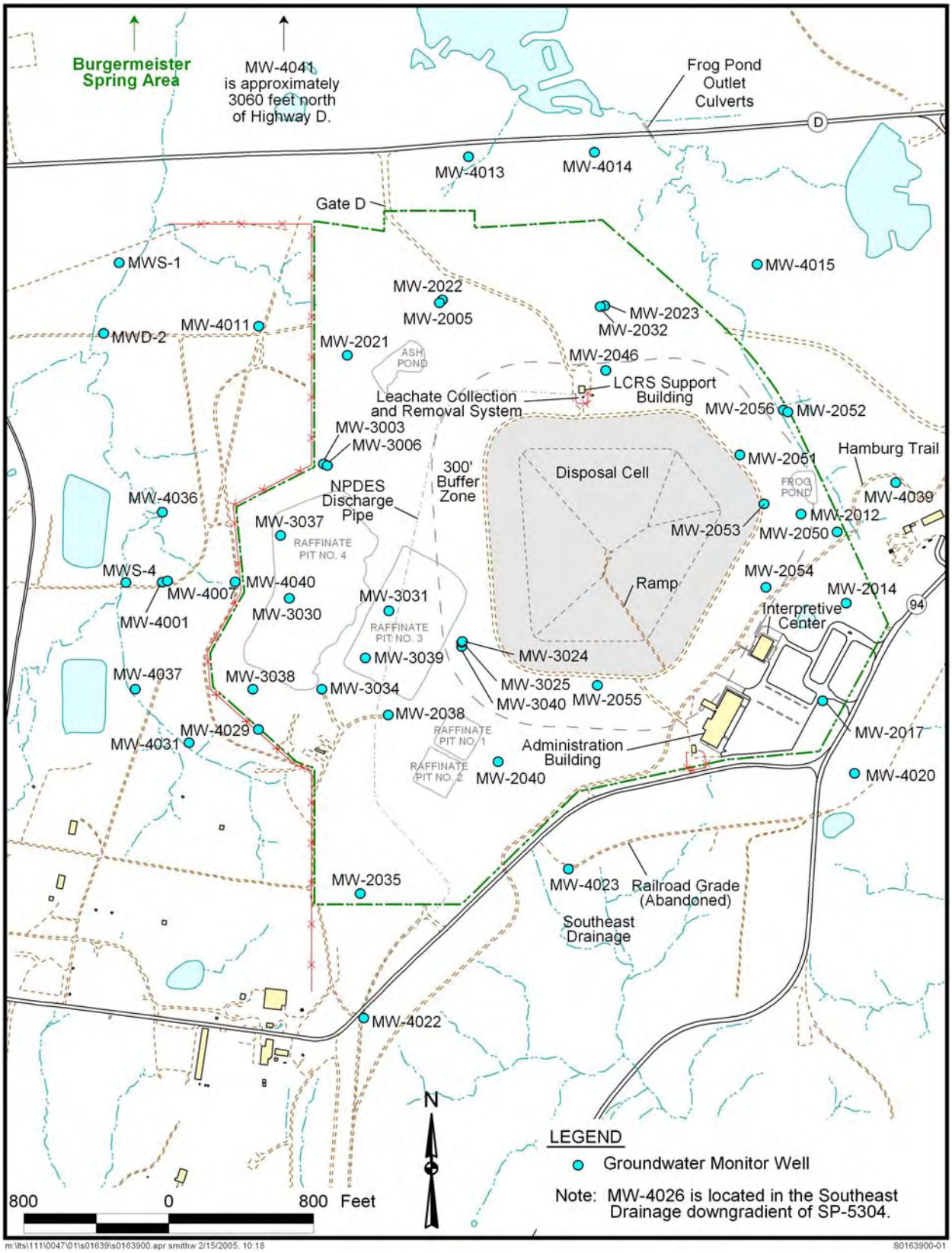

Figure A−20. Groundwater Monitoring Well Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site

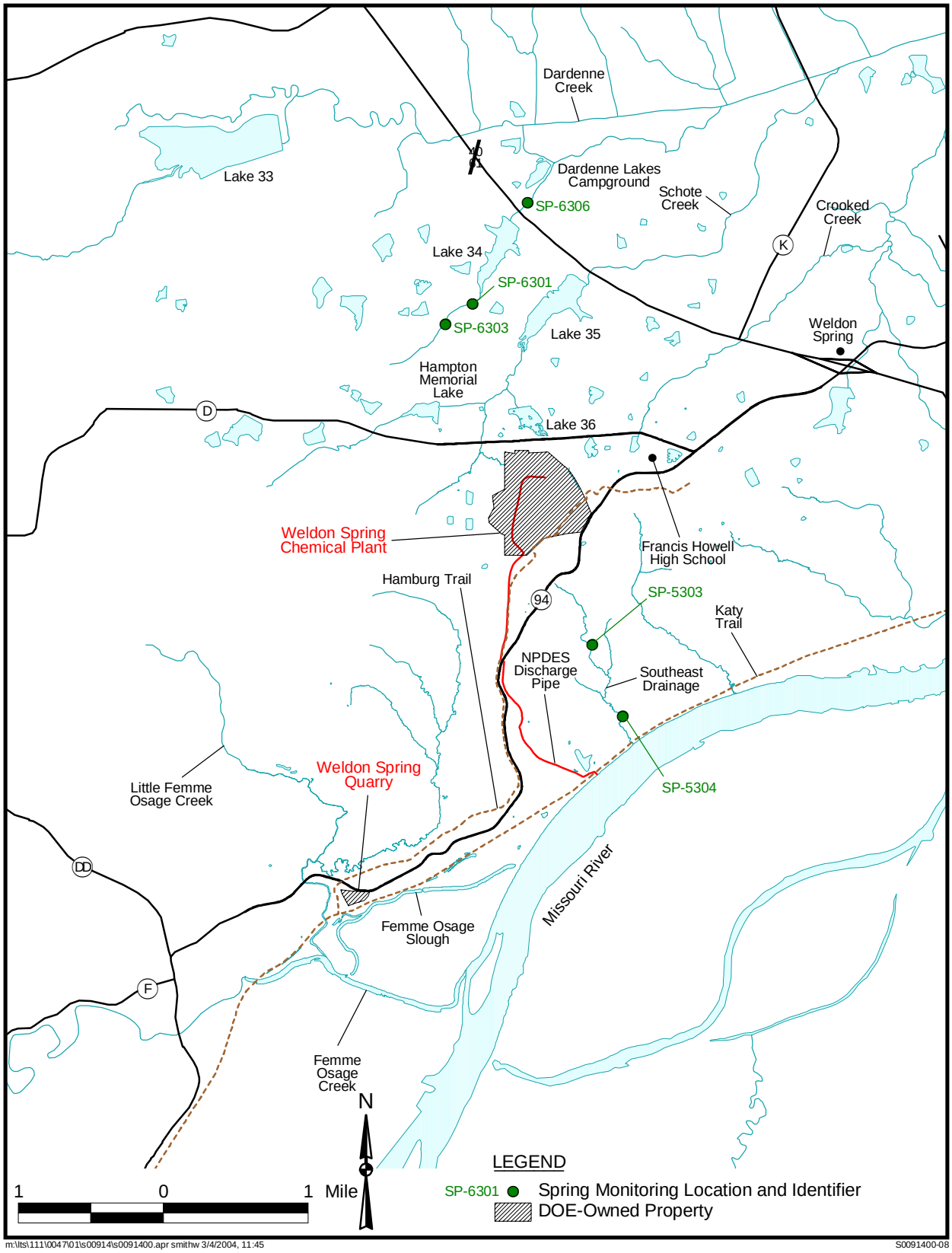

Figure A−21. Spring Monitoring Locations at the Chemical Plant Area of the Weldon Spring, Missouri, Site

Upgradient-downgradient water quality comparisons are not feasible for the Chemical Plant because it is located on the regional groundwater divide. Site-specific background levels were established during the Groundwater OU remedial investigation (DOE 1997d) and will be used for future comparisons.

A summary of analytical results for groundwater samples collected from the Chemical Plant in 2002 is provided in Table A–7.

Table A−7. Summary of 2002 Groundwater Analytical Results at the Chemical Plant

Constituent	Unit of Measure	Minimum	Maximum	Average
Nitrate (as N)	mg/L	<0.05	826	167.2
Sulfate	mg/L	23.5	334	105.3
Total Uranium	pCi/L	<0.68	59.9	4.6
2,4,6-TNT	µg/L	<0.03	290	6.1
2,4-DNT	µg/L	<0.04	1,600	32.2
2,6-DNT	µg/L	<0.06	1,300	27.5
1,3,5-TNB	µg/L	<0.03	280	7.5
1,3-DNB	µg/L	<0.09	0.097	0.1
Nitrobenzene	µg/L	<0.03	69	0.4
TCE	µg/L	<1.0	580	80.2
DCE	µg/L	<2.0	25	3.6
PCE	µg/L	<1.0	50	2.2

Key: DCE = dichloroethylene; DNB = dinitrobenzene; DNT = dinitrotoluene; mg/L = milligram per liter; µg/L = microgram per liter; PCE = tetrachloroethylene (perchloroethylene); pCi/L = picocurie per liter; TCE = trichloroethylene; TNB = trinitrobenzene; TNT = trinitrotoluene

Uranium, nitrate, and TCE concentrations remained within recent historical ranges in the monitoring wells sampled in 2002, and concentrations at source areas decreased. Nitroaromatic compounds at the site indicate upward trends and new historical highs at some locations. An upward trend is not unusual following significant soil disturbances such as the large-volume excavations and regrading in this area.

The groundwater at the Chemical Plant has been contaminated by past operations that resulted in multiple source areas. The raffinate pits were the primary historical source of uranium contamination in groundwater. Uranium entered the shallow aquifer via infiltration through the overburden. The concentration of uranium in Chemical Plant groundwater was limited because uranium in the raffinate was partially adsorbed to the overburden materials (DOE 1997d). Uranium-contaminated groundwater is beneath the former raffinate pits.

During 2002, concentrations of uranium in groundwater from 34 of 68 wells exceeded the statistical (95-percent upper confidence limit) background level of 0.93 pCi/L. However, the uranium drinking water standard of 20 pCi/L was exceeded only in monitoring wells MW–3024 and MW–3030, which are installed in the former locations of Raffinate Pits 3 and 4. Little attenuation of uranium occurs in the bedrock aquifer; therefore, upon reaching the conduit system, uranium-affected groundwater discharges to Burgermeister Spring.

Nitrate is present in the groundwater near the former raffinate pits and Ash Pond area, which are the historical sources of this contaminant. Nitrate is mobile in the shallow groundwater system. Conditions for natural denitrification have not been identified in the shallow aquifer, so nitrate persists in groundwater and enters the limestone conduit system and subsequently discharges to springs north of the Chemical Plant.

Nitrate was monitored at 68 wells in the Chemical Plant in 2002. Concentrations (reported as N) exceeded the federal drinking water standard of 10 milligrams per liter (mg/L) at 36 of these monitoring well locations.

Nitroaromatic compounds in the groundwater system coincide with former production line locations. The presence of nitroaromatic compounds in groundwater is a result of leakage from former TNT and DNT process lines, discharges from wastewater lines, and leaching from contaminated soils and waste lagoons. The distribution of nitroaromatic compounds in the shallow aquifer at the Chemical Plant is controlled by several processes, such as transformation, adsorption, desorption, dilution, and dispersion; the primary attenuating mechanisms are dilution and dispersion. The mobility of nitroaromatic compounds in the bedrock aquifer is high due to their low distribution coefficients. Biotransformation processes also affect the distribution of nitroaromatic compounds in the subsurface. Microorganisms indigenous to the soils and the shallow aquifer have the ability to transform and degrade TNT and DNT (DOE 1997d), and the presence of nitroaromatic compound breakdown products (4-amino-2,6-DNT and 2-amino-2,6-DNT) in the shallow aquifer indicate that degradation is occurring.

Nitroaromatic compounds were detected in 45 wells during 2002. New historical highs occurred in several wells in the vicinity of Frog Pond, most notably MW–2012. Levels of nitroaromatics have increased at this well since 1999. Excavation of contaminated soil in the Frog Pond area by DOE and the excavation in the cross-gradient Lagoon 1 by the DA most likely caused mobilization of these compounds and subsequent concentration increases in the groundwater in this area. Additional wells were installed in the vicinity of Frog Pond in 2000 and 2001 to further determine extent of contamination in this area. The Missouri drinking water standard for 2,4-DNT (0.11 microgram per liter [µg/L]) was equaled or exceeded at 15 monitoring well locations at the Chemical Plant.

Groundwater contaminated with the volatile organic compounds (VOCs) TCE, tetrachloroethylene (PCE), and 1,2-dichloroethylene (DCE) is localized primarily in the weathered portion of the bedrock aquifer in the vicinity of Raffinate Pits 3 and 4. The source of TCE contamination was drums that were disposed of in Raffinate Pit 4.

Sampling for VOCs continued through 2002 to monitor the extent of contamination and changes in concentration that may have resulted from remediation activities and groundwater field studies. Samples from 25 wells in the raffinate pits area had detectable concentrations of at least one VOC (TCE, PCE, or 1,2-DCE). Concentrations of TCE in fifteen of these wells exceeded the federal water quality standard of 5 µg/L.

A2.2.1.2 Springs

Springs, a common feature in carbonate terrains, are present in the vicinity of the site. Five springs have been routinely monitored (Figure A−21). These springs are influenced by historical

Chemical Plant surface water runoff, historical process sewer effluent, or groundwater that contains one or more of the contaminants of concern. Springs are sampled during high-flow and low-flow conditions to assess the surface water and groundwater contributions, respectively. Nitrate, nitroaromatic compounds, and uranium are present at Burgermeister Spring (SP–6301) and at SP−6303 located north of the Chemical Plant; uranium and nitroaromatic compounds have been detected in springs in the Southeast Drainage.

Historical data on concentrations of uranium in nearby surface water, including Burgermeister Spring, indicate that during storm events, contaminated soils were transported from the Ash Pond and Frog Pond areas in surface water runoff. The uranium was transported in both dissolved and particulate forms. In the drainages downstream from Ash Pond and Frog Pond, surface water infiltrates the subsurface through stream bottoms, where a portion of the contaminated sediment was deposited in fractures and solution features.

The presence of elevated uranium and nitrate levels at Burgermeister Spring (SP–6301), which is 1.2 miles (1.9 kilometers) north of the site, indicates that discrete flow paths are present in the vicinity of the site. Groundwater tracer tests performed in 1995 (DOE 1997d) indicated that a discrete and rapid hydraulic connection exists between the northern portion of the Chemical Plant and Burgermeister Spring. However, uranium presence was predominantly the result of historical surface water runoff and resultant residual contamination in the fractured bedrock.

Burgermeister Spring is a perennial spring that represents a primary localized emergence of groundwater affected by a recognizable contribution of contaminants from the Chemical Plant. A summary of analytical results for samples collected at Burgermeister Spring is provided in Table A–8. Compared to 2001 results, concentrations in 2002 were in the same general range, although uranium levels were slightly lower during base flow and slightly higher during high flow. Of the nitroaromatic compounds analyzed, only 2,6-DNT was reported above detection limits. No VOCs were reported above detection limits at this spring.

Table A−8. Summary of 2002 Analytical Results for Samples from Burgermeister Spring (SP–6301) Located North of the Weldon Spring, Missouri, Site Chemical Plant

Constituent	Unit of Measure	High Flow			Low (Base) Flow		
		Min.	Max.	Avg.	Min.	Max.	Avg.
Nitrate (as N)	mg/L	0.94	1.1	1.0	0.97	10.9	5.1
Total Uranium	pCi/L	8.6	9.7	9.2	11.4	100	51.0
2,6-DNT	µg/L	<0.1	<0.1	<1.0	<0.1	0.17	0.12

Key: DNT = dinitroluene

Four additional springs, two located in the Southeast Drainage (SP−5303 and SP−5304) and two located in the Burgermeister Spring drainage (SP−6303 and SP−6306), were monitored in 2002 to assess the emergence of contaminated groundwater at possible exposure points. Annual average concentrations of constituents that exceeded detection limits are presented in Table A−9. No VOCs or the nitroaromatic compounds 1,3-DNT or 2,4-DNT were reported above detection limits at any of the springs.

Table A−9. Summary of 2002 Average Analytical Results for Samples from Other Springs in the Vicinity of the Weldon Spring, Missouri, Site Chemical Plant

Constituent	Unit of Measure	High Flow				Low (Base) Flow			
		SP–5303	SP–5304	SP–6303	SP–6306	SP–5303	SP–5304	SP–6303	SP–6306
Total Uranium	pCi/L	34.6	29.6	0.97	0.26	82.8	65.2	1.2	0.34
1,3,5-TNB	µg/L	<0.04	<0.04	0.11	< 0.04	0.34	<0.04	0.22	< 0.04
2,4,6-TNT	µg/L	2.0	0.10	0.10	< 0.08	42.6	0.10	0.09	< 0.08
2,4-DNT	µg/L	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.06	<0.06
2,6-DNT	µg/L	<0.10	<0.10	0.17	< 0.10	0.17	<0.10	0.30	< 0.10

Key: DNT = dinitrotoluene; TNB = trinitrobenzene; TNT = trinitrotoluene

A2.2.2 Remedial Activities

Remedial activities at the site were conducted in accordance with CERCLA, as amended. DOE, in conjunction with the DA, conducted a joint remedial investigation/feasibility study (RI/FS) to allow for a comprehensive evaluation of groundwater conditions at the Weldon Spring Chemical Plant area and the Weldon Spring Ordnance Works area, which is an Army site adjacent to the Chemical Plant. Consistent with DOE policy, National Environmental Policy Act (NEPA) values were incorporated into the CERCLA process, meaning that the analysis conducted and presented in the RI/FS reports (DOE 1997d and DOE 1998b) included an evaluation of environmental impacts similar to that performed under NEPA. After completion of the feasibility study, DOE and DA prepared separate CERCLA documentation for their respective projects.

A proposed plan (DOE 1999e) to address all the contaminants of concern in groundwater at the Chemical Plant was released to the public on August 3, 1999. This plan identified the proposed action of active remediation of TCE in groundwater and long-term monitoring for the remaining contaminants of concern. The MDNR would not concur with this remedy until additional pump and treat alternatives had been field tested. Following an informal dispute process and additional public comment, DOE agreed to conduct additional field tests and to conduct the TCE remedial action as planned under an interim ROD (DOE 2000b).

The *Record of Decision for the Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site* (DOE 2004a) was signed in February 2004. The selected remedy provides for monitored natural attenuation (MNA) for all the contaminants of concern, including TCE, with institutional controls (ICs) to limit groundwater use. The ultimate objective for the groundwater portion of this remedial action is to restore contaminated groundwater in the shallow aquifer to its beneficial use. The aquifer could potentially be used as a drinking water source; however, it is not currently being used as such. Groundwater and springs in the Chemical Plant will be monitored and groundwater use will be limited until contaminant concentrations decrease to cleanup standards. A detailed discussion about the activities performed under the Groundwater OU is presented in the draft *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site* (DOE 2004b).

A2.2.2.1 Additional Groundwater Field Studies

Results of the field studies conducted in 2001 indicate that the modifications to conventional pump and treat that were implemented did not increase the mass of contaminants removed as compared with a conventional vertical well system with no artificial recharge. Consequently, the amount of water extracted from the area due to artificial recharge (injection of potable water) would not reduce the remediation time frames for TCE, nitrate, uranium, or nitroaromatic compounds. Another modification, the use of an angled well, likewise failed to produce results comparable to the vertical extraction well. These results reflect the difficulty involved in siting productive wells in the complex geology of the site.

The hydrogeologic data obtained from these studies are consistent with the data collected during a previous study performed in 1998. The results from these field studies support the conceptual model, which is that the sustainable yields are low, and localized dewatering would likely occur. Recharge of the aquifer is very slow, as indicated by the long recovery time of the monitoring wells after the study.

The distribution of the contaminants did not change as a result of the field studies, with the exception of significant dilution in the vicinity of the injection wells. The majority of the wells returned to baseline concentrations or were showing increasing trends at the end of the monitoring period, which could be attributed to several mechanisms. One mechanism may be the transport of upgradient contaminated groundwater into the study area because of the low hydraulic gradient across the Chemical Plant. Another mechanism may be the diffusion of contaminants from poorly connected or dead-end fractures and solution features into the more transmissive portions of the aquifer (i.e., paleochannels). Either scenario would indicate that most of the contaminated groundwater removed was from the interconnected secondary porosity features (likely paleochannels). This would indicate that extracting the water from the more transmissive portions of the shallow aquifer would effectively remediate the groundwater within the paleochanel, and that desorption and/or slower groundwater movement from the lower conductivity portions of the aquifer would control the remediation time frames.

A2.2.2.2 In Situ Chemical Oxidation

Bench-scale testing was conducted in the spring of 2001 to evaluate the effectiveness of several different oxidants in destroying TCE in groundwater samples collected from the site. Tests by four different subcontractors demonstrated that, under laboratory conditions, oxidation chemistry was able to destroy TCE without significantly affecting the concentrations of the other contaminants.

The development of the design to achieve full-scale treatment of TCE throughout the plume was not possible at the outset due to uncertainties associated with the hydrogeology of the site that influenced design elements such as spacing of the injection wells, the zone of influence of these wells, and the amount of oxidant needed to be injected to achieve the reduction of TCE. Consequently, a phased approach was taken to allow for a pilot-scale test to be performed before a decision could be made regarding full implementation.

Pilot-scale treatment was performed in April and May 2002 to evaluate the effectiveness of the in situ chemical oxidation (ICO) process under actual field conditions and to assess the

feasibility of implementing a full-scale system. The pilot-scale testing was performed at two locations, representing the upper and lower limits of hydraulic conductivity, in the bedrock aquifer within the area of higher TCE concentrations. Two injections were performed at each location.

During Phase I, only the minimum calculated amount of sodium permanganate that might result in efficient distribution through the aquifer was injected. Based on the results of the Phase I injection, the target injection values were revised for Phase II injection.

The pilot-scale ICO appears to have achieved reduction of TCE in the area of influence. The oxidizing solution (sodium permanganate) was distributed to a distance of about 100 feet (30 meters) from the injection point, where the dispersion of the permanganate favored a downgradient direction toward the paleochannel features of the site. Uniform distribution of the injection solution was not achieved. The pilot-scale ICO also indicated that the injection volume at each point that would be required to achieve a radius of influence greater than 100 feet (30 meters) could average 20,000 gallons (75,708 liters). This value is 20 times greater than that estimated based on the results of the bench-scale testing and 5 times greater than that used during the first injection of the pilot-scale ICO.

The results of the pilot-scale ICO can not be directly applied to the whole TCE area because of the heterogeneity of the aquifer. The study was designed to perform the field tests at two locations bounding the range of hydraulic conductivities of the bedrock aquifer within the affected area. However, this may not have been achieved during implementation, because other areas with lower hydraulic conductivities and TCE concentrations that exceed the maximum contaminant level (MCL) are known to be present. Consequently, uncertainties associated with defining the zone of influence of the injection points and the volume of oxidants needed to achieve the required reduction of TCE across the affected area would still have to be addressed in designing a full-scale remediation effort.

It was envisioned in the feasibility study and the interim ROD that two sets of wells and two injections would achieve the MCL. These specifications were based on the understanding of the site and the knowledge regarding the innovative nature of the ICO technology at that time. Preliminary remedial design based on the results of the pilot-scale ICO indicated that at least 20 times as many injection wells would be needed and, therefore, 20 times as much volume of oxidant would need to be injected for a full-scale implementation. These estimates constitute the amounts needed at the initial phase of implementation with possibly additional injection wells and/or injections needed to attain the MCL throughout the entire area of impact. Due to the increased scope and uncertainties of a full-scale approach, DOE decided to address TCE within the context of a final remedy for all of the groundwater contaminants.

A2.2.2.3 Monitored Natural Attenuation

The groundwater monitoring program for the Groundwater OU has been developed to meet the following performance goals:

1. Contaminants will attenuate at a rate sufficient to meet cleanup standards in approximately 100 years.

2. Contaminant migration will remain confined to the currently impacted groundwater system.

3. Contaminant levels at potential exposure points (springs) will not pose unacceptable risks to receptors.

4. Contaminant levels at the springs will decline over time.

A2.3 Quarry Bulk Waste OU

Remedial activities under the Quarry Bulk Waste OU were performed under the *Record of Decision for Management of Bulk Wastes at the Weldon Spring Quarry* (DOE 1990). The Quarry Bulk Waste OU ROD was signed by EPA on September 28, 1990, and by DOE on March 7, 1991. The primary activities established were to:

- Excavate and remove bulk waste (i.e., structural debris, drummed and unconfirmed waste, process equipment, sludge, and soil).
- Transport the waste along a dedicated haul road to the TSA, which was located within the boundary of the Chemical Plant OU.
- Stage bulk wastes at the TSA for ultimate disposal in the on-site disposal cell.

Removal of the bulk waste was performed in a multitiered process similar to the one used at the Chemical Plant. In the first tier, the Quarry water treatment plant, which was designed to treat contaminated water from the Quarry sump, was constructed. In the second tier, the basic infrastructure, including decontamination facilities, a haul road, and the utilities needed to excavate and transport the waste from the Quarry to the Chemical Plant, was built. In the final tier, the waste was excavated.

The waste was removed with conventional equipment and excavation techniques, placed in covered trucks, and hauled via the haul road to the TSA at the Chemical Plant. The waste was retained in the temporary facility until it could be placed in the disposal cell. From May 1993 to October 1995, approximately 144,000 cubic yards (110,000 cubic meters) of soil and waste material were removed from the Quarry, transported to the Chemical Plant area, and placed in the TSA. All of the wastes were directly placed or treated and placed in the disposal cell by March 1999.

A2.4 Quarry Residuals OU

The Quarry Residuals OU was the second of two OUs established for the Quarry area of the Weldon Spring Site. The Quarry Residuals OU addresses the residual soil contamination in the Quarry proper, surface water and sediments in Femme Osage Slough and nearby creeks, and contaminated groundwater.

A2.4.1 Present Conditions

A2.4.1.1 Groundwater

Uranium and nitroaromatic compounds leached from the wastes in the Quarry proper and contaminated groundwater beneath the site. Uranium concentrations in groundwater have decreased in the area north of Femme Osage Slough by adsorption onto aquifer materials and precipitation by a naturally occurring chemical reduction process (DOE 1998a). The reduction zone is located north of Femme Osage Slough and extends south of the slough. The greatest effect is observed north of the slough where geochemical conditions change from oxidizing to reducing. A distinct contact separating alluvial soils with characteristics indicative of oxidizing conditions from those indicating reducing conditions is evident in this area. Uranium results from soil samples indicate a rapid precipitation of uranium at this location.

DOE sampled 34 wells in the Quarry area in 2002, which are completed in either bedrock or alluvium (Figure A−22). Sample results are summarized in Table A−10. All minimum results were below detection limits, and 1,3-dinitrobenzene was not detected in any of the wells.

Table A−10. Summary of 2002 Groundwater Analytical Results at the Weldon Spring, Missouri, Site Quarry

Constituent	Unit of Measure	Minimum	Maximum	Average
Sulfate	mg/L	<0.50	321	69.6
Iron	µg/L	4.1	46,300	6,894
Total Uranium	pCi/L	<0.68	4,420	301
2,4,6-TNT	µg/L	<0.03	2.2	0.11
2,4-DNT	µg/L	<0.04	2.5	0.07
2,6-DNT	µg/L	<0.06	2.6	0.16
1,3,5-TNB	µg/L	<0.03	18	0.27
1,3-DNB	µg/L	<0.09	0.14	<0.09
Nitrobenzene	µg/L	<0.03	3.1	0.07

Key: DNB = dinitrobenzene; DNT = dinitrotoluene; TNB = trinitrobenzene; TNT = trinitrotoluene

The highest uranium concentrations in groundwater continue to occur in the bedrock downgradient from the Quarry and in the alluvial material north of Femme Osage Slough. The groundwater standard of 20 pCi/L was exceeded at 13 locations, all located north of Femme Osage Slough (Figure A–23). The standard, although used as a reference level, is not applicable to groundwater north of the slough because this area is not considered a usable groundwater source due to low yield (DOE 2003c).

Background uranium concentrations in the Missouri River alluvium groundwater in the upgradient Darst Bottoms range up to 14.3 pCi/L, and background concentrations average 2.77 pCi/L. Historically, one location south of Femme Osage Slough (MW−1011) had uranium levels that exceeded the background range for a short time, but returned to levels less than 14.3 pCi/L. However, 90 percent of the historical samples from south of the slough have had uranium concentrations less than 2.77 pCi/L. Therefore, contamination north of the slough has no measurable impact on the drinking water source in the Missouri River alluvium.

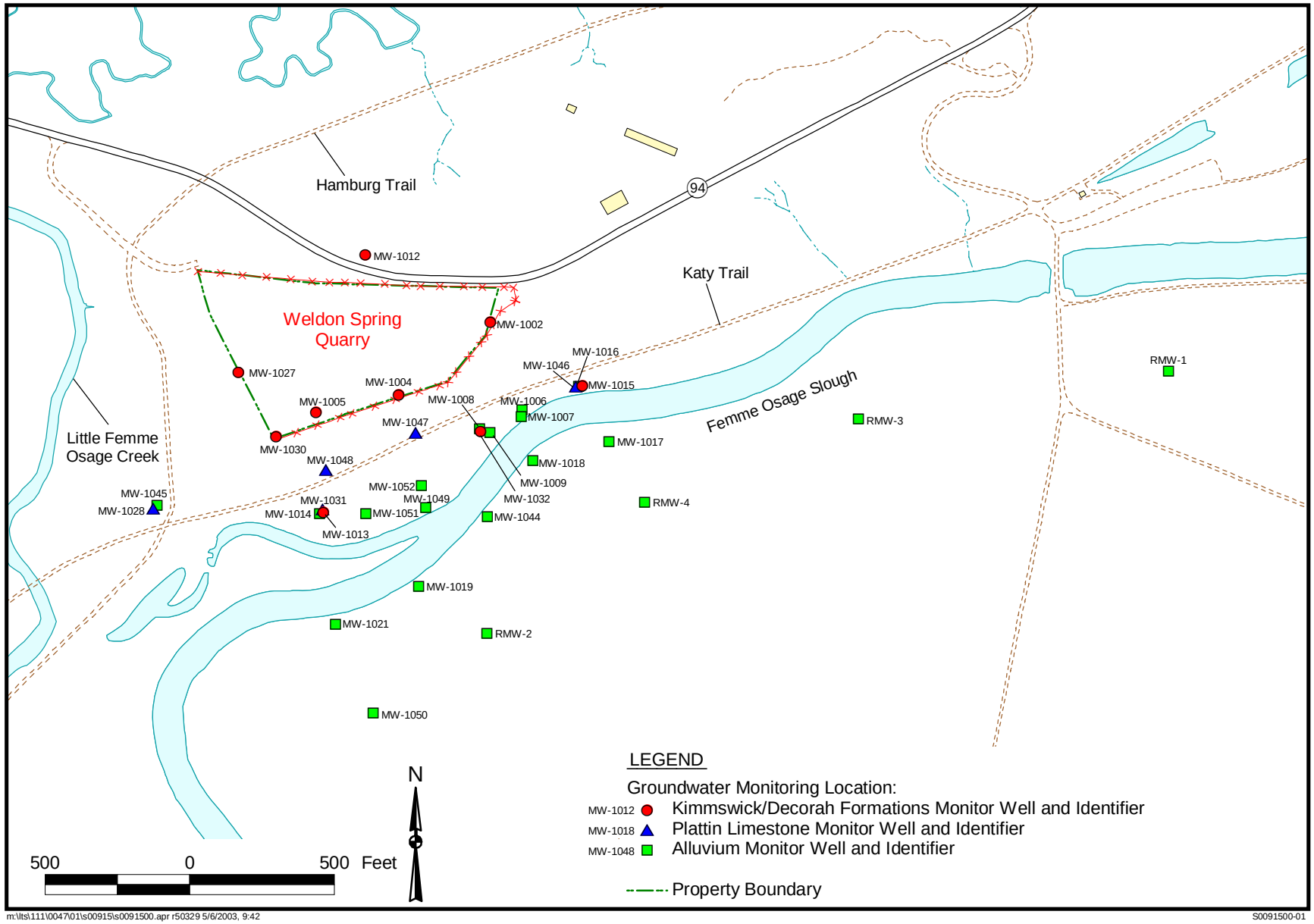

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Figure A–22. Groundwater Monitoring Well Locations at the Quarry Area of the Weldon Spring, Missouri, Site

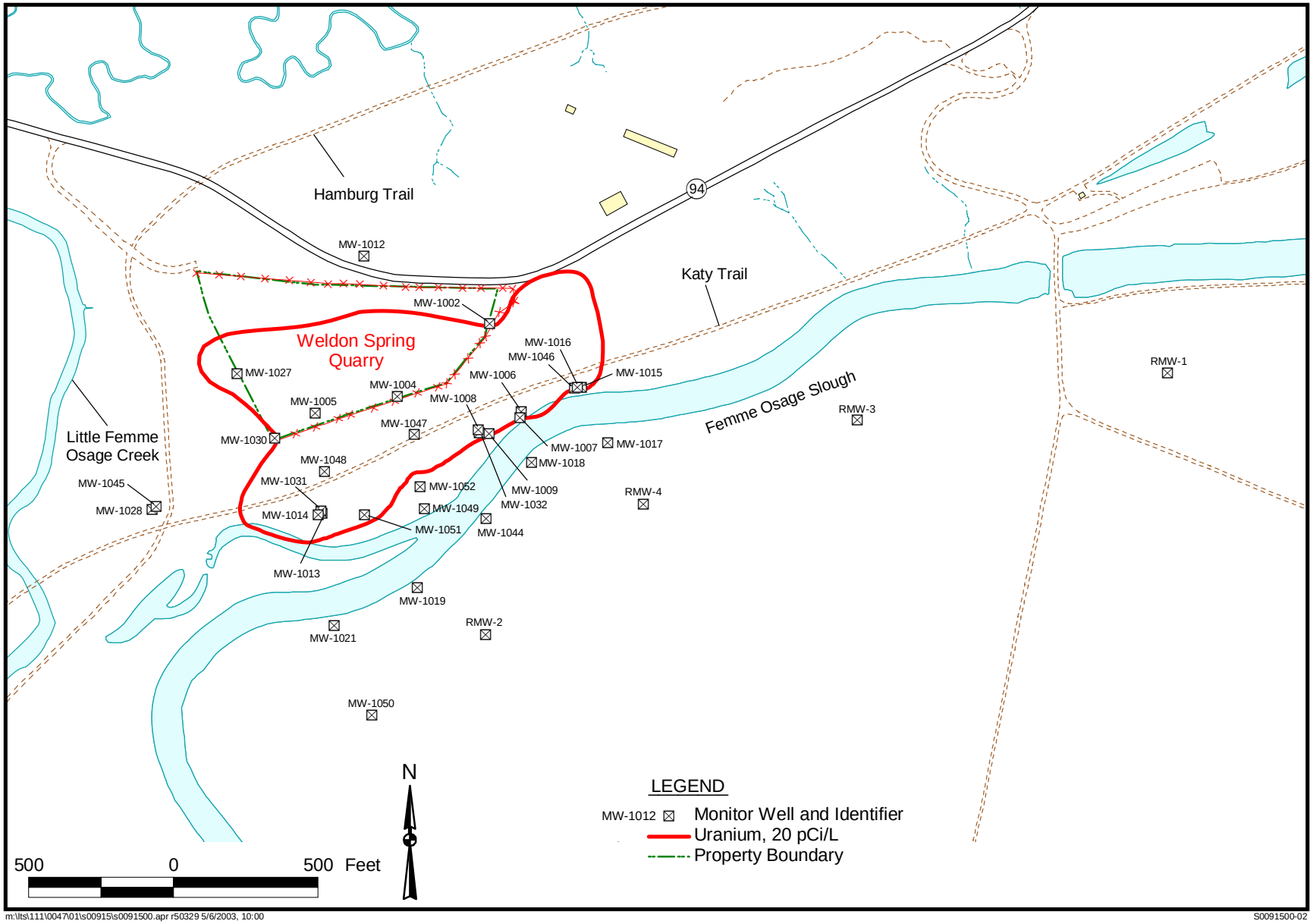

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Figure A−23. Extent of Uranium Contamination in Groundwater at the Weldon Spring, Missouri, Site Quarry Area

Nitroaromatic compounds in groundwater also were analyzed in 2002. These contaminants occur in the bedrock and alluvium downgradient of the Quarry and north of Femme Osage Slough. All concentrations were below detection limits in samples from locations south of Femme Osage slough. The average 2,4-DNT concentration for location MW–1027 remained above the Missouri drinking water standard of 0.11 µg/L in 2002 (DOE 2003c).

Groundwater analyses in 2002 continued to indicate elevated sulfate levels in monitoring wells in the bedrock of the Quarry rim and in the alluvial material north of Femme Osage slough. Eleven wells had averages above background, and one location, MW–1005, had an annual average that exceeded the Missouri secondary MCL of 250 mg/L. Sulfate is used as an indicator of the geochemical conditions of the aquifer, and the 2002 concentrations continue to provide evidence of the reduction zone.

A2.4.1.2 Surface Water

Surface water bodies in the Quarry are Femme Osage Slough, Little Femme Osage Creek, and Femme Osage Creek. These water bodies do not receive direct runoff from the Quarry but were sampled to monitor water quality due to possible movement of contaminated groundwater from the fractured bedrock of the Quarry through fine-grained alluvial materials. Femme Osage Slough is directly south of the Quarry and is known to receive contaminated groundwater through subsurface recharge. There is no natural surface flow from the slough; however, water can be introduced into the slough from the Missouri River through a gate valve. Little Femme Osage Creek, located west of the Quarry, discharges into Femme Osage Creek approximately 0.3 mile (0.5 kilometer) southwest of the Quarry. Femme Osage Creek flows into the Missouri River.

Annual average uranium concentrations for the surface water locations sampled in 2002 are summarized in Table A−11. Uranium levels in Femme Osage Slough remain within historical ranges. All maximum total uranium concentrations were below historical maximum concentrations for Quarry surface water during 2002. The slough continues to show declining uranium levels (DOE 2003c). Uranium concentrations in the slough do not pose a risk to recreational users or to the aquatic and terrestrial life associated with the slough.

Table A−11. 2002 Annual Averages for Total Uranium Concentrations at Weldon Spring, Missouri, Site Quarry Area Surface Water Locations

Identifier	Location	Average[a]	Maximum[a]	Minimum[a]	Historical Maximum[a] (year)
SW–1003	Femme Osage Slough	14.8	17.7	11.3	252.0 (1989)
SW–1004	Femme Osage Slough	16.4	17.4	14.4	362.0 (1991)
SW–1005	Femme Osage Slough	11.1	12.2	10.2	116.0 (1991)
SW–1007	Femme Osage Slough	7.1	9.3	6.3	69.0 (1992)
SW–1009	Femme Osage Slough	6.3	8.6	4.9	28.6 (1991)
SW–1010	Femme Osage Slough	15.0	19.3	12.3	156.0 (1991)

[a]All concentrations in pCi/L. Locations shown in DOE 2003c.

A2.4.1.3 Sediments

Sediments in Femme Osage Slough and nearby creeks were characterized during the RI (DOE 1998a). The 95-percent upper confidence limit background value for uranium in the creek and slough sediment is 4.35 pCi/g. Sediments in the creeks and lower portion of the slough have uranium levels similar to background. The upper portion of the slough, directly south of the Quarry, has uranium levels slightly greater than background (5.41 pCi/g). These levels pose no human health or ecological risks under a recreational scenario (see Appendix B).

A2.4.1.4 Soil in the Quarry Proper

Some areas of residual radioactive contamination remain in the Quarry proper. These areas were not targeted for removal because risk levels are within the acceptable range for a recreational visitor, and the areas were not easily accessible during previous soil removal activities (i.e., limited access for equipment, or soil in cracks and fissures). Some residually contaminated soils were removed from the Quarry proper under the Quarry Residuals OU. Since removal of contaminated structures and materials would be performed during the early stages of Quarry restoration, it was decided to remove soils from selected areas.

The locations within the Quarry proper that still have residual radioactive soil include the southeast slope, the knoll, wall and floor fractures, and the northeast slope (Figure A−24). Soil in these locations was not targeted for removal due to inaccessibility or extreme difficulty in excavation. A summary of the levels of contamination is presented in Table A−12.

Table A−12. Maximum Radionuclide Concentrations in Soil at Areas in the Weldon Spring, Missouri, Site Quarry Proper

Location	Radium-226[a]	Radium-228[a]	Thorium-230[a]	Uranium-238[a]	Notes
Northeast Slope	12.7	9.87	77.9	3.91	(1)
Southeast Slope	8.20	2.79	42.0	35.1	(2)
Knoll	1.70	1.39	12.9	2.33	(1)
Wall Fractures	7.07	8.77	81.1	32.7	(1)
Floor Fractures	9.44	7.53	396	202	(1)

[a]All concentrations in pCi/g .
Notes: (1) Below Soil Backfill >2 feet.
(2) Below Soil Backfill < 1 foot.

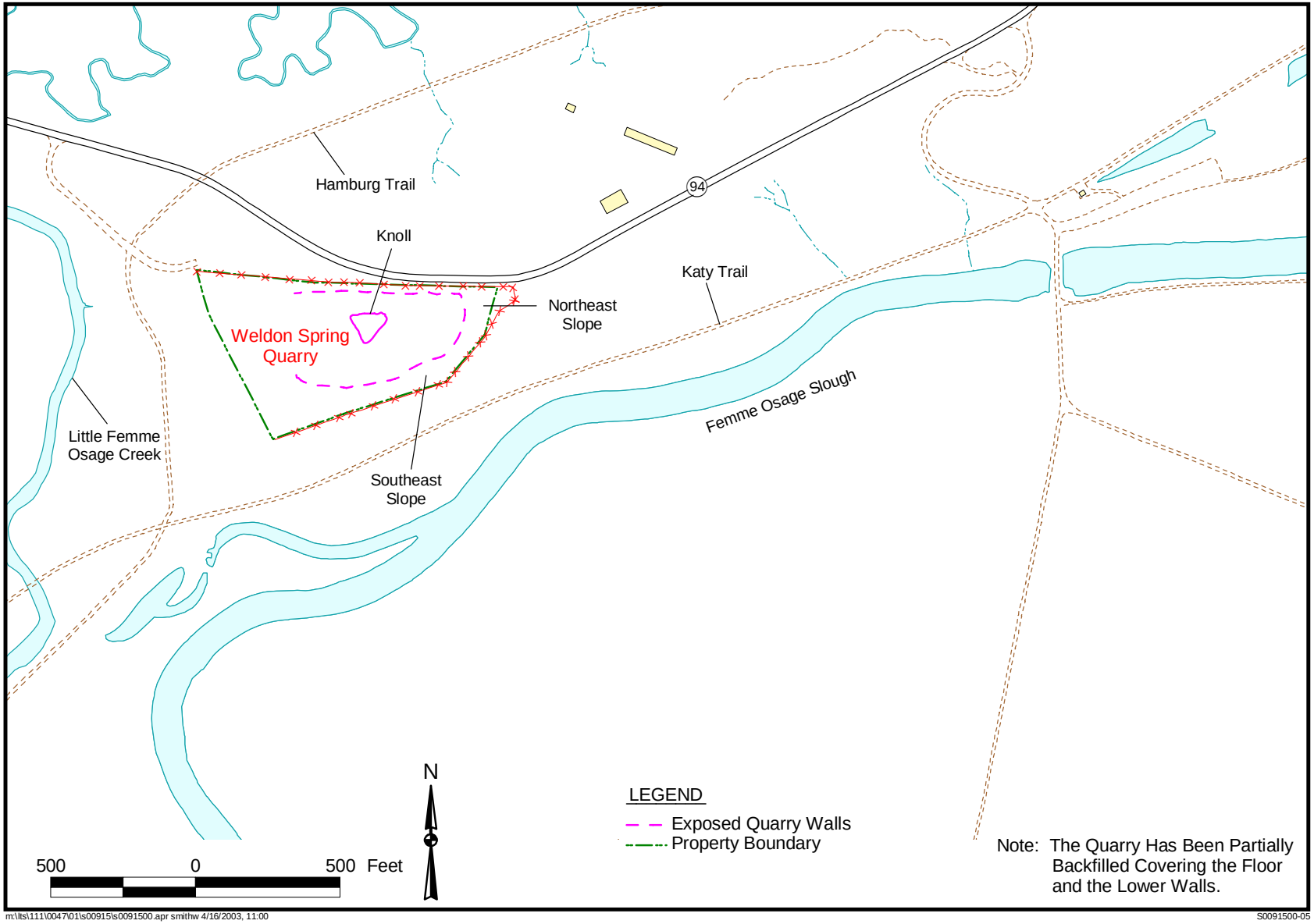

Figure A–24. Features of the Weldon Spring, Missouri, Site Quarry

A2.4.2 Remedial Activities

A RI/FS process was conducted for the Quarry Residuals OU in accordance with the requirements of CERCLA, as amended, to document the proposed management of the Quarry proper, Femme Osage Slough and nearby creeks, and contaminated groundwater. This process incorporated the values of NEPA and represented a level of analysis consistent with an environmental impact statement.

DOE and EPA signed the Quarry Residuals OU ROD for management of residual contamination in September 1998 (DOE 1998c). Components of the remedy for the Quarry Residuals OU were long-term monitoring and institutional controls to address contaminated groundwater north of Femme Osage Slough. Based on exposure assessments under current and reasonably anticipated recreational land uses, no further soil remediation inside or outside of the Quarry proper was necessary to protect human health and the environment (DOE 1997b). The selected remedy outlined the performance of two field studies to support the decision for long-term monitoring of groundwater. These studies would be used to verify predictive models on the effectiveness of uranium removal by groundwater extraction and support the hydrogeological conceptual model regarding natural attenuation of uranium north of the slough. An additional component of the Quarry Residuals OU was the reclamation of the Quarry area, including restoration of the Quarry proper, demolition of the Quarry water treatment plant, and dismantlement of facilities used during bulk waste removal activities. A detailed discussion about the activities performed under the Quarry Residuals OU is presented in the *Quarry Residuals Operable Unit Interim Remedial Action Report* (DOE 2003b).

A2.4.2.1 Long-Term Groundwater Monitoring

Long-term groundwater monitoring for the Quarry Residuals OU consists of two separate programs. The first program details the monitoring of uranium and 2,4-DNT south of the slough to ensure that levels remain protective of human health and the environment. The second program consists of monitoring groundwater contaminant levels within the area north of the slough until they attain a predetermined target level indicating negligible potential to affect groundwater south of the slough.

Groundwater monitoring is necessary to continue to ensure that uranium-contaminated groundwater has a negligible potential to affect the St. Charles County well field. Under current conditions, groundwater north of the slough poses no imminent risk to human health from water obtained from the well field. A target level of 300 pCi/L for uranium (10 percent of the 1999 maximum) was established to represent a significant reduction in the contaminant levels north of the slough. The target level for 2,4-DNT has been set at 0.11 µg/L, the Missouri Water Quality standard. Upon attainment of these target levels, it will be determined that the goal for the monitoring program has been met, and the long-term monitoring activities for this OU will be concluded. Following attainment of the long-term monitoring target levels in groundwater north of the slough, an assessment of the residual risks based on actual groundwater concentrations will be performed to determine the need for future institutional controls.

A2.4.2.2 Quarry Interceptor Trench Field Study

The selected remedy in the Quarry Residuals OU ROD (DOE 1998c) outlined the performance of two field studies to support the decision for long-term monitoring of groundwater and reliance on natural conditions to limit potential migration of uranium south of the slough. These field studies consisted of the installation and operation of an interceptor trench and hydrologic/geochemical sampling within the area of uranium impact to verify the effectiveness of uranium removal by groundwater extraction methods and support the conceptual fate and transport model for the Quarry.

The interceptor trench was constructed to support the action in the ROD. This field study was performed southeast of the Quarry to quantify the mass of uranium that could be removed from the alluvial aquifer by groundwater extraction. The trench was constructed to represent a cross-section of alluvial material and was optimally located to extract groundwater from the areas with high uranium concentrations. The trench was approximately 550 feet (168 meters) in length, and water produced from the trench was routed underground to the Quarry water treatment plant. The system was evaluated and monitored for 2 years (April 27, 2000, to April 26, 2002) to confirm model predictions. A total 1,666,234 gallons (6,307,382 liters) of water was pumped from the interceptor trench. Samples were collected daily from the operating pumps to determine the mass of uranium removed.

The objective of the interceptor trench field study was to confirm model predictions of the effectiveness of groundwater extraction systems to remove uranium from the shallow aquifer on the basis of field data. If the performance of the trench was not more effective than modeled (i.e., less than 10 percent of the mass of uranium removed within the 2-year testing period), further evaluation of groundwater treatment would not be necessary. If the performance of the trench exceeded the modeled values (greater than 10 percent of the mass of uranium removed within the 2-year testing period), the effectiveness and benefit of groundwater extraction would be reevaluated.

The efficiency of the interceptor trench system was defined as the ratio of the cumulative mass of uranium removed to the initial mass present within the capture zone of the trench. By the end of the 2-year study period, the interceptor trench had removed 14.0 kg of uranium. This accounted for 1.5 percent of the mass available to the interceptor trench. The predicted percent of removal for the 2-year operation was 10 percent. The percent removed was significantly below the predicted performance of the trench, which indicates that the modeled predictions were optimistic and that further evaluation of groundwater treatment was not warranted. A summary of the field study is provided in the *Evaluation of the Performance of the Interceptor Trench Field Study* (DOE 2003a).

A2.4.2.3 Hydrological and Geochemical Field Studies

The conceptual model for the Quarry is that sorption of uranium onto the aquifer matrix and organic material and precipitation of dissolved uranium from groundwater are responsible for the notable decrease of uranium concentrations (from 3,000 pCi/L to less than 1 pCi/L) over a short distance (100 to 300 feet, or 30 to 91 meters) north of the slough. The sharp decrease in uranium levels indicates that dispersion and dilution, which typically generate more diffuse boundaries, are not the primary processes attenuating the uranium in groundwater.

Several investigations were performed in the area north of the slough to evaluate uranium attenuation mechanisms. Oxidation state and redox-sensitive parameter data defined the oxidizing and reducing zones of the alluvial aquifer and the boundary between them. Distribution coefficients were estimated from depth-discrete sampling data to determine the sorption/desorption capacity of the aquifer matrix (both alluvial and bedrock). The distribution of uranium in soil across the reducing front was quantified where uranium was concentrated in a narrow band beneath the oxidized/reduced contact.

The results of the investigations provided a better understanding of the natural geochemistry of the alluvial aquifer north of the slough. The area contains a naturally occurring oxidation/reduction front, which acts as a barrier to the migration of dissolved uranium by inducing its precipitation. The physical and chemical parameters measured in groundwater samples were successfully correlated with the physical properties of the aquifer material and support the conceptual fate and transport model presented in the Quarry Residuals OU RI (DOE 1998a). Specific details are presented in the C*ompletion Report for the Geochemical Characterization Performed in Support of the QROU Field Studies* (DOE 2002).

A2.4.2.4 Quarry Reclamation

Reclamation of the Quarry included backfilling the Quarry proper, demolition of the Quarry treatment plant, removal of the Quarry interceptor trench system, and dismantlement of facilities used during bulk waste removal. Backfilling of the Quarry was designed to reduce physical hazards associated with an open Quarry, eliminate the ponding of water, and reduce infiltration of precipitation water into the groundwater system.

In 2000, DOE completed characterization of contamination remaining at the northeast slope and several other locations in the Quarry proper. Soil was excavated from three locations within the Quarry proper (1,574 cubic yards, or 1,203 cubic meters) during 2000 and placed in the permanent disposal cell at the Chemical Plant. Cleanup criteria for the Quarry proper soil were taken from the Chemical Plant ROD (DOE 1993), as specified in the Quarry Residuals OU ROD (DOE 1998c). Based on previous characterization activities, only radioactive contaminants of concern were targeted.

Backfill for the Quarry was acquired from an off-site borrow area, consisting of approximately 17 acres (6.9 hectares) of land on the MDC property. Approximately 76,400 cubic yards (58,400 cubic meters) of soil was excavated and transported to the Quarry for use as backfill. Uncontaminated soils from within the Quarry and the Quarry staging area were also used as backfill materials for the Quarry.

Fill material was placed and compacted to design elevations within the Quarry proper. During backfilling of the Quarry, selected wall and floor fractures were sealed to prevent infiltration of water and reduce the likelihood of later subsidence of the backfill. Upon completion of backfill activities, final grading and seeding were performed. Reclamation of the Quarry was completed on September 6, 2002.

A3.0 References

40 CFR 264. U.S. Environmental Protection Agency, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," *Code of Federal Regulations,* July 1, 2001.

10 CSR 25-7.264. Missouri *Code of State Regulations,* Title 10, "Department of Natural Resources," Division 25, "Hazardous Waste Management Commission," Chapter 7.264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities."

Boerner, A.J., 1986. *Radiological Survey of the August A. Busch and Weldon Spring Wildlife Areas Weldon Spring Site, St. Charles County, Missouri*, Final Report, prepared by Oak Ridge Associated Universities for U.S. Department of Energy Division of Remedial Action Projects, April.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

DA (U.S. Department of the Army), undated. *Histories of Ordnance Installations and Activities, 1940-45,* Entry 646, Records of the Office of the Chief of Ordnance (Record Group 156), Executive Branch, Historical Branch.

DOE (U.S. Department of Energy), 1989. *Engineering Evaluation/Cost Analysis for the Proposed Management of Contaminated Water in the Weldon Spring Quarry*, DOE/OR/21548-039, prepared by MacDonell, M.M., J.M. Peterson, and I.E. Joya for the U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 1990. *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry*, Rev. 0, DOE/OR/21548-317, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1993. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site*, Rev. 0, DOE/OR/21548-376, U.S. Department of Energy Oak Ridge Field Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1995. *Chemical Plant Area Cleanup Attainment Confirmation Plan*, Rev. 3, DOE/OR/21548-491, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, December.

DOE (U.S. Department of Energy), 1996. *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri*, DOE/OR/21548-584, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, August.

DOE (U.S. Department of Energy), 1997a. *Vicinity Property DOC-8 Close-Out Report*, Rev. 0, DOE/OR/21548-679, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, April.

DOE (U.S. Department of Energy), 1997b. *Baseline Risk Assessment for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-594, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 1997c. *Post-Remediation Sampling Plan for the Southeast Drainage*, Rev. 0, DOE/OR/21548-616, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 1997d. *Remedial Investigation for the Groundwater Operable Units at the Chemical Plant Area and the Ordnance Works Area, Weldon Spring, Missouri*, DOE/OR/21548-571, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 1997e. *Busch Lake 36 Summary Closeout Report*, Rev. 1, DOE/OR/21548-702, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, October.

DOE (U.S. Department of Energy), 1998a. *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring Missouri*, Rev. 2 (Final), DOE/OR/21548-587, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, February.

DOE (U.S. Department of Energy), 1998b. *Feasibility Study for Remedial Action for the Groundwater Operable Units at the Chemical Plant Area and the Ordnance Works Area, Weldon Spring, Missouri*, DOE/OR/21548-569, U.S. Department of Energy Oak Ridge Operations Office and U.S. Department of the Army Corps of Engineers, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, March.

DOE (U.S. Department of Energy), 1998c. *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-725, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1999a. *Completion Report for Sediment Sampling at Busch Lakes 34 and 35*, Rev. 0, DOE/OR/21548-768, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, February.

DOE (U.S. Department of Energy), 1999b. *Close-Out Report for Vicinity Properties MDC-6 and MDC-9*, Rev. 0, DOE/OR/21548-775, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, April.

DOE (U.S. Department of Energy), 1999c. *Closeout Report for Vicinity Properties DA-1, DA-2, DA-3, DA-5, and DA-7*, Rev. 0, DOE/OR/21548-778, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, May.

DOE (U.S. Department of Energy), 1999d. *Closeout Report for Vicinity Properties MDC-3, MDC-4, MDC-5, and MDC-10,* Rev. 1, DOE/OR/21548-789, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, June.

DOE (U.S. Department of Energy), 1999e. *Proposed Plan for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site,* DOE/OR/21548-733, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, June.

DOE (U.S. Department of Energy), 1999f. *Engineering Soils Sampling Plan for Army and MDC Vicinity Properties: Addendum 6: Engineering Characterization Sampling at Frog Pond Outlet (Soil Beneath Twin 60-Inch Culverts)*, Rev. 0, DOE/OR/21548-622:6, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1999g. *Southeast Drainage Closeout Report Vicinity Properties DA4 and MDC7*, Rev. 0, DOE/OR/21548-772, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 2000a. *Closure Report for Soil Sampling at the Frog Pond Outlet, Addendum 6 of the Engineering Soil Sampling Plan for Army and MDC Vicinity Properties,* Rev. 0, DOE/OR/21548-829, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 2000b. *Interim Record of Decision for Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site*, DOE/OR/21548-798, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 2000c. *Closeout Report for the Frog Pond Drainage,* Rev. 0, DOE/OR/21548-840 U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, October.

DOE (U.S. Department of Energy), 2001a. *Analytical Data Results for Engineering Characterization of Vicinity Property DA-6: Ash Pond Drainage,* Rev. 2, DOE/OR/21548-824, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 2001b. "Applications for Supplemental Surface Contamination Limits for Southeast Drainage and Frog Pond Drainage Culverts," memorandum from Pamela Thompson to Robert Boettner, Weldon Spring, Missouri, June 20.

DOE (U.S. Department of Energy), 2001c. "Application for Supplemental Surface Contamination Limits for Southeast Drainage and Frog Pond Drainage Culverts at the Weldon Spring Site Remedial Action Project," memorandum from Richard L. Nace to Pamela Thompson, Oak Ridge, Tennessee, July 26.

DOE (U.S. Department of Energy), 2002. *Completion Report for the Geochemical Characterization Performed in Support of the QROU Field Studies,* DOE/OR/21548-919, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, April.

DOE (U.S. Department of Energy), 2003a. *Evaluation of the Performance of the Interceptor Trench Field Study,* Draft, DOE/OR/21548-916, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri.

DOE (U.S. Department of Energy), 2003b. *Quarry Residuals Operable Unit Interim Remedial Action Report,* DOE/OR/21548-927, U.S. Department of Energy Oak Ridge Operations Office Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri.

DOE (U.S. Department of Energy), 2003c. *Weldon Spring Site Environmental Report for Calendar Year 2002,* Rev. 0, DOE/OR/21548-931, U.S. Department of Energy Oak Ridge Operations Office, St. Charles, Missouri.

DOE (U.S. Department of Energy), 2004a. *Record of Decision for the Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site,* DOE/GJ/79491-936a, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 2004b. *Remedial Design/Remedial Action Work Plan for the Final Remedial Action for the Groundwater Operable Unit at the Weldon Spring Site*, Draft, DOE/GJ/79491-943, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, February.

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Appendix B

Risk Assessment Information

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Summary of Post-Remediation Risk Status at the Weldon Spring Site

Baseline risk assessments addressing both human health and ecological risks were performed as part of the remedial investigation phase of the remedial investigation/feasibility study processes conducted. A limited assessment was performed for the Quarry Bulk Waste Operable Unit (OU) consistent with the focused scope of the remedial investigation/feasibility study conducted. These risk assessments are documented in the baseline risk assessment reports that have been prepared for the four operable units of the Weldon Spring Site (DOE 1990, 1992, 1997, 1998). The assessments provided information regarding actual and potential risks to human health and the environment posed by the site areas addressed in each of the operable units. The information was then used to determine whether a current or potential threat to human health or the environment exists that warranted consideration of a remedial action.

The risk assessment performed to support the removal action conducted at the Southeast Drainage is presented in the Engineering Evaluation/Cost Analysis report prepared for the drainage (DOE 1996). An assessment was also prepared for the contaminated culverts under County Highway D (Frog Pond culverts) (ANL 2000).

After remediation of the former Chemical Plant and vicinity properties, a post-cleanup risk assessment (DOE 2002) was performed to determine residual risk levels for the various soil areas remediated. A similar assessment was also performed after the removal action was completed for the Southeast Drainage (ANL 1999). Information from the post-remediation reports and from the baseline risk assessment reports (for areas that did not undergo remediation) was used to determine the need for and the nature of institutional controls to protect human health and the environment.

B1.0 Risk Assessment Methodology

B1.1 Human Health

Potential risks posed by exposure to site-related radiation and chemicals were assessed using methods developed by EPA and other agencies (EPA 1989b). Although exposure to ionizing radiation can result in cancer, serious genetic effects, and other detrimental health effects, the predominant health concern associated with radioactive contaminants at the Weldon Spring Site (which are primarily alpha-emitting radionuclides) is the induction of cancer. The radiological health risks evaluated were limited to this concern. This approach is consistent with EPA guidance, which notes that, in general, the risk of cancer is limiting and may be used as the sole basis for assessing the radiation-related human health risks for a site contaminated with radionuclides (EPA 1989b). For exposure to site chemicals, cancer and noncancer endpoints were evaluated consistently with EPA guidance (EPA 1989b).

Potential human health risks were estimated with reference to current and likely foreseeable future land use. Risk assessments conducted for the Weldon Spring Site have been performed by DOE in consultation with EPA and the state of Missouri and conform to procedures recommended by both agencies.

The EPA risk assessment process as implemented at the Weldon Spring Site consists of four primary steps. Recognition and careful consideration of the uncertainties associated with each of the four steps presented below is an important component of the risk assessment process.

Data Collection and Hazard Assessment—Site-related hazards or contaminants of concern are identified.

Exposure Assessment—An estimate is made as to the nature and magnitude of potential exposures associated with the site. Exposure scenarios, exposure pathways, potential receptors, exposure concentrations, and intakes are postulated or estimated. An exposure pathway is considered complete only if all the following elements are present: presence of a contaminated medium (e.g., drinking water, soil), presence of a person or ecological receptor at the location where the contaminated medium exists, and opportunity for the person or ecological receptor to come in contact with the contaminated medium.

Toxicity Assessment—Toxicity of the contaminants of concern are evaluated, and appropriate toxicity values for quantifying the potential health effects of the contaminants of concern are identified; these values have been developed by EPA for conducting risk assessments at CERCLA sites.

Risk Characterization—Potential cancer and noncancer risks are quantified. For cancer risks, EPA has established an acceptable risk range of 1 in 1 million to 1 in 10,000 (EPA 1990). This means that contaminant concentrations at a site that could result in increasing a person's chances of developing cancer by 1 chance in 1 million to 1 chance in 10,000 (in addition to this person's chances of developing cancer from other causes) would be considered acceptable. The quantitative measure of noncarcinogenic health effects is the hazard index. EPA has defined a hazard index greater than 1 as indicating possible adverse noncarcinogenic health effects.

Table B−1 presents a summary of the exposure scenarios, scenario assumptions, and intake parameters used in the various risk assessments performed for the site.

B1.2 Ecological Risk Assessment

The ecological assessments conducted for the Weldon Spring Site addressed both aquatic biota and terrestrial wildlife, as appropriate for the four operable units (EPA 1989a and 1989c). For aquatic biota, the risk assessment included consideration of both exposure and effects. Biotic surveys of fish and invertebrate communities were performed. This method provided direct information on the status of the aquatic community inhabiting a spring (e.g., Burgermeister Spring) or a site surface water area (e.g., Femme Osage Slough) and the habitat quality of these spring water or surface water areas. Acute and chronic toxicity tests were also performed. The risk assessment for terrestrial wildlife modeled uptake of contaminants through a drinking water pathway.

Table B−1. Exposure Scenarios and Scenario Assumptions Presented in Risk Assessments for the Weldon Spring, Missouri, Site

Occurrence	Exposure Scenario	Scenario Assumptions and Intake Parameters	Comment/Reference
Chemical Plant soil	Site worker at former Chemical Plant[a]	Assumed 10 years of exposure for 200 days/year at 8 hours per day. Evaluated the ingestion, inhalation, and external gamma pathways.	Baseline Assessment Report (DOE 1992).
	Site trespasser at former Chemical Plant[a]	Assumed 10 years of exposure for 5 times a year for 1 hour each time. Evaluated the ingestion, inhalation, and external gamma pathways.	(same as above)
	Current/future recreational visitor[a]	Assumed 30 years of exposure for 20 times or days per year for 4 hours each time. Evaluated the ingestion, inhalation, and external gamma pathways.	(same as above)
	Hypothetical resident[b]	Assumed 30 years of exposure for 350 days per year. Evaluated the ingestion, inhalation (including radon) and external gamma pathway.	Post-Remediation Risk Assessment Report (DOE 2002)
Chemical Plant groundwater and springs (including Burgermeister Spring)	Current/future recreational visitor (assumed ingestion of spring water only)[a]	Assumed ingestion for 30 years at 20 visits per year consuming a cupful (200 mL) each time.	Baseline Risk Assessment Report (DOE 1997).
	Hypothetical resident (assumed ingestion of groundwater)[a]	Assumed ingestion for 30 years, 350 days/year at 2 L per day.	
Quarry Bulk Waste	Hypothetical passerby[a]	Evaluated the inhalation to radon pathway for an adult passing by 500 to 700 times per year for 5 to 10 years.	These scenarios were postulated to assess potential exposure to the bulk waste present at the time when the Quarry was fenced and closed to the public. Assessment presented in the Baseline Risk Evaluation Report (DOE 1990).
	Hypothetical trespasser[a]	Assumed to be 11 to 18 years old; trespassed 12 to 50 times a year for 2 to 4 hours each time for 5 to 10 years.	

Table B−1 (continued). Exposure Scenarios and Scenario Assumptions Presented in Risk Assessments for the Weldon Spring, Missouri, Site

Occurrence	Exposure Scenario	Scenario Assumptions and Intake Parameters	Comment/Reference
Residual Soil at Quarry Proper (soil that remained after bulk waste removal)	Recreational visitor[a]	Assumed ingestion, inhalation, external gamma pathways; 30 years of exposure, 20 visits per year.	Baseline Risk Assessment Report (DOE 1998).
Quarry Area soil	Recreational visitor[a]	Assumed ingestion, inhalation, external gamma pathways; 30 years of exposure, 20 visits per year.	(same as above)
Femme Osage Slough and Little Femme Osage Creek	Current/future recreational visitor[a]	Assumed ingestion of sediment, surface water, and fish.	(same as above)
	Hypothetical resident[c]	Assumed exposure to sediment and surface water via the ingestion and external gamma pathway.	Letter transmittal to DOE (ANL 2003).
Quarry groundwater	Hypothetical resident (assumed ingestion of groundwater)[a]	Assumed ingestion of groundwater for 30 years, 350 days/year at 2 L per day.	Baseline Risk Assessment Report (DOE 1998).
Southeast Drainage	Current/future recreational visitor/hunter[a]	Assumed 20 visits/year for 30 years; evaluated external gamma and ingestion pathways[d].	Southeast Drainage Engineering Evaluation/Cost Analysis (DOE 1996).
	Hypothetical child resident[a]	Assumed 90 days/year visits for 10 years; evaluated for external gamma and ingestion pathways[d].	
Frog Pond culverts	Utility construction worker[a]	Assumed exposure for 5 working days, 8 hours per day; evaluated external gamma, inhalation, and ingestion pathways.	Letter transmittal to DOE (ANL 2000).
	Recreational visitor[a]	Assumed exposure for 10 years, 10 days per year for 1 hour per day. Same pathways as that for construction worker.	

[a]Exposure scenario evaluated for the baseline risk assessment.
[b]Exposure scenario evaluated for the post-remediation risk assessment.
[c]Data from baseline risk assessment (DOE 1998) reevaluated for hypothetical resident scenario.
[d]For calculating the external gamma doses, it was assumed that only 25 percent of the exposure time was spent in areas with elevated radionuclide concentrations because a receptor would be likely to move around the drainage.
Key: mL = milliliter, L = liter

B2.0 Baseline Risk Assessment Results

B2.1 Human Health

The baseline risk assessment performed for the former Chemical Plant soils, structures, surface water, and sludges at the raffinate pits indicates that elevated concentrations of site-related contaminants (both radioactive and chemical) could pose an unacceptable risk and a hazard index greater than 1 for the future recreational visitor scenario evaluated (DOE 1992).

Risk estimates for contaminated groundwater in the shallow aquifer beneath the Chemical Plant area indicate that some contaminants could pose an unacceptable risk if ingested at frequencies and amounts similar to those of residential use (DOE 1997).

Risk estimates for springs (including Burgermeister Spring) at the Chemical Plant indicate that site-related contaminant levels are within the acceptable risk range and below a hazard index of 1 for the current and future recreational visitor accessing the spring water (DOE 1997).

For the Southeast Drainage, risk estimates for a recreational visitor and hypothetical child resident scenario indicated that contaminant levels in spring water are within the acceptable risk range and below a hazard index of 1. However, radioactive contaminant levels in sediment at several locations posed a risk slightly greater than the acceptable range when evaluated using the hypothetical child resident scenario (DOE 1996). The hypothetical child resident was evaluated as the reasonably maximally exposed individual at the drainage. DOE consulted with EPA, the Missouri Department of Natural Resources, and the Missouri Department of Health in developing this scenario and its exposure assumptions for evaluating potential exposure to the contaminants in the drainage.

For the Quarry, residual soils at the Quarry proper, including those in the fractures, indicated that contaminant levels are within the acceptable risk range and below a hazard index of 1 for the recreational visitor scenario. Surface water, sediment, and fish samples from Femme Osage Slough also indicate that contaminant levels are within the acceptable risk range and below a hazard index of 1 for the recreational visitor scenario (DOE 1998).

Uranium in groundwater north of Femme Osage Slough poses a risk greater than the acceptable risk range for a hypothetical resident scenario. Site-related contaminants have not been detected at monitoring wells south of Femme Osage Slough (including those at the St. Charles County well field) (DOE 1998).

B2.2 Ecological Risk

At the former Chemical Plant, the area of most ecological concern was the four raffinate pits, largely due to chemicals (generally metals) in the ponded water and raffinate pit sludges. Although the industrial portion of the former Chemical Plant did not present good habitat for wildlife, the undeveloped areas supported fauna similar to that in the surrounding wildlife areas. Tissue concentrations in fish collected in Lakes 34, 35, and 36 in the Busch Wildlife Area indicated uranium concentrations at levels for which no adverse effects have been observed. Overall, there were no obvious adverse ecological impacts to area biota, with the possible

exception of the biota at the raffinate pits. Remedial action at the former Chemical Plant and raffinate pits has significantly reduced ecological risks in the area (DOE 1992).

Results of the biotic surveys, media toxicity testing, and contaminant uptake modeling for terrestrial wildlife indicate that current contaminant levels in surface water and sediment at Burgermeister Spring pose little or no risk to the aquatic and terrestrial biota of the area (DOE 1997).

The Quarry proper provides minimal suitable habitat for vegetation and wildlife and was not addressed in the ecological risk assessment. The media and areas of interest in terms of ecological risk are surface water and sediment in Femme Osage Slough and Little Femme Osage Creek. Results of the ecological risk assessment indicated that there are no risks to terrestrial wildlife receptors foraging in Femme Osage Slough or ingesting water from Little Femme Osage Creek. Biotic surveys indicated that the aquatic and terrestrial communities are typical of those expected to be in the area. Tissue analyses of small mammals and fish indicated uranium concentrations within the range for which no adverse effects have been observed. The levels of site-related contaminants in surface water and sediment in Femme Osage Slough and Little Femme Osage Creek present no risk to biota in the area (DOE 1998).

At the Southeast Drainage, surface water in the drainage does not pose risk to terrestrial biota drinking the water at the drainage. Surface water and sediment in the drainage pose minor risks to aquatic biota, and adverse effects would more likely result from the intermittent flow of surface water than from contamination in the drainage. Any ecological impacts would be localized within the drainage and would not have demonstrable effect on the ecological resources in the area. Removal of contaminated sediments has further reduced the low ecological risks that existed previously (DOE 1996).

B3.0 Residual Risk Summary

Table B−2 presents a summary of the human health risk status based on current conditions at the areas that constitute the Weldon Spring Site. The table is a compilation of risk results presented in post-remediation reports for remediated areas (e.g., the post-remediation risk assessment prepared for the former Chemical Plant soils, structures, and raffinate pits [DOE 2002]) and those presented in the baseline risk assessment reports for areas that did not undergo remediation, such as Femme Osage Slough, Burgermeister Spring, and Quarry groundwater. For the areas that were not remediated, DOE reviewed more recent data to determine whether risk results presented in the baseline risk assessments still reflect current conditions, and risk estimates were updated as needed.

The post-cleanup risk assessment performed for the Chemical Plant and vicinity properties (DOE 2002) incorporated all the soil data collected during the confirmation process. These data represent the levels of soil contaminants of concern that remain. The risk assessment considered each confirmation unit as separate one-half acre exposure units. The 95 percent upper confidence limit of the arithmetic mean of all samples collected for each confirmation unit was used as the exposure point concentration for calculating potential risk based on a hypothetical resident scenario. The ingestion, inhalation (including radon), and external gamma pathways were evaluated.

Table B−2. Summary of Residual Risk Status at the Weldon Spring, Missouri, Site

Site Area	Risk Status	Reference
Chemical Plant soil	Similar to background.[a]	DOE 2002
Vicinity property soil	Similar to background.[a]	DOE 2002
Chemical Plant groundwater	Greater than acceptable risk range and hazard index of 1 for a hypothetical resident scenario.[b]	DOE 1997
Burgermeister Spring	Within acceptable risk range for recreational visitor.[b]	DOE 1997
Quarry proper	Within acceptable risk range for recreational visitor.[b]	DOE 1998
Quarry area groundwater north of slough	Greater than acceptable risk range and hazard index of 1 due to uranium concentrations remaining.[b]	DOE 1998
Quarry area groundwater south of slough	Within acceptable risk range for resident scenario.[b]	DOE 1998
Femme Osage Slough and Little Femme Osage Creek	Within acceptable risk range for the recreational visitor[b] scenario. Within acceptable risk range for a hypothetical[c] resident scenario.	DOE 1998 ANL 2003
Southeast Drainage	Within acceptable risk range for recreational visitor and hypothetical child resident.[b]	DOE 1996
Frog Pond outlet/culverts	Within acceptable risk range for a utility construction worker and recreational visitor scenario.[b]	ANL 2000

[a]Risk status after remediation.
[b]Risk status at baseline risk assessment phase and still representative of current conditions.
[c]Data from baseline risk assessment (DOE 1998) reevaluated for hypothetical resident scenario.

For the Southeast Drainage, confirmation data that were collected for the locations remediated were also evaluated to determine the residual risk and the risk reduction that was achieved. The removal action performed has resulted in reducing potential risk posed by the drainage (ANL 1999).

Finally, data evaluated in the baseline risk assessment (DOE 1998) for Femme Osage Slough and Little Femme Osage Creek were re-evaluated to estimate potential risk using a hypothetical resident scenario. The evaluation in the baseline risk assessment was based on a recreational visitor scenario and was consistent with current and reasonable future land use. Results indicate that contaminant levels in the sediment and surface water are also within the acceptable risk range for the hypothetical resident scenario (ANL 2003).

B4.0 References

ANL (Argonne National Laboratory), 1999. Transmittal letter from M. Picel to T. Pauling, U.S. Department of Energy, Weldon Spring Site Remedial Action Project, St. Charles, Missouri, September 14.

ANL (Argonne National Laboratory), 2000. Transmittal letter from M. Picel to T. Pauling, U.S. Department of Energy, Weldon Spring Site Remedial Action Project, St. Charles, Missouri, March 9.

ANL (Argonne National Laboratory), 2003. Transmittal letter from M. Picel to T. Pauling U.S. Department of Energy, Weldon Spring Site Remedial Action Project, St. Charles, Missouri, April.

DOE (U.S. Department of Energy), 1990. *Baseline Risk Evaluation for Exposure to Bulk Wastes at the Weldon Spring Quarry, Weldon Spring, Missouri,* DOE/OR/21548-065, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

DOE (U.S. Department of Energy), 1992. *Baseline Assessment for the Chemical Plant Area of the Weldon Spring Site,* DOE/OR/21548-091, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, November.

DOE (U.S. Department of Energy), 1996. *Engineering Evaluation/Cost Analysis for the Proposed Removal at the Southeast Drainage near the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-584, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, August.

DOE (U.S. Department of Energy), 1997. *Baseline Risk Assessment for the Groundwater Operable Units at the Chemical Plant Area and the Ordnance Works Area, Weldon Spring, Missouri,* DOE/OR/21548-568, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 1998. *Baseline Risk Assessment for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri,* DOE/OR/21548-594, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, February.

DOE (U.S. Department of Energy), 2002. *Post-Remediation Risk Assessment for the Chemical Plant Operable Unit, Weldon Spring Site, St. Charles, Missouri,* Rev. 1, DOE/OR/21548-910, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, March.

U.S. Environmental Protection Agency (EPA), 1989a. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish,* EPA/444/4-89-001, Assessment and Watershed Protection Division, Office of Water, Washington, D.C., May.

EPA (U.S. Environmental Protection Agency), 1989b. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, (Part A)*, EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., December.

EPA (U.S. Environmental Protection Agency), 1989c. *Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual,* Interim Final, EPA/540/1-89/001, Office of Emergency and Remedial Response, Washington, D.C., March.

EPA (U.S. Environmental Protection Agency), 1990. "National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (40 CFR Part 300)," *Federal Register* 55(46):8666−8865, March 8.

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Appendix C

Disposal Cell Contents

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Table C−1. Contents of the Weldon Spring, Missouri, Disposal Cell

Work Zone Per WP437 and Material Description	Cell Placement Considerations	Occupied Cell Volume (cy)
Raffinate Pits Work Zone		
CSS Grout	Produced in CSS Plant and pumped to cell. Volume as determined at the plant.	188,443.00
Raffinate Pit 4 residual sludge	Stabilized in situ with grout then mixed with TSA aggregates. Conversion calculated assuming aggregates alone would not shrink and the mix ratio was 2.5 to 1.	2,530.00
Raffinate Pit 3 residual sludges	Mixed with > or = 3 parts contaminated soil. Conversion factor calculated assuming that soil alone will shrink with 0.965.	10,277.00
Raffinate Pit 3 soils	Conversion factor bank/fill for soils is 0.965.	52,365.73
Raffinate Pit 4 soils	Conversion for soils is 0.965.	65,649.92
Raffinate Pits 1 and 2 soils (some residual sludge mixed with the soils)	Conversion factor is 0.950.	58,197.95
Raffinate Pits metal debris	Mixed with soil in the cell. Conversion loose/fill for metal is 10 to 1.	21.00
Raffinate Pit 1 interceptor trench	North and east of Raffinate Pit 1. Estimated at 481 + 489 + 1894 = 3274 cy. Use 0.90 for conversion.	2,946.60
Trench for the 2 inch PVC line	Estimated at 133 cy. Use 0.900.	119.70
Entrance ramp in Raffinate Pits 1 and 2	Aggregate surface estimated at 100 cy. Use conversion of 1 to 1.	100.00
Raffinate Pit 3 overflow line and manhole	Estimated at 726 cy of soil. Use 0.900 conversion.	653.40
Intermediate dike in Raffinate Pit 4	Estimated at 8366 cy. Conversion is 0.965 to 1.	8,073.19
Interceptor trench east of Raffinate Pit 3	Estimated at 2198 cy. Conversion is 0.900 to 1.	1,978.20
Aggregate on SW corner of Raffinate Pit 4 dike	Estimated at 370 cy. Conversion is 0.900.	333.00
TSA Work Zone		
Soil stockpiles from Quarry cleanup	Used alone or in various mixes. Conversion factor for soils is 0.965.	99,332.28
Nitro soil pile, Quarry origin	Previously treated with cement/fly ash. Conversion factor for this mix is 1.00.	25,100.00
Soil pile NW of TSA	Created during excavations for SWTP basins and TSA construction (1992). Conversion factor is 0.965.	19,029.80
Rubble pile from Quarry cleanup	Conversion factor loose/fill is 0.900.	16,290.00
Metal stockpiles	Resulted from site demolitions. Conversion for metals is 10 to 1.	220.00
HEPA filters	From site demolitions. Entombed in concrete and soil under the CSS monolith. Volume includes concrete and soil.	452.00
B-25 boxes	Unreleasable content. Grouted with clean grout on a grout pad and under the CSS monolith. 36 boxes @ 5 cy each.	180.00
Containers, 20-cy each	Boxes with process pipe from site demolitions. Grouted with clean grout on a clean grout base, then entombed under the CSS monolith. 117 containers @ (20cy + 5cy base) = 2925 cy.	2,925.00
Filter cake from SWTP in 4-cy boxes	Total volume is 800 cy.	800.00
TSA facility (construction gravel and sand, liners)	Mostly mixed with Raffinate Pit 4 stabilized soil. Conversion factor assuming aggregates were placed alone is 1.0.	37,700.00
TSA in situ soil excavations	Conversion factor for these soils is 0.965.	26,540.40
TSA concrete transfer station	Estimated at 162 cy. Use 1.67 for bulking at placement.	270.54
TSA transfer station metal debris	Estimated at 30 cy. Use 10 to 1 conversion.	3.00

Table C−1 (continued). Contents of the Weldon Spring, Missouri, Disposal Cell

Work Zone Per WP437 and Material Description	Cell Placement Considerations	Occupied Cell Volume (cy)
TSA aggregates under transfer station	Estimated at 797 cy. Use 1 to 1 conversion.	797.00
TSA transfer station underlying soils	Estimated at 142 cy. Use 0.965 conversion.	137.03
TSA decontamination station concrete	Estimated at 125 cy. Use 1.67 for bulking in cell.	208.75
TSA various liners (basin, decontamination station, etc)	All liners (HDPE, geotextile) generated from the TSA were shredded and entombed in soil. Total occupied volume is below 50 cy. Use 50 cy.	50.00
Brine tanks from SWTP	Mixed with soil. Est. conversion factor is 0.430.	25.80
Contaminated Jersey barriers	27 each at 0.5 cy.	13.50
TSA equalization basin sediment	estimated at 1800 cy mixed with soil in the cell. Conversion factor is 0.43.	774.00
PCB contaminated concrete	200 cy. Conversion is .900 to 1.	180.00
PCB contaminated aggregates	Estimated at 108 cy. Conversion 1 to 1.	108.00
TSA scrap metal, wood and debris	Estimated at 430 cy. Conversion is 1 to 10.	43.00
20-cy rolloffs	Emptied in cell then crushed. Misc. materials estimated to 180 cy. Conversion is 1 to 5.	36.00
PMC stored equipment	Estimated at 50 cy. Entombed in CSS or soil. Conversion is .66 to 1.	33.00
Ash Pond Work Zone		
Soil stockpiled from cell foundation, including Ash Pond capping	From WP420 excavations. Factor bank to fill is 0.965.	437,310.98
Soil stockpiled from Raffinate Pit 4 excavations	Conversion factor is 0.965.	47,478.00
Soil stockpiled from VP−9 cleanup	Conversion factor is 0.80 due to presence of vegetation and roots.	2,680.00
Wood piles from site	Mixed with 3 parts of soil. Volumetric conversion factor is 0.50.	910.00
Rubble	from site foundations removal. Conversion factor is 0.900.	65,419.20
In-situ soils	Conversion factor is 0.965.	108,461.18
Buried rubble	Conversion 0.9.	292.50
Sediments in sedimentation basins	Mixed with several soil parts for drying. Conversion factor is 0.2.	785.00
Soil under DHO equipment parking area	Conversion is 0.965.	11,469.03
Nitro-contaminated soils	Estimated at 370 cy. Conversion is 1 to 1.	370.00
Root balls from VP−9	Estimated at 300 cy. Conversion is 1 to 0.5 because were mostly placed in CSS grout.	150.00
Various debris (concrete, bricks, rocks, gravel)	Estimated at 8185 cy. Conversion is 0.8 to 1.	6,548.00
Contaminated soil under cell footprint	Estimated at 8000 cy. Conversion is 0.965.	7,720.00
MSA Work Zone		
Structural metal piles	Entombment in soil. Conversion is 5 to 1 between loose and fill cy.	3,260.00
Shreddable metal piles	Same as above.	6,860.00
Aluminum piles	Same as above.	336.00
Copper piles	Entombed in CSS grout. Conversion assumes 30% of voids filled, thus a factor of 0.7 applies.	634.90
Window frames	Entombed in soil. Conversion is 5 to 1.	55.00
ACM siding bundles	Placed directly in cell.	650.00
Intact metal objects	Big pieces placed in CSS. Some void filling and crushing is assumed. Conversion loose to fill is 0.5.	1,660.00
Drums	Placed intact and crushed. Assume 0.5 of volume is reduced.	351.50

Table C−1 (continued). Contents of the Weldon Spring, Missouri, Disposal Cell

Work Zone Per WP437 and Material Description	Cell Placement Considerations	Occupied Cell Volume (cy)
Sling bags with cemented filter cake and brine from SWTP	Placed to block CSS flow. Bulking of 10% assumed due to uneven voids when placed.	715.00
13 cy roll-off containers	Content emptied in the cell and grouted or covered with soil. Assume 50% voids filled with soil.	338.00
4-cy roll-off containers	Entombed in CSS grout. Add 1 cy per box for the clean grout base. 36 boxes @ 5cy = 180 cy.	180.00
20-cy roll-off containers	Contents placed in the cell. Assume 50% voids filled with soil or compacted.	1,670.00
PCB contaminated concrete	Placed near or within CSS monolith. Assume voids remain as in the stockpile.	500.00
MSA trash and rubble	Estimated at 700 cy. Conversion is 1 to 5.	140.00
Transite pipe	Crushed and entombed in soil. Assume reduction of 5 to 1.	166.00
MSA pad and facility	Assumed factor of 1.0 in-situ to placed in the cell.	14,800.00
MSA in situ soils	Conversion factor in-situ to placed in the cell is 0.965.	4,855.88
Frog Pond Work Zone		
Frog Pond in situ soils	Conversion is 0.965.	15,721.78
Sediments	Conversion after mixing with soil is 1 to 0.43.	2,290.61
Soil under the sediments	Conversion is 0.965.	2,068.00
Frog Pond outlet	Estimated at 473 cy. Conversion is 1 to 1.	473.00
SWTP and 434 Work Zones		
Soil excavated in this work zone	Conversion is 0.965.	7,047.40
Sediments	Conversion is 1 to 0.43.	206.40
Boxes	Content mixed with soil. Conversion is 1 to 0.43.	87.72
SWTP foundations	Estimated at 582 cy. Bulking factor of 1.67.	971.94
SWTP debris	Estimated at 220 cy. Use 0.2 conversion factor.	44.00
SWTP liners	Total of 175,000 sq. ft HDPE, 43,000 sq. ft geonet and 43,000 GCL. Shredded and entombed in soil. Estimated total volume is approximately 500 cy.	500.00
Building 434 foundations	Estimated at 635 cy concrete. Conversion factor for bulking is 1.67.	1,060.45
CSS Plant Work Zone		
CSS pilot plant concrete debris	Estimated at 222 cy Conversion is 1 to 1.	222.00
CSS pilot plant metal debris	Estimated at 100 loose cy. Conversion is 10:1.	10.00
Road at the CSS Pilot plant	Estimated at 500 cy aggregates. Conversion is 1 to 1.	500.00
CSS Plant metal debris	Estimated at 3700 cy. Due to size and volume, placement requirements are as for the MSA metal. Conversion loose to fill is 5 to 1.	740.00
CSS Plant concrete debris	Estimated at 676 cy. Conversion is 1 to 1.	676.00
Contaminated aggregate under the CSS Plant	Per estimates. Conversion is 1 to 1.	1,686.00
in situ contaminated soils in this area	Conversion is 0.965.	3,638.05
Administration Area Work Zone		
Concrete foundations (decontamination pad and others)	Estimated at 100 cy. Conversion 1.67 to 1.	167.00
Storm sewer removal, metal, concrete and soil	Estimated at approximately 200 cy. Factor of conversion 1 to 1.	200.00

Table C−1 (continued). Contents of the Weldon Spring, Missouri, Disposal Cell

Work Zone Per WP437 and Material Description	Cell Placement Considerations	Occupied Cell Volume (cy)
ASA Work Zone		
In situ soils	Conversion is 0.965.	2,080.54
Aggregate pad	Estimated at 3009 cy.	3,009.00
Sea-Land containers	Emptied, covered with soil and demolished. Conversion is 1 to 1.	3,987.00
Misc. Contaminated Items		
Access road aggregate from DHO equipment staging area to north decontamination pad	Estimated at 300 cy. Conversion is 1 to 1.	300.00
Aggregate surface at north decontamination pad and DHO shop	Estimated at 1,700 cy. Conversion factor is 1 to 1.	1,700.00
Sediments in the DHO recirculation pond (north decontamination pad)	Estimated at 350 cy. Conversion factor is 1 to 2.27.	150.50
Liners, pipelines, soil around pipes at north DHO decontamination pad	Estimated at 150 cy. Conversion 1 to 0.8.	3,320.00
Concrete foundations at DHO north decontamination pad and shop	Estimated at 294 cy. Bulking factor is 1.67.	490.98
Debris at north DHO decontamination pad	Estimated at 150 cy. Conversion factor is 1 to 5.	30.00
Contaminated soils around north DHO decontamination pad	Estimated at 150 cy. conversion is 0.965.	144.75
Resurfacing of contaminated haul roads	Estimated at 4,489 cy. Conversion is 1 to 1.	4,489.00
DHO equipment staging area	Estimated at 2,900 cy aggregates. Conversion is 1 to 1.	2,900.00
SWTP filter cake boxes directly to cell	129 4-cy boxes = 496 cy. Conversion is 1 to 0.43.	213.28
Sling bags	48 bags.	48.00
SWTP brine as grout pumped placed in the cell	3,697.5 cy. Conversion is 1 to 1.	3,698.00
General hot spots on Chemical Plant site	1,2098 cy. Conversion is 0.965.	11,674.57
Sediments from CMSA basin	4,617 cy. Conversion factor is 0.43.	1,985.31
Clean Items Used In Cell Waste Containment Area		
6-inch soil cushion on the upper 3:1 slope	Per design, 4,600 cy.	4,600.00
Rock on the CSS haul routes inside the cell	As built, 4,950 cy.	4,950.00
Pads for pumps between Phase 1 and 2	As built, 60 cy.	60.00
Erosion berms on the LCRS sand	As built, 30 cy.	30.00
Separation berm Phase 1 from Phase 2	As built, 3,160 cy.	3,160.00
North low-permeability berm	As built, 140 cy.	140.00
East rebuilt Penetration	As built, 50 cy.	50.00
Gravel on west entrance berm	As built, 1,200 cy.	1,200.00
Overbuilt within tolerances on the LCRS sand layer	As built, 2,600 cy.	2,600.00
Select soil waste built of clean common fill	1,020 cy. Used in covering the cell dimple = 1,150 cy.	2,270.00
Peat used for the geochemical barrier	Per purchase and 1/4 mix ratio with soil.	9,295.00
Army Waste		
Waste from army property	As received, 26,220 cy. Conversion is 0.9.	23,598.00
Wastes in the Cell Dimple		
Quarry geonet	Entombed in clean grout.	175.00
Quarry Water Treatment Plant tanks and metal debris	Entombed in clean grout.	570.00
Quarry HDPE liners	Entombed in clean grout.	30.00
Quarry soils, sediments, filter and media	Placed and compacted in the cell dimple.	1,875.00

Table C−1 (continued). Contents of the Weldon Spring, Missouri, Disposal Cell

Work Zone Per WP437 and Material Description	Cell Placement Considerations	Occupied Cell Volume (cy)
Quarry concrete debris	Placed and compacted in the cell dimple.	304.00
Quarry wood and railroad ties	Placed and compacted in the cell dimple.	20.00
Admin. Area asphalt and metal debris	Placed and compacted in the cell dimple.	310.00
Various trash generated on site	Placed and compacted in the cell dimple.	70.00
Admin. Area concrete debris	Placed and compacted in the cell dimple.	77.00
Waste from army property	Placed and compacted in the cell dimple.	50.00

Key:
ACM = asbestos containing material
ASA = asbestos storage area
CMSA = construction material staging area
CSS = chemical stabilization/solidification
cy = cubic yard(s)
DHO = direct hire organization
GCL = geosynthetic clay liner
HEPA = high-efficiency particulate air
LCRS = leachate collection and removal system
PCB = polychlorinated biphenyls
MSA = material staging area
PMC = Project Management Contractor
SWTP = site water treatment plant
TSA = temporary storage area
WP = work package
VP = vicinity property

Table C−2. Weldon Spring Site Disposal Cell Total Activity Final Estimate

Waste Stream[a]	Volume (cy)	Mass (g)[c]	Radiological Profile[d]	Nuclide Activity (Ci)[e]									Total Activity (Ci)	% of Total (if > 1%)
				U-238	U-234	U-235	Th-228	Th-230	Th-232	Ra-226	Ra-228	Rn-222[f]		
Raffinate Pits Work Zone														
Raffinate processed through CSS Plant[b]	159990	1.49E+11	Raffinate	6.12E+01	6.12E+01	2.84E+00	8.95E+00	4.03E+03	4.78E+01	1.25E+02	9.10E+00	1.47E+02	4.49E+03	68.44%
Pit 4 residual sludge	2530	2.36E+09	Raffinate	9.68E-01	9.68E-01	4.48E-02	1.42E-01	6.37E+01	7.55E-01	1.98E+00	1.44E-01	2.33E+00	7.11E+01	1.08%
Pit 3 residual sludge	10277	9.59E+09	Raffinate	3.93E+00	3.93E+00	1.82E-01	5.75E-01	2.59E+02	3.07E+00	8.05E+00	5.85E-01	9.47E+00	2.89E+02	4.40%
Pit 3 soil	52366	6.74E+10	Raffinate pit soils	2.76E+00	2.76E+00	1.35E-01	4.04E-01	1.82E+02	2.16E+00	5.66E+00	4.11E-01	6.66E+00	2.03E+02	3.09%
Pit 4 soil	65650	8.45E+10	Raffinate pit soils	3.46E+00	3.46E+00	1.69E-01	5.07E-01	2.28E+02	2.70E+00	7.10E+00	5.15E-01	8.35E+00	2.54E+02	3.88%
Pits 1 & 2 soil	58198	7.49E+10	Raffinate pit soils	3.07E+00	3.07E+00	1.50E-01	4.49E-01	2.02E+02	2.40E+00	6.29E+00	4.57E-01	7.40E+00	2.26E+02	3.44%
Pit 1 Interceptor Trench	2947	3.79E+09	Site soils	3.94E-01	3.89E-01	2.20E-02	1.67E-02	4.13E-02	4.25E-02	1.86E-02	1.52E-02	1.86E-02	9.58E-01	
Pit 3 Overflow & Manhole	653	8.40E+08	Site soils	8.72E-02	8.62E-02	4.87E-03	3.70E-03	9.16E-03	9.41E-03	4.12E-03	3.36E-03	4.12E-03	2.12E-01	
Pit 4 Intermediate Dike	8073	1.04E+10	Site soils	1.08E+00	1.07E+00	6.03E-02	4.57E-02	1.13E-01	1.16E-01	5.09E-02	4.16E-02	5.09E-02	2.62E+00	
Interceptor Trench east of Pit 3	1978	2.55E+09	Site soils	2.64E-01	2.61E-01	1.48E-02	1.12E-02	2.77E-02	2.85E-02	1.25E-02	1.02E-02	1.25E-02	6.43E-01	
TSA Work Zone														
Quarry soils stockpiles	99332	1.28E+11	TSA bulk waste	2.53E+01	2.53E+01	1.16E+00	1.23E+01	4.19E+01	3.29E+00	1.39E+01	1.23E+01	1.39E+01	1.50E+02	2.28%
Nitro soils pile	25100	3.23E+10	TSA bulk waste	6.40E+00	6.40E+00	2.94E-01	3.11E+00	1.06E+01	8.30E-01	3.52E+00	3.11E+00	3.52E+00	3.78E+01	
B-25 boxes	180	2.32E+08	TSA non-filter cake	7.41E-01	7.41E-01	3.48E-02	2.23E-02	5.33E+00	1.99E+01	2.50E-02	2.23E-02	2.50E-02	2.69E+01	
20 cy rolloffs	2925	3.76E+09	TSA non-filter cake	1.20E+01	1.20E+01	5.65E-01	3.63E-01	8.66E+01	3.24E+02	4.07E-01	3.63E-01	4.07E-01	4.37E+02	6.65%
SWTP filter cake	800	7.65E+08	TSA filter cake	1.19E+00	1.19E+00	5.58E-02	6.12E-04	4.48E-02	8.72E-03	4.82E-03	4.05E-03	4.82E-12	2.50E+00	
TSA in-situ soil	26540	3.42E+10	Site soils	3.55E+00	3.50E+00	1.98E-01	1.50E-01	3.72E-01	3.83E-01	1.67E-01	1.37E-01	1.67E-01	8.63E+00	
TSA Transfer Station underlying soil	137	1.76E+08	Site soils	1.83E-02	1.81E-02	1.02E-03	7.76E-04	1.92E-03	1.97E-03	8.64E-04	7.05E-04	8.64E-04	4.45E-02	
TSA Equalization Basin sediment	774	9.96E+08	Site soils	1.03E-01	1.02E-01	5.78E-03	4.38E-03	1.09E-02	1.12E-02	4.88E-03	3.98E-03	4.88E-03	2.52E-01	
Ash Pond Work Zone														
Soil stockpile	426737	5.49E+11	Site soils	5.70E+01	5.64E+01	3.19E+00	2.42E+00	5.99E+00	6.15E+00	2.69E+00	2.20E+00	2.69E+00	1.39E+02	2.11%
Vicinity Properties	10575	1.36E+10	Site soils	1.41E+00	1.40E+00	7.89E-02	5.99E-02	1.48E-01	1.52E-01	6.67E-02	5.44E-02	6.67E-02	3.44E+00	
Soils stockpiled from Pit 4 excavations	47478	6.11E+10	Site soils	6.34E+00	6.27E+00	3.54E-01	2.69E-01	6.66E-01	6.84E-01	2.99E-01	2.44E-01	2.99E-01	1.54E+01	
Soils from VP 9 cleanup	2680	3.45E+09	Site soils	3.58E-01	3.54E-01	2.00E-02	1.52E-02	3.76E-02	3.86E-02	1.69E-02	1.38E-02	1.69E-02	8.71E-01	
In-situ soil	108461	1.40E+11	Site soils	1.45E+01	1.43E+01	8.10E-01	6.14E-01	1.52E+00	1.56E+00	6.84E-01	5.58E-01	6.84E-01	3.52E+01	
Sedimentation basin sediments	785	1.01E+09	Site soils	1.05E-01	1.04E-01	5.86E-03	4.45E-03	1.10E-02	1.13E-02	4.95E-03	4.04E-03	4.95E-03	2.55E-01	
Soil under DHO equip parking area	11469	1.48E+10	Site soils	1.53E+00	1.51E+00	8.56E-02	6.50E-02	1.61E-01	1.65E-01	7.23E-02	5.90E-02	7.23E-02	3.73E+00	
Nitro soils	370	4.76E+08	Site soils	4.94E-02	4.89E-02	2.76E-03	2.10E-03	5.19E-03	5.33E-03	2.33E-03	1.90E-03	2.33E-03	1.20E-01	
Soil under cell footprint	7720	9.94E+09	Site soils	1.03E+00	1.02E+00	5.76E-02	4.37E-02	1.08E-01	1.11E-01	4.87E-02	3.97E-02	4.87E-02	2.51E+00	
MSA Work Zone														
SWTP filter cake	715	6.83E+08	MSA filter cake	6.18E+01	6.18E+01	2.84E+00	2.88E-03	4.00E-02	7.79E-03	1.20E-01	4.44E-02	1.20E-01	1.27E+02	1.93%
13 cy rolloffs	338	4.35E+08	MSA containerized waste	2.28E+00	8.61E-02	5.66E-03	1.31E-03	6.96E-03	1.22E-02	1.31E-03	0	1.31E-03	2.39E+00	
4 cy rolloffs	180	2.32E+08	MSA containerized waste	1.21E+00	4.59E-02	3.01E-03	6.95E-04	3.71E-03	6.49E-03	6.95E-04	0	6.95E-04	1.28E+00	
20 cy rolloffs	1670	2.15E+09	MSA containerized waste	1.13E+01	4.26E-01	2.79E-02	6.45E-03	3.44E-02	6.02E-02	6.45E-03	0	6.45E-03	1.18E+01	
Drums	352	4.53E+08	MSA containerized waste	2.37E+00	8.97E-02	5.89E-03	1.36E-03	7.25E-03	1.27E-02	1.36E-03	0	1.36E-03	2.49E+00	
Waste Piles	13622	NA	MSA waste piles	6.16E-02	6.16E-02	2.89E-03	0	0	0	0	0	0	1.26E-01	
MSA in-situ soil	4856	6.25E+09		6.49E-01	6.41E-01	3.63E-02	2.75E-02	6.81E-02	7.00E-02	3.06E-02	2.50E-02	3.06E-02	1.58E+00	

Table C−2 (continued). Weldon Spring Site Disposal Cell Total Activity Final Estimate

Frog Pond Work Zone													
In-situ soil	15722	2.02E+10	Site soils	2.10E+00	2.08E+00	1.17E-01	8.90E-02	2.21E-01	2.27E-01	9.92E-02	8.09E-02	9.92E-02	5.11E+00
Sediments	2291	2.95E+09	Site soils	3.06E-01	3.03E-01	1.71E-02	1.30E-02	3.21E-02	3.30E-02	1.44E-02	1.18E-02	1.44E-02	7.45E-01
Soil under sediments	2068	2.66E+09	Site soils	2.76E-01	2.73E-01	1.54E-02	1.17E-02	2.90E-02	2.98E-02	1.30E-02	1.06E-02	1.30E-02	6.72E-01
Frog Pond Outlet	473	6.09E+08	Site soils	6.32E-02	6.25E-02	3.53E-03	2.68E-03	6.64E-03	6.82E-03	2.98E-03	2.44E-03	2.98E-03	1.54E-01
SWTP & Bldg 434 Work Zones													
Soil excavated from these zones	7047	9.07E+09	Site soils	9.41E-01	9.31E-01	5.26E-02	3.99E-02	9.89E-02	1.02E-01	4.44E-02	3.63E-02	4.44E-02	2.29E+00
Sediments - Train 1	155	1.99E+08	Site soils	2.07E-02	2.05E-02	1.16E-03	8.78E-04	2.17E-03	2.23E-03	9.78E-04	7.98E-04	9.78E-04	5.04E-02
Sediments - Train 2	52	6.69E+07	Site soils	6.95E-03	6.87E-03	3.88E-04	2.94E-04	7.30E-04	7.50E-04	3.28E-04	2.68E-04	3.28E-04	1.69E-02
CSS Plant Work Zone													
In-situ soil	3638	4.68E+09	Site soils	4.86E-01	4.80E-01	2.72E-02	2.06E-02	5.10E-02	5.24E-02	2.29E-02	1.87E-02	2.29E-02	1.18E+00
ASA Work Zone													
In-situ soil	2081	2.68E+09	Site soils	2.78E-01	2.75E-01	1.55E-02	1.18E-02	2.92E-02	3.00E-02	1.31E-02	1.07E-02	1.31E-02	6.76E-01
Miscellaneous													
DHO decon pad recirculation pond	150	1.93E+08	Site soils	2.00E-02	1.98E-02	1.12E-03	8.49E-04	2.10E-03	2.16E-03	9.46E-04	7.72E-04	9.46E-04	4.87E-02
Soils around DHO decon pad	145	1.87E+08	Site soils	1.94E-02	1.91E-02	1.08E-03	8.21E-04	2.03E-03	2.09E-03	9.14E-04	7.47E-04	9.14E-04	4.71E-02
SWTP filter cake	213	2.74E+08	Site soils	2.85E-02	2.81E-02	1.59E-03	1.21E-03	2.99E-03	3.07E-03	1.34E-03	1.10E-03	1.34E-03	6.92E-02
Hot spots	11675	1.50E+10	Site soils	1.56E+00	1.54E+00	8.72E-02	6.61E-02	1.64E-01	1.68E-01	7.36E-02	6.01E-02	7.36E-02	3.79E+00
CMSA basin sediments	1985	2.55E+09	Site soils	2.65E-01	2.62E-01	1.48E-02	1.12E-02	2.78E-02	2.86E-02	1.25E-02	1.02E-02	1.25E-02	6.45E-01
Cell Dimple Items													
Quarry soils, sediments, filter & media	1875	2.41E+09	Site soils	2.50E-01	2.48E-01	1.40E-02	1.06E-02	2.63E-02	2.70E-02	1.18E-02	9.65E-03	1.18E-02	6.09E-01
Totals	1206028			2.95E+02	2.78E+02	1.38E+01	3.09E+01	5.12E+03	4.17E+02	1.77E+02	3.08E+01	2.04E+02	6.57E+03
% of Total				4.5%	4.2%	0.2%	0.5%	78.0%	6.4%	2.7%	0.5%	3.1%	
								Summed for All Listed Nuclides = 6,57E+03 Ci					

Notes:
[a]Waste streams with < 0.01 Ci not included.
[b]Source: *Chemical Plant Operable Unit Remedial Action Report* (DOE/OR/21548-909) Rev. A, September 2002, p. 13.
[c]mass (g) = volume (cy) x density (g/cy). See Density Calculations worksheet for raffinate, soil, and filter cake density calculations.
[d]See Radiological Profiles worksheet.
[e]Nuclide Activity (Ci) = mass (g) x Nuclide Activity Concentration (pCi/g) [from Radiological Profiles worksheet] x (1E-12 Ci/pCi).
[f]Rn-222 assumed to be in equilibrium with Ra-226 when Rn-222 concentration not reported in reference.

Table C−3. Contamination Profiles for the Various Waste Streams

Profile	Nuclide Activity Concentration (pCi/g)									Source
	U-238	U-234	U-235	Th-228	Th-230	Th-232	Ra-226	Ra-228	Rn-222[a]	
Site soils	103.8	5.8	102.6	4.4	10.9	11.2	4.9	4	4.9	Table C-4
TSA bulk waste	198	198	9.1	96.4	328	25.7	109	96.4	109	Ref. 1 Tbl 2-2
Raffinate[b,c]	410	410	19	60	27000	320	840	61	988	Ref. 1 Tbl 2-10
Raffinate pit soils[c,d]	41	41	2	6	2700	32	84	6.1	98.8	Ref. 1 Tbl 2-2 footnote (e)
MSA waste piles[c,e]	Total surficial activity = 0.126 Ci									Ref. 1 Tbl 2-15
MSA containerized waste	5239	198	13	3	16	28	3	0	3	Ref. 1 Tbl 2-16
MSA WTP filter cake	90420	90420	4159	4.22	58.6	11.4	175	65	175	Ref. 1 Tbl 2-17
TSA filter cake[2]	1563	1563	73	0.8	58.6	11.4	6.3	5.3	6.3	Ref. 2 Tbl 3-3
TSA non-filter cake containerized waste[2]	3200	3200	150	96.4	23000	86000	108.8	96.4	108.8	Ref. 2 Tbl 3-5

References:
1. *Hazard Categorization for the Disposal Cell* (DOE/OR/21548-579) Rev. 2, September 1997
2. *Interim Facility Safety Documentation for the Temporary Storage Area* (DOE/OR/21548-513) Rev. 3, December 1997

Notes:
[a]Rn-222 assumed to be in equilibrium with Ra-226 when Rn-222 concentration not reported in reference.
[b]This is raffinate concentrations, not grout (i.e. first column of Table 2-10).
[c]Reference provides either total U only, or U-238 only. Natural U ratios assumed to calculate isotopic i.e. U-238 = U-234 = total U/2.047, and U-235 = total U x (0.047/2.047).
[d]Raffinate pit soils activity is assumed to be equivalent to 10% of raffinate activity.
[e]MSA waste piles were building components surficially contaminated with uranium. Total (surficial) uranium activity is 0.126 Ci.

Table C−4. Site Soils Radiological Profile Calculation

Source[a]	Source Vol (cy)	Wtd Vol[b]	Activity Concentration (pCi/g)							
			U-238	U-235	U-234	Th-228	Th-230	Th-232	Ra-226	Ra-228
Imhoff Tank sludge Tbl 3-1	510	0.001972	843.0	35.9	831.1	5.6	26.0	5.2		
Weighted Activity (pCi/g)[c]			1.7	0.1	1.6	0.0	0.1	0.0		
Decon sump Tbl 3-2	56	0.000217	256.4	10.9	252.7					
Weighted Activity (pCi/g)[c]			0.1	0.0	0.1					
Bldg demo waste Tbl 3-3	73270	0.283327	250.0	15.0	246.0	2.7	25.7	28.0	3.4	
Weighted Activity (pCi/g)[c]			70.8	4.2	69.7	0.8	7.3	7.9	1.0	
Vicinity prop. soils Tbl 3-4	3640	0.014075	20.0	0.9	20.0	1.4	1.2	0.8	1.3	1.4
Weighted Activity (pCi/g)[c]			0.3	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Bldg found. soils Tbl 3-5	170000	0.657371	42.3	2.0	42.3	5.5	5.4	5.0	6.0	6.0
Weighted Activity (pCi/g)[c]			27.8	1.3	27.8	3.6	3.5	3.3	3.9	3.9
Bldg found. conc. Tbl 3-6	11130	0.043038	73.3	3.4	73.3					
Weighted Activity (pCi/g)[c]			3.2	0.1	3.2					
Total waste volume (cy)	258606									
Sum of Weighted Activities			103.8	5.8	102.6	4.4	10.9	11.2	4.9	4.0

Notes:
[a]From *Interim Facility Safety Documentation for the Ash Pond Storage Area* (DOE/OR/21548-551) Rev. 1, December 1996
[b]Weighted volume = source volume / total waste volume
[c]Weighted Activity = weighted volume x activity concentration

Table C−5. Density Calculations

From *Hazard Categorization for the Chemical Stabalization and Solidification Facility* (DOE/OR/21548-570) Rev. 4, November 1997:

1. Section 2.1, p. 4: maximum sludge concentration (i.e. dry sludge solids in water) in raffinate pits before dredging = 27%
2. Section 2.1, p. 5: density of dry sludge solids = 1.8148 g/cu cm

in-situ sludge density = [fractional sludge concentration x density of dry sludge solids] + [fractional water concentration x density of water]
= [0.27 x 1.8148] + [0.73 x 1.00]
= 1.22 g/cu cm

= 1.22 g/cu cm x [2.54 cm/(1/12) ft]^3 x (27 cf/cy)
= 932754 g/cy
76 lb/cf

From e-mail from Serban Grozescu to David Fleming dated 9-9-02, subject "sludge":

Soil density = 105 lb/cf
= 105 lb/cf x (454 g/lb) x (27 cf/cy)
= 1287090 g/cy

From *Interim Facility Safety Documentation for the Temporary Storage Area* (DOE/OR/21548-513) Rev. 3, December 1997, p. 10:

Density of filter cake = 1.25 g/cu cm
= 1.25 g/cu cm x [2.54 cm/(1/12) ft]^3 x (27 cf/cy)
= 955694 g/cy

Appendix D

Legal Descriptions and Ownership Information of Institutional Control Areas

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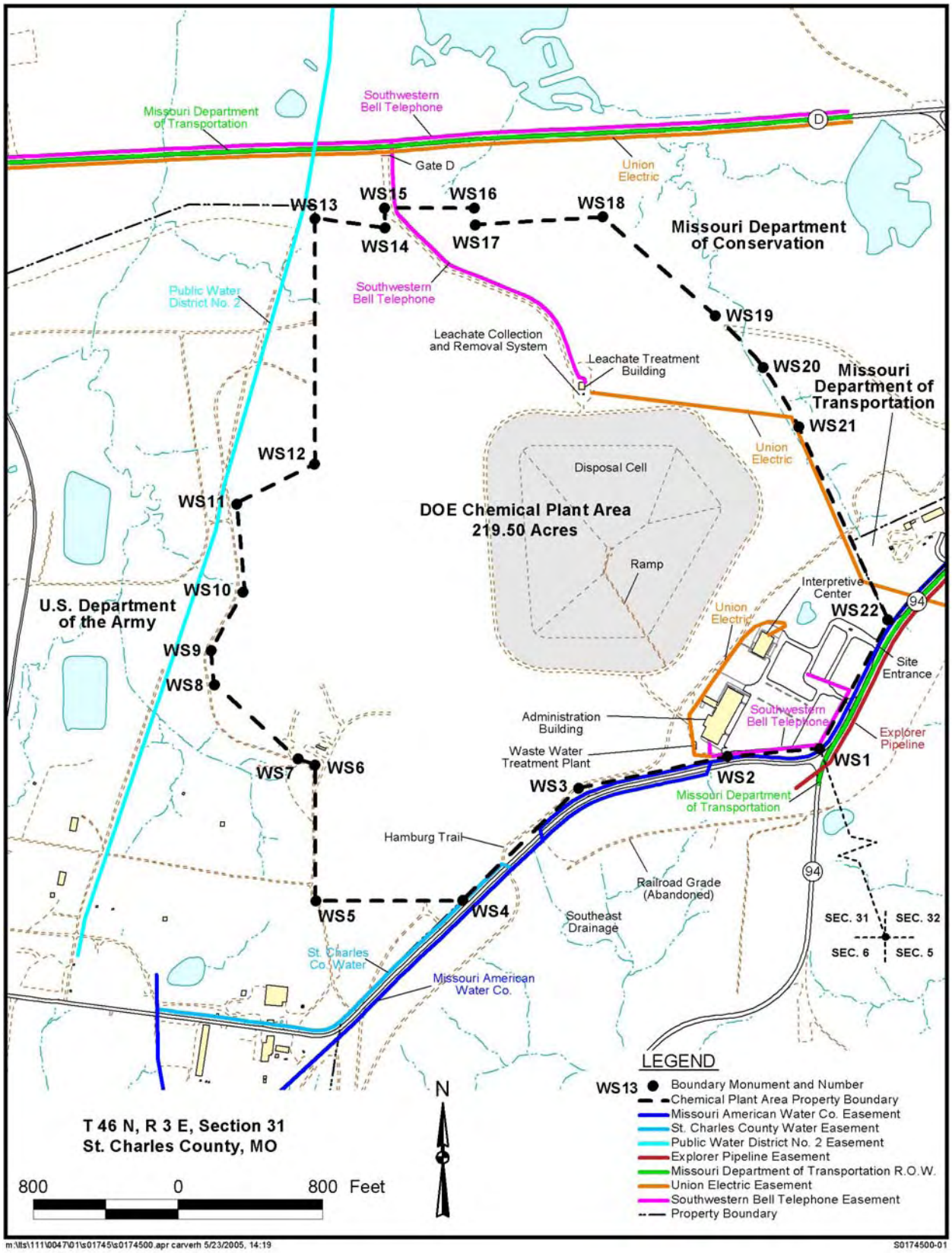

Figure D−1. DOE Property Boundary for the Chemical Plant Area

Legal Description for the Chemical Plant Area

All that parcel of land lying within St. Charles County, Missouri, comprising the Federal facility identified as the Weldon Spring Site Remedial Action Project, as shown on maps dated September 2002 prepared by St. Charles Engineering Surveying, Inc. and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Boundary Survey for WSSRAP Site.* The bearings and distances are based on the Missouri State Plane Coordinate System (NAD 83). Said parcel is more particularly described as follows:

Being a parcel of land lying within Section 31, Township 46 North, Range 3 East of the 5th Principal Meridian in St. Charles County, Missouri. Beginning at a point identified by concrete Monument WS 1 set at Missouri State Plane Coordinates N=1,042,054.0867 and E=756,224.5074, said point also being located North 29° 04' 06" West for a distance of 1789.86 feet from the southeast corner of Section 31; thence along the following bearings and distances:

South 84° 59' 43" West, 511.53 feet to set Monument WS 2,
South 77° 59' 16" West, 839.83 feet to set Monument WS 3,
South 45° 55' 46" West, 894.25 feet to set Monument WS 4,
South 89° 59' 22" West, 812.12 feet to set Monument WS 5,
North 00° 02' 16" East, 749.79 feet to set Monument WS 6,
North 70° 25' 08" West, 105.03 feet to set Monument WS 7,
North 48° 12' 56" West, 618.60 feet to set Monument WS 8,
North 04° 34' 10" West, 189.65 feet to set Monument WS 9,
North 29° 11' 22" East, 384.67 feet to set Monument WS 10,
North 05° 22' 06" West, 474.62 feet to a point that is offset 20 feet from set Monument WS 11,
North 63° 03' 07" East, 485.67 feet to set Monument WS 12,
North 00° 04' 28" West, 1,355.33 feet to set Monument WS 13,
South 81°55'03" East, 389.64 feet to set Monument WS 14,
North 00° 05' 38" West, 109.85 feet to set Monument WS 15,
North 89° 54' 31" East, 499.21 feet to set Monument WS 16,
South 00° 00' 02" East, 93.62 feet to set Monument WS 17,
North 86° 28' 56" East, 705.14 feet to set Monument WS 18,
South 48° 44' 32" East, 828.97 feet to set Monument WS 19,

Thence along a curve to the right having a radius of 1,862.61 feet with a chord bearing and distance of South 36° 47' 33" East, 771.35 feet for an arc length of 776.97 feet, passing set Monument WS 20, to set Monument WS 21; thence, South 24° 50' 33" East, 1171.92 feet to set Monument WS 22, South 28° 17' 16" West, 801.90 feet to the point of beginning and containing 219.50 acres, more or less.

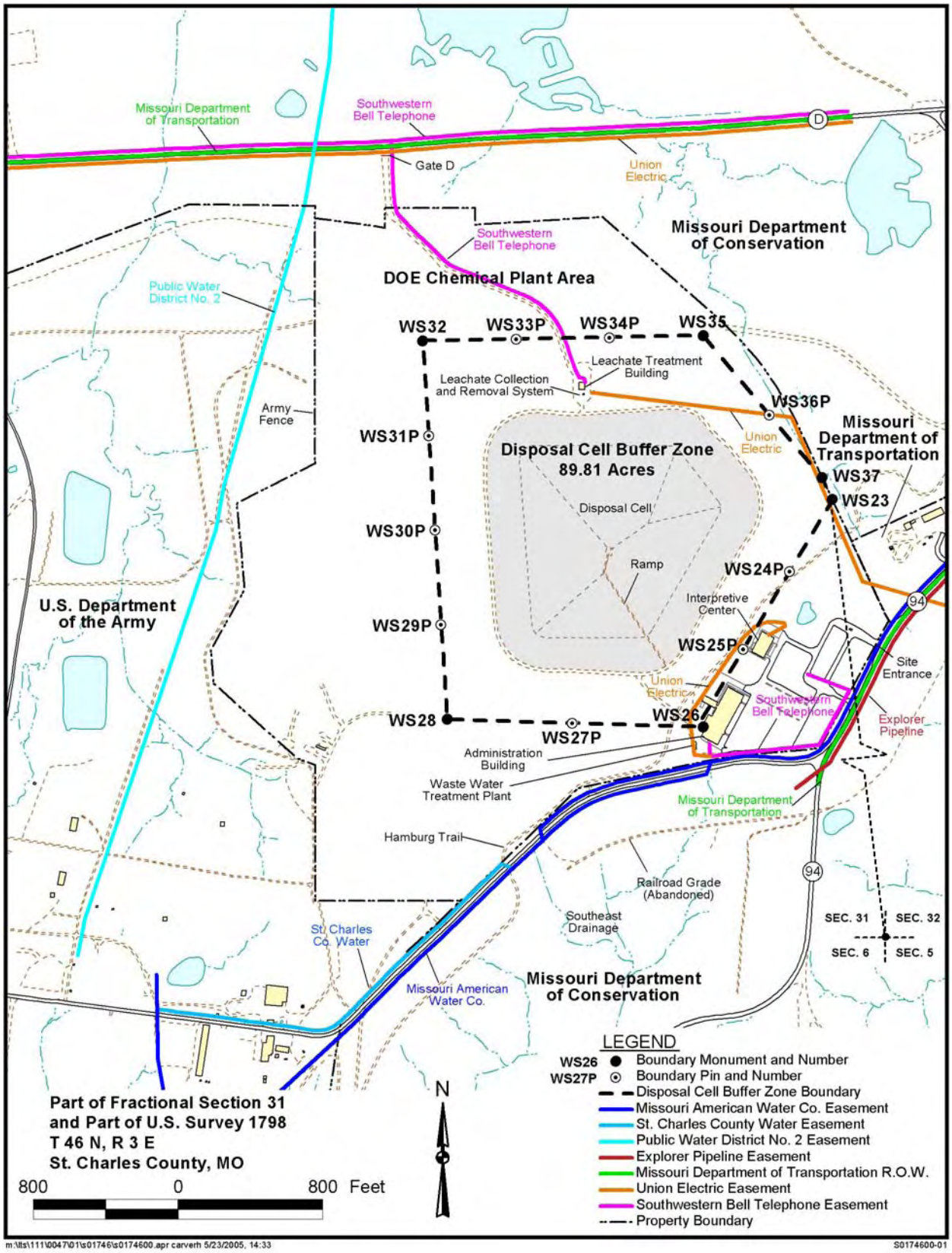

Figure D−2. Boundary for the Disposal Cell Buffer Zone

Legal Description for the Disposal Cell Buffer Zone

All that parcel of land located in part of Fractional Section 31 and part of U.S. Survey 1798, Township 46 North, Range 3 East, of the 5th Principal Meridian, St. Charles County, Missouri, as shown on a map dated May 2004, prepared by ABNA Engineering, Inc., and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Survey for 300-Foot Buffer Limits of Disposal Cell*, the basis of bearing being the Missouri State Plane Coordinate System of 1983—East Zone (adopting the 1993 adjustment values for first-order control points used), and being more particularly describes as follows:

Commencing at an aluminum disk marking the southeast corner of Section 31, Township 46 North, Range 3 East, of the 5th Principal Meridian, thence North 12° 52' 09" West a distance of 2,950.67 feet to set concrete Monument WS 23 having coordinates of N=1,043,428.02 and E=756,295.20, and being the point of beginning of the buffer limit of the disposal cell of the Weldon Spring Site. Thence along the following bearings and distances:

South 30° 44' 40" West, 462.46 feet to iron pipe WS 24P,
South 30° 44' 40" West, 499.04 feet to iron pipe WS 25P,
South 30° 44' 40" West, 498.13 feet to set monument WS 26, which bears South 88° 17' 31" East, 35.00 feet,
North 88° 17' 31" West, 689.97 feet to iron pipe WS 27P,
North 88° 17' 31" West, 690.00 feet to set Monument WS 28,
North 03° 43' 25" West, 523.66 feet to iron pipe WS 29P,
North 03° 43' 25" West, 523.66 feet to iron pipe WS 30P,
North 03° 43' 25" West, 523.67 feet to iron pipe WS 31P,
North 03° 43' 25" West, 523.65 feet to set Monument WS 32,
North 88° 58' 37" East, 516.13 feet to iron pipe WS 33P,
North 88° 58' 37" East, 516.14 feet to iron pipe WS 34P,
North 88° 58' 37" East, 516.13 feet to set Monument WS 35,
South 39° 59' 11" East, 569.72 feet to iron pipe WS 36P,
South 39° 59' 11" East, 454.14 feet to set Monument WS 37,
South 24° 48' 28" East, 132.23 feet to set Monument WS 23, being the point of beginning and containing 89.81 acres, more or less.

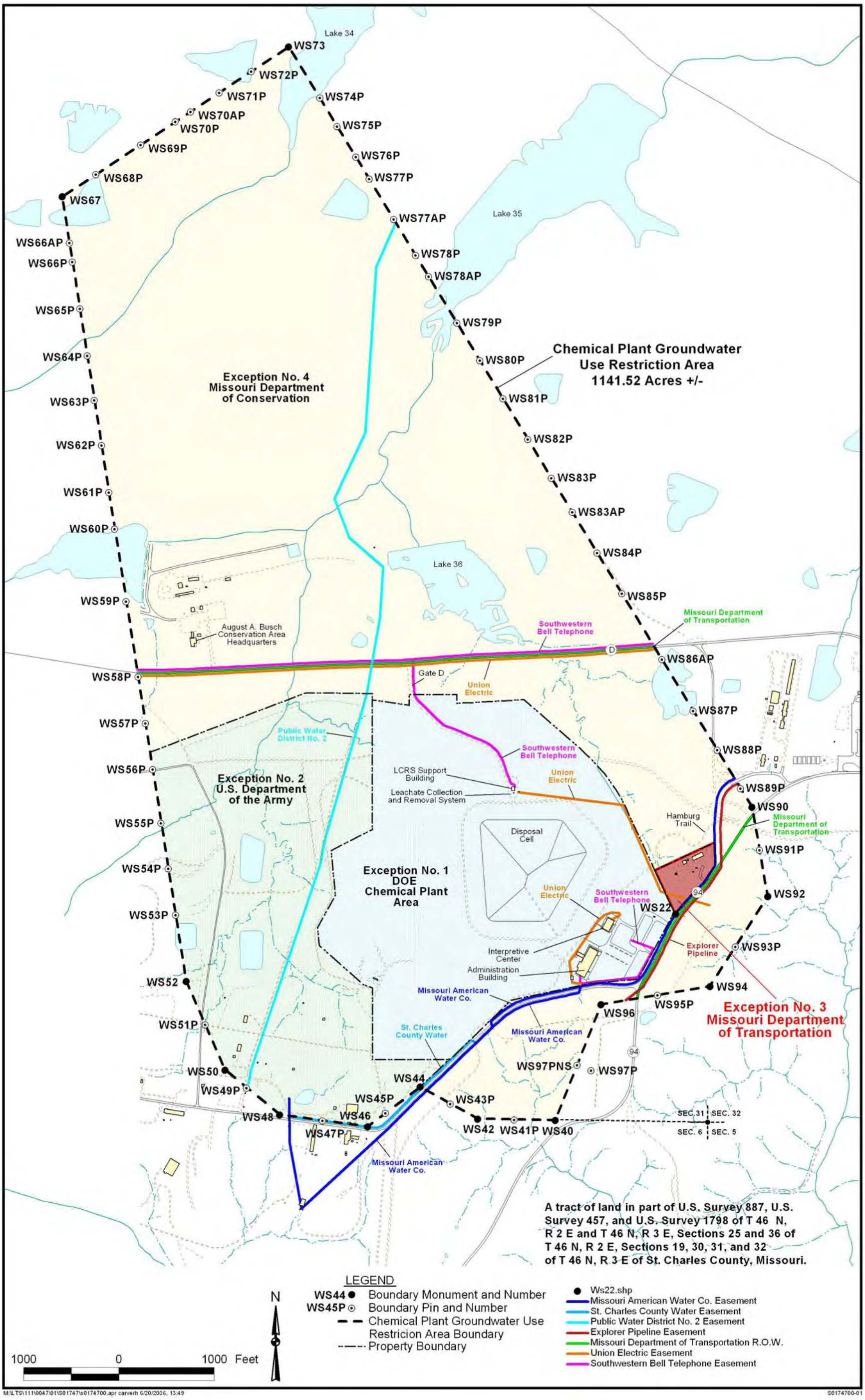

Figure D−3. Use Restriction Boundary for the Chemical Plant Groundwater Use Restriction Area

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Legal Description for the Chemical Plant Groundwater Use Restriction Area

A groundwater use restriction area, being in U.S. Survey 887, U.S. Survey 457, and U.S. Survey 1798 of Township 46 North, Range 2 East, and Township 46 North, Range 3 East; Sections 25 and 36, Township 46 North, Range 2 East; and Sections 19, 30, 31, and 32, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly describes as follows:

Commencing at an iron pin with aluminum cap, found to be the southeast corner of Section 31, Township 46 North, Range 3 East, St. Charles County, Missouri, state plane coordinates (NAD83, adjustment of 1993) N=317,161.314 m, E=230,720.511 m, recorded as Document No. 600-27639 and Index No. Z-5 with the Land Records Repository of the Land Survey Program of the Geological Survey and Resource Assessment Division of the Department of Natural Resources of the State of Missouri. Bearings contained herein are referenced to the Missouri State Plane Coordinate System; distances contained herein are grid distances; grid factor for the project is 0.999909366;

Thence, leaving the southeast corner of said Section 31, North 89° 09’ 34” West, a distance of 1,599.78 feet to a set concrete monument with an aluminum cap (WS 40), said point being the point of beginning of a herein described ground water use restriction area; thence, the following courses and distances:

North 88° 53’ 16” West, 427.44 feet to iron pin WS 41P,
North 88° 53’ 16” West, 384.00 feet to set Monument WS 42,
North 61° 04’ 10” West, 327.00 feet to iron pin WS 43P,
North 61° 04’ 10” West, 363.28 feet to set Monument WS 44,
South 53° 00’ 20” West, 454.35 feet to iron pin WS 45P,
South 53° 00’ 20” West, 233.47 feet to set Monument WS 46,
North 82° 26’ 24” West, 478.94 feet to iron pin WS 47P
North 82° 26’ 24” West, 451.86 feet to set Monument WS 48,
North 50° 52’ 03” West, 448.49 feet to iron pin WS 49P,
North 50° 52’ 03” West, 293.49 feet to set Monument WS 50,
North 23° 31’ 58” West, 519.51 feet to iron pin WS 51P,
North 23° 31’ 58” West, 495.37 feet to set Monument WS 52,
North 08° 59’ 03” West, 706.90 feet to iron pin WS 53P,
North 08° 59’ 03” West, 493.35 feet to iron pin WS 54P,
North 08° 59’ 03” West, 482.48 feet to iron pin WS 55P,
North 08° 59’ 03” West, 568.70 feet to iron pin WS 56P,
North 08° 59’ 03” West, 490.52 feet to iron pin WS 57P,
North 08° 59’ 03” West, 490.40 feet to iron pin WS 58P,
North 08° 59’ 03” West, 802.23 feet to iron pin WS 59P,
North 08° 59’ 03” West, 767.74 feet to iron pin WS 60P,
North 08° 59’ 03” West, 387.24 feet to iron pin WS 61P,
North 08° 59’ 03” West, 499.50 feet to iron pin WS 62P,
North 08° 59’ 03” West, 481.00 feet to iron pin WS 63P,
North 08° 59’ 03” West, 472.87 feet to iron pin WS 64P,
North 08° 59’ 03” West, 497.29 feet to iron pin WS 65P,
North 08° 59’ 03” West, 499.16 feet to iron pin WS 66P,
North 08° 59’ 03” West, 200.50 feet to iron pin WS 66AP,

North 08° 59’ 03” West, 488.76 feet to set Monument WS 67,
North 56° 29’ 12” East, 425.25 feet to iron pin WS 68P,
North 56° 29’ 12” East, 561.97 feet to iron pin WS 69P,
North 56° 29’ 12” East, 436.49 feet to iron pin WS 70P,
North 56° 29’ 12” East, 190.09 feet to iron pin WS 70AP,
North 56° 29’ 12” East, 361.68 feet to iron pin WS 71P,
North 56° 29’ 12” East, 403.91 feet to iron pin WS 72P,
North 56° 29’ 12” East, 468.84 feet to set Monument WS 73,
South 31° 22’ 09” East, 628.00 feet to iron pin WS 74P,
South 31° 22’ 09” East, 350.87 feet to iron pin WS 75P,
South 31° 22’ 09” East, 373.67 feet to iron pin WS 76P,
South 31° 22’ 09” East, 269.73 feet to iron pin WS 77P,
South 31° 22’ 09” East, 496.98 feet to iron pin WS 77AP,
South 31° 22’ 09” East, 440.41 feet to iron pin WS 78P,
South 31° 22’ 09” East, 260.24 feet to iron pin WS 78AP,
South 31° 22’ 09” East, 570.08 feet to iron pin WS 79P,
South 31° 22’ 09” East, 460.05 feet to iron pin WS 80P,
South 31° 22’ 09” East, 470.05 feet to iron pin WS 81P,
South 31° 22’ 09” East, 497.80 feet to iron pin WS 82P,
South 31° 22’ 09” East, 477.05 feet to iron pin WS 83P,
South 31° 22’ 09” East, 420.10 feet to iron pin WS 83AP,
South 31° 22’ 09” East, 499.55 feet to iron pin WS 84P,
South 31° 22’ 09” East, 499.36 feet to iron pin WS 85P,
South 31° 22’ 09” East, 805.66 feet to iron pin WS 86AP,
South 31° 22’ 09” East, 632.22 feet to iron pin WS 87P,
South 31° 22’ 09” East, 482.82 feet to iron pin WS 88P,
South 31° 22’ 09” East, 470.53 feet to iron pin WS 89P,
South 31° 22’ 09” East, 229.85 feet to set Monument WS 90,
South 09° 57’ 24” East, 456.66 feet to iron pin WS 91P,
South 09° 57’ 24” East, 495.04 feet to iron pin WS 92P,
South 32° 40’ 53” West, 625.07 feet to iron pin WS 93P,
South 32° 40’ 53” West, 497.15 feet to set Monument WS 94,
South 80° 40’ 16” West, 557.94 feet to iron pin WS 95P
South 80° 40’ 16” West, 600.00 feet to set Monument WS 96,
South 21° 35’ 27” West, 681.73 feet to iron pin WS 97PNS, a point from which bears iron pin WS 97P, South 68° 24’ 33” East, a distance of 158.91 feet.

Thence, leaving said point, South 21° 35’ 27” West, 625.93 feet back to the point of beginning, and containing 49,724,563 square feet, or 1,141.519 acres, more or less, according to field surveys and computations by Hanson Professional Services Inc., performed during the month of February 2004.

Chemical Plant Groundwater Use Restriction Area
Exception No. 1
DOE Chemical Plant

All that parcel of land lying within St. Charles County, Missouri, comprising the Federal facility identified as the Weldon Spring Site Remedial Action Project, as shown on maps dated

September 2002 prepared by St. Charles Engineering Surveying, Inc. and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Boundary Survey for WSSRAP Site.* The bearings and distances are based on the Missouri State Plane Coordinate System (NAD 83). Said parcel is more particularly described as follows:

Being a parcel of land lying within Section 31, Township 46 North, Range 3 East of the 5th Principal Meridian in St. Charles County, Missouri. Beginning at a point identified by concrete Monument WS 1 set at Missouri State Plane Coordinates N=1,042,054.0867 and E=756,224.5074, said point also being located North 29° 04' 06" West for a distance of 1789.86 feet from the southeast corner of Section 31; thence along the following bearings and distances:

South 84° 59' 43" West, 511.53 feet to set Monument WS 2,
South 77° 59' 16" West, 839.83 feet to set Monument WS 3,
South 45° 55' 46" West, 894.25 feet to set Monument WS 4,
South 89° 59' 22" West, 812.12 feet to set Monument WS 5,
North 00° 02' 16" East, 749.79 feet to set Monument WS 6,
North 70° 25' 08" West, 105.03 feet to set Monument WS 7,
North 48° 12' 56" West, 618.60 feet to set Monument WS 8,
North 04° 34' 10" West, 189.65 feet to set Monument WS 9,
North 29° 11' 22" East, 384.67 feet to set Monument WS 10,
North 05° 22' 06" West, 474.62 feet to a point that is offset 20 feet from set Monument WS 11,
North 63° 03' 07" East, 485.67 feet to set Monument WS 12,
North 00° 04' 28" West, 1,355.33 feet to set Monument WS 13,
South 81°55'03" East, 389.64 feet to set Monument WS 14,
North 00° 05' 38" West, 109.85 feet to set Monument WS 15,
North 89° 54' 31" East, 499.21 feet to set Monument WS 16,
South 00° 00' 02" East, 93.62 feet to set Monument WS 17,
North 86° 28' 56" East, 705.14 feet to set Monument WS 18,
South 48° 44' 32" East, 828.97 feet to set Monument WS 19,

Thence along a curve to the right having a radius of 1,862.61 feet with a chord bearing and distance of South 36° 47' 33" East, 771.35 feet for an arc length of 776.97 feet, passing set Monument WS 20, to set Monument WS 21; thence, South 24° 50' 33" East, 1171.92 feet to set Monument WS 22, South 28° 17' 16" West, 801.90 feet to the point of beginning and containing 219.50 acres, more or less.

Chemical Plant Groundwater Use Restriction Area
Exception No. 2
U.S. Department of the Army

Being in U.S. Survey 1798 of Township 46 North, Range 2 East and Township 46 North, Range 3 East; Section 36, Township 46 North, Range 2 East; Section 31, Township 46 North, Range 3 East; and Section 6, Township 45 North, Range 3 East of St. Charles County, Missouri and being more particularly described as follows:

Beginning at a concrete monument with a brass disk marked WS 44, Missouri State Plane Coordinates (NAD83, adjustment of 1993) N=1,040,926.55 and E=753,940.51, thence, the following courses and distances:

South 53° 00' 20" West, 454.35 feet to WS 45P,
South 53° 00' 20" West, 233.47 feet to WS 46,
North 82° 26' 24" West, 478.94 feet to WS 47P,
North 82° 26' 24" West, 451.86 feet to WS 48,
North 50° 52' 03" West, 448.49 feet to WS 49P,
North 50° 52' 03" West, 293.49 feet to WS 50,
North 23° 31' 58" West, 519.51 feet to WS 51P,
North 23° 31' 58" West, 495.37 feet to WS 52,
North 08° 59' 03" West, 706.90 feet to WS 53P,
North 08° 59' 03" West, 493.35 feet to WS 54P,
North 08° 59' 03" West, 482.48 feet to WS 55P,
North 08° 59' 03" West, 568.70 feet to WS 56P,
North 08° 59' 03" West, 194.93 feet to a point in fence line,
North 70° 23' 55" East, 1,854.01 feet to fence corner,
South 87° 57' 05" East, 585.24 feet to fence corner,
South 00° 15' 05" East, 84.30 feet to WS 13,
South 00° 04' 28" East, 1,355.33 feet to WS 12,
South 63° 03' 07" West, 485.67 feet to WS 11,
South 05° 22 '06" East, 474.62 feet to WS 10,
South 29° 11' 22" West, 384.67 feet to WS 9,
South 04° 34' 10"East, 189.65 feet to WS 8,
South 48° 12' 56" East, 618.60 feet to WS 7,
South 70° 25' 08" East, 105.03 feet to WS 6,
South 00° 02' 16" West, 749.79 feet to WS 5,
North 89° 59' 22" East, 812.12 feet to WS 4,
South 47° 19' 10" West, 427.22 feet back to the point of beginning, and containing 183.46 acres more or less.

Chemical Plant Groundwater Use Restriction Area
Exception No. 3
Missouri Department of Transportation

Being in Section 31, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows:

Beginning at a concrete monument with a brass disk marked WS 22, Missouri State Plane Coordinates (NAD83, adjustment of 1993) N=1,042,764.7573 and E=756,602.4254; thence North 25° 50' West 465.4 feet to a point (the western most point of said property described in Deed Book 314, Page 439 in the St. Charles County, Missouri, Recorder's Office); thence North 65° 10' East 615.78 feet to a point in the west right-of-way line of Missouri State Highway 94; thence South 0° 40' West 111.67 feet to a curve right, radius 438.34 feet; thence along curve 360.8 feet to a tangent; thence South 43° 58' West 178.5 feet to a curve left, radius 1,82.14 feet;

thence along curve 182.9 feet back to the point of beginning, and containing 4.3 acres more or less.

Chemical Plant Groundwater Use Restriction Area
Exception No. 4
Missouri Department Of Conservation

Being in U.S. Survey 887, U.S. Survey 453, and U.S. Survey 1798 of Township 46 North, Range 2 East and Township 46 North, Range 3 East; Sections 25 and 36, Township 46 North, Range 2 East; and Sections 19, 30, 31 and 32, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows:

Beginning at a concrete monument with a brass disk marked WS 40, Missouri State Plane Coordinates (NAD83, adjustment of 1993) N=1,040,576.88 and E=755,355.94, thence, the following courses and distances:

North 88° 53’ 16” West, 427.44 feet to WS 41P,
North 88° 53’ 16” West, 384.00 feet to WS 42,
North 61° 04’ 10” West, 327.00 feet to WS 43P,
North 61° 04’ 10” West, 363.28 feet to WS 44,
North 47° 19’ 10” East, 427.22 feet to WS 4,
North 45° 55’ 46” East, 894.25 feet to WS 3,
North 77° 59’ 16” East, 839.83 feet to WS 2,
North 84° 59’ 43” East, 511.53 feet to WS 1,
North 28° 17’ 16” East, 801.90 feet to WS 22 which is on the west right-of-way line of Missouri State Route 94, thence, in a northeasterly direction along said right-of-way to a point, thence,
South 65° 09’ 37” West, 612.41 feet to a point, thence,
North 24° 50’ 33” West, 708.57 feet to WS 21, thence, along a curve having a radius of 1,862.61 feet with a chord bearing and distance of north 36° 47’ 33” West, 771.35 feet for an arc distance of 776.97 feet to WS 19, thence,
North 48° 44’ 32” West, 828.97 feet to WS 18,
South 86° 28’ 56” West, 705.14 feet to WS 17,
North 00° 00’ 02” West, 93.62 feet to WS 16,
South 89° 54’ 31” West, 499.21 feet to WS 15,
South 00° 05’ 38” East, 109.85 feet to WS 14,
North 81° 55’ 03” West, 389.64 feet to WS 13,
North 00° 15’ 05” West, 84.30 feet to a fence corner,
North 87° 57’ 05” West, 585.24 feet to a fence corner,
South 70° 23’ 55” West, 1,854.01 feet to point in a fence line,
North 08° 59’ 03” West, 295.59 feet to WS 57P,
North 08° 59’ 03” West, 490.40 feet to WS 58P,
North 08° 59 ’03” West, 802.23 feet to WS 59P,
North 08° 59’ 03” West, 767.74 feet to WS 60P,
North 08° 59’ 03” West, 387.24 feet to WS 61P,
North 08° 59’03” West, 499.50 feet to WS 62P,

North 08° 59’ 03” West, 481.00 feet to WS 63P,
North 08° 59’ 03” West, 472.87 feet to WS 64P,
North 08° 59’ 03” West, 497.29 feet to WS 65P,
North 08° 59’ 03” West, 499.16 feet to WS 66P,
North 08° 59’ 03” West, 200.50 feet to WS 66AP,
North 08° 59’ 03” West, 488.76 feet to WS 67,
North 56° 29’ 12” East, 425.25 feet to WS 68P,
North 56° 29’ 12” East, 561.97 feet to WS 69P,
North 56° 29’ 12” East, 436.49 feet to WS 70P,
North 56° 29’ 12” East, 190.09 feet to WS 70AP,
North 56° 29’ 12” East, 361.68 feet to WS 71P,
North 56° 29’ 12” East, 403.91 feet to WS 72P,
North 56° 29’ 12” East, 468.84 feet to WS 73,
South 31° 22’ 09” East, 628.00 feet to WS 74P,
South 31° 22’ 09” East, 350.87 feet to WS 75P,
South 31° 22’ 09” East, 373.67 feet to WS 76P,
South 31° 22’ 09” East, 269.73 feet to WS 77P,
South 31° 22’ 09” East, 496.98 feet to WS 77AP,
South 31° 22’ 09” East, 440.41 feet to WS 78P,
South 31° 22’ 09” East, 260.24 feet to WS 78AP,
South 31° 22’ 09” East, 570.08 feet to WS 79P,
South 31° 22’ 09” East, 460.05 feet to WS 80P,
South 31° 22’ 09” East, 470.05 feet to WS 81P,
South 31° 22’ 09” East, 497.80 feet to WS 82P,
South 31° 22’ 09” East, 477.05 feet to WS 83P,
South 31° 22’ 09” East, 420.10 feet to WS 83AP,
South 31° 22’ 09” East, 499.55 feet to WS 84P,
South 31° 22’ 09” East, 499.36 feet to WS 85P,
South 31° 22’ 09” East, 805.66 feet to WS 86P,
South 31° 22’ 09” East, 632.22 feet to WS 87P,
South 31° 22’ 09” East, 482.82 feet to WS 88P,
South 31° 22’ 09” East, 470.53 feet to WS 89P,
South 31° 22’ 09” East, 229.85 feet to WS 90,
South 09° 57’ 24” East, 456.66 feet to WS 91P,
South 09° 57’ 24” East, 495.04 feet to WS 92,
South 32° 40’ 53” West, 625.07 feet to WS 93P,
South 32° 40’ 53” West, 497.15 feet to WS 94,
South 80° 40’ 16” West, 557.94 feet to WS 95P,
South 80° 40’ 16” West, 600.00 feet to WS 96,
South 21° 35’ 27” West, 681.73 feet to a point from which bears a set rebar with an aluminum cap (WS 97P), South 68° 24’ 33” East, a distance of 158.91 feet, thence,

Leaving said point, south 21° 35’ 27” West, 625.93 feet back to the point of beginning, and containing 734.23 acres more or less.

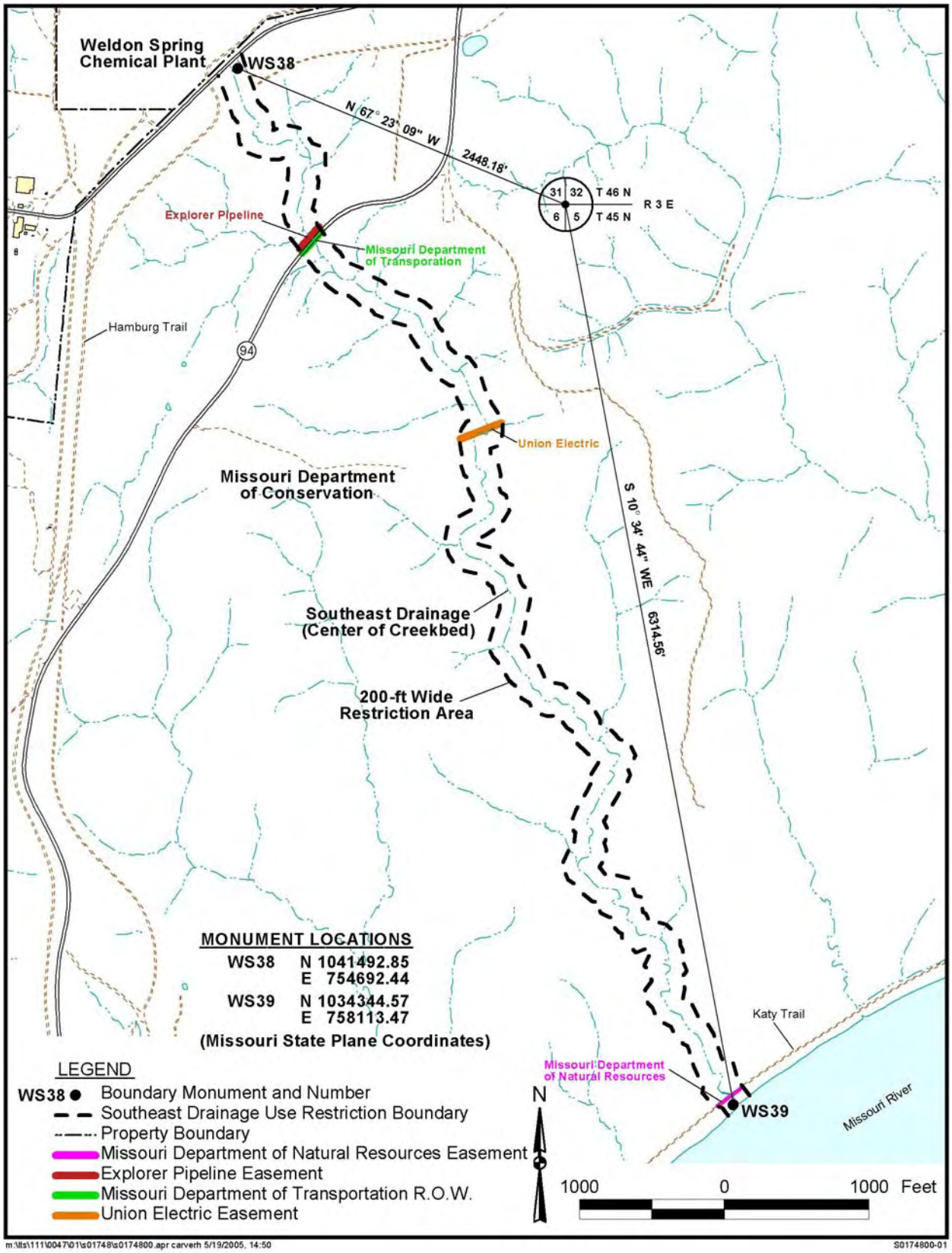

Figure D−4. Use Restriction Boundary for the Southeast Drainage

Restriction boundary for the Southeast Drainage is described on Figure D−4.

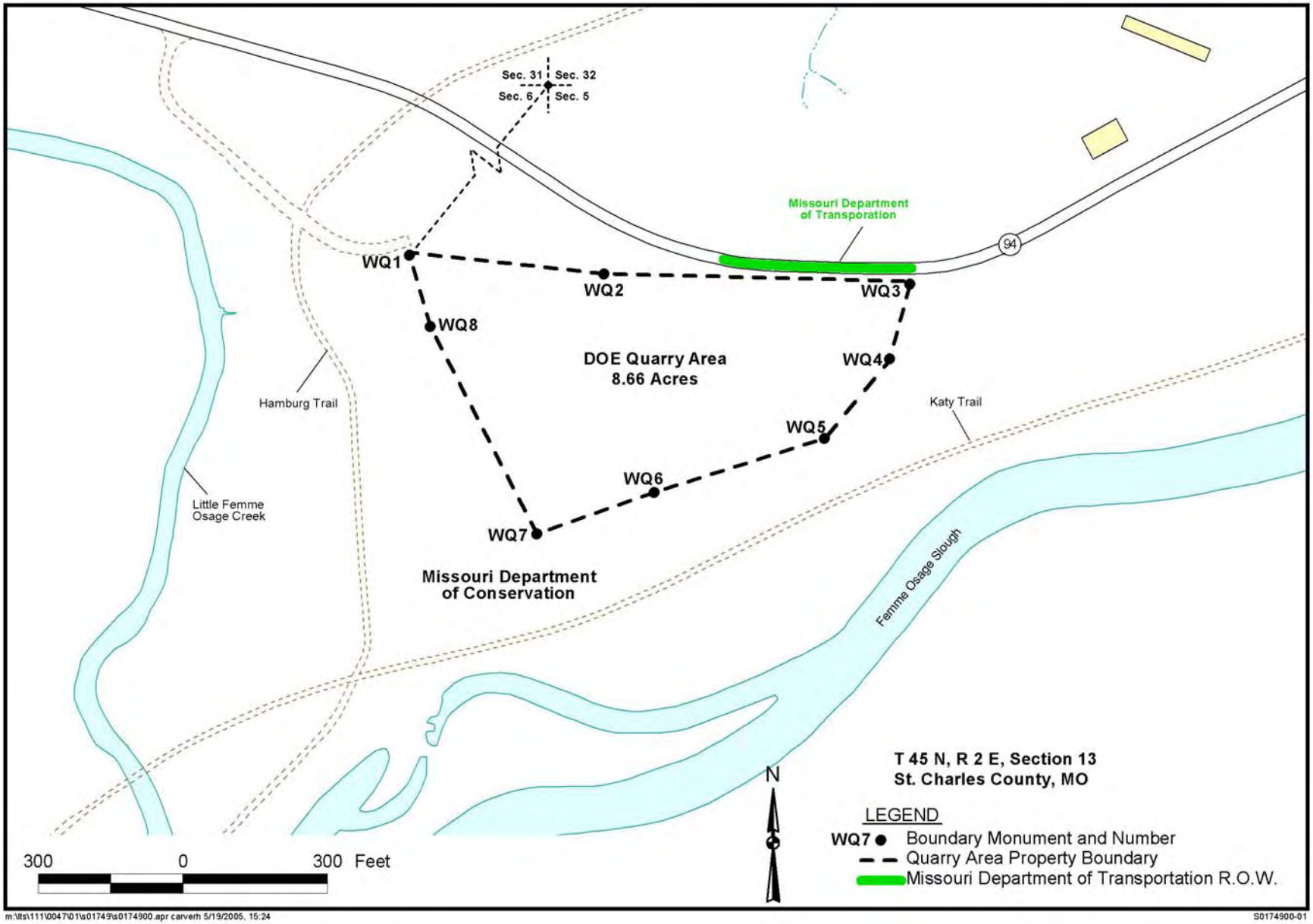

Figure D−5. DOE Property Boundary for the Quarry Area

Legal Description for Quarry Area

All that parcel of land lying within St. Charles County, Missouri, comprising the Federal facility identified as the Weldon Spring Site Remedial Action Project, as shown on maps dated September 2002 prepared by St. Charles Engineering Surveying, Inc. and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Boundary Survey for WSSRAP Site.* The bearings and distances are based on the Missouri State Plane Coordinate System (NAD 83). Said parcel is more particularly described as follows:

Being a parcel of land lying within Section 13, Township 45 North, Range 2 East of the 5th Principal Meridian in St. Charles County, Missouri. Beginning at a point identified by concrete monument WQ 1 offset 5 feet from Missouri State Plane Coordinates N=1,029,029.9933 and E=747,488.7459, said point also being located South 39° 59' 07" West a distance of 14,950.05 feet from the northeast corner of Section 6; thence along the following bearings and distances:

> South 83° 48' 22" East, 406.92 feet to an old iron pipe now designated as Monument WQ 2,
> South 88° 30' 22" East, 635.69 feet to an iron pipe at a point that is offset 5 feet from Monument WQ 3,
> South 15° 08' 38" West, 170.00 feet to an iron pipe at a point that is offset 5 feet from Monument WQ 4,
> South 39° 49' 38" West, 208.99 feet to set Monument WQ 5,
> South 72° 20' 38" West, 370.41 feet to set Monument WQ 6,
> South 70° 27' 38" West, 258.04 feet to set Monument WQ 7,
> North 27° 15' 22" West, 483.80 feet to set Monument WQ 8,
> North 15° 59' 50" West, 159.83 feet to the point of beginning. Said parcel contains 8.66 acres, more or less.

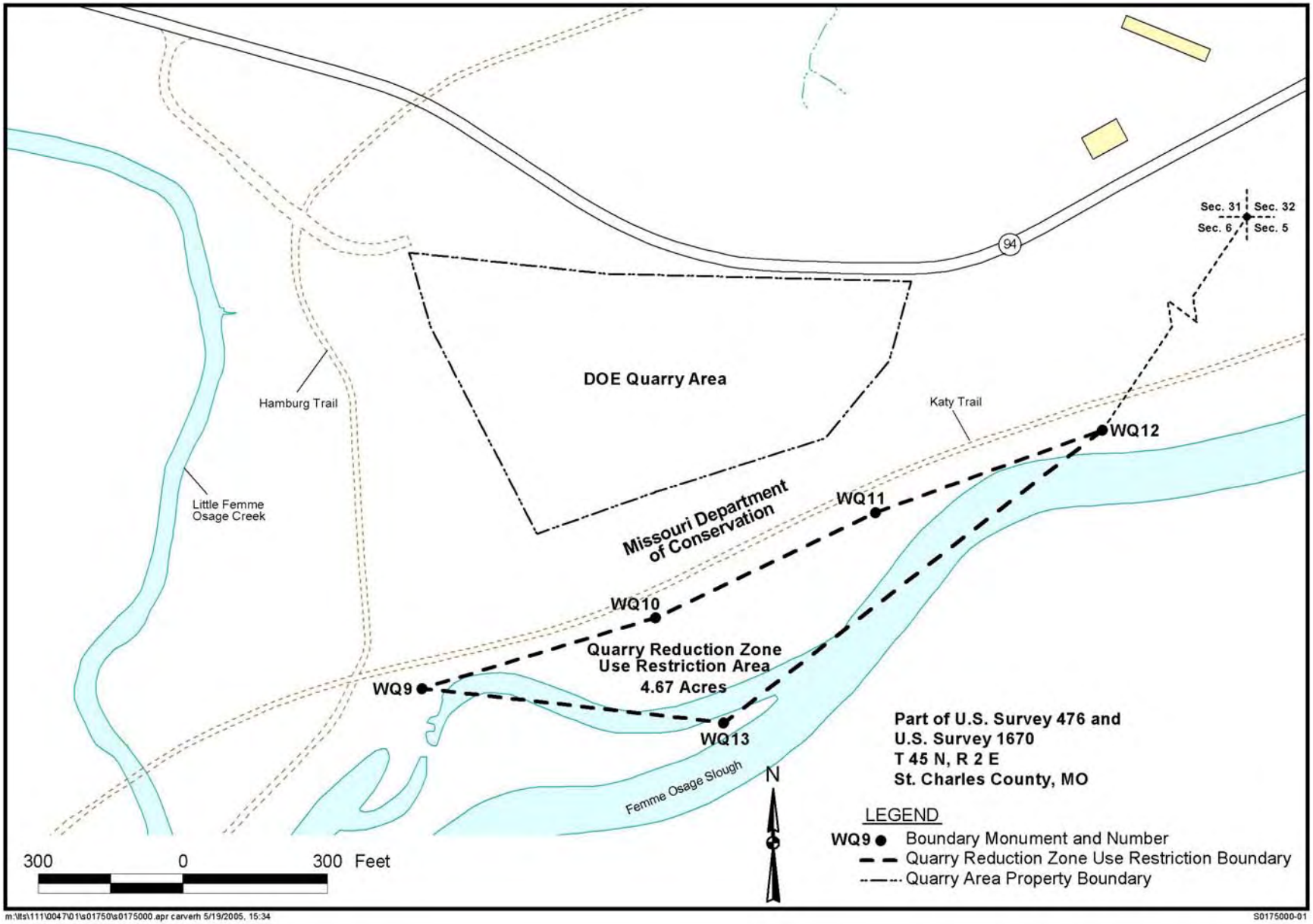

Figure D−6. Use Restriction Boundary for the Quarry Reduction Zone Restrictive Easement

Legal Description for the Quarry Reduction Zone Restrictive Easement

All that parcel of land identified as Tract 110E-2 and located in part of U.S. Survey 476 and part of U.S. Survey 1670, Township 45 North, Range 2 East of the 5th Principal Meridian, St. Charles County, Missouri, as shown on a map dated May 2004, prepared by ABNA Engineering, Inc., and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Survey for North Slough Area (Peapod), Soil Disturbance Restriction Area,* the basis of bearing being the Missouri State Plane Coordinate System of 1983—East Zone (adopting the 1993 adjustment values for first-order control points used), and being more particularly described as follows:

Commencing at an aluminum disk marking the northeast corner of Section 6, Township 45 North, Range 3 East of the 5th Principal Meridian, thence South 34° 02' 16" West a distance of 14,341.81 feet to set concrete Monument WQ 12, having coordinates of N=1,028,666.88 and E=748,924.69, and being the point of beginning of the soil disturbance restriction area of the North Slough area of the Weldon Spring Site Remedial Action Project. Thence along the following bearings and distances:

South 52° 14' 58" West, 992.12 feet to set Monument WQ 13,
North 83° 33' 13" West, 629.26 feet to set Monument WQ 9,
North 73° 06' 55" East, 506.22 feet to set Monument WQ 10,
North 64° 23' 25" East, 505.18 feet to set Monument WQ 11,
North 69° 57' 36" East, 500.07 feet to set Monument WQ 12, being the point of beginning and containing 4.67 acres, more or less.

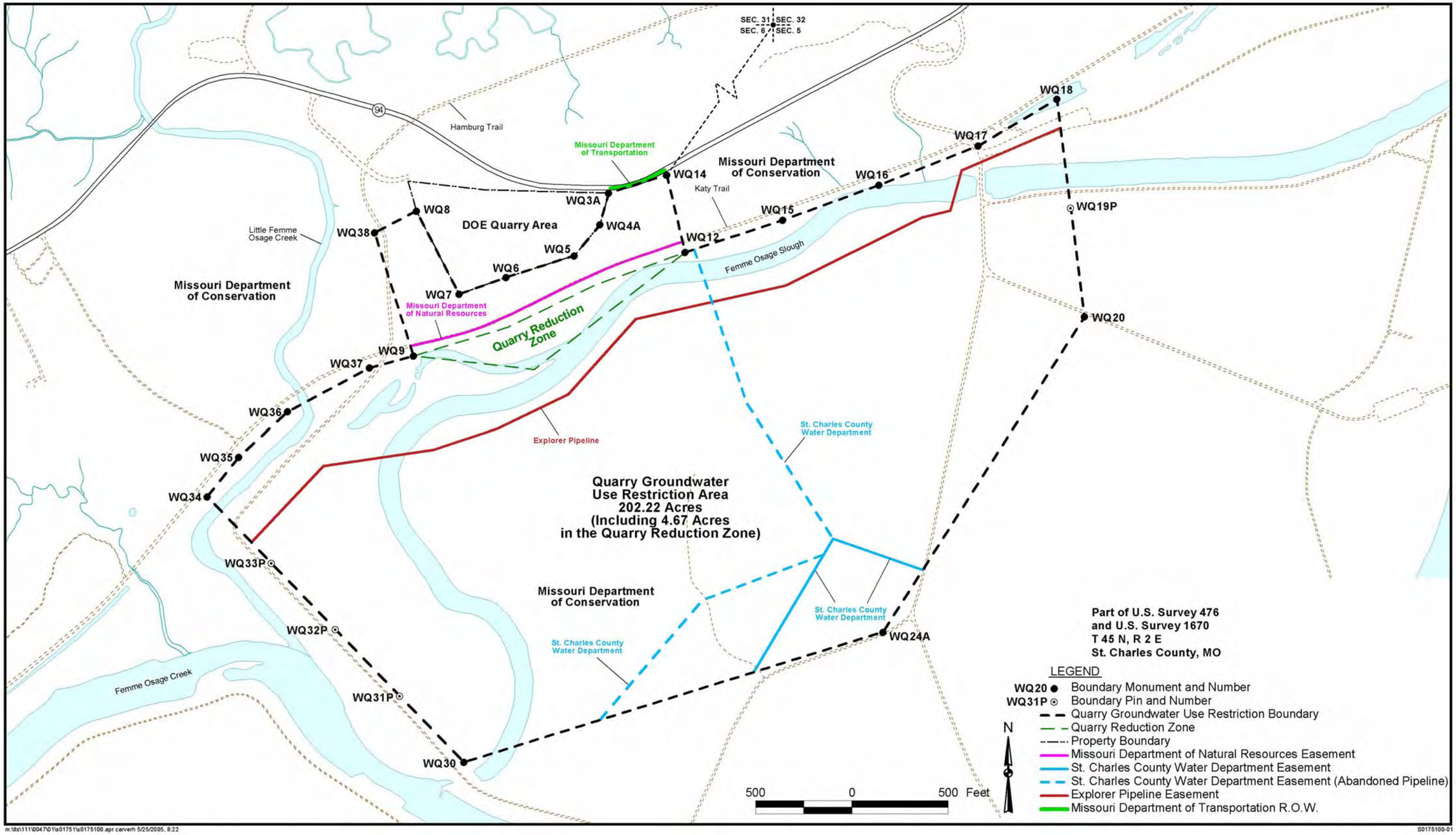

Figure D−7. Use Restriction Boundary for the Quarry Groundwater Use Restriction Area

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Legal Description for the Quarry Groundwater Use Restriction Area

All that parcel of land identified as Tract 110E-1 and located in part of U.S. Survey 476 and part of U.S. Survey 1670, Township 45 North, Range 2 East of the 5th Principal Meridian, St. Charles County, Missouri, as shown on a map dated May 2004, prepared by ABNA Engineering, Inc., and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Survey for Femme-Osage Slough Groundwater Restriction Area,* the basis of bearing being the Missouri State Plane Coordinate System of 1983—East Zone (adopting the 1993 adjustment values for first-order control points used), and being more particularly described as follows:

Commencing at an aluminum disk marking the northeast corner of Section 6, Township 45 North, Range 3 East of the 5th Principal Meridian, thence South 35° 16' 27" West a distance of 14,065.71 feet to set concrete Monument WQ 14, having coordinates of N=1,029,068.24 and E=748,829.61, and being the point of beginning of the restriction area of the Femme-Osage Slough area of the Weldon Spring Site Remedial Action Project. Thence along the following bearings and distances:

South 13° 19' 39" East, 412.47 feet to set Monument WQ 12,
North 71° 42' 15" East, 533.24 feet to set Monument WQ 15,
North 69° 59' 08" East, 530.50 feet to set Monument WQ 16,
North 68° 28' 50" East, 553.70 feet to set Monument WQ 17,
North 59° 19' 46" East, 473.87 feet to set Monument WQ 18,
South 07° 15' 50" East, 568.13 feet to a wooden hub WQ 19P,
South 07° 15' 50" East, 568.14 feet to set Monument WQ 20,
South 32° 37' 45" East, 1,938.15 feet to set Monument WQ 24A,
South 72° 47' 18" East, 2,276.05 feet to set Monument WQ 30,
North 44° 03' 19" West, 478.37 feet to iron pipe WQ 31P,
North 44° 03' 19" West, 478.37 feet to iron pipe WQ 32P,
North 44° 03' 19" West, 478.37 feet to iron pipe WQ 33P,
North 44° 03' 19" West, 478.38 feet to set Monument WQ 34,
North 38° 31' 53" East, 261.79 feet to set Monument WQ 35,
North 47° 17' 12" East, 344.82 feet to set Monument WQ 36,
North 61° 55' 03" East, 481.51 feet to set Monument WQ 37,
North 74° 47' 59" East, 235.88 feet to set Monument WQ 9,
North 17° 27' 16" West, 669.24 feet to set Monument WQ 38,
North 62° 35' 43" East, 244.65 feet to set Monument WQ 8,
South 27° 15' 22" East, 483.80 feet to set Monument WQ 7,
North 70° 27' 38" East, 258.04 feet to set Monument WQ 6,
North 72° 20' 38" East, 370.41 feet to set Monument WQ 5,
North 39° 49' 38" East, 208.99 feet to iron pipe WQ 4A,
North 15° 08' 38" East, 170.00 feet to iron pipe WQ 3A,
North 72° 44' 16" East, 316.48 feet to set Monument WQ 14, being the point of beginning and containing 202.22 acres, more or less. Said acreage includes 4.67 acres, more or less, overlapped into Tract 110E-1 identified as the north slough Reduction Zone Restrictive Easement ("peapod") and that portion of the above which falls within the right-of-way of State Highway 94.

End of legal descriptions

Phone: 314-862-0303

Investors Title Company

219 So. Central, Clayton, Missouri 63105

Stewart Title Guaranty Company, Stewart Title Insurance Company, Stewart Title Insurance Company of Oregon, National Land Title Insurance Company, Arkansas Title Insurance Company, Charter Land Title Insurance Company

Privacy Policy Notice

PURPOSE OF THIS NOTICE

Title V of the Gramm-Leach-Bliley Act (GLBA) generally prohibits any financial institution, directly or through its affiliates, from sharing nonpublic personal information about you with a nonaffiliated third party unless the institution provides you with a notice of its privacy policies and practices, such as the type of information that it collects about you and the categories of persons or entities to whom it may be disclosed. In compliance with the GLBA, we are providing you with this document, which notifies you of the privacy policies and practices of **Stewart Title Guaranty Company, Stewart Title Insurance Company, Stewart Title Insurance Company of Oregon, National Land Title Insurance Company, Arkansas Title Insurance Company, Charter Land Title Insurance Company.**

We may collect nonpublic personal information about you from the following sources:

- Information we receive from you, such as on applications or other forms.
- Information about your transactions we secure from our files, or from our affiliates or others.
- Information we receive from a consumer reporting agency.
- Information that we receive from others involved in your transaction, such as the real estate agent or lender.

Unless it is specifically stated otherwise in an amended Privacy Policy Notice, no additional nonpublic personal information will be collected about you.

We may disclose any of the above information that we collect about our customers or former customers to our affiliates or to nonaffiliated third parties as permitted by law.

We also may disclose this information about our customers or former customers to the following types of nonaffiliated companies that perform marketing services on our behalf or with whom we have joint marketing agreements:

- Financial service providers such as companies engaged in banking, consumer finance, securities and insurance.
- Non-financial companies such as envelope stuffers and other fulfillment service providers.

WE DO NOT DISCLOSE ANY NONPUBLIC PERSONAL INFORMATION ABOUT YOU WITH ANYONE FOR ANY PURPOSE THAT IS NOT SPECIFICALLY PERMITTED BY LAW.

We restrict access to nonpublic personal information about you to those employees who need to know that information in order to provide products or services to you. We maintain physical, electronic, and procedural safeguards that comply with federal regulations to guard your nonpublic personal information.

American Land Title Association Commitment - 1966

COMMITMENT FOR TITLE INSURANCE
ISSUED BY

stewart®
title guaranty company

STEWART TITLE GUARANTY COMPANY, a Texas Corporation, herein called the Company, for a valuable consideration, hereby commits to issue its policy or policies of title insurance, as identified in Schedule A, in favor of the proposed Insured named in Schedule A, as owner or mortgagee of the estate or interest covered hereby in the land described or referred to in Schedule A, upon payment of the premiums and charges therefor; all subject to the provisions of Schedules A and B and to the Conditions and Stipulations hereof.

This Commitment shall be effective only when the identity of the proposed Insured and the amount of the policy or policies committed for have been inserted in Schedule A hereof by the Company, either at the time of the issuance of this Commitment or by subsequent endorsement.

This Commitment is preliminary to the issuance of such policy or policies of title insurance and all liability and obligations hereunder shall cease and terminate six months after the effective date hereof or when the policy or policies committed for shall issue, whichever first occurs, provided that the failure to issue such policy or policies is not the fault of the Company.

Signed under seal for the Company, but this Commitment shall not be valid or binding until it bears an authorized Countersignature.

IN WITNESS WHEREOF, Stewart Title Guaranty Company has caused its corporate name and seal to be hereunto affixed by its duly authorized officers on the date shown in Schedule A.

Stewart Morris Jr.
Chairman of the Board

stewart®
title guaranty company

STEWART TITLE GUARANTY CO. INCORPORATED 1908 TEXAS

Malcolm S. Morris
President

Countersigned by:

Mary Rosales
Authorized Signatory

Investors Title Company
Company

Clayton, MO 63105
City, State

005 – UN – Rev. 3/78

CONDITIONS AND STIPULATIONS

1. The term mortgage, when used herein, shall include deed of trust, trust deed, or other security instrument.

2. If the proposed Insured has or acquires actual knowledge of any defect, lien, encumbrance, adverse claim or other matter affecting the estate or interest or mortgage thereon covered by this Commitment other than those shown in Schedule B hereof, and shall fail to disclose such knowledge to the Company in writing, the Company shall be relieved from liability for any loss or damage resulting from any act of reliance hereon to the extent the Company is prejudiced by failure to so disclose such knowledge. If the proposed Insured shall disclose such knowledge to the Company, or if the Company otherwise acquires actual knowledge of any such defect, lien, encumbrance, adverse claim or other matter, the Company at its option may amend Schedule B of this Commitment accordingly, but such amendment shall not relieve the Company from liability previously incurred pursuant to paragraph 3 of these Conditions and Stipulations.

3. Liability of the Company under this Commitment shall be only to the named proposed Insured and such parties included under the definition of Insured in the form of policy or policies committed for and only for actual loss incurred in reliance hereon in undertaking in good faith (a) to comply with the requirements hereof, or (b) to eliminate exceptions shown in Schedule B, or (c) to acquire or create the estate or interest or mortgage thereon covered by this Commitment. In no event shall such liability exceed the amount stated in Schedule A for the policy or policies committed for and such liability is subject to the insuring provisions, the Conditions and Stipulations, and the Exclusions from Coverage of the form of policy or policies committed for in favor of the proposed Insured which are hereby incorporated by reference and are made a part of this Commitment except as expressly modified herein.

4. Any action or actions or rights of action that the proposed Insured may have or may bring against the Company arising out of the status of the title to the estate or interest or the status of the mortgage thereon covered by this Commitment must be based on and are subject to the provisions of this Commitment.

stewart®
title guaranty company

All notices required to be given the Company and any statement in writing required to be furnished the Company shall be addressed to it at P.O. Box 2029, Houston, Texas 77252.

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

1. Policy or Policies to be issued:

   (a) ☐ ALTA Owner's Policy -10/17/92 Amount - 0 -
   Proposed Insured: NONE

   (b) ☐ ALTA Loan Policy - 10/17/92 Amount - 0 -
   Proposed Insured: NONE

2. The estate or interest in the land described or referred to in this Commitment and covered herein is a fee simple and title thereto is at the effective date hereof vested in:

   PARCEL A – the Groundwater Use Restriction Area at and surrounding the Department of Energy Plant, comprised of the following subparcels referred to as Exceptions to the main parcel
   PARCEL A, EXCEPTION 1 – Plant Site Proper: Ownership is not part of this title commitment. Investors Title Company has been told by the Department of Energy that it is in federal ownership
   PARCEL A, EXCEPTION 2 – Department of Army: Ownership is not part of this title commitment. Investors Title Company has been told by the Department of Energy that it is in federal ownership
   PARCEL A, EXCEPTION 3 – MODOT: vested in The Missouri State Highway Commission as per Warranty Deed recorded August 27, 1958 in Book 314 page 439 of the St. Charles County Records and also known as MODOT Maintenance Yard
   PARCEL A, EXCPTION 4 – Missouri Department of Conservation: vested in the Conservation Commission of the State of Missouri as per Quit Claim Deed recorded July 17, 1947 in Book 225 page 64 of the St. Charles County Records and also known as Missouri Department of Conservation August A. Busch Memorial Conservation Area

   PARCEL B – the Natural Surface Water Drainage: vested in the Conservation Commission of the State of Missouri as per Deed recorded June 26, 1979 in Book 842 page 1778 of the St. Charles County Records and also known as the Southeast Drainage and also known as the Missouri Department of Conservation Weldon Spring Conservation Area. ALSO that strip known as the Katy Trail which is vested in the Missouri Department of Natural Resources per Quit Claim Deed recorded July 14, 1988 in Book 1222 page 2 of the St. Charles County Records and crosses this parcel along the Missouri River (see Exception listed in Legal Description)

Investors Title Company
By: Mary Rosales
Mary Rosales, Authorized Officer

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

PARCEL C – the Groundwater Use Restriction Area South of the Department of Energy Quarry including the smaller land use restriction area contained therein: vested in the Conservation Commission of the State of Missouri as per Deed recorded June 26, 1979 in Book 842 page 1778 of the St. Charles County Records and also known as the Missouri Department of Conversation Weldon Spring Conservation Area. ALSO that strip known as the Katy Trail which is vested in the Missouri Department of Natural Resources per Quit Claim Deed recorded July 14, 1988 in Book 1222 page 2 of the St. Charles County Records and crosses this parcel in the Missouri River floodplain just south of the Department of Energy Quarry (see Exception listed in Legal Description)

3. The land referred to in the Commitment is described as follows:

PARCEL A:

A proposed Ground Water Use Restriction Area, being in U.S. Survey 887, U.S. Survey 457, and U.S. Survey 1798 of Township 46 North, Range 2 East, and Township 46 North, Range 3 East, Sections 25 and 36, Township 46 North, Range 2 East, Sections 19, 30, 31, and 32, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows: COMMENCING at an iron pin with aluminum cap, found to be the Southeast Corner of Section 31, Township 46 North, Range 3 East, St. Charles County, Missouri, State Plane Coordinates (NAD83, Adjustment of 1993) North 317161.314m, East, 230720.511m), recorded as Document No. 600-27639 and Index No. Z-5 with the Land Records Repository of the Land Survey Program of the Geological Survey and Resource Assessment Division of the Department of Natural Resources of the State of Missouri. Bearings contained herein are referenced to the Missouri State Plane Coordinate System; distances contained herein are Grid Distances; Grid Factor for this Project is 0.999909366; thence leaving the Southeast Corner of said Section 31, North 89° 09' 34" West, a distance of 1,599.78 feet to a set concrete monument with an aluminum cap (WS 40), said point being the "POINT OF BEGINNING" of a herein-described Ground Water Use Restriction Area; thence the following courses and distances: North 88° 53' 16" West, 427.44 feet; North 88° 53' 16" West, 384.00 feet; North 61° 04' 10" West, 327.00 feet; North 61° 04' 10" West, 363.28 feet; South 53° 00' 20" West, 454.35 feet; South 53° 00' 20" West, 233.47 feet; North 82° 26' 24" West, 478.94 feet; North 82° 26' 24" West, 451.86 feet; North 50° 52' 03" West, 448.49 feet; North 50° 52' 03" West, 293.49 feet; North 23° 31' 58" West, 519.51 feet; North 23° 31' 58" West, 495.37 feet; North 08° 59' 03" West, 706.90 feet; North 08° 59' 03" West, 493.35 feet; North 08° 59' 03" West, 482.48 feet; North 08° 59' 03" West, 568.70 feet; North 08° 59' 03" West, 490.52 feet; North 08°

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

59' 03" West, 490.40 feet; North 08° 59' 03" West, 802.23 feet; North 08° 59' 03" West, 767.74 feet; North 08° 59' 03" West, 387.24 feet; North 08° 59' 03" West, 499.50 feet; North 08° 59' 03" West, 481.00 feet; North 08° 59' 03" West, 472.87 feet; North 08° 59' 03" West, 497.29 feet; North 08° 59' 03" West, 499.16 feet; North 08° 59' 03" West, 200.50 feet; North 08° 59' 03" West, 488.76 feet; North 56° 29' 12" East, 425.25 feet; North 56° 29' 12" East, 561.97 feet; North 56° 29' 12" East, 436.49 feet; North 56° 29' 12" East, 190.09 feet; North 56° 29' 12" East, 361.68 feet; North 56° 29' 12" East, 403.91 feet; North 56° 29' 12" East, 468.84 feet; South 31° 22' 09" East, 628.00 feet; South 31° 22' 09" East, 350.87 feet; South 31° 22' 09" East, 373.67 feet; South 31° 22' 09" East, 269.73 feet; South 31° 22' 09" East, 496.98 feet; South 31° 22' 09" East, 440.41 feet; South 31° 22' 09" East, 260.24 feet; South 31° 22' 09" East, 570.08 feet; South 31° 22' 09" East, 460.05 feet; South 31° 22' 09" East, 470.05 feet; South 31° 22' 09" East, 497.80 feet; South 31° 22' 09" East, 477.05 feet; South 31° 22' 09" East, 420.10 feet; South 31° 22' 09" East, 499.55 feet; South 31° 22' 09" East, 499.36 feet; South 31° 22' 09" East, 805.66 feet; South 31° 22' 09" East, 632.22 feet; South 31° 22' 09" East, 482.82 feet; South 31° 22' 09" East, 470.53 feet; South 31° 22' 09" East, 229.85 feet; South 09° 57' 24" East, 456.66 feet; South 09° 57' 24" East, 495.04 feet; South 32° 40' 53" West, 625.07 feet; South 32° 40' 53" West, 497.15 feet; South 80° 40' 16" West, 557.94 feet; South 80° 40' 16" West, 600.00 feet; South 21° 35' 27" West, 681.73 feet to a point from which bears a set rebar with an aluminum cap (WS 97P), South 68° 24' 33" East, a distance of 158.91 feet; thence leaving said point, South 21° 35' 27" West, 625.93 feet back to the "POINT OF BEGINNING", more or less, according to Field Surveys and Computations by Hanson Professional Services, Inc. performed during the month of February, 2004.

EXCEPTION NO. 1: PLANT SITE PROPER

All those two parcels of land located in St. Charles County, Missouri, as shown on maps dated February, 2002 prepared by St. Charles Engineering & Surveying, Inc. and titled *Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Boundary Survey of WSSRAP Site*. The bearings and distances are based on the Missouri State Plane Coordinate System (NAD 83). Said parcels are more particularly described as follows:

Being a parcel of land situated in Part of U.S. Survey 1798 and Section 31, Township 46 North, Range 3 East of the Fifth Principal Meridian, St. Charles County, Missouri: COMMENCING at a point at the Southeast Corner of said Section 31 at an aluminum monument located at Missouri State Plane Coordinates N=1,040,489.6750 and E=757,094.1204; thence North 29° 04' 06" West, 1,789.86 feet to the true point of beginning of the herein described parcel; thence along the following bearings and distances marked with concrete monuments: South 84° 59' 43" West, 511.53 feet; South 77° 59' 16" West, 839.83 feet; South 45° 55' 46" West, 894.25 feet; South 89° 59' 22" West, 812.12

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

feet; South 00° 02' 16" East, 749.79 feet; North 70° 25' 08" West, 105.03 feet; North 48° 12' 56" West, 618.60 feet; North 04° 34' 10" West, 189.65 feet; North 29° 11' 22" East, 384.67 feet; North 05° 22' 06" West, 474.62 feet; North 63° 03' 07" East, 485.67 feet; North 00° 04' 28" West, 1,355.33 feet; South 81° 55' 03" East, 389.64 feet; North 00° 05' 38" West, 109.85 feet; North 89° 54' 31" East, 499.21 feet; South 00° 00' 02" East, 93.62 feet; North 86° 28' 56" East, 705.14 feet; South 48° 44' 32" East, 828.98 feet; thence along a curve to the right having a radius of 1,862.61 feet with a chord bearing and distance of South 36° 47' 33" East, 771.35 feet, for an arc distance of 776.9 feet; thence South 24° 50' 33" East, 1,171.92 feet; South 28° 17' 16" West, 801.90 feet to the POINT OF BEGINNING, more or less.

EXCEPTION NO. 2: DEPARTMENT OF THE ARMY

Being in U.S. Survey 1798 of Township 46 North, Range 2 East, and Township 46 North, Range 3 East, Section 36, Township 46 North, Range 2 East, Section 31, Township 46 North, Range 3 East, Section 6, Township 45 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows: BEGINNING at a concrete monument with a brass disk marked WS44, Missouri State Plane Coordinates (NAD 83, Adjustment of 1993) North 1,040,926.55 and East 753,940.51; thence the following courses and distances: South 53° 00' 20" West, 454.35 feet to WS45P; South 53° 00' 20" West, 233.47 feet to WS46; North 82° 26' 24" West, 478.94 feet to WS47P; North 82° 26' 24" West, 451.86 feet to WS48; North 50° 52' 03" West, 448.49 feet to WS49P; North 50° 52' 03" West, 293.49 feet to WS50; North 23° 31' 58" West, 519.51 feet to WS51P; North 23° 31' 58" West, 495.37 feet to WS52; North 08° 59' 03" West, 706.90 feet to WS53P; North 08° 59' 03" West, 493.35 feet to WS54P; North 08° 59' 03" West, 482.48 feet to WS55P; North 08° 59' 03" West, 568.70 feet to WS56P; North 08° 59' 03" West, 194.93 feet to a point in fence line; North 70° 23' 55" East, 1,854.01 feet to fence corner; South 87° 57' 05" East, 585.24 feet to fence corner; South 00° 15' 05" East, 84.30 feet to WS13; South 00° 04' 28" East, 1,355.33 feet to WS12; South 63° 03' 07" West, 485.67 feet to WS11; South 05° 22' 06" East, 474.62 feet to WS10; South 29° 11' 22" West, 384.67 feet to WS9; South 04° 34' 10" East, 189.65 feet to WS8; South 48° 12' 56" East, 618.60 feet to WS7; South 70° 25' 08" East, 105.03 feet to WS6; South 00° 02' 16" West, 749.79 feet to WS5; North 89° 59' 22" East, 812.12 feet to WS4; South 47° 19' 10" West, 427.22 feet back to the "POINT OF BEGINNING", more or less.

EXCEPTION NO. 3: MODOT

Being in Section 31, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows: BEGINNING at a concrete monument with a brass disk marked WS22, Missouri State Plane Coordinates (NAD 83, Adjustment of 1993) North

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

1,042,764.7573 and East 756,602.4254; thence North 25° 50' West, 465.4 feet to a point (the Westernmost point of said property); thence North 65° 10' East, 615.78 feet to a point in West right-of-way line of Missouri State Highway 94; thence South 0° 40' West, 111.67 feet to a curve right radius 438.34 feet; thence along curve 360.8 feet to a tangent; thence South 43° 58' West, 178.5 feet to a curve left, radius 1.82.14 feet; thence along curve 182.9 feet back to the "POINT OF BEGINNING", more or less.

EXCEPTION NO. 4: MISSOURI DEPARTMENT OF CONSERVATION

Being in U.S. Survey 887, U.S. Survey 453, and U.S. Survey 1798 of Township 46 North, Range 2 East, and Township 46 North, Range 3 East, Sections 25 and 36, Township 46 North, Range 2 East, Sections 19, 30, 31 and 32, Township 46 North, Range 3 East of St. Charles County, Missouri, and being more particularly described as follows: BEGINNING at a concrete monument with a brass disk marked WS40, Missouri State Plane Coordinates (NAD 83, Adjustment of 1993) North 1,040,576.88 and East 755,355.94; thence, the following courses and distances: North 88° 53' 16" West, 427.44 feet to WS41P; North 88° 53' 16" West, 384.00 feet to WS42; North 61° 04' 10" West, 327.00 feet to WS43P; North 61° 04' 10" West, 363.28 feet to WS44; North 47° 19' 10" East, 427.22 feet to WS4; North 45° 55' 46" East, 894.25 feet to WS3; North 77° 59' 16" East, 839.83 feet to WS2; North 84° 59' 43" East, 511.53 feet to WS1; North 28° 17' 16" East, 801.90 feet to WS22, which is on the West right-of-way line of Missouri State Route 94; thence in a Northeasterly direction along said right-of-way to a point; thence South 65° 09' 37" West, 612.41 feet to a point; thence North 24° 50' 33" West, 708.57 feet to WS21; thence along a curve having a radius of 1,862.61 feet with a chord bearing and distance of North 36° 47' 33" West, 771.35 feet for an arc distance of 776.97 feet to WS19; thence; North 48° 44' 32" West, 828.97 feet to WS18; South 86° 28' 56" West, 705.14 feet to WS17; North 00° 00' 02" West, 93.62 feet to WS16; South 89° 54' 31" West, 499.21 feet to WS15; South 00° 05' 38" East, 109.85 feet to WS14; North 81° 55' 03" West, 389.64 feet to WS13; North 00° 15' 05" West, 84.30 feet to a fence corner; North 87° 57' 05" West, 585.24 feet to a fence corner; South 70° 23' 55" West, 1,854.01 feet to point in fence line; North 08° 59' 03" West, 295.59 feet to WS57P; North 08° 59' 03" West, 490.40 feet to WS58P; North 08° 59' 03" West, 802.23 feet to WS59P; North 08° 59' 03" West, 767.74 feet to WS60P; North 08° 59' 03" West, 387.24 feet to WS61P; North 08° 59' 03" West, 499.50 feet to WS62P; North 08° 59' 03" West, 481.00 feet to WS63P; North 08° 59' 03" West, 472.87 feet to WS64P; North 08° 59' 03" West, 497.29 feet to WS65P; North 08° 59' 03" West, 499.16 feet to WS66P; North 08° 59' 03" West, 200.50 feet to WS66AP; North 08° 59' 03" West, 488.76 feet to WS67; North 56° 29' 12" East, 425.25 feet to WS68P; North 56° 29' 12" East, 561.97 feet to WS69P; North 56° 29' 12" East, 436.49 feet to WS70P; North 56° 29' 12" East, 190.09 feet to

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Stewart Title Guaranty Company

COMMITMENT

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Effective Date: February 4, 2005 at 8:00 AM.

WS70AP; North 56° 29' 12" East, 361.68 feet to WS71P; North 56° 29' 12" East, 403.91 feet to WS72P; North 56° 29' 12" East, 468.84 feet to WS73; South 31° 22' 09" East, 628.00 feet to WS74P; South 31° 22' 09" East, 350.87 feet to WS75P; South 31° 22' 09" East, 373.67 feet to WS76P; South 31° 22' 09" East, 269.73 feet to WS77P; South 31° 22' 09" East, 496.98 feet to WS77AP; South 31° 22' 09" East, 440.41 feet to WS78P; South 31° 22' 09" East, 260.24 feet to WS78AP; South 31° 22' 09" East, 570.08 feet to WS79P; South 31° 22' 09" East, 460.05 feet to WS80P; South 31° 22' 09" East, 470.05 feet to WS81P; South 31° 22' 09" East, 497.80 feet to WS82P; South 31° 22' 09" East, 477.05 feet to WS83P; South 31° 22' 09" East, 420.10 feet to WS83AP; South 31° 22' 09" East, 499.55 feet to WS84P; South 31° 22' 09" East, 499.36 feet to WS85P; South 31° 22' 09" East, 805.66 feet to WS86P; South 31° 22' 09" East, 632.22 feet to WS87P; South 31° 22' 09" East, 482.82 feet to WS88P; South 31° 22' 09" East, 470.53 feet to WS89P; South 31° 22' 09" East, 229.85 feet to WS90; South 09° 57' 24" East, 456.66 feet to WS91P; South 09° 57' 24" East, 495.04 feet to WS92; South 32° 40' 53" West, 625.07 feet to WS93P; South 32° 40' 53" West, 497.15 feet to WS94; South 80° 40' 16" West, 557.94 feet to WS95P; South 80° 40' 16" West, 600.00 feet to WS96; South 21° 35' 27" West, 681.73 feet to a point from which bears a set rebar with an aluminum cap (WS97P), South 68° 24' 33" East, a distance of 158.91 feet; thence leaving said point, South 21° 35' 27" West, 625.93 feet back to the "POINT OF BEGINNING", more or less.

PARCEL B:

Natural surface water drainage area southeast of Parcel A, Exception 1 referred to as the Southeast Drainage also known as the Missouri Department of Conservation Weldon Spring Conservation Area. No legal description available.

PARCEL C:

All that parcel of land identified as Tract 110E-1 and located in part of U.S. Survey 476 and part of U.S. Survey 1670, Township 45 North, Range 2 East of the 5th Principal Meridian, St. Charles County, Missouri, as shown on a map dated May, 2004, prepared by ABNA Engineering, Inc. and titled *"Dept. of Energy, Weldon Spring Site Remedial Action Project, MO, Survey for Femme-Osage Slough Groundwater Restriction Area"*, the basis of bearing being the Missouri State Plane Coordinate System of 1983 – East Zone (adopting the 1993 adjustment values for first-order control points used), and being more particularly described as follows: COMMENCING at an aluminum disk marking the northeast corner of Section 6, Township 45 North, Range 3 East of the Fifth Principal Meridian, thence South 35° 16' 27" West a distance of 14,065.71 feet to Monument designated as WQ14, having coordinates of N=1,029,068.24 and E=748,829.61, and being the point

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Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

of beginning of the restriction area of the Femme-Osage Slough area of the Weldon Spring Site Remedial Action Project. Thence along the following bearings and distances: South 13° 19' 39" East for a distance of 412.47 feet to Monument WQ12, North 71° 42'15" East for a distance of 533.24 feet to Monument WQ15, North 69° 59' 08" East for a distance of 530.50 feet to Monument WQ16, North 68° 28' 50" East for a distance of 553.70 feet to Monument WQ17, North 59° 19' 46" East for a distance of 473.87 feet to Monument WQ18, South 7° 15' 50" East for a distance of 568.13 feet to a wooden hub WQ19P, South 7° 15' 50" East for a distance of 568.14 feet to Monument WQ20, South 29° 51' 25" West for a distance of 455.54 feet to a wooden hub WQ21P, South 29° 51' 25" West for a distance of 455.54 feet to a wooden hub WQ22P, South 29° 51' 25" West for a distance of 455.54 feet to a wooden hub WQ23P, South 29° 51' 25" West for a distance of 455.52 feet to a Monument WQ24, South 65° 46' 47" West for a distance of 441.81 feet to a wooden hub WQ25P, South 65° 46' 47" West for a distance of 441.89 feet to a wooden hub WQ26P, South 65° 46' 47" West for a distance of 441.89 feet to a wooden hub WQ27P, South 65° 46' 47" West for a distance of 441.89 feet to a wooden hub WQ28P, South 65° 46' 47" West for a distance of 441.98 feet to Monument WQ29, North 58° 39' 14" West for a distance of 347.84 feet to Monument WQ30, North 44° 03' 19" West for a distance of 478.37 feet to iron pipe WQ31P, North 44° 03' 19" West for a distance of 478.37 feet to iron pipe WQ32P, North 44° 03' 19" West for a distance of 478.37 feet to iron pipe WQ33P, North 44° 03' 19" West for a distance of 478.38 feet to Monument WQ34, North 38° 31' 53" East for a distance of 261.79 feet to Monument WQ35, North 47° 17' 12" East for a distance of 344.82 feet to Monument WQ36, North 61° 55' 03" East for a distance of 481.51 feet to Monument WQ37, North 74° 47' 59" East for a distance of 235.88 feet to Monument WQ9; North 17° 27' 16" West for a distance of 669.24 feet to Monument WQ38, North 62° 35' 43" East for a distance of 244.65 feet to Monument WQ8, South 27° 15' 22" East for a distance of 483.80 feet to Monument WQ7, North 70° 27' 38" East for a distance of 258.04 feet to Monument WQ6, North 72° 20' 38" East for a distance of 370.41 feet to Monument WQ5, North 39° 49' 38" East for a distance of 208.99 feet to iron pipe WQ4A, North 15° 03' 38" East for a distance of 170.00 feet to iron pipe WQ3A, North72° 44' 16" East a distance of 316.48 feet to Monument WQ14 being the point of beginning, more or less. Said tract includes 4.67 acres, more or less, overlapped into Tract 110E-1 identified as the North Slough "peapod" area and that portion of the above which falls within the right-of-way of State Highway 94.

EXCEPTING FROM above described Parcels B and C those portions of the "Katy Trail" which are a part of the following described: A strip or parcel of land of varying widths on either side of the centerline of Missouri-Kansas-Texas Railroad Company's former St. Louis Subdivision main track, beginning at the intersection of said centerline with the west right-of-way line of the Burlington

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE A

Commitment No. 623-980-A-000 Aim File No. 174812

Effective Date: February 4, 2005 at 8:00 AM.

Northern Railroad, in U.S. Survey 174, Township 48 North, Range 6 East of the 5th Principal Meridian, in St. Charles County, Missouri, and continuing in a generally southwesterly direction through Township 47 North, Range 6 East; Township 47 North, Range 5 East; Township 46 North, Range 5 East; Township 46 North, Range 4 East; Township 46 North, Range 3 East; Township 45 North, Range 3 East; Township 45 North, Range 2 East; Township 44 North, Range 2 East; Township 44 North, Range 1 East; to the intersection of said main track centerline with the west boundary line of St. Charles County; it being the intention to convey hereby all of its property between those two points.

Acreage in Weldon Springs
N/A-St. Charles

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Schedule A consists of 8 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE B-I

Requirements

Commitment No.: 623-980-A-000

1. The following are the requirements to be complied with:
    1. Payment to, or for the account of, the seller or mortgagors of the full consideration for the estate or interest to be insured.
    2. Instruments which must be approved by the company, executed, delivered and duly filed for record:

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule B1 consists of 1 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE B-II

Exceptions

Commitment No.: 623-980-A-000

Schedule B of the policy to be issued will contain exceptions to the following matters unless the same are disposed of to the satisfaction of the Company.

1. If an owner's policy is to be issued, the mortgage encumbrance, if any, created as part of the purchase transaction.
2. Defects, liens, encumbrances, adverse claims or other matters, if any created, first appearing in the public records or attaching subsequent to the effective date hereof but prior to the date the proposed insured acquires for value of record the estate or interest or mortgage thereon covered by this commitment.
3. Rights or claims of parties in possession not shown by the public records.
4. Encroachments, overlaps, boundary line disputes, and any other matters which would be disclosed by an accurate survey and inspection of the premises.
5. Easements or claims of easements not shown by the public records.
6. Any lien, or right to a lien, for services, labor or material heretofore or hereafter furnished, imposed by law and not shown by the public records.
7. Taxes or special assessments which are not shown as existing liens by the public records.
8. General and special taxes and assessments as hereafter listed, if any (all amounts shown being exclusive of interest, penalties and costs.
9. The lien of all taxes and assessments for the year 2005 and all subsequent years. 2004 taxes are exempt.
10. Easement granted by Curators of the University of Missouri to Atomic Energy Commission for right of way as recorded in Book 292 page 597 of the St. Charles County Records. (Parcel B)
11. Permanent right-of-way and easement to the United States Atomic Energy Commission as recorded in Book 342 page 309 of the St. Charles County Records. (Parcel C)
12. Easement granted to Southwestern Bell Telephone Company as recorded in Book 344, Page 525 of the St. Charles County Records. Exact location of easement cannot be determined.
13. Decree of Incorporation of Public Water Supply District No. 2 of St. Charles County as recorded in Book 481 page 302 (Parcel C).
14. Reservation for the conservation of wildlife subject to conditions, limitations and covenants as per Quit Claim Deed recorded in Book 517 page 124 of the St. Charles County Records. (Parcel A)

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule B2 consists of 4 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE B-II

Exceptions

Commitment No.: 623-980-A-000

STANDARD EXCEPTIONS NOTE: Item 2 will be deleted from Title Insurance Policy. Items 4 and 5 will be eliminated from policy provided an appropriate currently certified survey is presented and found to be acceptable to the company. Items 3, 6, and 7 may be eliminated from the policy provided there is no new construction and further provided we are furnished an appropriate affidavit concerning possession and construction. We require full payment of premiums as a condition to the issuance of policies pursuant to this commitment. Policies will not be issued until we have received payment of said premiums.

CLOSING INFORMATION NOTE: If the closing for the subject property is to be conducted by Investors Title Insurance Company, we require all monies due from the purchase to be in the form of a Cashier's Check, Certified Check or Wire Transfer. If the sale proceeds for any "payoffs" pursuant to the closing require "Good Funds", then monies received by us for such must be by bank or wire transfer.

The above applies to all closing unless other specific arrangements are made. Due to wide variances in banking practices and lack of control over funds "on the wire" we cannot accept financial responsibility for delays in the clearing of funds.

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule B2 consists of 4 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE B-II

Exceptions

Commitment No.: 623-980-A-000

15. Right of Way Agreement subject to the terms and conditions therein by and between The Curators of the University of Missouri, for and on behalf of the University of Missouri and Explorer Pipeline Company as recorded in Book 593 page 800 of the St. Charles County Records. (Parcels B and C)
16. Easements for way to wells and water line system as per deeds recorded in Book 633 page 781 and Book 652 page 1680 of the St. Charles County Records. (Parcels A, B, and C)
17. Release and Abrogation of conditions as recorded in Book 830 page 205 of the St. Charles County Records. (Parcel C)
18. A non-exclusive easement, terms, covenants and conditions by and between the Conservation Commission of the State of Missouri and Missouri Edison Company of St. Charles County as recorded in Book 911 page 997 of the St. Charles County Records. (Parcel B)
19. A non-exclusive easement, terms, covenants and conditions by and between the Conservation Commission of the State of Missouri and Missouri Edison Company of St. Charles County as recorded in Book 916 page 1418 of the St. Charles County Records. (Parcel B)
20. Non-exclusive easement granted to Missouri Cities Water Company as recorded in Book 1075, Page 1096 of the St. Charles County Records. Exact location of easement cannot be determined.
21. Non-exclusive easement granted to St. Charles County as recorded in Book 1076 page 1996 of the St. Charles County Records. Exact location of easement cannot be determined.
22. Easement granted for pumping system and discharge line as recorded in Book 1140, Page 196 of the St. Charles County Records. (Parcel C)
23. Non-exclusive easement granted for ingress and egress to the United States Department of Energy as recorded in Book 1168, Page 1795 of the St. Charles County Records. (Parcels A, B and C)
24. Easement granted to Union Electric Company as recorded in Book 1229, Page 814 of the St. Charles County Records. Exact location of easement cannot be determined.
25. Non-exclusive easement granted for underground telecommunications facilities to Southwestern Bell Telephone Company by the Conservation Commission of the State of Missouri as recorded in Book 1278, Page 555 of the St. Charles County Records. (Parcel A)
26. Quit Claim of Easement Interest to the United States of America as recorded in Book 1506 Page 3 (Parcel A).
27. Non-exclusive easement granted to Union Electric Company as recorded in Book 1668, Page 138 of the St. Charles County Records (Parcel A).
28. Easement granted for right of way to the United States of America as recorded in Book 1777, Page 734 of the St. Charles County Records (Parcel A).

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule B2 consists of 4 page(s)

Stewart Title Guaranty Company

COMMITMENT

SCHEDULE B-II

Exceptions

Commitment No.: 623-980-A-000

29. Perpetual easement granted to County of St. Charles for the use and benefit of the St. Charles County Water Department as recorded in Book 2520, Page 779 of the St. Charles County Records (Parcel C).
30. Reservations and easements as per deed recorded in Book 2694 page 1746 of the St. Charles County Records. (Parcel A)
31. Assessments for maintenance of sanitary sewer systems, if any.
32. Assessments by trustees of said subdivision, if any.
33. We find no judgments.
34. The following figures are furnished for informational purposes only:
    Locator # 623-980-A-000 (Parcel A)
    Assessed Valuation: 0.00
    Rate: 6.0950

    Locator #: 623-975-B-000 (Parcels A and B)
    Assessed Valuation: 0.00
    Rate: 6.0950

    Locator #: 623-710-A-000 (Parcel C)
    Assessed Valuation: 0.00
    Rate: 6.0950

    Locator #: 624-100-B-000 (Parcel C)
    Assessed Valuation: 0.00
    Rate: 6.0950

    NOTE: The above tax information encumbers more property than is being examined.

This commitment is invalid unless the Insuring Provisions and Schedules A and B are attached.

Schedule B2 consists of 4 page(s)

Appendix E

Institutional Control Documentation

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Appendix E
Institutional Control Documentation

1. Notation on Ownership Record for Notification to Potential Owners of Contaminated Groundwater and Applied Restrictions Chemical Plant Site and Quarry Areas (Recorded Book 3754, Pages 419-424, St. Charles County, Missouri) ..... E−1

2. Real Estate License, Groundwater Wells and Sampling on property owned by Missouri Department of Conservation (not recorded) ..... E−7

3. Real Estate License, Effluent Water Pipeline on property owned by Missouri Department of Conservation (not recorded) ..... E−21

4. Real Estate License, Access to North Gate Area on property owned by Missouri Department of Conservation (not recorded) ..... E−27

5. Southeast Drainage Easement, open outfall sewer, on property owned by Missouri Department of Conservation (Recorded Book 292, Pages 597-601, St. Charles County, Missouri) ..... E−33

6. Real Estate License, Groundwater Wells and Sampling on property on which Missouri Department of Natural Resources holds an interest (not recorded) ..... E−39

7. Real Estate License, Effluent Water Pipeline on property on which Missouri Department of Natural Resources holds an interest (not recorded) ..... E−45

8. Memorandum of Understanding between the U.S. Department of Energy and the U.S. Department of Army Concerning Transfer of Custody and Accountability for, and Funding of Remedial Actions at, the Weldon Spring Chemical Plant ..... E−51

9. Special Area Designation Under the State Well Drillers Act [10 CSR 23-3.100(8)] .. E−61

10. Agreement with MDNR-Parks for Special Assistance ..... E−69

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S-3
L-1
E-5

20040108000017370 NOTICE
Bk:DE3754 Pg:419
01/08/2004 08:10:12AM 1/6

CERTIFIED-FILED FOR RECORD
Barbara J. Hall
Recorder of Deeds
St. Charles County, MO
BY: Janice James

1) Title of the Document: NOTATION ON OWNERSHIP RECORD FOR NOTIFICATION TO POTENTIAL OWNERS OF CONTAMINATION IN GROUNDWATER AND APPLIED RESTRICTIONS CHEMICAL PLANT SITE AND QUARRY AREAS

2) Date of the Document: December 11, 2003

3) Grantors' Names: United States Department of Energy

4) Grantees' Names: United States Department of Energy

5) Any Statutorily required addresses: United States Department of Energy
Katy Kates, AD-42
Procurement and Contracts Division
P.O. Box 2001
Oak Ridge, TN 37830

6) The legal description of the property affected:

Chemical Plant Site Area:

a. Tract 1-A (later B-136) was acquired from Daisy Sutton Johnson et al through the filing of a Declaration of Taking on June 18, 1941 under Civil Action 984.
b. Tract 16/38 (later D-322) was acquired from Chiles F. Stewart et ux through the filing of a Declaration of Taking on April 9, 1941 under Civil Action 805.
c. Tract 94 (later B-135) was acquired by deed dated December 14, 1940 from Howard W. Carrico et ux. Deed was recorded in Deed Book 194, Page 471 in St. Charles County, Missouri.
d. Tract 186 (later B-137) was acquired from Addie M. Sutton et al through the filing of a Declaration of Taking on April 8, 1941 under Civil Action 790.
e. Tract 202 (later D-321) was acquired from George H. Hackmann et ux through the filing of a Declaration of Taking on April 8, 1941 under Civil Action 794.
f. Tract 209 (later B-138) was acquired from Marvin Howell through the filing of a Declaration of Taking on April 9, 1941 under Civil Action 804.
g. Tract 189 (later D-252) was acquired from Elizabeth Thiele through the filing of a Declaration of Taking on May 7, 1945 under Civil Action 980.

Quarry Area:

Tract 11-A (later D-242) was acquired from Ed J. and Emma Linnenbringer through the filing of a Declaration of Taking on May 7, 1945 under Civil Action 987.

7) Reference book and pages for statutory requirements:

PAM THOMPSON/PROJECT MANAGER - US
DEPARTMENT OF ENERGY - WELDON SPRI

ENV- 7295 HIGHWAY 94 SOUTH
ST CHARLES, MO 63304

This document prepared by
Katy Kates, Realty Officer
U.S. Dept. of Energy, P.O. Box 2001
Oak Ridge, Tennessee 37831

NOTATION ON OWNERSHIP RECORD
FOR NOTIFICATION TO POTENTIAL OWNERS OF CONTAMINATION
IN GROUNDWATER AND APPLIED RESTRICTIONS
CHEMICAL PLANT SITE AND QUARRY AREAS

This action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 USC, Section 9601 et seq.

The United States of America, Department of Energy (DOE), is the current jurisdictional owner of the areas identified as the chemical plant portion and the quarry portion of the Weldon Spring Site Remedial Action Project in Missouri and depicted on the attached survey maps of the site. Said survey maps are titled *Weldon Spring Site Remedial Action Project, MO., Boundary Survey for WSSRAP Site*, dated September 2002, prepared by St. Charles Engineering & Surveying, Inc. DOE gives notice that certain activities occurred on the sites that resulted in contamination of underground water and soils which could pose risks to human health and the environment. DOE has completed the remedies for the Chemical Plant Site Area and the Quarry area in accordance with CERCLA but some restrictions are required to maintain the protectiveness of these remedies.

With the exceptions noted below, DOE hereby places the following restrictions and/or prohibitions on the land:

a. Current owners or users of these areas shall not disturb the land and its soils by drilling, boring, or digging within the restricted areas and shall not access the groundwater for any use-type activity. Exceptions to these restrictions include DOE's rights to perform or grant rights for landscaping activities; to perform ongoing environmental restoration including planting of interpretive gardens; maintenance; and investigation and sampling by DOE, including drilling of necessary monitoring wells, to discern the types and extent of possible contamination.

b. Current owners or users of the areas shall not construct, erect nor permit to be constructed or erected any type of residential dwelling or facility for human occupancy on the premises, other than for facilities to be occupied for mission-connected purposes including activities associated with performing environmental investigation and/or restoration and expansion of the existing Interpretive Center.

DOE shall continue to monitor and analyze the groundwater through approved investigative techniques. Should the land be conveyed to another party, notice of the restrictions and/or prohibitions cited herein shall be placed within the conveyance document(s) noting such restrictions and/or prohibitions on use.

Title to the land, which is the subject of this Notation, was originally acquired by the United States of America (Department of Army) in connection with the Weldon Spring Ordnance Works as follows. Civil Actions were filed in the Eastern Division of the United States District Court for the Eastern District of Missouri:

1. Chemical Plant Site Area:

a. Tract 1-A (later B-136) was acquired from Daisy Sutton Johnson et al through the filing of a Declaration of Taking on June 18, 1941 under Civil Action 984.

b. Tract 16/38 (later D-322) was acquired from Chiles F. Stewart et ux through the filing of a Declaration of Taking on April 9, 1941 under Civil Action 805.

c. Tract 94 (later B-135) was acquired by deed dated December 14, 1940 from Howard W. Carrico et ux. Deed was recorded in Deed Book 194, Page 471 in St. Charles County, Missouri.

d. Tract 186 (later B-137) was acquired from Addie M. Sutton et al through the filing of a Declaration of Taking on April 8, 1941 under Civil Action 790.

e. Tract 202 (later D-321) was acquired from George H. Hackmann et ux through the filing of a Declaration of Taking on April 8, 1941 under Civil Action 794.

f. Tract 209 (later B-138) was acquired from Marvin Howell through the filing of a Declaration of Taking on April 9, 1941 under Civil Action 804.

g. Tract 189 (later D-252) was acquired from Elizabeth Thiele through the filing of a Declaration of Taking on May 7, 1945 under Civil Action 980.

2. Quarry Area

Tract 11-A (later D-242) was acquired from Ed J. and Emma Linnenbringer through the filing of a Declaration of Taking on May 7, 1945 under Civil Action 987.

The Realty Officer hereunto subscribes her name on this 11th day of December, 2003.

Signed and acknowledged in the presence of:

Katy Kates
Realty Officer
U.S. Department of Energy

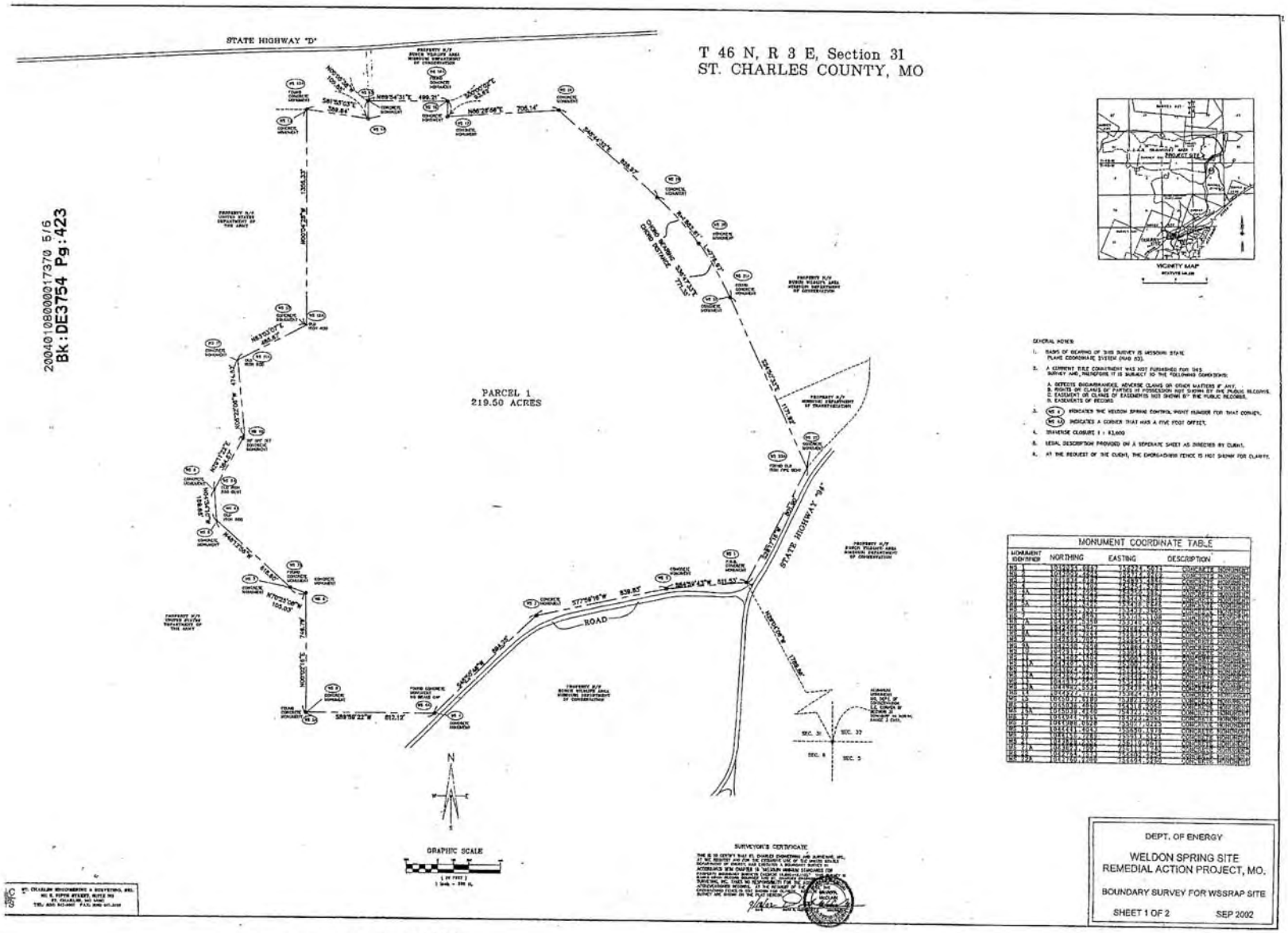
ACKNOWLEDGEMENT

State of Tennessee)
Anderson County)

On this the 11th day of December, 2003, before me M. Jill Stephenson, a Notary Public in and for said state, personally appeared Katy Kates, Realty Officer of the Oak Ridge Operations Office of the U.S. Department of Energy, known to me to be the person who executed the within Notation on Ownership Record on behalf of said U.S. Department of Energy and acknowledged to me that she executed the same for the purpose therein stated.

M. Jill Stephenson
Notary Public

(Seal)
My commission expires on: 9/17/2007
9/17/2007



200401080000017370 5/5
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RECORD AS IS

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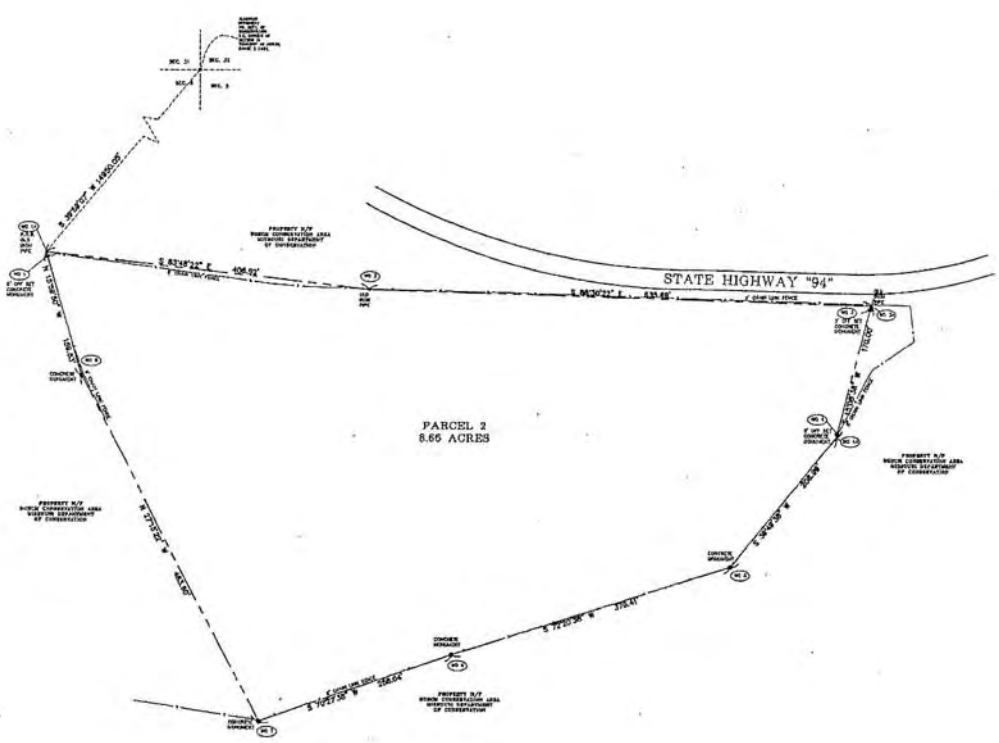
BK:DE3754 Pg:424

T 45 N, R 2 E, Section 13
ST. CHARLES COUNTY, MO



LOCATION MAP

GENERAL NOTES:

1. BASIS OF BEARING OF THIS SURVEY IS MISSOURI STATE PLANE COORDINATE SYSTEM (NAD 83).
2. C.I.S. INDICATES A CONCRETE MONUMENT TO BE SET BY ST. CHARLES ENGINEERING AND SURVEYING, INC.
3. A CURRENT TITLE COMMITMENT WAS NOT FURNISHED FOR THIS SURVEY AND THEREFORE IT IS SUBJECT TO THE FOLLOWING CONDITIONS:
   A. DEFECTS ENCUMBRANCES, ADVERSE CLAIMS OR OTHER MATTERS IF ANY.
   B. RIGHTS OR CLAIMS OF PARTIES IN POSSESSION NOT SHOWN BY THE PUBLIC RECORDS.
   C. EASEMENT OR CLAIMS OF EASEMENTS NOT SHOWN BY THE PUBLIC RECORDS.
   D. EASEMENTS OF RECORD
4. (WS 1) INDICATES THE WELDON SPRING QUARRY CORNER, POINT NUMBER FOR THAT CORNER.
5. TRAVERSE CLOSURE 1 : 48,000
6. LEGAL DESCRIPTION PROVIDED ON SEPARATE SHEET AS DIRECTED BY CLIENT.

MONUMENT COORDINATE TABLE

MONUMENT IDENTIFIER	NORTHING	EASTING	DESCRIPTION
WQ1	1029029.9033	747489.1459	CONCRETE MONUMENT
WQ1A	1029031.1923	747487.3686	OLD IRON PIPE
WQ2	1028938.8954	747891.9123	OLD IRON PIPE
WQ3	1028969.4935	748526.0802	CONCRETE MONUMENT
WQ3A	1028971.9223	748527.3864	OLD IRON PIPE
WQ4	1028815.0522	748484.2911	CONCRETE MONUMENT
WQ4A	1028816.2240	748482.9748	CONCRETE MONUMENT
WQ5	1028649.7201	748349.1215	CONCRETE MONUMENT
WQ6	1028537.3398	747996.1453	CONCRETE MONUMENT
WQ7	1028451.8770	747752.3864	CONCRETE MONUMENT
WQ8	1028881.1600	747531.14155	CONCRETE MONUMENT

SURVEYOR'S CERTIFICATE

ST. CHARLES ENGINEERING & SURVEYING, INC.

DEPT. OF ENERGY
WELDON SPRING SITE
REMEDIAL ACTION PROJECT, MO.
BOUNDARY SURVEY FOR WSSRAP SITE
SHEET 2 OF 2 SEP 2002

RECORD AS IS

958 26

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831

January 13, 2003

Joel W. Porath, Wildlife District Supervisor
Missouri Department of Conservation
August A. Busch Conservation Area
2360 Highway D
St. Charles, Missouri 63304

Dear Mr. Porath:

REAL ESTATE LICENSE REORDOER-7-03-0102, GROUNDWATER WELLS AND SAMPLING, WELDON SPRING SITE, MO

Enclosed is a fully executed copy of the subject license designed to grant the Department of Energy (DOE) permission to install and operate groundwater wells and perform water sampling on property owned by the Missouri Department of Conservation (MDOC).

It was noted that when this was signed by MDOC, Mr. Erickson inadvertently signed the Exhibit "C" attached to the license. Since that exhibit is intended to be used only in the event that additional wells are required or existing wells must be relocated, I took the liberty of reprinting that page and inserting it in its unexecuted form back into the license.

If you have any questions, please feel free to contact me at 865-576-0977. Thank you for your coordination of this action.

Sincerely,

Katy Kates

Katy Kates
Realty Officer

Enclosure
As stated

cc: Pamela Thompson, DOE Site Manager at WSSRAP
Scott Anderson, MK Ferguson at WSSRAP

REAL ESTATE LICENSE NO.
REORDOER-7- 23-0102

DEPARTMENT OF ENERGY

LICENSE

PROJECT: WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO
PURPOSE: GROUNDWATER WELLS, SAMPLING

THIS LICENSE, between the Missouri Department of Conservation, known as the "Grantor" and the U.S. Department of Energy, known as the "Grantee", is subject to the following terms and conditions.

1. Rights Granted - The Grantor grants to the Grantee, its agents, employees, or representatives permission to use the premises or facilities, together with ingress and egress, for the purpose of installing, operating, and maintaining groundwater monitoring well(s); performing well sampling and water sampling; and for performing miscellaneous sampling to determine the levels of contamination, if any, at the locations shown depicted on Exhibits "A-1", "A-2", and "B" attached to this instrument.

2. Term/Termination Rights - This License is effective upon the date of execution by the Grantee of this instrument and shall continue in effect for a period of ten (10) years unless terminated by either of the parties on not less than thirty (30) days prior written notice given to the other; provided, however, that the Grantor may not terminate this License without the Grantee's approval.

3. Authority to License - The Grantor represents and warrants that it is the owner of the property and has full right, power, and authority to enter into this License and grant the rights set out in this License.

4. Grantor Responsibility - The Grantor responsibility is set out within the terms and conditions of the rights granted under this License. The Grantor makes no representation as to the suitability or fitness of the premises for the intended purpose.

5. Grantee Responsibility - The Grantee, its agents, employees, or representatives will be responsible for property damage or injury to persons caused by the sole and direct negligence of their respective employees in performing on the Grantor's premises the activities and restoration which are the subject of this License. Grantee shall obtain all necessary permits, licenses, and approvals in connection with the activities to be conducted by the Grantee on the premises. During the performance of the activities specified in this License, the Grantee shall not unreasonably interfere with the use and enjoyment of the premises by the Grantor.

6. Access - During the term of this License, the Grantee, its agents, employees, or representatives shall have the right of access to and egress from the premises as needed and shall have the right to bring necessary equipment upon the premises in connection with the performance of the Grantee's activities as set out in Condition 1.

7. Installation, Maintenance, Closure of Groundwater Monitoring Wells – As deemed necessary in connection with the groundwater well sampling and analysis program of the Grantee, groundwater monitoring wells have been installed at the various locations shown on Exhibits "A-1", "A-2", and "B" attached to this License. If the Grantor deems it necessary to expand its facility or operation within the premises, the wells may be relocated at the expense of the Grantee. The exact siting of each

well shall be agreed on by the Grantor and Grantee following a walkover survey of the premises. The Grantee shall properly dispose of cuttings and development water from its well installation activities. The Grantee shall maintain the wells throughout the term of this License in a manner to ensure their continued usefulness for groundwater monitoring purposes. Following completion of the installation of any additional wells as provided for in subsequent Supplemental Agreements to this License or upon closure of any well, the Grantee shall restore the premises in accordance with Condition No. 11. Upon termination of this License, the Grantee shall seal, close and abandon the wells in place following established industry standards and environmental regulations and guidance applicable at the time of closure.

8. Additional or Relocated Wells – As required by Grantee's groundwater monitoring program, additional sites or the need to relocate the location of existing wells may be deemed necessary. If this occurs, appropriate Supplemental Agreements to this License in the format shown in Exhibit "C" will be executed by the Grantor and the Grantee's Federal Realty Officer.

9. Well Sampling – During the term of this License, the Grantee will from time to time bore, drive, sample and analyze surface water and water from any existing well (to include all existing groundwater wells) and from any newly installed groundwater monitoring wells on the premises in order to determine the levels, if any, of contaminants and other constituents of interest to the Grantee. Grantee shall attempt to notify the Grantor of the times at which samples will be taken at least twenty-four (24) hours in advance, and afford the Grantor an opportunity to observe the sampling. Grantee shall properly dispose of purge water from its boring and sampling activities.

10. Title to Equipment, Fixtures - Title to all equipment, fixtures, appurtenances, and other improvements furnished and installed in connection with the Grantee's activities under this License shall remain with the Grantee.

11. Restoration - Upon termination of this License, the Grantee shall remove all its equipment, fixtures, appurtenances, and other improvements furnished and installed on the premises in connection with the Grantee's activities under this License. The Grantee shall restore the premises, when such restoration is required in connection with the Grantee's activities, to the extent reasonably practical, to the condition existing at the time of initiation of the Grantee's activities. With the consent of the Grantor, the Grantee may abandon Grantee-owned equipment, fixtures, appurtenances, and other improvements in place in lieu of restoration when it is in the best interests of the Grantee.

12. Successors in Interest - This License and the parties' commitments within, shall be binding on both parties, their successors, and assigns.

13. Funding - Obligations of the Grantee under this License shall be subject to the availability of funds appropriated by the Congress which the Grantee may legally spend for such purposes and nothing in this License implies that Congress will appropriate funds to perform this License.

14. Notices - All notices regarding the specific terms and conditions of this License, and within the restrictions of this License, shall be in writing and shall be deemed effectively given upon personal delivery, upon verified facsimile receipt, or upon mailing by registered or certified mail, postage prepaid, and addressed to the parties at the following respective addresses, or to such other persons or at such other addresses as may be designated in writing by either party to the other.

REAL ESTATE LICENSE NO.
REORDOER-7- 03-0102

If to the Grantee:

Katy Kates, Realty Officer
U.S. Department of Energy
P.O. Box 2001
Oak Ridge, Tennessee 37831

If to the Grantor:

Joel W. Porath, Wildlife District Supervisor
Missouri Department of Conservation
August A. Busch Conservation Area
2360 Highway D
St. Charles, Missouri 63304

15. Entire Agreement - This License represents the entire understanding of the parties on this matter and no oral statements or collateral documents (except as noted within) may modify this License.

16. Amendment - This License may not be amended or superseded except by an agreement in writing executed by the Grantor and Grantee's Realty Officer.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

GRANTOR: Missouri Department of Conservation

By: [signature]

Title: [illegible]

Date: [illegible]

GRANTEE: U.S. Department of Energy

By: Katy Kates
Katy Kates

Title: Realty Officer

Date: January 13, 2003

REAL ESTATE LICENSE NO.
REORDOER-7-03-0102

EXHIBIT "C"

SUPPLEMENTAL AGREEMENT OF LICENSE

SUPPLEMENTAL AGREEMENT NO. _____ EFFECTIVE DATE _____

TYPE OF GRANT License GRANT NUMBER REORDOER-7-03-0102

GRANTOR Missouri Dept. of Conservation GRANTEE Dept. of Energy

PROJECT Weldon Spring Site Remedial Action Project, MO PURPOSE Groundwater Monitoring Wells, Sampling

The above numbered grant is modified in the following respects:

a. Under Condition No. 8 of the basic License, (an) additional _____ groundwater well(s) may be installed on property of the Grantor at the location(s) shown on revised Exhibit ____ attached hereto and made a part of the basic License.

Except as provided herein, all terms and conditions of the document referred to above remain unchanged and in full force and effect.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

GRANTOR: Missouri Department of Conservation GRANTEE: U.S. Department of Energy

By: _____ By: _____
Katy Kates
DOE Real Estate Office

Title: _____ Title: Realty Officer

Date: _____ Date: _____

REAL ESTATE LICENSE NO.
REORDOER-7-03-0102

SUPPLEMENTAL AGREEMENT OF LICENSE

SUPPLEMENTAL AGREEMENT NO. 1 EFFECTIVE DATE 6-14-2004

TYPE OF GRANT License GRANT NUMBER REORDOER-7-03-0102

GRANTOR Missouri Dept. of Conservation GRANTEE Dept. of Energy

PROJECT Weldon Spring Site, MO PURPOSE Groundwater Monitoring Wells, Sampling

The above numbered grant is modified in the following respects:

a. Under Condition No. 8 of the basic License, one additional groundwater well will be installed on the property of the Grantor at the location shown on revised Exhibit "A-1" attached hereto and made a part of the basic License. Grantee will select one groundwater well location from the three (3) boreholes to be drilled at the locations shown on Exhibit "A-1". Said well will be designated as MW-4041.

Except as provided herein, all terms and conditions of the document referred to above remain unchanged and in full force and effect.

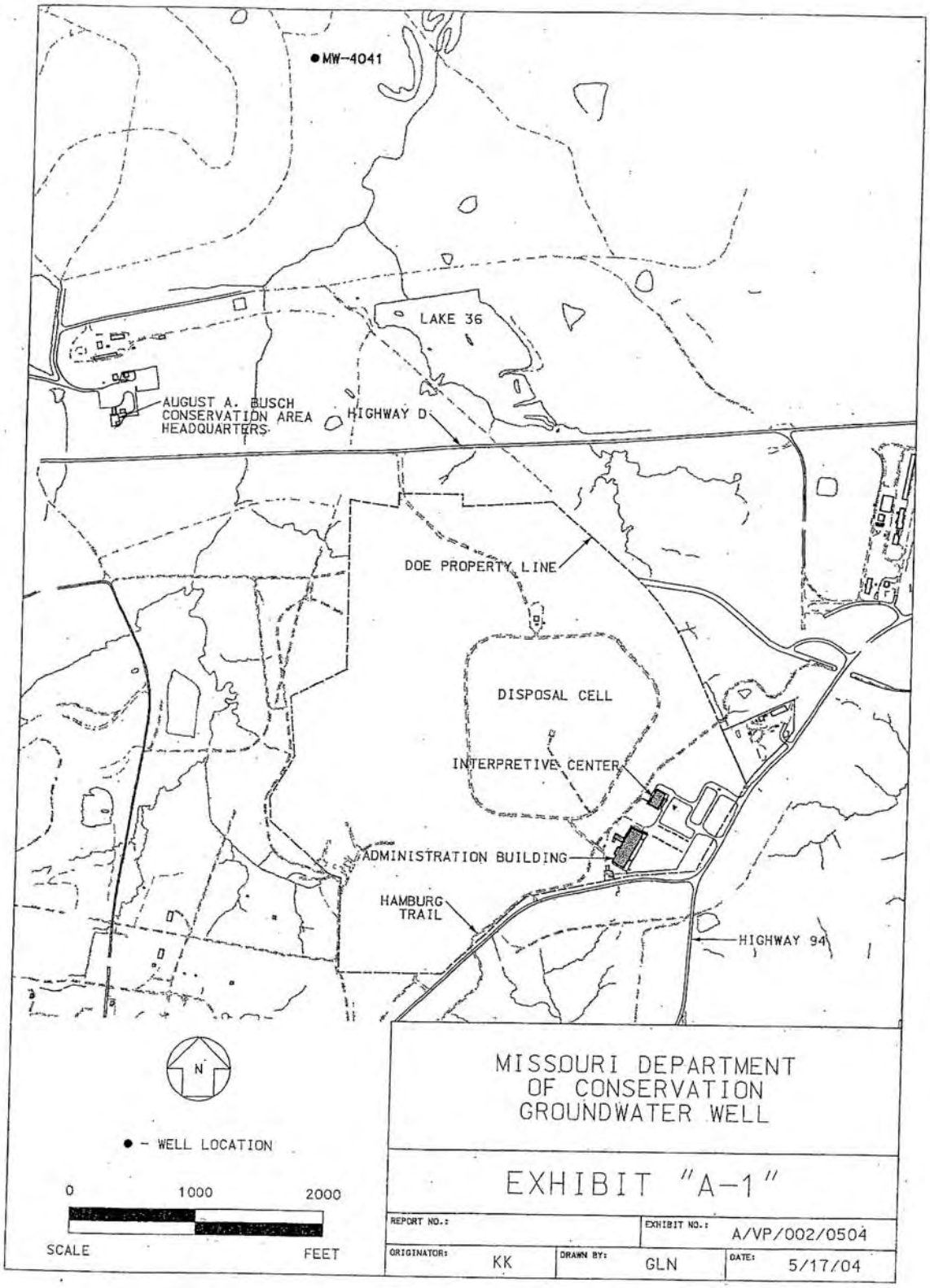
The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

GRANTOR: Missouri Department of Conservation GRANTEE: U.S. Department of Energy

By: [signature] By: Katy Kates
Katy Kates
DOE Real Estate Office

Title: Wildlife Div. Administrator Title: Realty Officer

Date: 6/8/04 Date: June 14, 2004


MW-4041
LAKE 36
AUGUST A. BUSCH
CONSERVATION AREA
HEADQUARTERS
HIGHWAY D
DOE PROPERTY LINE
DISPOSAL CELL
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
HAMBURG
TRAIL
HIGHWAY 94
N
● - WELL LOCATION
0
1000
2000
SCALE
FEET
MISSOURI DEPARTMENT
OF CONSERVATION
GROUNDWATER WELL
EXHIBIT "A-1"
REPORT NO.:
EXHIBIT NO.:
A/VP/002/0504
ORIGINATOR:
KK
DRAWN BY:
GLN
DATE:
5/17/04

Contract No. AT-(23-2)-41

Tr. 100E

EASEMENT

THIS AGREEMENT, made and entered into as of the 3rd day of August, 1956, by and between THE CURATORS OF THE UNIVERSITY OF MISSOURI (hereinafter called the "Grantor"), and the UNITED STATES ATOMIC ENERGY COMMISSION acting for and in behalf of the UNITED STATES OF AMERICA (hereinafter called the "Grantee").

WITNESSETH THAT:

The Grantor does by these present grant, bargain, sell, convey, and confirm to the Grantee a right-of-way and easement, for as long as said property is used for the purposes described herein, in the following described property located in St. Charles County, Missouri to wit:

A strip of land 200 ft. in width, approximately 6,989 ft. in length, containing approximately 32 acres and having a center line description as follows: 32.09

Commencing at the Northeast corner of Section 6, T.45 N - R.3 E thence South 300 ft. to a point, thence 1,740 ft. West to the point of beginning; thence South 52 degrees East for a distance of 990 ft. to a point, thence South 25 degrees East for a distance of 730 ft. to a point, thence South 1 degree East for a distance of 820 ft. to a point, thence South 21 degrees East for a distance of 960 ft. to a point, thence South 56 degrees East for a distance of 630 ft. to a point, thence South 13 degrees 30 minutes West for a distance of 730 ft. to a point, thence South 25 degrees East for a distance of 1,009 ft. to a point, thence South 33 degrees East for a distance of 1,120 ft. to a point that is identical to the center line of the Missouri-Kansas-Texas Railroad Bridge.

Tr. 100E

This easement is conveyed for use in the construction and maintenance of an open outfall sewer for the conveyance of plant process and sanitary waste from the Grantee's plant facilities adjacent to the land of the Grantor, and the Grantee shall have the right, privilege, and authority to construct and maintain such outfall sewer.

Later reacq. as Tr. G which subsequently was merged into Tr. I

3079

Grantor covenants as follows:

1. Warrants that it has and owns the unencumbered title to said premises, subject only to conditions and limitations set forth in a Quitclaim Deed made the thirtieth day of November, 1948, between the United States of America, acting by and through the Federal Farm Mortgage Corporation, and The Curators of the University of Missouri, recorded in Book 230, page 481, of the Deed Records of St. Charles County, Missouri.

2. That the Grantee performing the terms and conditions hereunder shall quietly hold and enjoy said premises for the full term herein created.

3. That it will give to Grantee reasonable ingress and egress across its property for the purpose of construction and maintenance of the fence hereinafter described.

Grantee covenants:

1. That for and in consideration of the easement granted herein, the Grantee shall erect a five-strand, barbed-wire fence upon the Grantor's property on a line described as follows, excepting that no fence shall be erected along that portion of said line which runs along the bluff of the Missouri river, consisting of approximately 2,590 feet:

Commencing at the Southeast corner of Section 31, T.46 North R.3 E thence West 2,438 ft, thence North 1,120 ft. to the point of beginning; thence North 47 degrees 06 minutes 15 seconds East a distance of 50 ft, thence South 42 degrees 53 minutes 45 seconds East a distance of 170.7 ft, thence South 10 degrees 02 minutes 30 seconds East a distance of 360.7 ft, thence North 70 degrees 57 minutes 30 seconds East a distance of 200 ft, thence South 10 degrees 02 minutes 30 seconds East a distance of 267.54 ft, thence South 24 degrees 01 minute 41 seconds East a distance of 393.8 ft, thence South 65 degrees 58 minutes 19 seconds West a distance of 100 ft, thence South 24 degrees 01 minute 41 seconds East a distance of 198.12 ft.

to the Northern right-of-way line of State Highway No. 94, thence South 42 degrees 13 minutes West along the Northern right-of-way line of State Highway No. 94 a distance of 491.7 ft, thence North 24 degrees 01 minute 41 seconds West a distance of 395.67 ft, thence North 65 degrees 58 minutes 19 seconds East a distance of 300 ft, thence North 24 degrees 01 minute 41 seconds West a distance of 415 ft, thence South 70 degrees 57 minutes 30 seconds West a distance of 50 ft, thence North 19 degrees 02 minutes 30 seconds West a distance of 606.83 ft, thence North 42 degrees 53 minutes 45 seconds West a distance of 149.3 ft, thence North 47 degrees 06 minutes 15 seconds East a distance of 50 ft, to the point of beginning.

Commencing at the Northwest corner of Northeast one-fourth of Section 6, Township 45 North, Range 3 East; thence South 66 degrees 12 minutes East 755.75 ft, to the point of beginning, thence North 48 degrees 35 minutes East 384.4 ft, thence North 87 degrees 43 minutes East 392.1 ft, thence South 58 degrees 58 minutes East 334.4 ft, thence South 53 degrees 44 minutes East 446.5 ft, thence South 14 degrees 10 minutes East 311.7 ft, thence South 14 degrees 11 minutes East 364.6 ft, thence South 39 degrees 32 minutes East 507.7 ft, thence South 72 degrees 37 minutes East 678.3 ft, thence South 8 degrees 43 minutes East 511.8 ft, thence South 49 degrees 34 minutes East 281.2 ft, thence South 73 degrees 49 minutes East 412.0 ft, thence North 15 degrees 57 minutes East 264.0 ft, thence South 67 degrees 35 minutes East 257.4 ft, thence South 7 degrees 42 minutes East 207.1 ft, thence South 41 degrees 46 minutes East 314.9 ft, thence South 45 degrees 25 minutes East 390.1 ft, thence South 52 degrees 42 minutes East 392.0 ft, thence South 35 degrees 33 minutes East 353.7 ft, thence South 27 degrees 06 minutes East 685.6 ft, thence South 1 degree 26 minutes West 587.0 ft, thence South 41 degrees 46 minutes

West 93.5 ft, thence South 43 degrees 50 minutes West 253.3 ft, thence South 71 degrees 2 minutes West 131.3 ft, thence South 51 degrees 19 minutes West 176.2 ft, thence South 72 degrees 08 minutes West 100.3 ft, thence South 51 degrees 25 minutes West 79.0 ft, thence South 8 degrees 8 minutes East 98.1 ft, thence South 57 degrees 58 minutes West 996.0 ft, thence South 53 degrees 02 minutes West 1,031.6 ft, thence North 16 degrees 45 minutes West 100.2 ft, thence North 44 degrees 37 minutes East 83.0 ft, thence North 65 degrees 52 minutes East 103.1 ft, thence North 38 degrees 09 minutes West 415.4 ft, thence North 20 degrees 52 minutes West 316.1 ft, thence North 39 degrees 22 minutes West 253.3 ft, thence North 50 degrees 37 minutes West 423.7 ft, thence North 57 degrees 57 minutes West 224.4 ft, thence North 7 degrees 10 minutes West 182.6 ft, thence North 34 degrees 09 minutes West 202.4 ft, thence North 60 degrees 23 minutes West 190.6 ft, thence North 39 degrees 59 minutes West 211.5 ft, thence North 42 degrees 33 minutes West 360.1 ft, thence North 31 degrees 08 minutes West 254.8 ft, thence North 12 degrees 55 minutes West 243.6 ft, thence North 35 degrees 57 minutes East 213.4 ft, thence North 27 degrees 00 minutes West 330.7 ft, thence North 26 degrees 24 minutes East 155.5 ft, thence North 7 degrees 05 minutes West 361.6 ft, thence South 88 degrees 49 minutes West 195.5 ft, thence North 11 degrees 03 minutes West 484.0 ft, thence North 22 degrees 45 minutes West 178.3 ft, thence North 29 degrees 18 minutes West 211.0 ft, thence North 50 degrees 42 minutes West 1,029.4 ft, thence North 29 degrees 29 minutes East 975.8 ft, thence North 23 degrees 33 minutes East 247.9 ft, to the point of beginning.

2. That it will maintain said fence along the line above described in good and serviceable condition for the term of the easement, or so long as the Grantor shall request but not to exceed the term of this easement.

3. That it will use due care in the maintenance and use of said outfall sewer, taking into consideration the nature of the discharge and waste running there through, and that it will comply with all rules and regulations of the Board of Health of the State of Missouri, or other governmental agencies, with reference to discharging the waste into the Missouri River.

4. That Grantor shall have the right to remove any timber that is growing or may grow upon said easement right-of-way and the free use of said strip of land in any way that shall not interfere or conflict with use and maintenance of said outfall sewer.

5. That it will, subject to the availability of funds, save and hold the Grantor harmless from any liability that the Grantor may, without fault or negligence of Grantor, incur on account of the Grantee's use of the rights granted hereunder; provided, however, that the Grantee shall not be liable for any claim settlement or judgment made or obtained against the Grantor unless the Grantee has been notified of such claim and has had the opportunity to defend such claim or agree to any settlement made by the Grantor.

6. That its maintenance of the fence herein provided shall give it no interest or right in any lands of the Grantors other than the 200 foot strip hereinabove specifically described.

7. That this easement is accepted subject to the terms and conditions set forth in the Quitclaim Deed made the thirtieth day of November, 1948, by and between the United States of America, acting by and through the Federal Farm Mortgage Corporation, and The Curators of the University of Missouri, recorded in Book 230, page 481, of the Deed Records of St. Charles County, Missouri.

IN WITNESS WHEREOF, the Grantor has caused this lease to be executed and its corporate seal hereto affixed the day and year first above written.

Approved: J. H. Longwell, Director
Agricultural Experimental Station

THE CURATORS OF THE UNIVERSITY OF MISSOURI

ATTEST: Mary Ropnett, Secretary

By: James A. Finch, Jr.
President

ACCEPTED FOR THE UNITED STATES ATOMIC ENERGY COMMISSION

By:

State of Missouri }
County of Boone } ss

On this 3rd day of August, 1956, before me appeared James A. Finch, Jr., to me personally known, who, being by me duly sworn, did say he is President of The Curators of the University of Missouri, a public corporation of the State of Missouri, and that the seal affixed to the foregoing instrument is the corporate seal of said corporation and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Curators, and said James A. Finch, Jr. acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in Columbia, Missouri, Boone County, Missouri, the day and year last above written.

My term expires: October 13, 1958

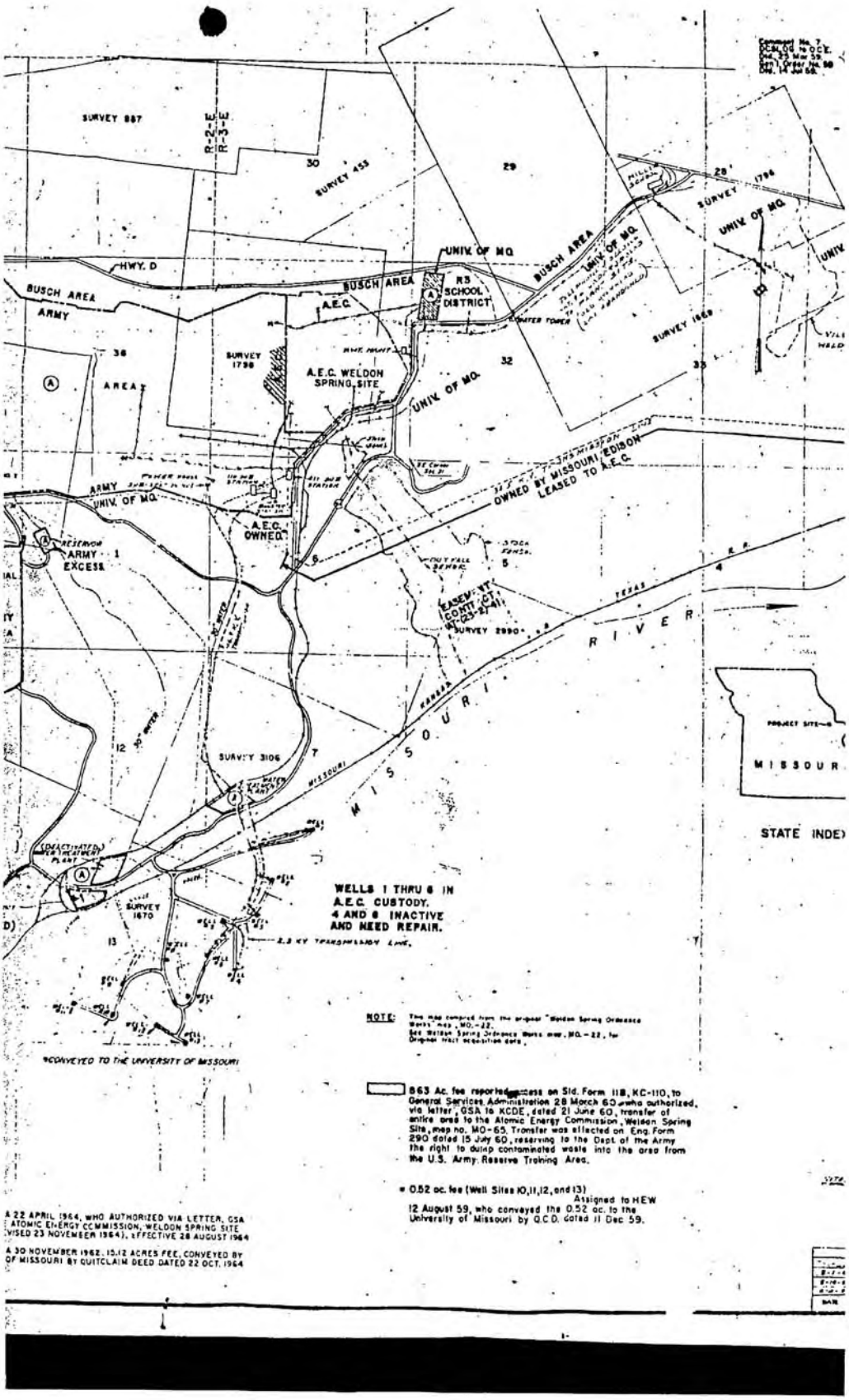
Sue Wagner
Notary Public within and for Boone County, Missouri

STATE OF MISSOURI }
County of St. Charles, } ss.

I, the undersigned, Recorder of Deeds for said County and State do hereby certify that the foregoing and annexed instrument of writing was filed for record in my office on the 20th day of August A. D. 1956 at 2:00 o'clock P. M. and is truly recorded in Book 292 Page 527

Witness my hand and official seal on the day and year aforesaid.

Deputy Ernest E. Pauls Recorder of Deeds


SURVEY 887
R 2 W
R 3 W
30
SURVEY 453
29
28
SURVEY 1796
UNIV. OF MO.
HWY. D
BUSCH AREA
ARMY
A.E.C.
R3 SCHOOL DISTRICT
WATER TOWER
SURVEY 1668
36
AREA I
SURVEY 1798
A.E.C. WELDON SPRING SITE
32
33
OWNED BY MISSOURI EDISON LEASED TO A.E.C.
A.E.C. OWNED
ARMY EXCESS
5
4
TEXAS
SURVEY 2990
MISSOURI RIVER
KANSAS
12
SURVEY 3106
7
MISSOURI
STATE INDEX
(DEACTIVATED) WATER TREATMENT PLANT
SURVEY 1670
13
WELLS 1 THRU 6 IN A.E.C. CUSTODY. 4 AND 6 INACTIVE AND NEED REPAIR.
2.3 KV TRANSMISSION LINE.
NOTE:
863 Ac. fee reported excess on Sld. Form 118, KC-110, to General Services Administration 28 March 60 who authorized, via letter, GSA to KCDE, dated 21 June 60, transfer of entire area to the Atomic Energy Commission, Weldon Spring Site, map no. MO-65. Transfer was effected on Eng. Form 290 dated 15 July 60, reserving to the Dept of the Army the right to dump contaminated waste into the area from the U.S. Army Reserve Training Area.
* 0.52 ac. fee (Well Sites 10,11,12, and 13) Assigned to HEW 12 August 59, who conveyed the 0.52 ac. to the University of Missouri by Q.C.D. dated 11 Dec 59.
A 22 APRIL 1964, WHO AUTHORIZED VIA LETTER, GSA ATOMIC ENERGY COMMISSION, WELDON SPRING SITE VISED 23 NOVEMBER 1964), EFFECTIVE 28 AUGUST 1964
A 30 NOVEMBER 1962, 15.12 ACRES FEE, CONVEYED BY OF MISSOURI BY QUITCLAIM DEED DATED 22 OCT. 1964

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831-—

March 7, 2003

Joel W. Porath, Wildlife Regional Supervisor
Missouri Department of Conservation
August A. Busch Conservation Area
2360 Highway D
St. Charles, Missouri 63304

LICENSE REORDOER-7-03-0105, WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO

Enclosed is a fully executed copy of the subject license designed to grant the Department of Energy (DOE) continuing operation and maintenance of a pipeline for effluent water flow across your agency's property.

As a matter of information, it was noted on the license you returned to this office that you had highlighted a portion of the license identifier at the top right-hand corner. Perhaps it was your assumption that there was a typographical error in that identifier. Actually, it is correct and stands for "Real Estate Oak Ridge Department of Energy Realty" or REORDOER. I was able to make the change you had indicated on page 2 to revise your title to Wildlife Regional Supervisor as opposed to the Wildlife District Supervisor that the license initially carried.

Thank you again for your coordination of this action. Please feel free to contact me at 865-576-0977 for any questions or comments you may have.

Sincerely,

Katy Kates

Katy Kates
Realty Officer

Enclosure
As stated

Cc: Pamela Thompson, WSSRAP Site Manager
Scott Anderson, Project Director, MK Ferguson

REAL ESTATE LICENSE NO.
REORDOER-7- 03 0105

DEPARTMENT OF ENERGY

LICENSE

PROJECT: WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO
PURPOSE: EFFLUENT WATER PIPELINE

THIS LICENSE, between Missouri Department of Conservation, known as the "Grantor" and the U.S. Department of Energy, known as the "Grantee", is subject to the following terms and conditions.

1. Rights Granted - The Grantor grants to the Grantee, its agents, employees, or representatives permission to use the premises or facilities, together with ingress and egress, for the purpose of continuing operation, maintenance and repair of an underground eight-inch (8") polyethylene pipeline for effluent water flow under Grantor's property at the approximate location shown depicted on Exhibit "A" attached to this instrument. Said exhibit may depict a greater area than owned by the Grantor; however, this License is intended to grant rights only over the property of the Grantor.

2. Term/Termination Rights - This License is effective upon the date of execution by the Grantee of this instrument and shall continue in effect for a period of ten (10) years unless terminated by either of the parties on not less than thirty (30) days prior written notice given to the other; provided, however, that the Grantor may not terminate this License without the Grantee's approval, which approval shall not be unreasonably withheld.

3. Authority to License - The Grantor represents to the extent of its interest in the property that it has full right, power, and authority to enter into this License and grant the rights set out in this License.

4. Grantor Responsibility - The Grantor's responsibility is set out within the terms and conditions of the rights granted under this License. The Grantor makes no representation as to the suitability or fitness of the premises for the intended purpose.

5. Grantee Responsibility - The Grantee, its agents, employees, or representatives will be responsible for property damage or injury to persons caused by the sole and direct negligence of their respective employees in performing on the Grantor's premises the activities which are the subject of this License. Grantee shall obtain all necessary permits, licenses, and approvals in connection with the activities to be conducted by the Grantee on the premises. During the performance of the activities specified in this License, the Grantee shall not unreasonably interfere with the use and enjoyment of the premises by the Grantor.

6. Access - During the term of this License, the Grantee, its agents, employees, or representatives shall have the right of access to and egress from the premises as needed and shall have the right to bring necessary equipment upon the premises in connection with the performance of the Grantee's activities as set out in Condition 1.

7. Title to Equipment, Fixtures - Title to all equipment, fixtures, appurtenances, and other improvements furnished and installed in connection with the Grantee's activities under this License shall remain with the Grantee.

8. Restoration – Upon termination of this License, the Grantee shall remove all its equipment, fixtures, appurtenances, and other improvements furnished and installed on the premises in connection with the Grantee's activities under this License. The Grantee shall restore the premises, when such restoration is required in connection with the Grantee's activities, to the extent reasonably practical, to the condition existing at the time of initiation of the Grantee's activities. With the consent of the Grantor, the Grantee may abandon Grantee-owned equipment, fixtures, appurtenances, and other improvements in place in lieu of restoration when it is in the best interests of the Grantee.

9. Successors in Interest - This License and the parties' commitments within, shall be binding on both parties, their successors, and assigns.

10. Funding - Obligations of the Grantee under this License shall be subject to the availability of funds appropriated by the Congress which the Grantee may legally spend for such purposes and nothing in this License implies that Congress will appropriate funds to perform this License.

11. Notices - All notices regarding the specific terms and conditions of this License, and within the restrictions of this License, shall be in writing and shall be deemed effectively given upon personal delivery, upon verified facsimile receipt, or upon mailing by registered or certified mail, postage prepaid, and addressed to the parties at the following respective addresses, or to such other persons or at such other addresses as may be designated in writing by either party to the other.

If to the Grantee:	If to the Grantor:
Katy Kates, Realty Officer AD-42 (865-576-0977) Department of Energy P.O. Box 2001 Oak Ridge, Tennessee 37831	Joel W. Porath, Wildlife Regional Supervisor Missouri Department of Conservation August A. Busch Conservation Area 2360 Highway D St. Charles, Missouri 63304

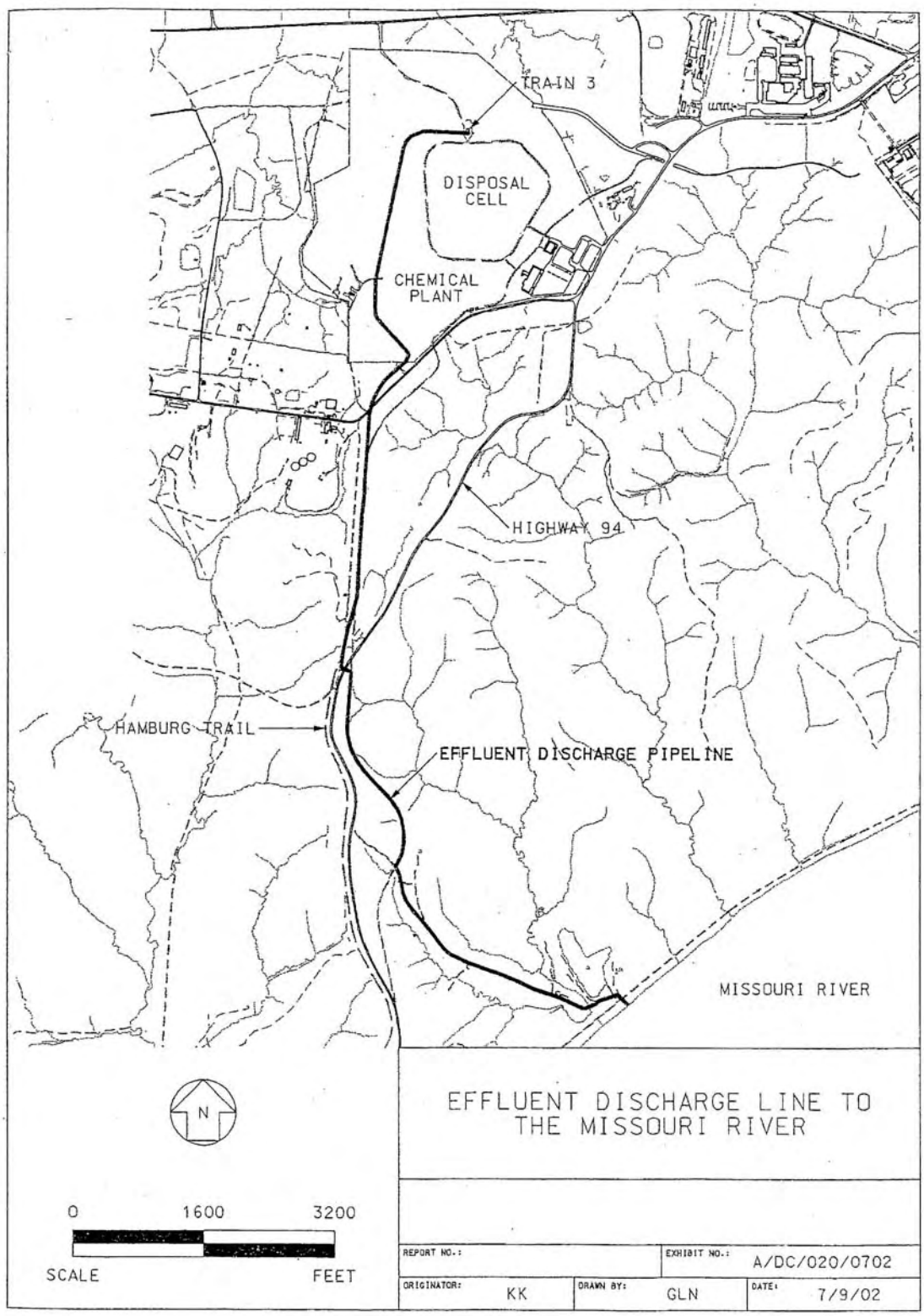
12. Entire Agreement - This License represents the entire understanding of the parties on this matter and no oral statements or collateral documents (except as noted within) may modify this License.

13. Amendment - This License may not be amended or superseded except by an agreement in writing executed by the Grantor and Grantee.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

REAL ESTATE LICENSE NO.
REORDOER-7- 03-0105

GRANTOR:	Missouri Department of Conservation	GRANTEE:	U.S. Department of Energy
By:	Joel W. Pratt	By:	Katy Kates Katy Kates DOE Real Estate Office
Title:	Wildlife Regional Supervisor	Title:	Realty Officer
Date:	3 March 2003	Date:	3-7-2003


TRAIN 3
DISPOSAL CELL
CHEMICAL PLANT
HIGHWAY 94
HAMBURG TRAIL
EFFLUENT DISCHARGE PIPELINE
MISSOURI RIVER
N
0
1600
3200
SCALE
FEET
EFFLUENT DISCHARGE LINE TO THE MISSOURI RIVER
REPORT NO.:
EXHIBIT NO.:
A/DC/020/0702
ORIGINATOR:
KK
DRAWN BY:
GLN
DATE:
7/9/02

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Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

October 7, 2002

Joel W. Porath, Wildlife District Supervisor
Missouri Department of Conservation
August A. Busch Conservation Area
2360 Highway D
St. Charles, Missouri 63304

Dear Mr. Porath:

REAL ESTATE LICENSE REORDOER-7-03-0100, ACCESS TO NORTH GATE AREA, WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO

Enclosed is a fully signed copy of the subject license designed to permit the Department of Energy (DOE) access to its North Gate entrance at the site. Thank you for your coordination of this action. Should you have any questions, please feel free to call me at 865-576-0977.

I look forward to meeting you next time I am at Weldon. Please extend my greetings to John Vogel of your staff. He has been most helpful during my trips to your area and truly represents the desired dedication required for public interaction.

Sincerely,

Katy Kates

Katy Kates
Realty Officer

Enclosure
As stated

REAL ESTATE LICENSE NO.
REORDOER-7-03-0100

DEPARTMENT OF ENERGY

LICENSE

PROJECT: WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO
PURPOSE: NORTH ACCESS TO SITE

THIS LICENSE, between the Missouri Department of Conservation, known as the "Grantor" and the U.S. Department of Energy, known as the "Grantee", is subject to the following terms and conditions.

1. Rights Granted - The Grantor grants to the Grantee, its agents, employees, or representatives permission to use the premises or facilities, together with ingress and egress, for the purpose of serving as Grantee's northerly ingress/egress to the Weldon Spring Site Remedial Action Project, MO at the location shown depicted on Exhibit "A" attached to this instrument. Said location, connected between St. Charles State Highway D and the Grantee's site, is locally identified as the "Gate D Access".

2. Term/Termination Rights - This License is effective upon the date of execution by the Grantee of this instrument and shall continue in effect for a period of ten (10) years unless terminated by either of the parties on not less than thirty (30) days prior written notice given to the other; provided, however, that the Grantor may not terminate this License without the Grantee's approval.

3. Authority to License - The Grantor represents and warrants that it is the owner of the property and has full right, power, and authority to enter into this License and grant the rights set out in this License.

4. Grantor Responsibility - The Grantor responsibility is set out within the terms and conditions of the rights granted under this License. The Grantor makes no representation as to the suitability or fitness of the premises for the intended purpose.

5. Grantee Responsibility - The Grantee, its agents, employees, or representatives will be responsible for property damage or injury to persons caused by the sole and direct negligence of their respective employees in performing on the Grantor's premises the activities and restoration which are the subject of this License. Grantee shall obtain all necessary permits, licenses, and approvals in connection with the activities to be conducted by the Grantee on the premises. During the performance of the activities specified in this License, the Grantee shall not unreasonably interfere with the use and enjoyment of the premises by the Grantor.

6. Access - During the term of this License, the Grantee, its agents, employees, or representatives shall have the right of access to and egress from the premises as needed and shall have the right to bring necessary equipment upon the premises in connection with the performance of the Grantee's activities as set out in Condition 1.

7. Title to Equipment, Fixtures - Title to all equipment, fixtures, appurtenances, and other improvements furnished and installed in connection with the Grantee's activities under this License shall remain with the Grantee.

8. Restoration - Upon termination of this License, the Grantee shall remove all its equipment, fixtures, appurtenances, and other improvements furnished and installed on the premises in connection with the Grantee's activities under this License. The Grantee shall restore the premises, when such restoration is required in connection with the Grantee's activities, to the extent reasonably practical, to the condition existing at the time of initiation of the Grantee's activities. With the consent of the Grantor, the Grantee may abandon Grantee-owned equipment, fixtures, appurtenances, and other improvements in place in lieu of restoration when it is in the best interests of the Grantee.

9. Successors in Interest - This License and the parties' commitments within, shall be binding on both parties, their successors, and assigns.

10. Funding - Obligations of the Grantee under this License shall be subject to the availability of funds appropriated by the Congress which the Grantee may legally spend for such purposes and nothing in this License implies that Congress will appropriate funds to perform this License.

11. Notices - All notices regarding the specific terms and conditions of this License, and within the restrictions of this License, shall be in writing and shall be deemed effectively given upon personal delivery, upon verified facsimile receipt, or upon mailing by registered or certified mail, postage prepaid, and addressed to the parties at the following respective addresses, or to such other persons or at such other addresses as may be designated in writing by either party to the other.

If to the Grantee:

Katy Kates, Realty Officer
U.S. Department of Energy
P.O. Box 2001
Oak Ridge, Tennessee 37831

If to the Grantor:

Joel W. Porath, Wildlife District Supervisor
Missouri Department of Conservation
August A. Busch Conservation Area
2360 Highway D
St. Charles, Missouri 63304

13. Entire Agreement - This License represents the entire understanding of the parties on this matter and no oral statements or collateral documents (except as noted within) may modify this License.

14. Amendment - This License may not be amended or superseded except by an agreement in writing executed by the Grantor and Grantee.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

REAL ESTATE LICENSE NO.
REORDOER-7- 03-0100

GRANTOR: Missouri Department of Conservation

By: Joel W. Poirath
JOEL W. POIRATH

Title: Wildlife Regional Supervisor

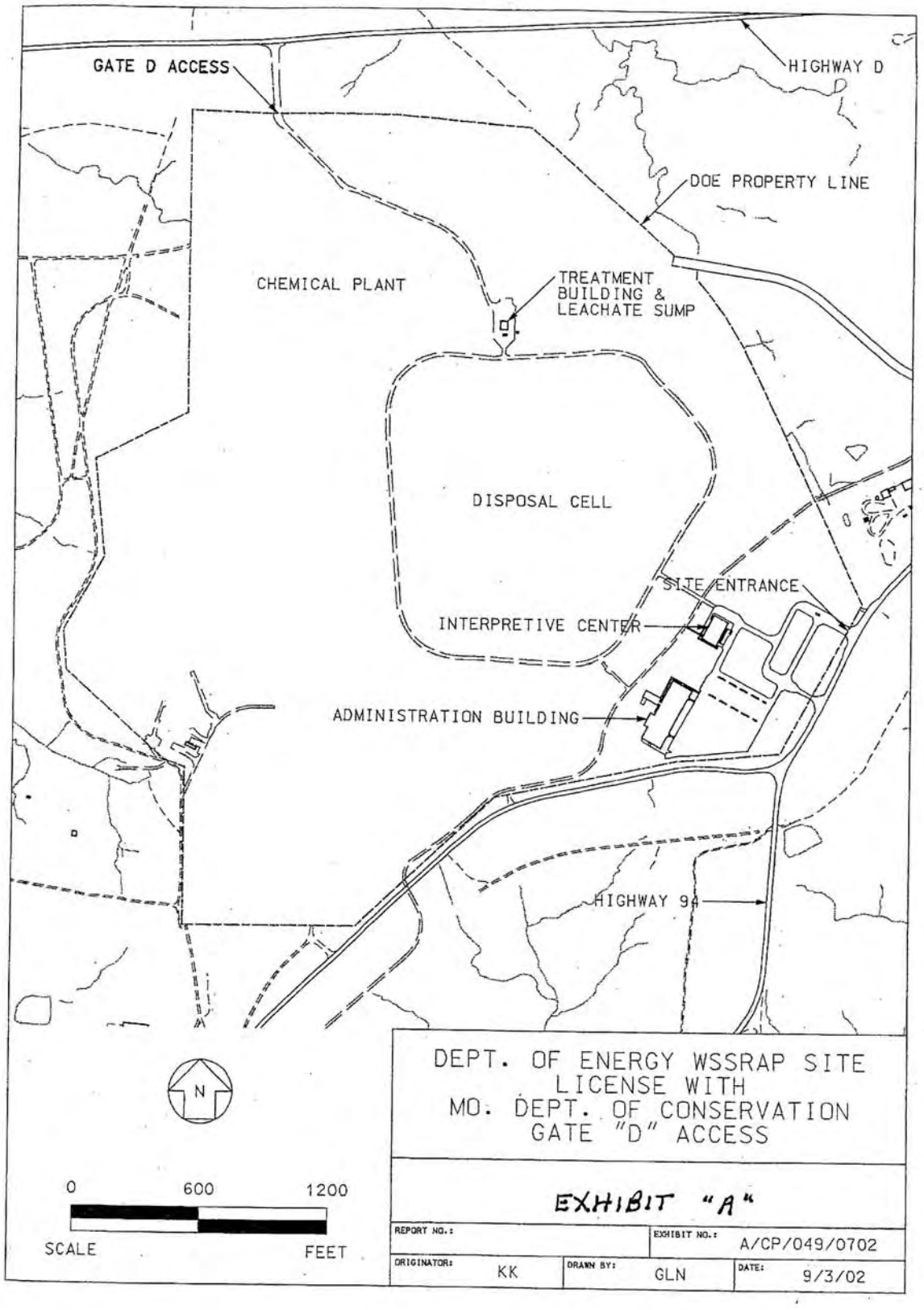
Date: 2 OCTOBER 2002

GRANTEE: U.S. Department of Energy

By: Katy Kates
Katy Kates

Title: Realty Officer

Date: October 7, 2002


GATE D ACCESS
HIGHWAY D
DOE PROPERTY LINE
CHEMICAL PLANT
TREATMENT BUILDING & LEACHATE SUMP
DISPOSAL CELL
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
HIGHWAY 94
N
0
600
1200
SCALE
FEET
DEPT. OF ENERGY WSSRAP SITE LICENSE WITH MO. DEPT. OF CONSERVATION GATE "D" ACCESS
EXHIBIT "A"
REPORT NO.:
EXHIBIT NO.: A/CP/049/0702
ORIGINATOR: KK
DRAWN BY: GLN
DATE: 9/3/02

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Contract No. AT-(23-2)-41

EASEMENT

THIS AGREEMENT, made and entered into as of the 3rd day of August, 1956, by and between THE CURATORS OF THE UNIVERSITY OF MISSOURI (hereinafter called the "Grantor"), and the UNITED STATES ATOMIC ENERGY COMMISSION acting for and in behalf of the UNITED STATES OF AMERICA (hereinafter called the "Grantee").

WITNESSETH THAT:

The Grantor does by these present grant, bargain, sell, convey, and confirm to the Grantee a right-of-way and easement, for as long as said property is used for the purposes described herein, in the following described property located in St. Charles County, Missouri to wit:

A strip of land 200 ft. in width, approximately 6,989 ft. in length, containing approximately 32 acres and having a center line description as follows:

Commencing at the Northeast corner of Section 6, T.45 N - R.3 E thence South 300 ft. to a point, thence 1,740 ft. West to the point of beginning; thence South 52 degrees East for a distance of 990 ft. to a point, thence South 25 degrees East for a distance of 730 ft. to a point, thence South 1 degree East for a distance of 820 ft. to a point, thence South 21 degrees East for a distance of 960 ft. to a point, thence South 56 degrees East for a distance of 630 ft. to a point, thence South 13 degrees 30 minutes West for a distance of 730 ft. to a point, thence South 25 degrees East for a distance of 1,009 ft. to a point, thence South 33 degrees East for a distance of 1,120 ft. to a point that is identical to the center line of the Missouri-Kansas-Texas Railroad Bridge.

This easement is conveyed for use in the construction and maintenance of an open outfall sewer for the conveyance of plant process and sanitary waste from the Grantee's plant facilities adjacent to the land of the Grantor, and the Grantee shall have the right, privilege, and authority to construct and maintain such outfall sewer.

3075

Grantor covenants as follows:

1. Warrants that it has and owns the unencumbered title to said premises, subject only to conditions and limitations set forth in a Quitclaim Deed made the thirtieth day of November, 1948, between the United States of America, acting by and through the Federal Farm Mortgage Corporation, and The Curators of the University of Missouri, recorded in Book 230, page 481, of the Deed Records of St. Charles County, Missouri.

2. That the Grantee performing the terms and conditions hereunder shall quietly hold and enjoy said premises for the full term herein created.

3. That it will give to Grantee reasonable ingress and egress across its property for the purpose of construction and maintenance of the fence hereinafter described.

Grantee covenants:

1. That for and in consideration of the easement granted herein, the Grantee shall erect a five-strand, barbed-wire fence upon the Grantor's property on a line described as follows, excepting that no fence shall be erected along that portion of said line which runs along the bluff of the Missouri river, consisting of approximately 2,590 feet:

Commencing at the Southeast corner of Section 31, T.46 North R.3 E thence West 2,438 ft, thence North 1,120 ft. to the point of beginning; thence North 47 degrees 06 minutes 15 seconds East a distance of 50 ft, thence South 42 degrees 53 minutes 45 seconds East a distance of 170.7 ft, thence South 10 degrees 02 minutes 30 seconds East a distance of 360.7 ft, thence North 70 degrees 57 minutes 30 seconds East a distance of 200 ft, thence South 10 degrees 02 minutes 30 seconds East a distance of 267.54 ft, thence South 24 degrees 01 minute 41 seconds East a distance of 393.8 ft, thence South 65 degrees 58 minutes 19 seconds West a distance of 100 ft, thence South 24 degrees 01 minute 41 seconds East a distance of 198.12 ft.

to the Northern right-of-way line of State Highway No. 94, thence South 42 degrees 13 minutes West along the Northern right-of-way line of State Highway No. 94 a distance of 491.7 ft, thence North 24 degrees 01 minute 41 seconds West a distance of 395.67 ft, thence North 65 degrees 58 minutes 19 seconds East a distance of 300 ft, thence North 24 degrees 01 minute 41 seconds West a distance of 415 ft, thence South 70 degrees 57 minutes 30 seconds West a distance of 50 ft, thence North 19 degrees 02 minutes 30 seconds West a distance of 606.83 ft, thence North 42 degrees 53 minutes 45 seconds West a distance of 149.3 ft, thence North 47 degrees 06 minutes 15 seconds East a distance of 50 ft, to the point of beginning.

Commencing at the Northwest corner of Northeast one-fourth of Section 6, Township 45 North, Range 3 East; thence South 66 degrees 12 minutes East 755.75 ft, to the point of beginning, thence North 48 degrees 35 minutes East 384.4 ft, thence North 87 degrees 43 minutes East 392.1 ft, thence South 58 degrees 58 minutes East 334.4 ft, thence South 53 degrees 44 minutes East 446.5 ft, thence South 14 degrees 10 minutes East 311.7 ft, thence South 14 degrees 11 minutes East 364.6 ft, thence South 39 degrees 32 minutes East 507.7 ft, thence South 72 degrees 37 minutes East 678.3 ft, thence South 8 degrees 43 minutes East 511.8 ft, thence South 49 degrees 34 minutes East 281.2 ft, thence South 73 degrees 49 minutes East 412.0 ft, thence North 15 degrees 57 minutes East 264.0 ft, thence South 67 degrees 35 minutes East 257.4 ft, thence South 7 degrees 42 minutes East 207.1 ft, thence South 41 degrees 46 minutes East 314.9 ft, thence South 45 degrees 25 minutes East 390.1 ft, thence South 52 degrees 42 minutes East 392.0 ft, thence South 35 degrees 33 minutes East 353.7 ft, thence South 27 degrees 06 minutes East 685.6 ft, thence South 1 degree 26 minutes West 587.0 ft, thence South 41 degrees 46 minutes

West 93.5 ft, thence South 43 degrees 50 minutes West 253.3 ft, thence South 71 degrees 2 minutes West 131.3 ft, thence South 51 degrees 19 minutes West 176.2 ft, thence South 72 degrees 08 minutes West 100.3 ft, thence South 51 degrees 25 minutes West 79.0 ft, thence South 8 degrees 8 minutes East 98.1 ft, thence South 57 degrees 58 minutes West 996.0 ft, thence South 53 degrees 02 minutes West 1,031.6 ft, thence North 16 degrees 45 minutes West 100.2 ft, thence North 44 degrees 37 minutes East 83.0 ft, thence North 65 degrees 52 minutes East 103.1 ft, thence North 38 degrees 09 minutes West 415.4 ft, thence North 20 degrees 52 minutes West 316.1 ft, thence North 39 degrees 22 minutes West 253.3 ft, thence North 50 degrees 37 minutes West 423.7 ft, thence North 57 degrees 57 minutes West 224.4 ft, thence North 7 degrees 10 minutes West 182.6 ft, thence North 34 degrees 09 minutes West 202.4 ft, thence North 60 degrees 23 minutes West 190.6 ft, thence North 39 degrees 59 minutes West 211.5 ft, thence North 42 degrees 33 minutes West 360.1 ft, thence North 31 degrees 08 minutes West 254.8 ft, thence North 12 degrees 55 minutes West 243.6 ft, thence North 35 degrees 57 minutes East 213.4 ft, thence North 27 degrees 00 minutes West 330.7 ft, thence North 26 degrees 24 minutes East 155.5 ft, thence North 7 degrees 05 minutes West 361.6 ft, thence South 88 degrees 49 minutes West 195.5 ft, thence North 11 degrees 03 minutes West 484.0 ft, thence North 22 degrees 45 minutes West 178.3 ft, thence North 29 degrees 18 minutes West 211.0 ft, thence North 50 degrees 42 minutes West 1,029.4 ft, thence North 29 degrees 29 minutes East 975.8 ft, thence North 23 degrees 33 minutes East 247.9 ft, to the point of beginning.

2. That it will maintain said fence along the line above described in good and serviceable condition for the term of the easement, or so long as the Grantor shall request but not to exceed the term of this easement.

3. That it will use due care in the maintenance and use of said outfall sewer, taking into consideration the nature of the discharge and waste running there through, and that it will comply with all rules and regulations of the Board of Health of the State of Missouri, or other governmental agencies, with reference to discharging the waste into the Missouri River.

4. That Grantor shall have the right to remove any timber that is growing or may grow upon said easement right-of-way and the free use of said strip of land in any way that shall not interfere or conflict with use and maintenance of said outfall sewer.

5. That it will, subject to the availability of funds, save and hold the Grantor harmless from any liability that the Grantor may, without fault or negligence of Grantor, incur on account of the Grantee's use of the rights granted hereunder; provided, however, that the Grantee shall not be liable for any claim settlement or judgment made or obtained against the Grantor unless the Grantee has been notified of such claim and has had the opportunity to defend such claim or agree to any settlement made by the Grantor.

6. That its maintenance of the fence herein provided shall give it no interest or right in any lands of the Grantors other than the 200 foot strip hereinabove specifically described.

7. That this easement is accepted subject to the terms and conditions set forth in the Quitclaim Deed made the thirtieth day of November, 1948, by and between the United States of America, acting by and through the Federal Farm Mortgage Corporation, and The Curators of the University of Missouri, recorded in Book 230, page 481, of the Deed Records of St. Charles County, Missouri.

IN WITNESS WHEREOF, the Grantor has caused this lease to be executed and its corporate seal hereto affixed the day and year first above written.

Approved: J. H. Longwell
J. H. Longwell, Director
Agricultural Experimental
Station

THE CURATORS OF THE UNIVERSITY OF MISSOURI

ATTEST: Mary Robnett
Mary Robnett, Secretary

By: James A. Finch, Jr.
James A. Finch, Jr.
President

ACCEPTED FOR THE UNITED STATES ATOMIC
ENERGY COMMISSION

By: [illegible]

State of Missouri)
County of Boone) ss

On this 3rd day of August, 1956, before me appeared James A. Finch, Jr., to me personally known, who, being by me duly sworn, did say he is President of The Curators of the University of Missouri, a public corporation of the State of Missouri, and that the seal affixed to the foregoing instrument is the corporate seal of said corporation and that said instrument was signed and sealed in behalf of said corporation by authority of its Board of Curators, and said James A. Finch, Jr. acknowledged said instrument to be the free act and deed of said corporation.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my notarial seal at my office in Columbia, Missouri, Boone County, Missouri, the day and year last above written.

My term expires: October 13, 1958

Sue Hagen
Notary Public within and for Boone
County, Missouri

STATE OF MISSOURI
County of St. Charles, } ss.

I, the undersigned, Recorder of Deeds for said County and State do hereby certify that the foregoing and annexed instrument of writing was filed for record in my office on the 20th day of August A. D. 1956 at 2:00 o'clock P M. and is truly recorded in Book 292 Page 597

Witness my hand and official seal on the day and year aforesaid.

Deputy Lemuel E. Pauls Recorder of Deeds

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

April 7, 2003

Lori Huber, Parks Operations Officer
Missouri Department of Natural Resources
Division of State Parks
P.O. Box 176
Jefferson City, Missouri 65102

Dear Ms. Huber:

REAL ESTATE LICENSE REORDOER-7-03-0116 (STATE STC0303), WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO

Enclosed is a fully executed copy of the subject license designed to grant the Department of Energy (DOE) permission for continued use of groundwater wells within the Katy Trail State Park right-of-way limits.

May I also thank you, Lori, for your excellent coordination of our recent actions with your agency. We appreciate your willingness to work with DOE in a common sense approach to the various issues related to both our entities.

Sincerely,

Katy Kates

Katy Kates
Realty Officer

Enclosure
As stated

Cc: ~~Pamela~~ Thompson, DOE Site Manager at WSSRAP
Scott Anderson, MK Ferguson, Project Director at WSSRAP

REAL ESTATE LICENSE NO.
REORDOER-7-03- 0116
STC0303.

DEPARTMENT OF ENERGY

LICENSE

PROJECT: WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO
PURPOSE: GROUNDWATER WELLS, SAMPLING

THIS LICENSE, between the Missouri Department of Natural Resources, known as the "Grantor" and the U.S. Department of Energy, known as the "Grantee", is subject to the following terms and conditions.

1. Rights Granted - The Grantor grants to the Grantee, its agents, employees, or representatives permission to use the premises or facilities, together with ingress and egress, for the purpose of installing, operating, and/or maintaining groundwater monitoring well(s); performing well and water sampling; and performing miscellaneous sampling to determine the levels of contamination, if any, at the locations shown depicted on Exhibit "A" attached to this instrument.

2. Term/Termination Rights - This License is effective upon the date of execution by the Grantee of this instrument and shall continue in effect for a period of ten (10) years unless terminated by either of the parties on not less than thirty (30) days prior written notice given to the other; provided, however, that the Grantor may not terminate this License without the Grantee's approval, which approval shall not be unreasonably withheld. Grantee may terminate this License upon ninety (90) days written notice if right-of-way is required for railroad purposes pursuant to the National Trails System Act, Public Law 90-543 (16 U.S.C. § 1241, et seq.), as amended. No termination or expiration shall affect the rights and liabilities, if any, of the parties hereto then existing.

3. Authority to License - The Grantor represents to the extent of its interest in the property that it has full right, power, and authority to enter into this License and grant the rights set out in this License.

4. Grantor Responsibility - The Grantor's responsibility is set out within the terms and conditions of the rights granted under this License. The Grantor makes no representation as to the suitability or fitness of the premises for the intended purpose. The Grantor shall not be responsible for damages to property or injuries to persons which may arise from or be incident to the use and occupation of the premises nor shall it be responsible for damages to the property or injuries to the persons of the Grantee arising from Grantee activities.

5. Grantee Responsibility - The Grantee, its agents, employees, or representatives will be responsible for property damage or injury to persons caused by the sole and direct negligence of their respective employees in performing on the Grantor's premises the activities and restoration which are the subject of this License. Grantee shall obtain all necessary permits, licenses, and approvals in connection with the activities to be conducted by the Grantee on the premises. During the performance of the activities specified in this License, the Grantee shall not unreasonably interfere with the use and enjoyment of the premises by the Grantor nor endanger or interfere with the safe operation of the Katy Trail. All work and restoration performed by Grantee under this License shall be at Grantee's sole expense.

6. Access - During the term of this License, the Grantee, its agents, employees, or representatives shall have the right of access to and egress from the premises as needed and shall have the right to bring necessary equipment upon the premises in connection with the performance of the Grantee's

activities as set out in Condition 1. Grantee shall take all reasonable measures to prevent unauthorized use of the Grantee's areas of access/exit from the premises. Trail users will be given the right-of-way and encourage to proceed without stopping within any Grantee current zone of activity on the Katy Trail State Park.

7. Installation, Maintenance, Closure of Groundwater Monitoring Wells – As deemed necessary in connection with the groundwater well sampling and analysis program of the Grantee, groundwater monitoring wells have been installed at the locations shown on Exhibit "A" attached to this License. If the Grantor deems it necessary to expand its facility or operation within the premises, the wells may be relocated at the expense of the Grantee. The exact siting of each relocated well shall be agreed on by the Grantor and Grantee following a walkover survey of the premises. The Grantee shall properly dispose of cuttings and development water from its well installation activities. Grantee will assure prompt removal of any equipment, tools and materials placed on the trail property by the Grantee in order that it does not unreasonably interfere with the public's use of the Katy Trail. The Grantee shall maintain the wells throughout the term of this License in a manner to ensure their continued usefulness for groundwater monitoring purposes. Following completion of the installation of any replacement wells as provided for within this License or upon closure of any well, the Grantee shall restore the premises in accordance with Condition No. 10. Upon termination of this License, the Grantee shall seal, close and abandon the wells in place following established industry standards and environmental regulations and guidance applicable at the time of closure.

8. Well Sampling – During the term of this License, the Grantee will from time to time bore, drive, sample and analyze surface water and water from any existing well (to include all existing groundwater wells) and from any relocated groundwater monitoring wells on the premises in order to determine the levels, if any, of contaminants and other constituents of interest to the Grantee. Grantee shall attempt to notify the Grantor of the times at which samples will be taken at least twenty-four (24) hours in advance, and afford the Grantor an opportunity to observe the sampling. Grantee shall properly dispose of purge water from its boring and sampling activities.

9. Title to Equipment, Fixtures - Title to all equipment, fixtures, appurtenances, and other improvements furnished and installed in connection with the Grantee's activities under this License shall remain with the Grantee.

10. Restoration - Upon termination of this License, the Grantee shall remove all its equipment, fixtures, appurtenances, and other improvements furnished and installed on the premises in connection with the Grantee's activities under this License. The Grantee shall restore the premises, when such restoration is required in connection with the Grantee's activities, to the extent reasonably practical, to the condition existing at the time of initiation of the Grantee's activities. The phrase "to the extent reasonably practical" is intended to indicate that should certain construction materials no longer be available, an equal or better product will be used in restoring the site. With the consent of the Grantor, the Grantee may abandon Grantee-owned equipment, fixtures, appurtenances, and other improvements in place in lieu of restoration when it is in the best interests of the Grantee.

11. Successors in Interest - This License and the parties' commitments within, shall be binding on both parties, their successors, and assigns.

12. Funding - Obligations of the Grantee under this License shall be subject to the availability of funds appropriated by the Congress which the Grantee may legally spend for such purposes and nothing in this License implies that Congress will appropriate funds to perform this License. In the event funding for a subsequent fiscal year shall not provide for the ongoing activities, Grantee shall restore the premises in accordance with Condition No. 10 of this License.

REAL ESTATE LICENSE NO.
REORDOER-7-03- 0116

13. Notices - All notices regarding the specific terms and conditions of this License, and within the restrictions of this License, shall be in writing and shall be deemed effectively given upon personal delivery, upon verified facsimile receipt, or upon mailing by registered or certified mail, postage prepaid, and addressed to the parties at the following respective addresses, or to such other persons or at such other addresses as may be designated in writing by either party to the other.

If to the Grantee:

Katy Kates, Realty Officer
U.S. Department of Energy
P.O. Box 2001
Oak Ridge, Tennessee 37831

If to the Grantor:

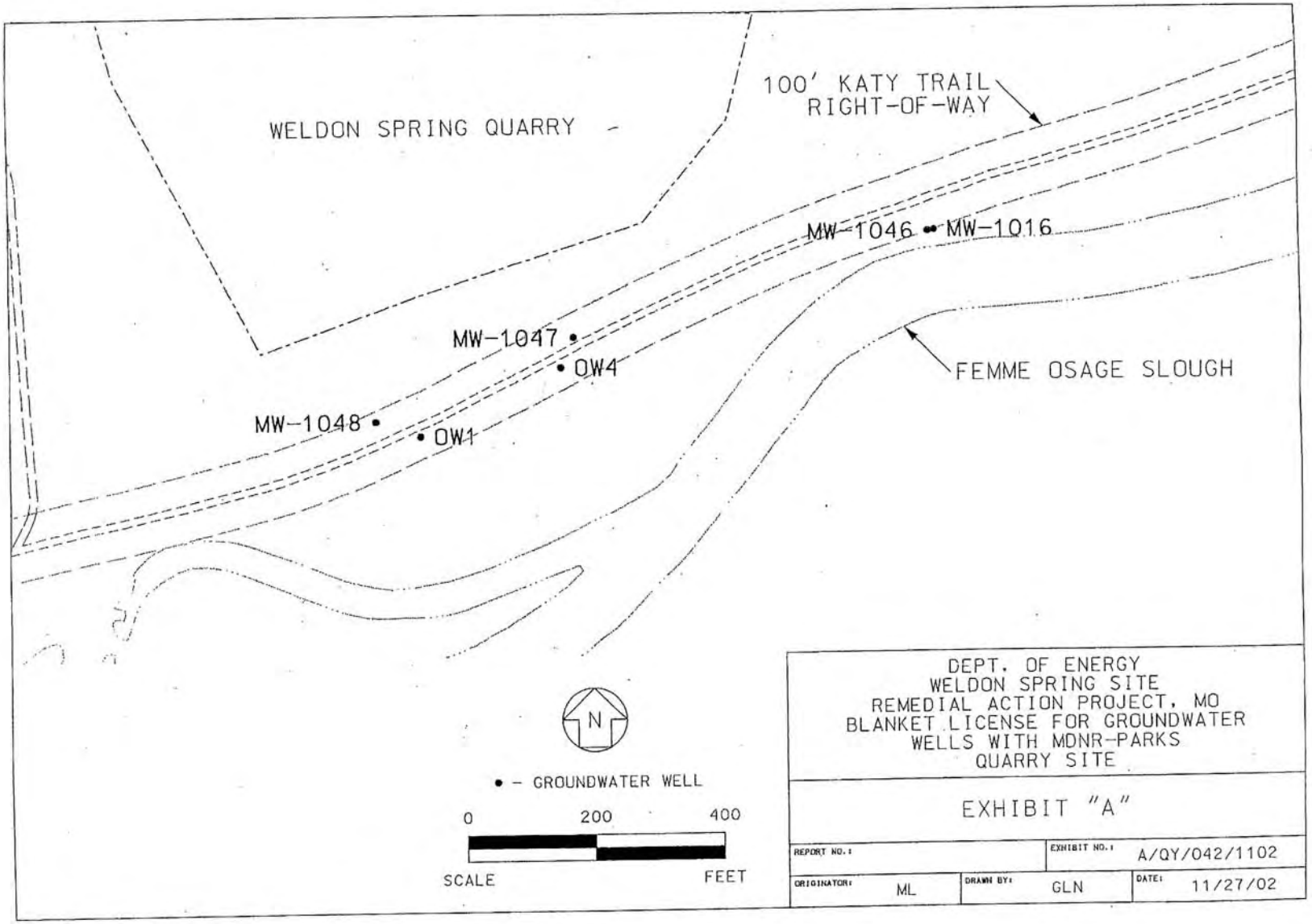
Missouri River District
Park Operations Officer
Department of Natural Resources
P.O. Box 166
Boonville, Missouri 65233

14. Entire Agreement - This License represents the entire understanding of the parties on this matter and no oral statements or collateral documents (except as noted within) may modify this License. This License does not create any rights, claims, or causes of action between the parties to this License in favor of any third parties or nonparties to this License.

15. Amendment - This License may not be amended or superseded except by an agreement in writing executed by the Grantor and Grantee's Realty Officer.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

GRANTOR: Missouri Department of Natural Resources	GRANTEE: U.S. Department of Energy
By: Douglas K. Eiken	By: Katy Kates
Title: Director, Div. of State Parks	Title: Realty Officer
Date: 3/25/03	Date: April 1, 2003


WELDON SPRING QUARRY
100' KATY TRAIL
RIGHT-OF-WAY
MW-1046
MW-1016
MW-1047
OW4
MW-1048
OW1
FEMME OSAGE SLOUGH
N
• - GROUNDWATER WELL
0
200
400
SCALE
FEET
DEPT. OF ENERGY
WELDON SPRING SITE
REMEDIAL ACTION PROJECT, MO
BLANKET LICENSE FOR GROUNDWATER
WELLS WITH MDNR-PARKS
QUARRY SITE
EXHIBIT "A"
REPORT NO.:
EXHIBIT NO.: A/QY/042/1102
ORIGINATOR: ML
DRAWN BY: GLN
DATE: 11/27/02

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Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—

November 1, 2002

Lori Huber, Parks Operations Officer
Missouri Dept. of Natural Resources
Division of State Parks
P.O. Box 176
Jefferson City, Missouri 65102

Dear Ms. Huber:

LICENSE REORDOER-7-03-0101 (STC OO1PX), WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO

Enclosed for your records is the fully executed copy of the subject license designed to grant the Department of Energy (DOE) continuing rights for the 8-inch underground water effluent pipeline which crosses beneath the Katy Trail.

Please feel free to contact me at 865-576-0977 for any questions you may have.

Sincerely,

Katy Kates

Katy Kates
Realty Officer

Enclosure
As stated

cc: Pamela Thompson, DOE WSSRAP Site Manager
Scott Anderson, MK Ferguson Project Director

REAL ESTATE LICENSE NO.
REORDOER-7- 03-0101

DEPARTMENT OF ENERGY STC 061 Px

LICENSE

PROJECT: WELDON SPRING SITE REMEDIAL ACTION PROJECT, MO
PURPOSE: EFFLUENT WATER PIPELINE CROSSING

THIS LICENSE, between Missouri Department of Natural Resources, known as the "Grantor" and the U.S. Department of Energy, known as the "Grantee", is subject to the following terms and conditions.

1. Rights Granted - The Grantor grants to the Grantee, its agents, employees, or representatives permission to use the premises or facilities, together with ingress and egress, for the purpose of continuing operation, maintenance and repair of an underground eight-inch (8") polyethylene pipeline for effluent water flow under Grantor's linear state park identified as the Katy Trail State Park at the location shown depicted on Exhibit "A" attached to this instrument and more specifically identified in whole or in part as Parcel No.(s) N/A filed in Deed/Plat Book N/A, Page N/A in the records of St. Charles County, Missouri. For purposes of further identification, the Katy Trail is comprised of the 100-foot width interest held by the Grantor; the portion of the Katy Trail affected by this License is identified by the Grantor as follows:

> Being situated within Section 8, Township 45 North, Range 3 East of the Fifth Principal Meridian in St. Charles County, Missouri with the centerline of said pipeline crossing being situated at chaining station 2883+46 near milepost 55.

2. Term/Termination Rights - This License is effective upon the date of execution by the Grantee of this instrument and shall continue in effect for a period of ten (10) years unless terminated by either of the parties on not less than thirty (30) days prior written notice given to the other; provided, however, that the Grantor may not terminate this License without the Grantee's approval, which approval shall not be unreasonably withheld. Grantor may terminate this License upon ninety (90) days written notice if right-of-way is required for railroad purposes pursuant to the National Trails System Act, Public Law 90-543 (16 U.S.C. § 1241, et seq.), as amended. No termination or expiration shall affect the rights and liabilities, if any, of the parties hereto then existing.

3. Consideration – Upon execution of this License by the Grantee, the Grantee shall initiate action to pay to the Grantor the sum of $ One Thousand Six Hundred and Forty Dollars ($1,640.00) as full and complete payment for the rights granted within this License.

4. Authority to License - The Grantor represents to the extent of its interest in the property that it has full right, power, and authority to enter into this License and grant the rights set out in this License. Grantee waives the right to challenge the validity of the License issued by the Grantor or the power of the Grantor to execute and enforce the same.

5. Grantor Responsibility - The Grantor's responsibility is set out within the terms and conditions of the rights granted under this License. The Grantor makes no representation as to the suitability or fitness of the premises for the intended purpose. The Grantor shall not be responsible for damages to property or injuries to persons which may arise from or be incident to the use and occupation of the premises nor shall it be responsible for damages to the

property or injuries to the persons of the Grantee arising from Grantee activities.

6. Grantee Responsibility - The Grantee, its agents, employees, or representatives will be responsible for property damage or injury to persons caused by the direct negligence of their respective employees in performing on the Grantor's premises the activities which are the subject of this License. Grantee shall obtain all necessary permits, licenses, and approvals in connection with the activities to be conducted by the Grantee on the premises. During the performance of the activities specified in this License, the Grantee shall not unreasonably interfere with the use and enjoyment of the premises by the Grantor nor endanger or interfere with the safe operation of the Katy Trail. All work and restoration performed by Grantee under this License shall be at Grantee's sole expense. Grantee shall submit final plans and specifications of proposed work and materials to Grantor five (5) days in advance and obtain his/her written approval prior to initiation of activities. Said work shall be performed by or on behalf of Grantee in such a manner and at such times as shall not endanger or interfere with the safe operation of the Trail established along the railroad right-of-way with Grantor's permission, or any railroad operation which may be required pursuant to the National Trails System Act, 16 U.S.C. § 1241, et seq., as amended, at said location.

7. Access - During the term of this License, the Grantee, its agents, employees, or representatives shall have the right of access to and egress from the premises as needed and shall have the right to bring necessary equipment upon the premises in connection with the performance of the Grantee's activities as set out in Condition 1. Grantee shall take all reasonable measures to prevent unauthorized use of the Grantee's areas of access/exit from the premises.

8. Title to Equipment, Fixtures - Title to all equipment, fixtures, appurtenances, and other improvements furnished and installed in connection with the Grantee's activities under this License shall remain with the Grantee.

9. Grantee's Activities on Katy Trail – In the active performance of its permitted activities, any construction vehicles used during the operation, maintenance and repair of the pipeline, will have lights on at all times while in operation, will be equipped with backup (reverse gear) alarms, and will be restricted to 15 mph on the Katy Trail. Dust from any Grantee's activities will be controlled by potable water spray. Trail users will be given the right-of-way and encouraged to proceed without stopping within any Grantee current zone of activity on the Katy Trail State Park. Grantee will assure prompt removal of any equipment, tools and materials placed on the trail property by the Grantee in order that it does not unreasonably interfere with the public's use of the Katy Trail.

10. Restoration - Within twenty-one (21) days of termination of this License, the Grantee shall remove all its equipment, fixtures, appurtenances, and other improvements furnished and installed on the premises in connection with the Grantee's activities under this License. The Grantee shall restore the premises, when such restoration is required in connection with the Grantee's activities, to the extent reasonably practical, to the condition existing at the time of initiation of the Grantee's activities. The phrase "to the extent reasonably practical" is intended to indicate that should certain construction materials no longer be available, an equal or better product will be used in restoring the site. With the consent of the Grantor, the Grantee may abandon Grantee-owned equipment, fixtures, appurtenances, and other improvements in place in lieu of restoration when it is in the best interests of the Grantee.

REAL ESTATE LICENSE NO.
REORDOER-7- 03-0101

11. Successors in Interest - This License and the parties' commitments within, shall be binding on both parties, their successors, and assigns.

12. Funding - Obligations of the Grantee under this License shall be subject to the availability of funds appropriated by the Congress which the Grantee may legally spend for such purposes and nothing in this License implies that Congress will appropriate funds to perform this License. In the event funding for a subsequent fiscal year shall not provide for the ongoing activities, Grantee shall restore the premises in accordance with Condition No. 9 of this License.

13. Notices - All notices regarding the specific terms and conditions of this License, and within the restrictions of this License, shall be in writing and shall be deemed effectively given upon personal delivery, upon verified facsimile receipt, or upon mailing by registered or certified mail, postage prepaid, and addressed to the parties at the following respective addresses, or to such other persons or at such other addresses as may be designated in writing by either party to the other.

If to the Grantee:

Katy Kates, Realty Officer
AD-421 (865-576-0977)
Department of Energy
P.O. Box 2001
Oak Ridge, Tennessee 37831

If to the Grantor:

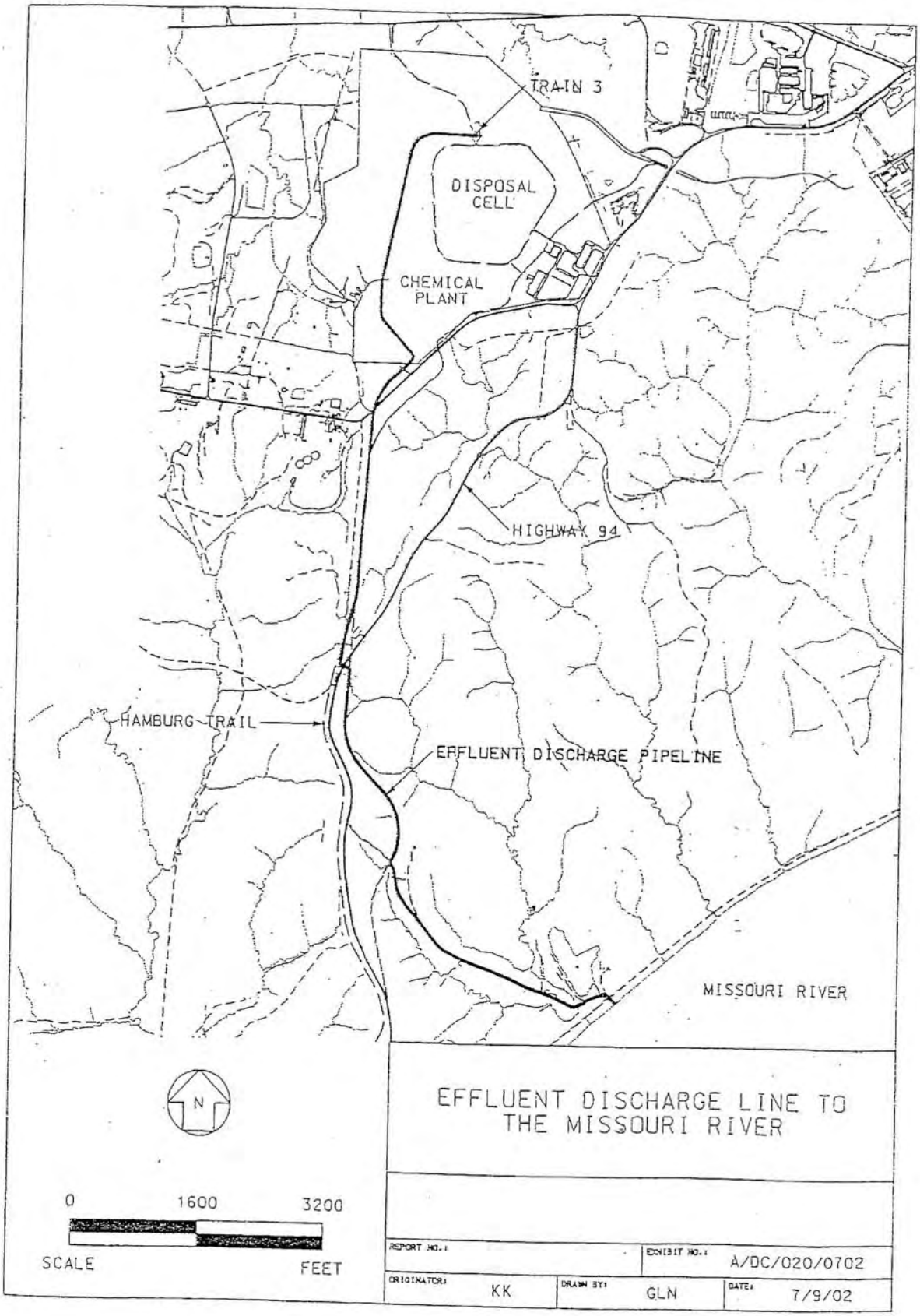
Missouri River District
Park Operations Officer
Department of Natural Resources
P. O. Box 166
Boonville, Missouri 65233

14. Entire Agreement - This License represents the entire understanding of the parties on this matter and no oral statements or collateral documents (except as noted within) may modify this License. This License does not create any rights, claims, or causes of action between the parties to this License in favor of any third parties or nonparties to this License.

15. Amendment - This License may not be amended or superseded except by an agreement in writing executed by the Grantor and Grantee.

The above terms and conditions are acknowledged and agreed upon as indicated by the signatures affixed below:

GRANTOR:	Missouri Department of Natural Resources	GRANTEE:	U.S. Department of Energy
By:	Douglas K. Eaton	By:	Katy Kates Katy Kates DOE Real Estate Office
Title:	Division Director State Parks	Title:	Realty Officer
Date:	10/23/02	Date:	November 1, 2002


TRAIN 3
DISPOSAL CELL
CHEMICAL PLANT
HIGHWAY 94
HAMBURG TRAIL
EFFLUENT DISCHARGE PIPELINE
MISSOURI RIVER
N
0
1600
3200
SCALE
FEET
EFFLUENT DISCHARGE LINE TO THE MISSOURI RIVER
REPORT NO.:
EXHIBIT NO.: A/DC/020/0702
ORIGINATOR: KK
DRAWN BY: GLN
DATE: 7/9/02

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Memorandum of Understanding
Between the
U.S. Department of Energy
and the
U.S. Department of Army
Concerning Transfer of Custody and Accountability for,
and Funding of Remedial Actions at, the Weldon Spring Chemical Plant

1. Objective and Purpose

The Department of Army (DA) and Department of Energy (DOE) are entering into this Agreement to set forth the understandings and commitments of the parties with respect to transfer of custody and accountability for the Weldon Spring Chemical Plant (WSCP) from the DA to the DOE, and funding arrangements and responsibilities for remedial actions and further disposition regarding the WSCP (see attachment 1, OMB Letters to DA and DOE). DOE will integrate the remedial action at the WSCP with DOE remedial actions to be conducted at the Weldon Spring Raffinate Pits and Weldon Spring Quarry sites in future years.

2. Definitions

WSCP - defined as the land and easements outlined in red and shown in purple and blue on the attached map (Attachment 2) together with all buildings, equipment, materials, improvements, and appurtenances, including radioactive and chemical wastes thereon and interest to the easement to St. Charles County with equipment and facilities shown in green on the map.

Remedial Action - the actions taken to plan and bring the WSCP in conformance with applicable standards and guidelines for managing radioactive and other wastes on the WSCP, the surveillance, maintenance, and further actions needed to assure continued conformance with these standards and guidelines, actions for long-term management and disposal of these wastes in conformance with applicable laws, rules and regulations and the activities required to close out and document final completion of these actions, and any other action necessary to address contamination from WSCP.

3. Transfer of Custody and Accountability

DA will take all necessary action to report WSCP to General Services Administration (GSA) and will request that GSA transfer WSCP to DOE without reimbursement effective 1 October 1985. DOE agrees to accept transfer of the WSCP and easements from GSA and to take such actions as may be required on its part to perfect the transfer. DA will request the Nuclear Regulatory Commission (NRC) to terminate the DA license with the NRC for WSCP effective at the date of turnover. DA agrees to terminate all outgrants on WSCP. DOE will assume radiological custody and accountability for the site for disposition in accordance with its orders, requirements, standards and guidelines, and all other applicable laws.

DA will provide DOE assistance in preparing for the turnover. DA will provide assistance, both prior to and for a short period after the transfer, in the training of DOE and contractor personnel in maintenance and surveillance of the site and in the preparation of relevant procedures for these activities.

4. Access to the WSCP, DA Monitoring Data, and WSCP Records Prior to Transfer

Prior to transfer of custody and accountability to the DOE, DA will allow DOE and its contractors access to the WSCP site to conduct characterization (radiological, chemical and geologic) studies and to obtain other information as may be necessary for preliminary engineering studies. Permits for such work, if required, will be in DOE's name with DA cooperating in such instances as may be required. These studies will include measuring and sampling surface and subsurface soils and stored materials, drilling of wells for geologic and water sampling purposes, air monitoring, civil and radiological surveys, and other sampling and tests within buildings and surrounding areas as may be necessary to plan the remedial action. The DA will make available its data from environmental monitoring at and near the WSCP. DA will provide DOE access to all records relating to the WSCP as soon as possible or by February 28, 1985. All records will be turned over to DOE at the time of transfer.

5. Remedial Action Responsibility

The DOE is responsible for designing, managing and implementing remedial actions at WSCP. Upon completion, DOE is responsible for further disposition of WSCP. The Army will be given 45 days to review and comment on plans for each phase of work. Extension of this time will be upon mutual agreement.

6. Funding Arrangement for Remedial Actions at WSCP

The DA and DOE will each pay 50 percent of the remedial action costs as set forth below and subject to the availability of appropriated funds. Adjustments will be made as appropriate during conduct of the WSCP remedial actions to maintain a 50 percent sharing. Beginning with the FY 1987 budget, each agency will request its prorated share of the WSCP costs each subsequent fiscal year from the Office of Management and Budget and Congress.

DA funding responsibility is limited to 50 percent of the cost incurred to address contamination at WSCP. This includes interim control actions, remedial action planning and engineering, site characterization, NEPA documentation, plant demolition, site cleanup, and waste disposal. DOE is responsible for 100% of the costs of guards, groundskeeping, long-term management (including monitoring), other actions at WSCP unrelated to decontaminating WSCP, and for all funding of other sites including the raffinate pit and quarry areas. Where indirect and general purpose expenses (See Attachment 3) are incurred to decontaminate the Weldon Spring Quarry, Weldon Spring raffinate pits, and/or WSCP, the share attributable to WSCP will be fairly apportioned, i.e., by WSCP's share of direct cost as compared to total project direct cost.

DOE will advise DA of funds to be requested by DA by January 1, each year for the budget to be submitted to Congress in the following January. DOE will revise this estimate later as needed. The estimate will describe the work to be accomplished, an itemization of expenses, and the apportioning of expenses to the Army's share. By January 1 of each year, DOE will provide to DA an annual WSCP report which includes accounting of costs for the preceding fiscal year.

7. Liabilities

Except as expressly provided herein, this Agreement does not affect federal contractual and other rights against third parties, and allocation of responsibility among DOE, DA, or other federal entities for contractual and other liabilities to third parties (including federal entities). All actions undertaken by the parties pursuant to this Agreement shall be subject to applicable laws.

8. Resolution of Interagency Conflicts

Any conflict arising under this Agreement will be resolved at successive levels of Agency decisionmaking until agreement is reached. If no agreement can be reached, the conflict shall be referred to OMB for resolution in accordance with applicable law.

9. Amendments

This agreement may be amended at any time by mutual agreement of DA and DOE. Amendments will be in writing and will be signed by appropriate DA and DOE officials.

10. Period of Agreement

This Agreement will continue in effect until terminated by agreement of both parties.

11. Points of Contact

The points of contact for the parties are:

DOE: John E. Baublitz, Director or successor
Division of Remedial Action Projects
Telephone: 233-5272 (FTS)
301-353-5272 (Commercial)

DA: Lewis D. Walker, Deputy for Environment, Safety & Occupational Health, OASA(I&L) or successor
Telephone: (202) 695-7824

4

12. Public Information

DOE will provide information to the local citizens and public officials relative to activities at the WSCP, including records on the period when DA controlled the site, consistent with applicable laws.

13. Effective Date

This Agreement will become effective upon signature of both parties.

William R. Voigt, Jr., Acting Director, Office of Terminal Waste Disposal and Remedial Action

2/11/85
Date

Lewis D. Walker, Deputy for Environment, Safety and Occupational Health, OASA(I&L)

2/4/85
Date

Attachment 1 - Nov 27, 1984 ltrs fm Stockman to Hodel and Stockman to Marsh
Attachment 2 - Figure 1 - Property Diagram
Attachment 3 - Examples of Indirect & General Purpose Expenses

5

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

NOV 27 1984

Honorable Donald Paul Hodel
Secretary of Energy
Washington, D.C. 20585

Dear Don:

Enclosed for your information ard review is a copy of my response to Army Secretary Marsh's request earlier this year for assistance in resolving the dispute between the Departments of Energy and Army over which agency should assume responsibility for decontaminating the former Weldon Spring Chemical Plant complex located outside St. Louis, Missouri.

The implementing details of this agreement will be contained in a Memorandum of Understanding (MOU), being prepared by your agency, in cooperation with the Department of the Army. It is requested that a copy of this MOU be provided to the Office of Management and Budget following its approval by both agencies, but in no case, later than January 30, 1985.

I would like to express my personal appreciation to all Department of Energy officials, but particularly the Office of Nuclear Energy, whose fine work, cooperation and valued assistance were so instrumental in achieving a solution to this dispute.

Sincerely,

David A. Stockman
Director

Enclosure

cc:
Mr. Earl Jones, GSA
Mr. Richard E. Cunningham, NRC

1984 DEC -5 AM 9:16

Attachment 1

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

NOV 27 1984

Honorable John O. Marsh, Jr.
Secretary of the Army
Washington, D.C. 20310

Dear Secretary Marsh:

Earlier this year you wrote me asking OMB's assistance in resolving a long-standing dispute between the Departments of the Army and Energy over which agency should assume responsibility for decontaminating the former Weldon Spring Chemical Plant (WSCP) complex located outside St. Louis, Missouri. This letter is in response to that request.

To gain a full understanding of this issue and of the respective positions of each agency, discussions were held between OMB officials and representatives of the Environmental Protection Agency, the Nuclear Regulatory Commission, General Services Administration, and the Department of Justice. These meetings were held concurrent with ongoing deliberations between OMB and the Departments of the Army and Energy. The results of these discussions--and a tentative recommendation for a solution to the problem--were then reviewed and approved by the OMB General Counsel's office.

As a result of this process, the following Terms of Agreement are presented in settlement of this dispute:

a. Duties and Responsibilities of the Department of Energy

• DOE shall assume responsibility for cleanup of the main plant site and facilities. Ongoing DOE decontamination activities at Weldon Spring will now be integrated with this effort. Responsibility for decontamination at Weldon Spring will now be consolidated under one Federal agency, the Department of Energy.

• DOE shall assume custody and possession for all radioactive materials located on the plant site.

• DOE shall assume funding responsibility for one-half (50%) the costs incurred in decontaminating the main plant complex.

• DOE shall accept transfer from Department of the Army of the property comprising the main plant complex to include custodial and guard responsibilities thereof.

b. Duties and Responsibilities of the Department of the Army

- Army shall be responsible for one-half (50%) the costs incurred in decontaminating the main plant complex.

- Army shall transfer all licensed materials to DOE and subsequently request that its license with the U.S. Nuclear Regulatory Commission (NRC) be terminated.

- Army shall transfer to Department of Energy all property, records and data pertinent to the main plant complex and custodial guard responsibilities. Because the property has no value in its current condition, the transfer will be accomplished at no cost and through the General Services Administration (GSA).

Both the Departments of Army and Energy should identify resources in their respective budget requests to Congress sufficient to initiate this decontamination program. Out-year funding for this program will be included as an integral part of each agency's normal budget process. Currently appropriated funds should be utilized for Weldon Spring activities, as planned.

The implementing details of this agreement will be contained in a Memorandum of Understanding (MOU) between the Departments of Army and Energy. It is requested that a copy of this MOU be provided to the Office of Management and Budget following its approval by both agencies, but in no case, later than January 30, 1985.

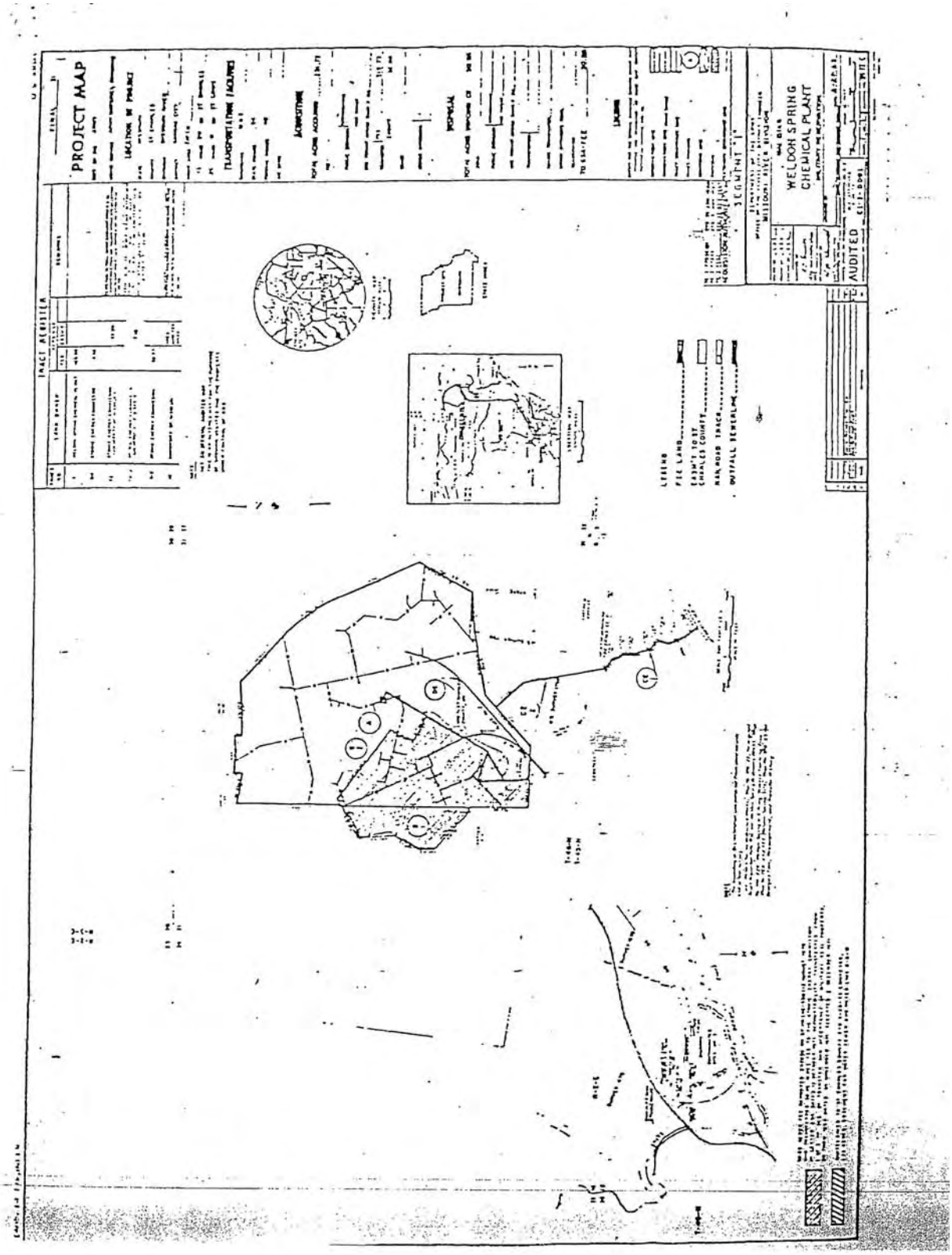
I would like to express my appreciation to all Department of the Army officials, but particularly Assistant Secretary Hillier, his Deputies, Messrs. Lewis D. Walker and Paul W. Johnson, and Captain Barry Breen of the General Counsel's office, whose cooperation and valued assistance were so instrumental in achieving a solution to this dispute.

Sincerely,

David A. Stockman

David A. Stockman
Director

cc:
Mr. Earl Jones, GSA
Mr. Richard E. Cunningham, NRC


PROJECT MAP
WELDON SPRING
CHEMICAL PLANT
AUDITED

EXAMPLES OF INDIRECT AND GENERAL PURPOSE EXPENSES

Listed below are examples of indirect and general purpose expenses that are necessary for the performance of remedial actions at WSCP and should be shared on a fairly apportioned basis:

•Costs associated with obtaining office space, change rooms, lunch room, first aid station, etc., either via repair or modification of WSCP building, temporary trailers or prefab buildings. Where it is cost effective to utilize an existing WSCP building(s) for this service, the necessary costs to modify and maintain such space in a habitable condition.

•Costs to hook-up to water, installation of temporary sanitary sewer lines, development of a sewage drain field, and similar efforts.

•Costs to hook-up to electrical services, either via modification or repair of existing installed lines or via installation of new auxiliary substation and auxiliary power lines, and similar effort.

•Costs to develop access roads and parking areas.

•Costs associated with environmental surveillance, effluent and occupational monitoring, offsite shipments of samples, etc., during the remedial action phase of the effort.

Attachment 3

AUTHORITY: sections 256.606 and 256.626, RSMo Supp. 1991. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.100 Sensitive Areas

PURPOSE: This rule sets specific additional construction standards for sensitive areas shown on the map that have been designated on the basis of either naturally occurring problems caused by unique groundwater chemistry, anthropogenic contamination, or because they are located in a fragile groundwater environment which is experiencing rapid population growth or urbanization.

(1) Sensitive Area A. All persons engaged in drilling wells in this area (Figure 8) and encounter Pennsylvanian shales and/or sandstones shall—

(A) Set no less than eighty feet (80') of casing extending not less than thirty feet (30') into bedrock where Pennsylvanian shale and sandstone are not present and no less than one hundred fifty feet (150') of casing extending not less than thirty feet (30') into bedrock where the Pennsylvanian shale and sandstone are present;

(B) Construct the drillhole a minimum of eight and five-eighths inches (8 5/8") in diameter to the surface casing point;

(C) Install new steel or plastic casing as specified in 10 CSR 23-3.030 (steel) or 10 CSR 23-3.070 (plastic);

(D) Install and seal casing as follows:

1. Full-length grout is preferred and will ensure a better annular seal but sealing the lowermost thirty feet (30') of casing using approved grout materials and procedures set out in 10 CSR 23-3.030 is required. Drill cuttings and a drive shoe or drill cuttings used by themselves are not approved grout materials. Drill cuttings may be placed above grouted interval to fill in the annular space—

A. If steel casing is used, a drive shoe is required except on wells where the grout is allowed to cure before drilling resumes; and

B. If plastic casing is used, a packer, coupling or inverted bell is required to be secured near the bottom of the casing and must hold the grout in place while drilling continues. No packer, coupling or inverted bell is required if grout is allowed to cure before drilling resumes; and

2. The following times must be followed for curing grout when no packer is used:

A. Hi-early cement—minimum set time of twelve (12) hours;

B. Portland Type I cement—minimum set time of seventy-two (72) hours;

C. Chipped bentonite—minimum hydration time of four (4) hours; and

D. High solids bentonite slurry—varies based on additives and manufacturer's specifications.

(2) Sensitive Area B. Wells drilled within one-quarter (1/4) mile of the major lakes in Missouri (Figure 8) (see list of lakes) must be cased so that they do not produce lake water into their wells. Wells drilled within one-quarter (1/4) mile of the major lakes that are not drilled below normal pool level of the lake are not required to meet sensitive Area B requirements. These wells must be constructed to Area 1 requirements stated in 10 CSR 23-3.090(1). The following specifications shall be followed:

(A) List of Lakes—

1. Truman;
2. Stockton;
3. Table Rock;
4. Bull Shoals;
5. Lake of the Ozarks;
6. Wappappello;
7. Pomme de Terre;
8. Norfolk; and
9. Clearwater.

(B) If the well is to be drilled closer than one-quarter (1/4) mile to the shoreline of the lake, casing must be set to a point fifty feet (50') below the bottom of the lake. The deepest part of the lake within one-quarter (1/4) mile radius from the well location shall be used in this determination. Example: If the drill site is located one thousand feet (1,000') from the lake, is located fifty feet (50') higher in elevation than the shoreline and the deepest estimated bottom of the lake within one-quarter (1/4) mile from the well is thirty feet (30') deep, then one hundred and thirty feet (130') of casing must be set. Fifty feet (50') (elevation above lake) + thirty feet (30') (depth of water) + fifty feet (50') (below lake bottom) = one hundred thirty feet (130') casing;

(C) It is highly recommended that before a well is drilled that is located closer than one-quarter (1/4) mile to the shoreline of any major lake, a casing point request form (supplied by the division) be submitted to the division. The casing point request form will be used to establish the required amount of casing and will supply information on requested water yield amounts and corresponding total depth of well. To ensure the location of the proposed drill site a copy of the landowner's property deed showing detailed location information and a copy of the landowner's plat (if available) showing proposed drilling site location, must be attached to completed casing point request form. The casing point request form will be processed quickly and returned to the landowner or driller, or both. After the well is drilled the casing point request form must be submitted with the certification form. If a well is drilled within one-quarter (1/4) mile of one (1) of the lakes contained in section (2) and less than the required amount of casing is set, the well installation contractor must bring the well up to the standards set in this rule and will be subject to disciplinary action deemed necessary by the division;

(D) A minimum of eighty feet (80') of casing must be set;

(E) The drill hole shall be constructed a minimum of eight and five-eighths inches (8 5/8") in diameter to the surface casing point;

(F) The new steel or plastic casing shall be installed as specified in 10 CSR 23-3.030 (steel) or 10 CSR 23-3.070 (plastic);

(G) The casing shall be installed and scaled as follows:

1. Full-length grout is preferred and will ensure a better annular seal but sealing the lowermost thirty feet (30') of casing using approved grout materials and procedures set out in 10 CSR 23-3.030 is required. Drill cuttings and a drive shoe or drill cuttings used by themselves are not approved grout materials. Drill cuttings may be placed above grouted interval to fill in the annular space;

A. If steel casing is used, a drive shoe is required except on wells where the grout is allowed to cure before drilling resumes;

B. If plastic casing is used, a packer, coupling or inverted bell is required near the bottom of the casing and must hold the grout in place while drilling continues. No packer, coupling or inverted bell is required if grout is allowed to cure before drilling resumes;

C. The following time must be followed for curing grout when no packer is used:

(I) Hi-early cement—minimum set time of twelve (12) hours;

(II) Portland Type I cement—minimum set time of seventy-two (72) hours;

(III) Chipped bentonite—minimum hydration time of four (4) hours; and

(IV) High solids bentonite slurry—varies based on additives and manufacturer's specifications; and

(H) In areas that have water quality problems that would be aggravated by the use of steel casing, plastic casing is recommended. If it is necessary to set steel casing due to

geologic reasons, the following may substitute for casing:

1. Set no less than eighty feet (80') of casing; and

2. Liner must be set through the casing to point as determined in subsection (1)(C). Example: If the casing point was determined to be one hundred and eighty feet (180'), one hundred and eighty feet (180') of liner must be set. The liner must meet all requirements as stated in 10 CSR 23-3.080, including grouting.

(3) Sensitive Area C. The Springfield area is one in which urbanization is occurring at a rapid rate in an extremely sensitive and fragile geologic and hydrologic setting. The area is underlain by fractured, and cavernous limestone and pollutants are able to migrate quickly, both vertically and horizontally. Because of these factors, it is necessary to treat this area differently than surrounding areas and have stricter well construction standards. All persons engaged in drilling of wells in the sensitive area C (Figure 8) shall—

(A) The casing shall be set as determined by Area C casing depth map. When drilling in Sensitive Area C, it is strongly recommended that a casing point request be submitted so that the exact amount of casing can be set, limiting the amount of grout required. Approval must be obtained before drilling begins. Area C casing depth map sets the minimum amount of required casing that will extend at least ten feet (10') below the Northview Shale. Due to surface elevation changes within the quarter (1/4) section (one-quarter (1/4) mile), the amount of casing stated on the casing depth map may extend more than ten feet (10') below the bottom of the Northview Shale. In those instances, where the casing extends more than ten feet (10') below the bottom of the Northview Shale, more than thirty feet (30') of grout is required to seal off the Northview Shale. See 10 CSR 23-3.100(3)(D);

(B) The drillhole shall be constructed a minimum of eight and five-eighths inches (8 5/8") in diameter to the surface casing point;

(C) New steel or plastic casing shall be installed as specified in 10 CSR 23-3.030 (steel) or 10 CSR 23-3.070 (plastic);

(D) Full-length grout is preferred and will ensure a better annular seal but sealing the lowermost thirty feet (30') of casing using approved grout materials and procedures set out in 10 CSR 23-3.030 is required if the casing does not go more than ten feet (10') below the bottom of the Northview Shale. Due to surface elevation changes within the quarter (1/4) section (one-quarter (1/4) mile), the amount of casing required is calculated at the highest elevation. Therefore, if a well is drilled in a lower elevation area, the required casing will go more than ten feet (10') below the bottom of the Northview Shale. In many cases, thirty feet (30') of grout will not seal off the Northview Shale since the bottom of the casing is much deeper. The Northview Shale interval must be grouted from ten feet (10') below to the top of the shale regardless of the amount of casing set. A minimum of thirty feet (30') of grout is required. Drill cuttings and a drive shoe or drill cuttings used by themselves are not approved grout materials. Drill cuttings may be placed above grouted interval to fill in the annular space. Install and seal casing as follows:

1. If steel casing is used, a drive shoe is required except on wells where the grout is allowed to cure before drilling resumes;

2. If plastic casing is used, a packer, coupling or inverted bell is required to be secured near the bottom of the casing and must hold the grout in place while drilling continues. No packer, coupling or inverted bell is required if grout is allowed to cure before drilling resumes; and

3. The following times must be followed for curing grout when no packer is used:

A. Hi-early cement—minimum set time of twelve (12) hours;

B. Portland Type I cement—minimum set time of seventy-two (72) hours;

C. Chipped bentonite—minimum hydration time of four (4) hours; and

D. High solids bentonite slurry—varies based on additives and manufacturer's specifications; and

(E) In areas that have water quality problems that would be aggravated by the use of steel casing, plastic casing is recommended. If it is necessary to set steel casing due to geologic reasons, the following may substitute for casing:

1. No less than one hundred feet (100') of casing shall be set. The drill hole shall be constructed a minimum of eight and five-eighths inches (8 5/8") in diameter and new six-inch (6") inside diameter steel casing shall be installed as specified in 10 CSR 23-3.030. A six-inch (6") hole is then drilled to total depth and a plastic liner having an outside diameter no greater than four and one-half inches (4 1/2") shall be secured into place. No variances will be issued for this requirement; and

2. Liner must be set through the casing to the required casing point. The liner must be set to the casing depth as determined by Area C casing depth map. The liner must meet all requirements as stated in 10 CSR 23-3.080 concerning liners, including grouting. More than sixty feet (60') of grout may be required as stated in 10 CSR 23-3.100(3)(D).

(4) Special Area. Due to the unique and varied geological conditions present because the bedrock is deeply weathered and often highly fractured, openings filled with mud may extend deep into the bedrock. Caving-in of the hole during drilling and after well construction is a problem. The following rules are the minimum that are required but in many cases much more steel casing may be necessary to secure the well bore. Also, in some cases plastic liner is not strong enough to hold the well bore open and steel should be used. All persons engaged in the drilling of a domestic well in special area 1 (see Figure 1 and Figure 7 included herein) shall—

(A) Set no less than eighty feet (80') of casing. The hole shall be cased fifteen feet (15') below residuum, broken rock, or mud pockets into solid bedrock or if rock is not encountered within one hundred and fifty feet (150') consult the division for further instructions concerning a variance, unless casing will be set into deeper bedrock;

(B) Construct the drill hole a minimum of eight and five-eighths inches (8 5/8") in diameter to the surface casing point;

(C) Install new steel casing as specified in 10 CSR 23-3.030. Plastic casing of any type will not be allowed in this area; and

(D) Install and seal casing as follows:

1. Full-length grout is highly recommended and will ensure a better annular seal but sealing the lowermost thirty feet (30') of casing using approved grout materials and procedures set out in 10 CSR 23-3.030 is required. Drill cuttings with a drive shoe or drill cuttings used by themselves are not approved grout materials. Drill cuttings may be placed above grouted interval to fill in the annular space;

2. A drive shoe is required except on wells where the grout is allowed to cure before drilling resumes.

A. The following times must be followed for curing grout when no packer is used:

(I) Hi-early cement—minimum set time of twelve (12) hours;

(II) Portland Type I cement—minimum set time of seventy-two (72) hours;

(III) Chipped bentonite—minimum hydration time of four (4) hours;

(IV) High solids bentonite slurry—varies based on additives and manufacturer's specifications; and

3. If drilling conditions do not permit a bottom seal, then the casing must be driven and grouting material introduced around the

outside casing while the casing is being driven. If the casing cannot be sealed to prevent surface contamination from entering the well, a liner must be set and sealed according to 10 CSR 23-3.080.

(E) In areas where poor drilling conditions exist and it is necessary to drive multiple strings of smaller diameter casing through the surface casing, each succeeding liner should extend into the preceding liner or casing at least twenty feet (20') and the annulus created between the casing and liner must be grouted.

(F) In wells where it is necessary to set casing below static water levels, it may be advisable to set plastic liner as stated in 10 CSR 23-3.080 from the surface to a point below the pumping water level to avoid excessive iron in the produced well water.

(5) Special Area 2 Definitions.

(A) "Lower aquifer" means that portion of transmissive, water-bearing geologic material extending from the Cotter Dolomite to igneous bedrock. The lower aquifer includes all formations constituting the Ozark Aquifer and the St. Francois Aquifer in the southwestern portion of the state.

(B) "Low-permeability bedrock" means that portion of geologic material between the lower aquifer and upper aquifer that does not readily transmit water in sufficient quantities to supply a well. The Northview Formation, the Chattanooga Shale, and the upper thirty feet (30') of the Cotter Dolomite shall constitute the low-permeability bedrock. The low-permeability bedrock serves as a natural barrier to groundwater mixing between the upper aquifer and lower aquifer. See Figure 7A included herein for an illustration of geology in Special Area 2.

(C) "Upper aquifer" means that portion of the transmissive, water-bearing geologic material above the top of the low-permeability bedrock. The upper aquifer includes all formations constituting the Springfield Plateau Aquifer in the southwestern portion of the state.

(D) "Maximum contaminant level (MCL)" is the maximum permissible concentration of a contaminant in drinking water as listed by the National Primary Drinking Water Regulations (NPDWR).

(E) "Action level (AL)" is the maximum permissible concentration of lead in drinking water as specified in the *Code of Federal Regulations*. ALs are levels used for contaminants that do not have established MCLs.

(F) "TCE" shall mean the organic chemical trichloroethylene (a common solvent) and its known degradation products, including but not limited to dichloroethylene and vinyl chloride.

(G) "Impact area" is defined as that land surface area that is underlain or surrounded by water-bearing units that contain groundwater above the MCL or AL for at least one (1) contaminant of concern (lead, cadmium, TCE or TCE degradation products, or other contaminants of the NPDWR). Standard contouring methodology shall be used to delineate the MCL and AL isoconcentration line, which will define the geographic limit of an impact area.

(6) Special Area 2. All of Newton County and Jasper County shall be listed as Special Area 2 (Figure 7B included herein) due to the contamination of portions of the upper aquifer by one (1) or more of the following: lead, cadmium, TCE, TCE degradation products or other contaminants of the NPDWR. The upper aquifer and lower aquifer are separated by a thickness of low-permeability bedrock (Figure 7A). This low-permeability bedrock limits migration of groundwater and any associated contamination from the upper aquifer to the lower aquifer. Wells that penetrate the low-permeability bedrock without an adequate length of surface casing which has had the annulus sealed by approved methods through the low-permeability bedrock may place the lower aquifer at risk to future contamination. Due to chemical and metal contamination present in the upper aquifer in portions of this area, it is necessary to require more stringent well construction standards for new wells that are drilled into the lower aquifer, to cease construction of additional upper aquifer wells in impact areas, and to limit deepening of existing upper aquifer wells in impact areas. New wells constructed outside of the impact area shall be constructed to standards that are no less stringent than the minimum well construction requirements for Area 1. All persons engaged in drilling wells in Special Area 2 shall—

(A) Before beginning construction of the well, determine if the well to be drilled is located within the impact area as shown on maps provided by the division or as determined by division staff. If data indicate change in impact area status, the impact area map may be modified by the division during January of the calendar year and that map will be maintained and available at: Department of Natural Resources, PO Box 250, Rolla, MO 65402-0250.

(B) Drill new wells within the impact area to a depth required to produce water from the lower aquifer. All new wells drilled in the impact area shall have steel or plastic casing properly installed and grouted to the depth determined by the Special Area 2 casing depth map.

1. The drill hole shall be a minimum of eight and five-eighths inches (8 5/8") in diameter to the surface casing point;

2. New steel casing shall be installed as specified in 10 CSR 23-3.030 (steel);

3. The well must be sealed by positive displacement grouting with high-solids bentonite slurry. The annulus between the casing and the borehole wall shall be grouted from the base of the borehole. The volume of grout shall be no less than the calculated volume necessary to accomplish full-length grouting of the annulus. Alternatively, full-length pressure grouting (10 CSR 23-3.030(3)(A)4.) with high-solids bentonite slurry or neat cement meets the requirements of this rule. In addition, casing must be sealed as follows:

A. When steel casing is used, a drive shoe is required except on wells where the grout is allowed to cure as specified in subparagraph (6)(B)3.C. of this rule before drilling resumes;

B. If plastic casing is used, a drill hole shall be constructed a minimum of ten inches (10") in diameter to the casing point. Plastic casing shall be installed as specified in 10 CSR 23-3.070 (plastic) and, a packer, coupling, or inverted bell is required to be secured near the bottom of the casing and must hold the grout in place while drilling continues. PVC and ABS plastic casing shall not be used when known gasoline or solvent contamination exists within the impact area. The annular space shall be sealed as specified in paragraph (6)(B)3. of this rule. No packer, coupling, or inverted bell is required on wells where the grout is allowed to cure as specified in subparagraph (6)(B)3.C. of this rule before drilling resumes; and

C. The following times must be allowed for curing grout when no packer is used:

(I) High-solids bentonite slurry—varies based on additives and manufacturer's specifications. At least one hour of curing after initial slurry placement is suggested. This amount of curing time should elapse during casing placement.

(C) Uncontaminated upper aquifer wells in impact areas of Special Area 2 existing before the date of this rule may be deepened to the top of the low-permeability bedrock.

(D) Water from all new wells and deepened old wells throughout Special Area 2 shall be sampled and analyzed for lead and cadmium, plus TCE and its degradation products within TCE impact areas. Where indicated by objective factors, the division may require sampling and analysis for other contaminants listed in the NPDWR. Qualified and properly trained persons must complete sample collection. The laboratory that analyzes the sample

must be approved by the EPA for such analysis. A copy of the chain of custody form shall be submitted to the division with the well certification report form to document sampling has occurred. An appropriate chain of custody form will be available from the division.

1. In order to ensure proper well development, the well pump must run continuously for five (5) hours or until the water clears, whichever occurs first, but in no case shall the well be pumped less than two (2) continuous hours.

2. After proper well development, water samples shall be collected from the tap nearest the well.

3. All new and deepened old wells in Special Area 2 shall be constructed with a sampling port or tap within ten feet (10') of the wellhead. Water must be purged from the sampling port prior to collection of a sample.

4. Water from all new wells in Special Area 2 with less than three (3) times the applicable maximum contaminant level (MCL) or action level (AL) may be retested over a one (1)-month period following pump installation and development to assess water quality changes that may have resulted from drilling and/or well construction. The well cannot be used for human consumption until contaminant levels are below MCLs or ALs. Qualified and properly trained persons must complete sample collection. The laboratory that analyzes the sample must be approved by the EPA for such analysis. A copy of the chain of custody form shall be submitted to the division with the well certification report form to document sampling has occurred. An appropriate chain of custody form will be available from the division. The division may require any new well, whose contaminant levels do not fall below MCLs or ALs after the retest period, to be plugged.

5. Properly constructed new lower aquifer wells that are determined to be contaminated may be allowed to use water treatment systems on a variance basis, if other domestic water sources are not available at the time of well construction. Otherwise, the well must be plugged by using full-length, high-solids bentonite grout emplaced by tremie pipe which extends to within twenty-five feet (25') of the bottom of the borehole. Grout, extending from the bottom of the borehole to within two feet (2') of land surface and finished per 10 CSR 23-3.110 (2)(A)3.G., is preferred; in any case, the minimum volume of grout shall be no less than the volume calculated as necessary to accomplish full length plugging of the well.

6. Existing wells that extend uncased and/or unsealed through the low-permeability bedrock and that are found to be contaminated with lead, or cadmium, or TCE, TCE degradation products, or other contaminants of the NPDWR may be required to be plugged full-length with high-solids bentonite grout, emplaced by tremie pipe, which extends to within twenty-five feet (25') of the bottom of the borehole. Grout, extending from the bottom of the borehole to within two feet (2') of land surface and finished per 10 CSR 23-3.110(2)(A)3.G., is preferred; in any case, the minimum volume of grout shall be no less than the volume calculated as necessary to accomplish full-length plugging of the well.

(7) Special Area 3. Portions of Franklin County within and south of the city of New Haven shall be listed as Special Area 3 (Figures 7B and 7C included herein) due to the contamination of portions of the aquifer by one (1) or more of the following chemicals of concern: tetrachloroethylene (PCE), trichloroethylene (TCE), perchloroethylene (PCE) degradation products, TCE degradation products or other contaminants of the National Public Drinking Water Regulations (NPDWR). In this area it is necessary to utilize more stringent well construction standards for new wells that are drilled into the aquifer and to limit the deepening of existing upper aquifer wells.

(A) The division shall be consulted before constructing a new well in Special Area 3. The division will provide specific guidance on well drilling protocol and construction specifications on a case-by-case basis. The division must provide written approval for all new wells prior to construction.

(B) Before deepening a well in Special Area 3, groundwater sampling and analysis for the chemicals of concern must be conducted by qualified and properly trained individuals and the data submitted within sixty (60) days of the sampling event by the well installation contractor to the division. The division must provide written approval for the deepening of all new wells in Special Area 3. Wells that have been sampled and analyzed and are contaminated with chemicals of concern exceeding maximum contaminant levels (MCLs) and/or action levels (ALs) shall not be deepened.

(C) In addition to specific instructions that are provided by the division pursuant to 10 CSR 23-3.100(7)(A) and (B), the following must be performed at all new wells installed in Special Area 3:

1. All drilling-derived fluids and solid materials shall be containerized and sampled before disposal in an appropriate location based on analytical results;

2. All new and deepened old wells in Special Area 3 shall be constructed with a sampling port or tap within ten feet (10') of the wellhead. Water must be purged from the sampling port prior to collection of a sample;

3. After proper well development, water from all new wells located in Special Area 3 shall be sampled and analyzed for the chemicals of concern, as determined by the division. Qualified and properly trained persons must complete sample collection. In order to document sampling has occurred, a copy of the chain of custody form shall be submitted by the pump installation contractor to the division within sixty (60) days of pump installation; and

4. The data report from all analyses shall be made available by the pump installation contractor to the division and the well owner within sixty (60) days of the sampling event.

(D) At any well being drilled, per division guidance, in which PCE and/or TCE is encountered in a pure-product phase (also known as dense non-aqueous phase liquid or DNAPL), drilling shall cease and the division shall be notified immediately. The division will determine further action.

(E) Properly constructed new or deepened wells that, upon sampling and analysis, are contaminated at levels exceeding MCLs or ALs shall:

1. Be plugged full-length using high-solids bentonite slurry, six percent (6%) bentonite cement or neat cement grout placed under pressure via tremie pipe which extends to within twenty-five feet (25') of the bottom of the borehole. Grout shall extend from the bottom of the borehole to within two feet (2') of land surface. Prior to plugging, all pumps and debris must be removed from the wells. Any liner must be removed or perforated if possible. Casing must be cut at least three feet (3') below ground surface. A registration report and fee (if required) must be submitted within sixty (60) days of abandonment; or

2. With approval from the division, the well owner shall be allowed to install a water treatment system that is designed to properly treat the chemical(s) of concern. The well shall not be used for human consumption until sampling and analysis demonstrates that the water treatment system reduces contaminant levels below MCLs and/or ALs for all chemicals of concern. The division shall be provided a copy of the post-treatment analytical data by the pump contractor within sixty (60) days of the sampling event.

(8) Special Area 4. Portions of St. Charles County west of the city of Weldon Spring shall be listed as Special Area 4 (Figure 7D included herein) due to the contamination of portions of the aquifer by one (1) or more of the following chemicals of concern: trinitrotoluene (TNT) and dinitrotoluene (DNT) at the U.S. Army Corps of Engineers (COE) site, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, dinitrobenzene (1,3-DNB), nitrobenzene (NB),

nitrate, uranium, and trichloroethylene (TCE) at the Department of Energy (DOE) Main Site, uranium, and 2,4-DNT, at the DOE Quarry, or other contaminants of the National Public Drinking Water Regulations (NPDWR). In this area it is necessary to utilize more stringent well construction standards for new wells that are drilled into the aquifer and to limit the deepening of existing upper aquifer wells.

(A) The division shall be consulted before constructing a new well in Special Area 4. The division will provide specific guidance on well drilling protocol, construction specifications and groundwater sampling on a case-by-case basis. The division must provide written approval for all new wells prior to construction.

(B) Before deepening a well in Special Area 4, groundwater sampling and analysis for the chemicals of concern must be conducted by qualified and properly trained individuals and the data submitted within sixty (60) days of the sampling event by the well installation contractor to the division. The division must provide written approval for the deepening of all new wells in Special Area 4. Wells that have been sampled and analyzed and are contaminated with chemicals of concern exceeding maximum contaminant levels (MCLs), action levels (ALs), and/or remediation goals included in the DOE/COE Record of Decision (ROD) for the Weldon Spring sites shall not be deepened.

(C) In addition to specific instructions that are provided by the division pursuant to 10 CSR 23-3.100(8)(A) and (B), the following must be performed at all new wells installed in Special Area 4:

1. All new and deepened old water wells in Special Area 4 shall be constructed with a sampling port or tap within ten feet (10') of the wellhead. Water must be purged from the sampling port prior to collection of a sample;

2. After proper well development, water from all new wells located in Special Area 4 shall be sampled and analyzed for the chemicals of concern, as determined by the division. Qualified and properly trained persons must complete sample collection. Sampling qualifications and training requirements will be determined in advance of sampling by the division and approval will be issued in written format. In order to document sampling has occurred, a copy of the chain of custody form shall be submitted by the pump installation contractor to the division within sixty (60) days of pump installation; and

3. The data report from all analyses shall be made available by the pump installation contractor to the division and the well owner within sixty (60) days of the sampling event.

(D) Properly constructed new or deepened wells that, upon sampling and analysis, are contaminated at levels exceeding MCLs, ALs, and/or remediation goals included in the DOE/COE ROD for the Weldon Spring sites shall:

1. Be plugged full-length using high-solids bentonite slurry, six percent (6%) bentonite cement or neat cement grout placed under pressure via tremie pipe which extends to within twenty-five feet (25') of the bottom of the borehole. Grout shall extend from the bottom of the borehole to within two feet (2') of land surface. Prior to plugging all pumps and debris must be removed from the wells. Any liner must be removed or perforated if possible. Casing must be cut at least three feet (3') below ground surface. A registration report and fee (if required) must be submitted within sixty (60) days of abandonment; or

2. With prior approval from the division, the well owner shall be allowed to install a water treatment system that is designed to properly treat the chemical(s) of concern. The well shall not be used for human consumption until sampling and analysis demonstrates that the water treatment system reduces contaminant levels below MCLs, ALs, and/or remediation goals included in the DOE/COE ROD for the Weldon Spring sites for all chemicals of concern. The division shall be provided a copy of the post-treatment analytical data by the pump contractor within sixty (60) days of the sampling event.

(E) Notwithstanding these provisions, the federal government does not waive its rights and authority under federal law, regulations, or executive order within the boundaries and applicable jurisdiction of federal property.

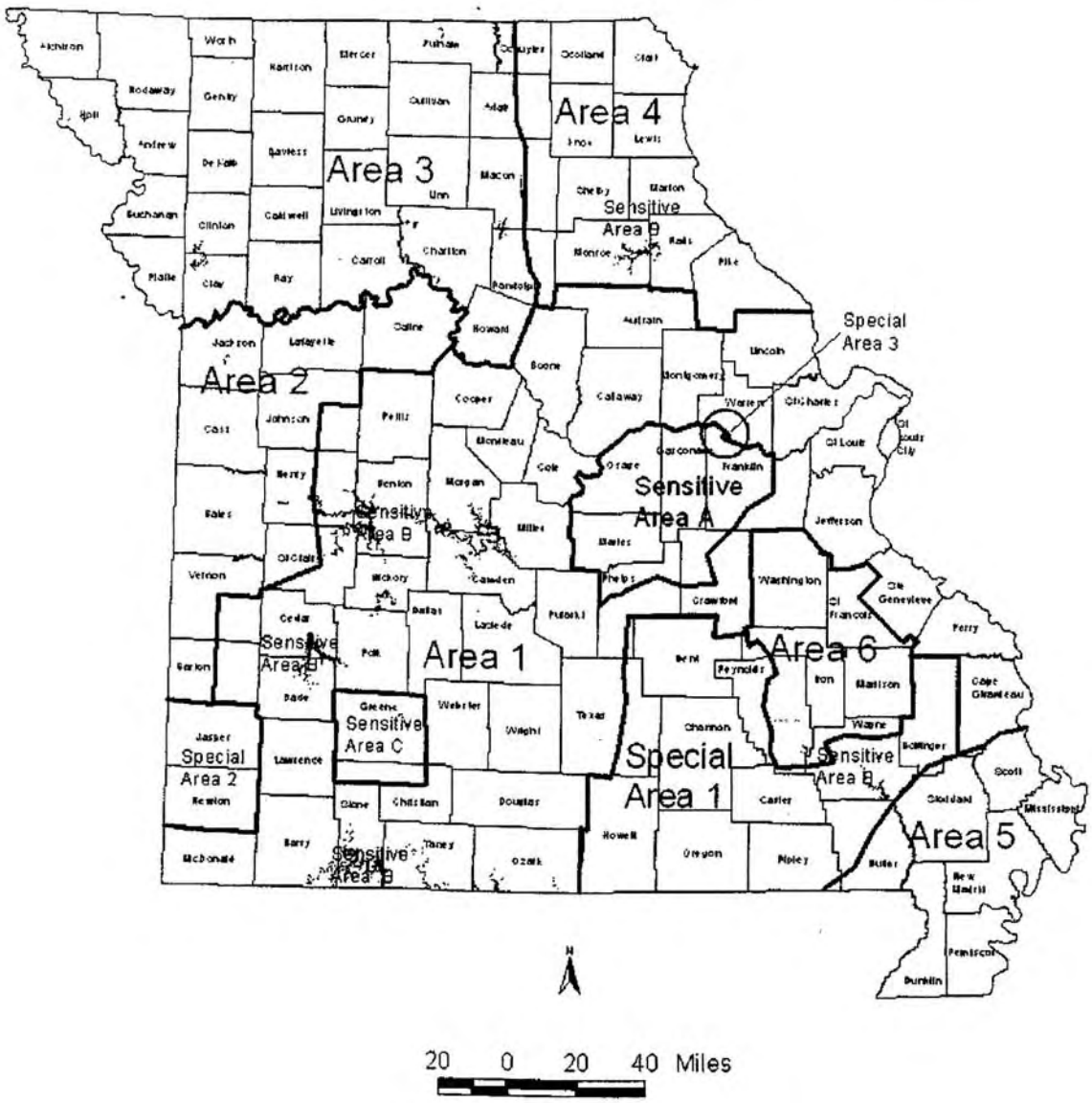
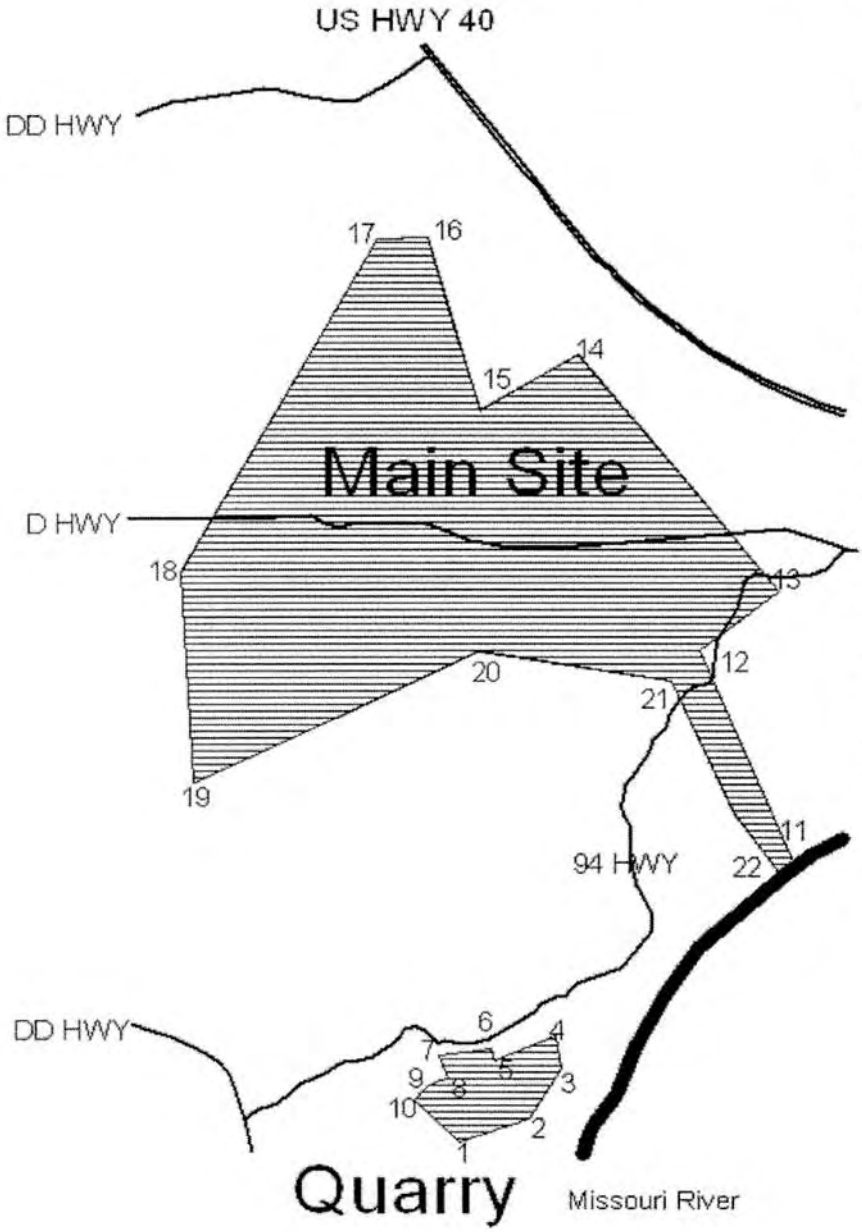


Figure 1. Map showing drilling areas for private well construction regulations. Areas are enlarged in maps on the following pages.

Special Area 4



CORNERS

	LAT	LONG
1	38 39' 03"	90 45' 13"
2	38 39' 10"	90 44' 44"
3	38 39' 26"	90 44' 32"
4	38 39' 37"	90 44' 33"
5	38 39' 30"	90 44' 58"
6	38 39' 33"	90 44' 59"
7	38 39' 32"	90 45' 19"
8	38 39' 25"	90 45' 16"
9	38 39' 22"	90 45' 22"
10	38 39' 18"	90 45' 29"
11	38 40' 28"	90 42' 58"
12	38 41' 31"	90 43' 32"
13	38 41' 52"	90 43' 02"
14	38 43' 11"	90 44' 15"
15	38 42' 53"	90 44' 54"
16	38 43' 49"	90 45' 13"
17	38 43' 50"	90 45' 33"
18	38 42' 02"	90 46' 52"
19	38 40' 53"	90 46' 49"
20	38 41' 37"	90 44' 57"
21	38 41' 22"	90 43' 44"
22	38 40' 24"	90 43' 04"

Figure 7D. Special Area 4, Weldon Spring Federal Area

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1. DOE recognizes that from time to time, the Missouri Department of Natural Resources may conduct construction and/or excavation activities, including bridge and culvert repair or replacement, on the Katy Trail State Park within the Southeast Drainage Operable Unit and the Quarry Residuals Operable Unit. These two specific areas, where the Katy Trail State Park intersects with the Southeast Drainage Operable Unit and the Quarry Residuals Operable Unit are shown on Figures D-4 and D-7, respectively.

2. If any time before or during such construction/excavation activities, the Missouri Department of Natural Resources has concerns about the exposure of its staff to contaminated soil or groundwater in the specific areas discussed above, the Department may notify DOE contact staff in Missouri. Within 48 hours, DOE shall respond with a verbal response regarding the documentation of groundwater or soil data in the area and/or a need for further characterization and the plans for characterization. DOE shall respond within seven days with field screening equipment or other sampling equipment as necessary to assess and monitor the situation from a health and safety perspective and provide advice and guidance on worker, and if appropriate, public protection.

3. If field conditions exist that jeopardize state park worker safety, as defined by appropriate DOE and/or EPA guidelines, then DOE shall either decontaminate the site as necessary to make the site safe for state park workers, or provide personnel trained to complete the construction/excavation work under the contaminated conditions to the satisfaction of the Missouri Department of Natural Resources. DOE shall be responsible for the proper disposal of any contaminated wastes or materials generated by the construction and/or decontamination activities described herein.

4. DOE shall be responsible for ensuring that the final conditions upon construction completion are safe for the public in accordance with DOE regulations and guidelines.

5. The terms of this agreement shall be kept by the Missouri Department of Natural Resources in its Operations Plan for the Eastern Section of the Katy Trail State Park.

6. As part of its annual inspection requirements, DOE shall provide the current manager of the Eastern Section of the Katy Trail State Park with the most current name and telephone number for the DOE contact staff in Missouri who are designated to respond to the requirements as described herein.

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Appendix F

Official Contact List

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Long-Term Surveillance and Maintenance Emergency Contact List

Environmental Protection Agency
Mr. Dan Wall
Remedial Project Manager
Superfund Division
U.S. EPA Region 7
901 North 5th Street
Kansas City, Kansas 66101
(913) 551-7710

Missouri Department of Natural Resources
Mr. Aaron Schmidt
Chief, Federal Facilities Section
Missouri Department of Natural Resources
1730 East Elm
Jefferson City, MO 65102
(573) 751-3907

St. Charles County
Mr. Mike Duvall
Director, Division of Environmental Services
St. Charles County Government
201 North Second Street, Suite 537
St. Charles, MO 63301
(636) 949-7583

St. Charles County
Division of Emergency Management
Rod Zerr, PDS, Director
301 North Second Street
St. Charles, MO 63301
Office: 636-949-3023
Mobile: 314-267-3318

Missouri Department of Health and Senior Services
Mr. Gale Carlson
Assessment Unit Chief
Missouri Department of Health and Senior Services
210 El Mercado
Jefferson City, MO 65102
(573) 751-6160

Long-Term Surveillance and Maintenance Emergency Notification List

Francis Howell School District
Dr. Renèe Shuster
Superintendent
Francis Howell School District
4545 Central School Road
St. Charles, MO 63304
636-851-4026

Francis Howell High School
Dr. Chris Greiner
Principal
Francis Howell High School
7001 Highway 94 South
St. Charles, MO 63304
636-851-4700

Missouri Department of Conservation
Mr. John Vogel
August A. Busch Memorial Conservation Area
2360 Highway D
St. Charles, MO 63304
636-300-1953 ext, 318

U.S. Department of Army
Marsha Miller, Facility Manager
Weldon Spring Training Area
7301 Highway 94 South
St. Charles, Missouri 63304
636-329-1200

Missouri Department of Transportation
Mr. Kevin Wideman, Environmental Compliance Coordinator
Missouri Department of Transportation
P.O. Box 270
Jefferson City, Missouri 65102
573-526-4171

Annual Inspection Contact List

Detailed Contact Information is included in Appendix H.

Regulatory Agencies (Notify 30 days in advance)

Environmental Protection Agency
Missouri Department of Natural Resources

Stakeholders

Weldon Spring Citizens Commission
Francis Howell High School
St. Charles County

Responding Agencies

St. Charles County Sheriff Office
Cottleville Fire Department
Simplex Grinnell (Alarm Company)

Institutional Control Contacts

Missouri Department of Conservation
Missouri Department of Natural Resources – Parks
Missouri Department of Transportation
U.S. Department of Army
St. Charles County Planning and Zoning
St. Charles County Recorder of Deeds – Check Institutional Control Instruments

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Appendix G

Distribution List

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Except for individual stakeholders, this distribution list is composed of people representing organizations, which have expressed interest in site activities. When individual turnover occurs in these positions, DOE will revise the list to reflect the current holder of these positions. This type of revision is considered minor and not subject to review. All individuals on this list will receive notices of upcoming meetings or the availability of certain documents such as the annual site inspection report, the 5-Year Review and proposed revisions of this Long-Term Surveillance and Maintenance Plan.

DISTRIBUTION LIST

Stakeholders

Ms. Linda Covilli
202 North Benton Avenue
St. Charles, MO 63301

Mr. Karl Daubel
15022 Willow Lake Court
Chesterfield, MO 63017

Ms. Kay Drey
515 West Point Avenue
University City, MO 63130

Ms. Clarissa Eaton
3419 Kathleen Drive
Festus, MO 63028

Dr. Michael Garvey
208 Pitman Hill Road
St. Charles, MO 63304

Dr. Dawn Garzon
2748 Royal Valley Way
O'Fallon, MO 63366

Mr. Brian Harcek
121 Oak Knob
Universal City, TX 78148-5509

Mr. David Hosking
4 Monet Court
O'Fallon, MO 63366

Immaculate Conception Church of Dardenne
2083 Hanley Road
O'Fallon, MO 63366

Stakeholders (continued)

Ms. Karen Johnson
220 Maryland Drive
O'Fallon, MO 63366

Dr. Daniel W. McKeel, Jr.
5587-C Waterman Blvd.
St. Louis, MO 63112

Mrs. Louise McKeel
5587-C Waterman Blvd.
St. Louis, MO 63112

John & Sharon Prokovich
1021 Meadow Lane
St. Charles, MO 63303

Ms. Elsa Steward
Great Rivers Environmental Law Center
705 Olive St., Suite 614
St. Louis, MO 63103

Ms. Rebecca Wright
2011 Rutger Street
St. Louis, MO 63104

Schools/Universities

Mr. Rick Pavia, Project Manager
Francis Howell School District
7055 Highway 94 South
St. Charles, MO 63304

Dr. Renèe Schuster, Superintendent
Francis Howell School District
4545 Central School Road
St. Charles, MO 63304

Schools/Universities (continued)

Dr. Chris Greiner, Principal
Francis Howell High School
7001 Highway 94 South
St. Charles, MO 63304

Julie Mueller, Chief Operations Officer
Lindenwood University
209 S. Kingshighway
St. Charles, MO 63301

Media Contact List

Mr. Shane Anthony
St. Louis Post Dispatch
190 Spring Drive
St. Charles, MO 63303-3255

Mr. Raymond Castile
St. Charles Journal
4212 N Service Road
St. Peters, MO 63376-6464

Mr. Kevin Lavery
KWMU
8001 Natural Bridge Road
St. Louis, MO 63121

Ms. Sara Shipley, Environmental Reporter
St. Louis Post-Dispatch
900 North Tucker Boulevard
St. Louis, MO 63101

Municipalities

Mayor
City of Wentzville
310 W. Pearce Blvd.
Wentzville, MO 63385

Mayor
City of St. Peters
One St. Peters Centre Blvd.
St. Peters, MO 63376

Municipalities (continued)

Mayor
City of Weldon Spring
711 Nancy Lane
Weldon Spring, MO 63304

Mayor
City of Lake St. Louis
200 Civic Center Drive
Lake St. Louis, MO 63367

Mayor
City of Cottleville
1280 Motherhead Road
Cottleville, MO 63304

Mayor
City of O'Fallon
100 North Main Street
O'Fallon, MO 63366

Mayor
City of St. Louis
City Hall, Room 200
1200 Market Street
St. Louis, MO 63103

Mayor
City of St. Charles
St. Charles City Hall
200 North Second Street
St. Charles, MO 63301

Mayor
City of New Melle
P.O. Box 114
New Melle, MO 63365

Ms. Catherine Davis, Chairperson
Weldon Spring Heights
16 Weldon Spring Heights
St. Charles, MO 63304

Municipalities (continued)

Mayor
City of Augusta
P.O. Box 42
Augusta, MO 63332

Ms. Virginia Dowden
League of Chambers
10 Hobie Cat Drive
Defiance, MO 63341

St. Charles County Agencies/ Companies/Organizations

County Executive
St. Charles County Courthouse
100 North Third Street Room 318
St. Charles, MO 63301

Councilman
District #1, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

Councilman
District #2, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

Councilman
District #3, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

Councilman
District #4, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

Councilman
District #5, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

St. Charles County Agencies/ Companies/Organizations (continued)

Councilman
District #6, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

Councilman
District #7, County Council
St. Charles County Courthouse
100 North Third Street
St. Charles, MO 63301

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Director – Division of Environmental Services
St. Charles County
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St. Charles, MO 63301

Mr. Wayne Anthony
St. Charles County Planning and Zoning
201 North Second Street, Suite 420
St. Charles, MO 63301

Mr. Gil Copley
St. Charles County Department of Health
1650 Booneslick
St. Charles, MO 63301

Mr. Pieter A. Sheehan, RCHS
Environmental Public Health Manager
St. Charles County Government
Dept. of Community Health and the Environment
1650 Boone's Lick Road
St. Charles, MO 63301

Mr. Barry Drucker, Environmental Sanitarian
St. Charles County Health Department
1650 Booneslick
St. Charles, MO 63301

St. Charles County Agencies/ Companies/Organizations (continued)

Ms. Bettie Yahn-Kramer, CPRP Director
St. Charles County Parks and Recreation Department
201 North Second Street, Suite 510
St. Charles, MO 63301

Middendorf-Kredell Library
Ms. Anna Sylvan, Documents Manager
2750 Highway K
O'Fallon, MO 63366

Mr. Steve Wilkins, Water Plant Supervisor
Public Water Supply District #2
1635 Highway 94 South
Defiance, MO 63341

Captain Jim Hudson
St. Charles County Sheriff Office
101 Crossing Industrial Ct
O'Fallon, MO 63366

Ms. Nancy Dickens
150 E. Dunn
Edwardsville, IL 62025

Mr. Richard Hoormann, County Program Director
University of Missouri-Cooperative Extension Service
260 Brown Road
St. Peters, MO 63376

Mr. Ron Molly, Manager
Missouri American Water Company
P.O. Box 355
Cottleville, MO 63338-0355

Mr. Mike Dougherty
Division Manager
Alliance Water Resources
410 East Elm St.
O'Fallon, MO 63366

St. Charles County Agencies/ Companies/Organizations (continued)

Tim Geraghty, P.E.
Manager of Engineering and Operations
Public Water Supply District #2
P.O. Box 370
O'Fallon, MO 63366

Mark Boehle, Assistant Fire Chief
Cottleville Fire Department
1385 Motherhead Road
St. Charles, MO 63304

St. Louis County Agencies/ Companies/Organizations

The Honorable Charlie A. Dooley
County Executive
St. Louis County
Administration Building, 9th floor
41 South Central Avenue
Clayton, MO 63105

Ms. Jacquelynn A. Meeks, Director
Environmental Administration
St. Louis County Health Department
111 South Meramec, 2nd Floor
Clayton, MO 63105

Mr. Roland A. Biehl
Environmental Associate Engineer
Metropolitan St. Louis Sewer District
10 East Grand Avenue
St. Louis, MO 63147-2913

Director
Environmental Engineering &
Site Services Department
Anheuser Busch
One Busch Place
St. Louis, MO 63118

Dr. Robert Nicolotti
St. Louis County Health Department
111 South Meremac
Fifth Floor
St. Louis, MO 63105

St. Louis County Agencies/ Companies/Organizations (continued)

Mr. Frank Hartman
Vice President for Production
Missouri American Water Company
535 North New Ballas Road
St. Louis, MO 63141

Mr. Don Rea
City of St. Louis Water Division
Chain of Rocks Plant
10450 Riverview Drive
St. Louis, MO 63137

Mr. Curtis Skouby
City of St. Louis Water Division
Howard Bend Plant
14769 Olive St.
Chesterfield, MO 63017

Mr. Mike Zlatic
St. Louis County Department of Health
111 S. Meramec
Clayton, MO 63105

Mr. Jack Frauenhoffer
Director, Site Development & Community Relations
Mallinckrodt Inc.
P.O. Box 5840
St. Louis, MO 63134

State - Elected Officials

The Honorable Matt Blunt, Governor
State of Missouri
State Capitol, Room 216
P.O. Box 720
Jefferson City, MO 65102

The Honorable Scott Rupp
R -2nd District
Missouri State Senator
State Capitol, Room 426
201 West Capitol Avenue
Jefferson City, MO 65101

State - Elected Officials (continued)

The Honorable Tom Dempsey
R-23rd District
Missouri State Senator
State Capitol, Room 433
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Joe Smith
R-14th District
Missouri House of Representatives
State Capitol, Room 316
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Sally Faith
R-15th District
Missouri House of Representatives
State Capitol, Room 207A
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Carl L. Bearden
R-16th District
Missouri House of Representatives
State Capitol, Room 301
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Vicki Schneider
R-17th District
Missouri House of Representatives
State Capitol, Room 114B
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Thomas D. Dempsey
R-18th District
Missouri House of Representatives
State Capitol, Room 309
201 West Capitol Avenue
Jefferson City, MO 65101

The Honorable Kevin Threlkeld
R-109th District
Missouri House of Representatives
State Capitol, Room 403A
201 West Capitol Drive
Jefferson City, MO 65101

State Agencies

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Jefferson City, MO 65102

Mr. Robert Geller
Missouri Department of Natural Resources
Post Office Box 176
Jefferson City, MO 65102

Mr. Aaron Schmidt
Chief, Federal Facilities Section
Missouri Department of Natural Resources
Post Office Box 176
Jefferson City, MO 65102

Mr. Thomas Siegel
Missouri Department of Natural Resources
7545 S. Lindbergh Blvd., Suite 210
St. Louis, MO 63125

Mr. Patrick Anderson
Missouri Department of Natural Resources
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Jefferson City, MO 65102-0176

Ms. Mimi Garstang, Director
Division of Geology and Land Survey
Missouri Department of Natural Resources
Post Office Box 250
Rolla, MO 65402

Ms. Myrna Rueff
Missouri Department of Natural Resources
Division of Geology and Land Survey
Post Office Box 250
Rolla, MO 65402

Ms. Jennier Frazier, Real Estate Manager
Missouri Department of Natural Resources
Division of State Parks
P.O. Box 176
Jefferson City, MO 65102

State Agencies (continued)

Mr. Quinn Kellner
Natural Resource Manager
Jones-Confluence Point State Park
P.O. Box 67
West Alton, MO 63386-0067

Ms. Ramona Huckstep
Community Relations Coordinator
Missouri Department of Natural Resources
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Jefferson City, MO 65102

Ms. Lorna Domke
Missouri Department of Conservation
Post Office Box 180
Jefferson City, MO 65102

Mr. John Hoskins
Missouri Department of Conservation
Post Office Box 180
Jefferson City, MO 65102

Mr. John Vogel
Missouri Department of Conservation
August A. Busch Memorial Conservation Area
2360 Highway D
St. Charles, MO 63304

Mr. Marvin Boyer
Missouri Department of Conservation
August A. Busch Memorial Conservation Area
2360 Highway D
St. Charles, MO 63304

Mr. Joel Porath
Missouri Deparment of Conservation
August A. Busch Memorial Conservation Area
2360 Highway D
St. Charles, MO 63304

State Agencies (continued)

Mr. Doyle F. Brown, Policy Coordinator
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Post Office Box 180
Jefferson City, MO 65102-0180

Mr. David McAllister
Missouri Department of Conservation
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Jefferson City, MO 65102

Ms. Cynthia Green, Realty Specialist
Missouri Department of Conservation
P.O. Box 180
Jefferson City, MO 65102

Mr. Lee Hughes
Missouri Department of Conservation
Post Office Box 180
Jefferson City, MO 65102

Mr. Ed Warhol, Buildings and Grounds Specialist
Missouri Department of Transportation
1590 Woodlake Dr.
Chesterfield, MO 63017

Mr. Tom Blair, Assistant District Engr.
Missouri Department of Transportation
1590 Woodlake Dr.
Chesterfield, MO 63017

Mr. Kevin Wideman
Environmental Compliance Coordinator
Missouri Department of Transportation
Post Office Box 270
Jefferson City, MO 65102

Mr. Gale Carlson
Assessment Unit Chief
Missouri Department of Health and Senior Services
Post Office Box 570
Jefferson City, MO 65102

Federal - Elected Officials

Dr. Bao Ping Zhu
State Epidemiologist
Missouri Department of Health and Senior Services
P.O. Box 570
Jefferson City, MO 65102

Mr. James Gremaud
St. Charles County Area Engineer
Missouri Department of Transportation
6780 Old Highway N
St. Charles, MO 63304

The Honorable Christopher S. Bond
U.S. Senate
274 Russell Senate Office Building
Washington, D.C. 20510

The Honorable Claire McCaskill
U.S. Senate
493 Russell Senate Office Building
Washington, D.C. 20510

The Honorable Russ Carnahan
U.S. House of Representatives
1710 Longworth House Office Building
Washington, D.C. 20515

The Honorable Kenny Hulshof
U.S. House of Representatives
412 Cannon House Office Building
Washington, D.C. 20515

Office of Congressman Kenny Hulshof
516 Jefferson Street
Washington, MO 63090

The Honorable W. Todd Akin
U.S. House of Representatives
117 Cannon House Office Building
Washington, D.C. 20515

Mr. Jim Mitas
Office of Congressman W. Todd Akin
301 Sovereign Court, Suite 201
Ballwin, MO 63011

Federal Agencies

The Honorable William L. Clay
U.S. House of Representatives
434 Cannon House Office Building
Washington, D.C. 20515

Office of Congressman William L. Clay
625 North Euclid St., Suite 326
St. Louis, MO 63108

Mr. John B. Askew
Regional Administrator
U.S. Environmental Protection Agency
Region VII
901 North 5th Street
Kansas City, KS 66101

Ms. Denise Jordan-Izaguire
Sr. Regional Representative
ATSDR c/o EPA Region VII
500 State Avenue, Suite 182
Kansas City, KS 66101

Mr. Dan Wall (2 copies)
Superfund Division
U.S. Environmental Protection Agency
Region VII
901 North 5th Street
Kansas City, KS 66101

Mr. Ed Louis
U.S. Army Corps of Engineers
Kansas City District (CENWK-PM-ED)
601 NE 12th Street
Kansas City, MO 64106

Federal Agencies (continued)

Mr. Dave Nelson
Program and Project Management Division
Attn: CENWK-EC-ED
U.S. Army Corps of Engineers
Kansas City District
601 East 12th Street
Kansas City, MO 64106

Mr. William S. (Tex) Titterington
Chief, Environmental Division
AFRC-CKS-ENE
89th Regional Readiness Command
3130 George Washington Blvd.
Wichita, KS 67210

Barry McFarland
Regional Environmental Program
Coordinator
89th Regional Readiness Command
3130 George Washington Blvd.
Wichita, KS 67210-1598

Facility Manager
89th Regional Readiness Command
Weldon Spring Training Area
7301 Highway 94 South
St. Charles, MO 63304

Mr. Jeff Imes
U.S. Geological Survey
1400 Independence Road
Mail Stop 200
Rolla, MO 65402

Ms. Mary Picel
EAD
Argonne National Laboratory
9700 South Cass Avenue, Building 900
Argonne, IL 60439

Internal

Mr. David Geiser
Office of Legacy Management
U.S. Department of Energy
1000 Independence Avenue S.W.
Washington, D.C. 20585

Mr. Ray Plieness
Office of Legacy Management
U.S. Department of Energy
2597 B 3/4 Road
Grand Junction, CO 81503

Mr. Tom Pauling
Office of Legacy Management
U.S. Department of Energy
2597 B 3/4 Road
Grand Junction, CO 81503

Internal (continued)

Ms. Jane Powell, DOE/LM-20
10995 Hamilton-Cleves Hwy.
Harison, OH 45030

Ms. Denise Mercer
S.M. Stoller, Corp.
513 Wood Duck Lane
Annapolis, MD 21409

Terri Uhlmeyer
S.M. Stoller, Corp.
7295 Hwy. 94 South
St. Charles, MO 63304

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Appendix H

Annual Inspection Checklist

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Annual Site Inspection Checklist

Purpose of the Checklist

This checklist has been developed from the EPA guidance document *Comprehensive Five Year Review Guidance* dated June 2001 (OSWER No. 9355.7-03B-P) and from Section 2.3 of the *Long-Term Surveillance and Maintenance Plan for the Weldon Spring, Missouri, Site*. The checklist was modified to site-specific conditions as recommended by the guidance document. The checklist will be completed annually during the Weldon Spring Site annual surveillance and maintenance inspection. The checklist will also be used to assist in compiling information for the five-year review.

I. SITE INFORMATION	
Site name: DOE Weldon Spring Site	**Date(s) of inspection:**
Location: St. Charles, MO	**EPA ID: MO6210022830**
Agencies accompanying DOE for portions of the annual inspection: ˜ EPA, Region 7 ˜ MDNR ˜ Other (list): _____ _____	**Weather:**
Remedy Includes: Disposal Cell Institutional controls Monitored Natural Attenuation Long Term Monitoring Other_____	
Inspectors _____ **Participants** _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	

II. INTERVIEWS (Check all that apply)

1. **Local Site Manager** _____ _____ _____
   Name Title Date
   Interviewed ˜ at site ˜ at office ˜ by phone Phone no. _____
   Problems, suggestions; ˜ Report attached _____
   _____

2. **Environmental Data Manager** _____ _____ _____
   Name Title Date
   Interviewed ˜ at site ˜ at office ˜ by phone Phone no. _____
   Check to ensure that environmental data is reviewed and trended.
   Problems, suggestions; ˜ Report attached _____
   _____

3. **Other Staff (as applicable)** _____ _____ _____
   Name Title Date
   Interviewed ˜ at site ˜ at office ˜ by phone Phone no. _____
   Problems, suggestions; ˜ Report attached _____
   _____

4. **Local response agencies**: Contact to notify of annual inspection and to determine if there are any concerns or issues.

   Agency: St. Charles County Sheriff
   Contact _____ _____ _____ 636-949-7325
   Name Title Date Phone no.
   Problems; suggestions; ˜ Report attached _____
   _____

   Agency: Cottleville Fire Department
   Contact _____ _____ _____ 636-447-6655
   Name Title Date Phone no.
   Problems; suggestions; ˜ Report attached _____
   _____

   Agency: SimplexGrinnel (LCRS and Interpretive Center Alarm Company)
   Contact _____ _____ _____ 888-746-7539
   Name Title Date Phone no.
   Problems; suggestions; ˜ Report attached _____
   _____

   Agency: _____
   Contact _____ _____ _____ _____
   Name Title Date Phone no.
   Problems; suggestions; ˜ Report attached _____
   _____

5. **Stakeholders:** Contact to notify of annual inspection and to determine if there are any concerns or issues.

Agency: Francis Howell High School **Contact Name:** Mr. Chris Greiner, Principal
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-851-4700
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____
_____

Agency: Missouri Department of Transportation (local office) **Contact Name:**
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ _____
Name (if different than above) Title Date Phone no.
Note: Set up date and time and provide annual training on the site institutional controls and culverts.
Problems; suggestions; ˜ Report attached _____
_____

Agency: St. Charles County **Contact Name:** Mike Duvall, Dir. of Env. Service
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-949-7583
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____

6. **Other interviews** ˜ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **Documents**
˜ Surveillance and Maintenance Plan ˜ Readily available ˜ Up to date ˜ N/A
˜ Maintenance logs ˜ Readily available ˜ Up to date ˜ N/A
Remarks_____
_____

2. **Health and Safety Procedures** ˜ Readily available ˜ Up to date ˜ N/A
Remarks_____
_____

3. **Permits and Service Agreements**
˜ NPDES Permits ˜ Readily available ˜ Up to date ˜ N/A
˜ MSD agreement and records ˜ Readily available ˜ Up to date ˜ N/A
˜ Other permits_____ ˜ Readily available ˜ Up to date ˜ N/A
Remarks_____
_____

4.	**Groundwater Monitoring Records** ˜ Readily available ˜ Up to date ˜ N/A Remarks_____ _____	
5.	**Leachate Records** ˜ Readily available ˜ Up to date ˜ N/A Remarks_____ _____	
6.	**Interpretative Center Sign-In Logs** ˜ Readily available ˜ Up to date ˜ N/A Remarks_____ _____	

IV. O&M COSTS

1. **O&M Cost Records** (This information may be reviewed and completed prior to the inspection)

   Original O&M cost estimate_____

   Total annual cost for prior federal fiscal year:

   From_____ To_____ _____
   Date Date Total cost

2. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons: _____
   _____
   _____
   _____
   _____
   _____

V. INSTITUTIONAL CONTROLS

Institutional Control (IC) Inspections

1. **Land and Shallow Groundwater Use within the Chemical Plant Site and Quarry Property**

   Inspect for indications of excavations into soil or bedrock and groundwater withdrawal or use in restricted areas. If any party has been granted use of portions of the Chemical Plant or Quarry area, inspect to ensure that land use is in compliance with the terms of the restrictions within the notation.
   Note any observations: _____
   _____
   _____
   _____
   _____

2. **Groundwater Use in Areas Surrounding the Chemical Plant**

   Groundwater use is restricted in areas. Inspect affected areas for evidence of groundwater or spring water use (Burgermeister Spring and Spring 6303). Inspect to ensure that land use continues to be in compliance with the terms of the license, easement, or permit and the restrictions contained therein.
   Note any observations: _____
   _____
   _____
   _____

3. **Groundwater (Quarry)**

Groundwater use is restricted in areas. Inspect affected areas for evidence of groundwater withdrawal or use in the area of impact. Inspect to ensure that land use continues to be in compliance with the terms of the license and the restrictions contained therein.

Note any observations: _____

4. **Land Use in Quarry Area Reduction Zone**

A naturally occurring reduction zone exists in soil south of the Katy Trail and north of the Femme Osage Slough. Inspect for indications of excavations into soils and bedrock in the uranium reduction zone. Inspect to ensure that land use continues to be in compliance with the terms of the easement and the restrictions contained therein.

Note any observations: _____

5. **Southeast Drainage**

Check for indications of residential use or construction in the Southeast Drainage (200-foot-wide corridor), or other activity that would indicate nonrecreational use of the area. Check Springs 5303 and 5304 for residential, commercial, or agricultural use of spring water.

Note any observations: _____

6. **Highway D Culvert**

Check for signs of disturbance of the affected region where the Frog Pong outlet culverts pass beneath Highway D and in the utility rights-of-way in the affected area.

Note any observations: _____

7. **State Route 94 Culvert**

Check for signs of disturbance of the affected region where the culvert passes beneath State Route 94 and in the utility rights-of-way in the affected area.

Note any observations: _____

8. **Pipeline from LCRS to Missouri River**

Inspect the entire length of the pipeline and outfall for any disturbances or maintenance needs.

Note any observations: _____

_____

_____

_____

_____

_____

Institutional Control Annual Contact Log

In accordance with the LTS&M Plan, the following will be contacted to verify cognizance of institutional controls and real estate agreements. Fill in all that apply.

1. **Agency**: Missouri Department of Conservation **Contact Name**: Joel Porath, Wildlife Regional Supv.
Address: August A. Busch Memorial Conservation Area, 2360 Highway D, St. Charles, MO 63304
Institutional Control and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, Quarry Area Groundwater Use Restriction, Quarry Reduction Zone Land Use Restriction, Southeast Drainage Residential Use Restriction, North Gate Access, Well Sampling Access Agreement, Effluent Discharge Pipeline, Hamburg Trail Use Agreement.
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-441-4554
Name (if different than above) Title Date Phone no.

Problems; suggestions; ˜ Report attached _____

_____

_____

_____

2. **Agency**: Missouri Department of Conservation **Contact Name:** John Vogel, Area Manager
Address: August A. Busch Memorial Conservation Area, 2360 Highway D, St. Charles, MO 63304
Institutional Control and Real Estate Licenses to Verify: See No. 1
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-300-1953 X 318
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____

_____

_____

3. **Agency**: Missouri Department of Conservation **Contact Name: Doyle Brown, Policy Coordinator**
Address: P.O. Box 180, Jefferson City, MO 65102
Institutional Control and Real Estate Licenses to Verify: See No. 1
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 573-522-4115 x3355
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____

_____

_____

4. **Agency**: Missouri Department of Natural Resources **Contact Name**: Jennifer Frazier, Parks Operation Off.
Address: P.O. Box 176, Jefferson City, MO 65102
Institutional Controls and Real Estate Licenses to Verify: Quarry Area Groundwater Use Restriction, Southeast Drainage Residential Use Restriction, Well Sampling Access Agreement, Effluent Discharge

Pipeline
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 573-751-7987
Name (if different than above Title Date Phone no.
Problems; suggestions; ˜ Report attached _____
_____
_____

5. **Agency**: Missouri Department of Natural Resources **Contact Name**: Quinn Kellner, Natural Resource Manager, Jones-Confluence Point State Park
Address: P.O. Box 67, West Alton, MO 63386
Institutional Controls and Real Estate Licenses to Verify: Quarry Area Groundwater Use Restriction, Southeast Drainage Residential Use Restriction, Well Sampling Access Agreement, Effluent Discharge Pipeline
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-899-1135
Name (if different than above Title Date Phone no.
Problems; suggestions; ˜ Report attached _____
_____
_____

6. **Agency:** Missouri Department of Transportation **Contact Name**: Tom Blair, Asst. District Engineer
Address: 1590 Woodlake Dr., Chesterfield, MO 63017
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, and question MoDOT regarding Missouri State Highway 94 Culvert and Highway D culverts about plans for repairs/replacements.
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 314-340-4203
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____
_____
_____
_____

7. **Agency:** Missouri Department of Transportation **Contact Name**: Kevin Wideman, Sr. Environmental Specialist
Address: P.O. Box 270, Jefferson City, MO 65102
Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, and question MoDOT regarding Missouri State Highway 94 Culvert and Highway D culverts about plans for repairs/replacements.
Contact Name Current ˜ yes ˜ no
Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 573-526-4171
Name (if different than above) Title Date Phone no.
Problems; suggestions; ˜ Report attached _____
_____
_____
_____

8. **Agency:** Missouri Department of Transportation **Contact Name**: Jim Gremaud, St. Charles County Area Engineer

Address: 6780 Old Hwy. N. St. Charles, MO 63304

Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, and question MoDOT regarding Missouri State Highway 94 Culvert and Highway D culverts about plans for repairs/replacements.

Contact Name Current ˜ yes ˜ no

Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-240-5277

Name (if different than above) Title Date Phone no.

Problems; suggestions; ˜ Report attached _____

_____

_____

_____

9. **Agency:** U.S. Dept. of Army **Contact Name**: Marsha Miller, Facility Manager

Address: Weldon Spring Training Area, 7301 Hwy 94 S. St. Charles, MO 63304

Institutional Controls to and Real Estate Licenses to Verify: Chemical Plant Groundwater Use Restriction, Effluent Discharge Pipeline, Well Sampling Access Agreement

Contact Name Current ˜ yes ˜ no

Phone Number Current ˜ yes ˜ no _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-329-1200

Name (if different than above) Title Date Phone no.

Problems; suggestions; ˜ Report attached _____

_____

_____

_____

10. **Agency:** St. Charles County Recorder of Deeds

Address: 201 N 2nd, St. Charles, MO 63301

Institutional Controls to and Real Estate Licenses to Verify: Recorded real estate restrictions at the Recorder of Deeds Office or on the Internet at www.saintcharlescounty.org

Contact _____ _____ _____ _____

Name Title Date Phone no.

Problems; suggestions; ˜ Report attached _____

_____

_____

_____

11. **Agency:** St. Charles County Planning and Zoning Department **Contact Name:** Wayne Anthony
Address: 201 N 2nd, St. Charles, MO 63301
Institutional Controls to and Real Estate Licenses to Verify: Awareness of Restrictions
Contact Name Current yes˜ no˜
Phone Number Current yes˜ no˜ _____ (new phone no. if applicable)

Contact _____ _____ _____ 636-949-7900x7221
Name Title Date Phone no.
Problems; Report attached˜ suggestions; _____

General

1. **Land Use Changes On Site** ˜ Yes ˜ No
Remarks_____

2. **Land Use Changes Off Site that could affect site** ˜ Yes ˜ No
Remarks_____

VI. GENERAL SITE CONDITIONS

1. **Roads** ˜ Location shown on site map Roads adequate ˜ Yes ˜ No
Remarks_____

2. **Vandalism** ˜ Location shown on site map Vandalism noted ˜ Yes ˜ No

Remarks_____

3. **Personal Injury Risks** Housekeeping maintained ˜ Yes ˜ No

Remarks_____

4. **Site Markers (Four Information Plaques on Top of Cell, Historical Markers, and Other Information Markers)**

˜ Location shown on site map Legible and Secure ˜ Yes ˜ No

In Good Condition ˜ Yes ˜ No

Remarks_____

_____

_____

5. **Guard Rail Around Cell** ˜ Location shown on site map Secure ˜ Yes ˜ No

Remarks_____

_____

_____

6. **Stairs to Top of Cell** ˜ Location shown on site map

Stairs in good condition ˜ Yes ˜ No Handrail stable and in good condition ˜ Yes ˜ No

Remarks_____

_____

_____

7. **Other Site Conditions:**

Remarks _____

_____

_____

_____

_____

_____

VII. EROSION

1. **Chemical Plant Areas** ˜ Location shown on site map Erosion evident ˜ Yes ˜ No

Depth_____

Remarks_____

_____

_____

_____

_____

2. **Quarry Area** ˜ Location shown on site map Erosion evident ˜ Yes ˜ No

Depth_____

Remarks_____

_____

_____

_____

VIII. CHEMICAL PLANT DISPOSAL CELL

1. **Settlement /Bulges** ˜ Location shown on site map New settlement noted ˜ Yes ˜ No

A. Annually: Walk along the grade break at the top of the side slopes, around the cell perimeter, and along 10 transects across the cell surface. Inspect for local depressions, regional departures from planar surfaces, and shifts in intersections (vertices) of cell surface planes. Inspect for vertical shear of the cover layers indicated by sudden, abrupt steps that exceed an approximately 6-inch change of surface level over no more than 10 feet distance.

B. During 5-Year Review Inspections (Beginning 2005 and at 5-year Intervals): Conduct an aerial mapping survey with a vertical resolution not less precise than 0.5 feet. Produce and record maps and survey data for the cell surface represented by 1.0 foot contour intervals. Evaluate the data for indications of settlement. Consider the position and spacing of contour lines as indications of elevation change and possible settlement.

Remarks_____

_____

_____

_____

_____

2. **Rock Cover** Signs of degradation ˜ Yes ˜ No Signs of intrusion ˜ Yes ˜ No

A. Annually: During settlement monitoring inspection also visually inspect for departures from original rock conditions or from the previous inspection. Note observable discoloration on areas larger than 2,500 square feet, presence of finer materials at surface and apparent rock gradation changes. Document rock conditions annually with photographs.

B. During 5-Year Review Inspections (Beginning 2005 and at 5-year Intervals): Inspect cell cover for gradation changes by walking 10 transects across the cell.
Concentrations of degraded, split, or weathered pieces of limestone will be mapped, photodocumented and visually assessed as a percentage of rock exposed within each mapped area. If degraded rock is evenly distributed, inspectors will estimate the overall percentage of degraded rock. If the amount of degraded rock appears to be increasing, based on a review of previous annual rock quality assessments, additional monitoring or gradation testing will be performed. If rock does not appear degraded, photodocumentation of several GPS located areas will establish rock conditions for future reference.

Remarks_____

_____

_____

_____

3. **Vegetative Growth** Weeds or Plants on Cell ˜ Yes ˜ No

Remarks_____

_____

_____

_____

_____

4. **Wet Areas/ Water Damage**

Wet areas ˜ Yes ˜ No ˜ Location shown on site map Areal extent_____

Ponding ˜ Yes ˜ No ˜ Location shown on site map Areal extent_____

Seeps ˜ Yes ˜ No ˜ Location shown on site map Areal extent_____

Remarks_____

_____

_____

5. **Toe/Apron Drains** Proper drainage ˜ Yes ˜ No Silting ˜ Yes ˜ No

Erosion ˜ Yes ˜ No

Remarks_____

_____

_____

6. **Slope Instability** ˜ Location shown on site map Evidence of slope instability ˜ Yes ˜ No

Remarks_____

_____

7. **Leachate Collection and Removal System** ˜ Fence/Gates/Locks in good condition

˜ Properly secured/locked ˜ Functioning ˜ Routinely sampled ˜ Good condition

˜ LCRS flow rates ˜ Review data trending and Action Leakage Rate

˜ Sump Containment System (Burrito) flow rates ˜ Burrito flow rate issues

˜ Compliance with MSD Agreement ˜ Review shipping records

Data Issues ˜ Yes ˜ No Flow Rate Issues ˜ Yes ˜ No

Remarks_____

_____

_____

_____

8. **Condition of 300 Ft. Buffer Zone** Erosion ˜ Yes ˜ No

Remarks_____

_____

_____

9. **Condition of Prairie** Erosion ˜ Yes ˜ No

Remarks_____

_____

_____

IX. GROUNDWATER MONITORING

1. **Disposal Cell Monitoring Well Network**

˜ Properly secured/locked˜ Functioning ˜ Sampled in accordance with LTS&M Plan

˜ Good condition ˜ Evidence of surface water infiltration at casing ˜ Needs maintenance

˜ Proper ID on each well ˜ Acceptable quality of data

Data Issues ˜ Yes ˜ No

Remarks_____

_____

_____

_____

2. **Chemical Plant Groundwater Monitoring Well Network**

˜ Properly secured/locked˜ Functioning ˜ Sampled in accordance with LTS&M Plan
˜ Good condition ˜ Evidence of surface water infiltration at casing ˜ Needs maintenance
˜ Acceptable quality of data
Data Issues ˜ Yes ˜ No
List wells checked by number (> 10% of wells)_____
_____
_____
Remarks_____
_____

3. **Quarry Monitoring Well Network**

˜ Properly secured/locked˜ Functioning ˜ Sampled in accordance with LTS&M Plan
˜ Good condition ˜ Evidence of surface water infiltration at casing ˜ Needs maintenance
˜ Acceptable quality of data
Data Issues ˜ Yes ˜ No
List wells checked by number (> 10% of wells)_____
_____
_____
Remarks_____
_____
_____

X. OVERALL OBSERVATIONS

Implementation of the Remedies

Describe issues and observations relating to whether the remedies are effective and functioning as designed.

_____
_____
_____
_____
_____
_____
_____
_____

Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedies.

_____
_____
_____
_____
_____
_____
_____
_____
_____

Early Indicators of Potential Remedy Problems
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of one or more of the remedies may be compromised in the future. _____ _____ _____ _____ _____ _____ _____ _____ _____
Opportunities for Optimization
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedies. _____ _____ _____ _____ _____ _____ _____ _____ _____

Appendix I

Leachate Collection and Removal System Operating Plan

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I1.0 Purpose

The purpose of this document is to provide information necessary for the proper operation and maintenance of the Leachate Collection and Removal System (LCRS). Specifically, the subsequent sections will provide the information relating to the management of leachate, maintenance and calibration of liquid level instruments, general equipment maintenance, and reporting requirements.

I2.0 Facility Description

The LCRS facility is located at the north end of the disposal cell and consists of an 11,500-gallon horizontal below-grade pipe storage sump, four pipes from the disposal cell (east and west primary and east and west secondary) to convey the leachate to the sump, liquid level monitoring instruments, and other related equipment. An 8-foot chain link and barbed wire fence surrounds the sump area. An approximately 1,200-square-foot building houses supplies, instrumentation and a water treatment system. This building is the LCRS Support Building and is located adjacent to the sump on the north side.

The sump has a secondary containment system that provides an additional barrier to the environment and a means to collect leakage and infiltration. The containment is known as the "burrito" and consists of a high density polyethylene (HDPE) liner system that totally encloses the primary and secondary leachate collection systems as well as the sump.

A 4-inch-diameter HDPE pipeline connects the LCRS Support Building to the Missouri River (NPDES outfall 007). This pipeline was extended to support the LCRS treatment system before approval was obtained to haul leachate to the Metropolitan St. Louis Sewer District (MSD), and is available for use if the treatment system contingency plan is implemented or if the NPDES permit is modified.

A drawing of the LCRS system is included as Attachment 1.

I3.0 Leachate Management

I3.1 Leachate Flow and Level Monitoring

The LCRS has been equipped to measure the volume of the primary and secondary leachate generated from the disposal cell. The east and west secondary leachate is monitored separately and the data are displayed (CTR [Counter] 401 and CTR 403) and recorded automatically at the instrumentation cabinet located in the LCRS Support Building. All three volumes (primary, east secondary, west secondary) are uploaded to the System Operation and Analysis at Remote Site (SOARS) database. The SOARS uploads LCRS data remotely and then allows operators to access data via the internet to retrieve and analyze the transferred data. At Weldon Spring the primary leachate level and east and west secondary counter data are recorded and transferred by modem to the SOARS. SOARS then estimates the primary leachate volume which is reviewed

for any potential anomolies or problems with the system. The SOARS data is used to calculate monthly totals to determine the overall performance of the LCRS.

A resistance-type probe (LS-1) installed in the sump monitors the total leachate volume. This information is digitally displayed at the instrumentation cabinet (LI-1) in the LCRS Support Building and uploaded to SOARS as described above. The primary leachate volume is calculated by taking the measured volume in the sump minus the volume of secondary leachate that has accumulated, and the burrito and purge water that has been added to the sump. The primary leachate flow rate is calculated by taking the primary leachate volume (calculated above) divided by the number of days of accumulation. A dedicated resistance-type probe (LSH-3) is installed to alarm when a high level is reached in the sump. The leachate flow rate was approximately 142 gallons per day in January 2006 and continued a slow downward trend to approximately 114 gallons per day in December 2007.

The sump has a secondary containment system (burrito) capable of collecting any leachate or infiltration generated outside of the normal primary and secondary collection systems. The burrito water level is manually measured and pumped to the sump. The level probe that was previously installed has been removed to allow access to the burrito water. The burrito water is periodically pumped, and the volume is measured and composited with the leachate in the sump. The flow rate in December 2007 was approximately 6.7 gallons per day. Flow to the secondary containment system (burrito) has shown some cyclic tendencies but little correlation to the flow rates of the primary and secondary leachate. Certain flow mechanisms are intentionally created inside the disposal cell to comply with regulatory requirements (for example: overflow when leachate head exceeds one foot over the primary liner or long-term clogging of the transport pipes).

The procedure for transferring and measuring the burrito water volume is presented in Attachment 5.

I3.2 Leachate Hauling

The Weldon Spring Site (WSS) was granted approval to haul the leachate to the Metropolitan St. Louis Sewer District (MSD) Bissell Point Plant and was later granted approval to haul monitoring well purge water with the leachate (see MSD letters in Attachment 2). Purge water is water that is generated during the sampling of monitoring wells. MSD imposed a revised uranium acceptance criteria in a letter dated April 15, 2004, which required the uranium level to meet the drinking water standard of 30 µg/L (Attachment 2). Pretreatment of leachate has been periodically necessary to reduce the uranium concentration to a level below the 30 µg/L standard. MSD granted a 5-year extension in a letter dated December 14, 2006, which references the previous agreement letters (Attachment 2).

WSS hauls leachate approximately every 4 to 5 months through a contract hauler. As the daily flow rate decreases in the LCRS, the hauling frequency will also decrease. The frequency of hauling must be such that leachate is not allowed to accumulate to a point that causes damage or inundates the LCRS instrumentation. The leachate flow rate is predictable and steady. The contract hauler is responsible for hookup and pumping, hauling, and manifesting the leachate. The hauler typically uses a 3,000-gallon tank truck with an integral vacuum pump to extract and haul the leachate. WSS personnel are responsible for scheduling the haul, performing

pretreatment if necessary, providing access to the LCRS, sampling leachate, recording the volume of leachate hauled, and general oversight of the activity.

The procedure for hauling leachate is presented in Attachment 5.

I3.3 Metropolitan Sewer District Agreement and Requirements

The WSS has monitoring and reporting obligations to the MSD that are conditions of the approval for hauling leachate. These obligations include sampling the leachate hauled to MSD and a 25,000 gallon per month maximum limit. The specific requirements are presented in the letters included in Attachment 2. Reports that present volume and chemical data must be submitted to MSD for review by the 28th day of the month following a haul event. The current authorization to haul leachate is valid through December 21, 2011. To continue past that date, a new agreement must be drafted by DOE and approved by MSD.

I4.0 Leachate Characteristics and Trends

I4.1 Characteristics

The leachate meets all permitted discharge limits and goals. Manganese concentration was an initial concern but has decreased to below the NPDES permitted limit of 0.5 mg/L. Uranium concentrations averaged 19.9 pCi/L during 2006 and 16.4 pCi/L for 2007 through September. These levels are below the goal of 30 pCi/L monthly average and 100 pCi/L daily maximum limits for discharge to the Missouri River. Concentrations of all other constituents, including radionuclides, are within permit limits. The untreated leachate characterization data for 2002 through June 2007 are presented in Attachment 3.

I4.2 Trends

The leachate flow rate has been decreasing and is predicted to continue decreasing until the flow rate is essentially zero. This trend is consistent with the disposal cell design in that the cell cap/cover was designed to eliminate infiltration and subsequent leachate generation. Leachate will continue to be hauled and the flow monitored until leachate flow ceases, or circumstances change.

Manganese concentration has continued to decrease and is below the permit discharge limit. The manganese concentration average has decreased from 1.1 mg/L in 2004 to 0.45 mg/L in 2006. Average uranium concentration was 19.9 pCi/L in 2006 and decreased to an average of 16.4 pCi/L for 2007. Since September 2004 the leachate hauled to MSD has been pretreated and the uranium concentration in the pretreated leachate was between 0.88 and 2.4 pCi/L during 2006 and through September of 2007.

I4.3 LCRS Sump Methane Monitoring System

The methane monitoring system has been removed. It was determined that the system no longer provided a useful function. Methane monitoring has indicated that the passive vent system for

methane removal continues to function properly. Administrative procedures for confined space entry into the sump are in place to govern access and maintenance for the sump. See the *Health and Safety Manual* (LMS/POL/S04321) for the most current version of the confined space procedure. Confined space training will also be required of all participants. Monitoring will be conducted and the blower will remain in place to provide ventilation when confined space entry is required.

I5.0 Discharge to the Missouri River

In the event that the leachate would no longer be accepted by MSD or other acceptable alternatives are available, the treated leachate could be discharged to the Missouri River via NPDES outfall 007. The procedure for discharging through the pipeline to outfall 007 is presented in Attachment 5.

I6.0 Facility Maintenance

LCRS monitoring instrumentation should be checked no less than once per year.

I6.1 LS-1/LT-1/LI-1

I6.1.1 Calibration of LT-1

LT-1 is in the blue explosion-proof junction box located inside the LCRS cabinet (approximately 3 feet off the bottom of the cabinet, on the left side of the cabinet). LT-1 receives information from LS-1 (level sensor 1) via communication cable. LT-1 translates the LS-1 signal to a level indicator that can be read on LT-1.

LT-1 also communicates the sump water level to the digital display (LI-1) red LED indicator on the outside of the LCRS cabinet and to chart recorder CR1. LT-1 accomplishes this by driving a 4 to 20 milliamp loop, in series, through the LED indicator and through chart recorder CR1.

LS-1/LT-1/LI-1 is used to monitor and record the leachate level in the sump. This instrument should be calibrated or checked once a year. The procedure for calibrating LS-1/LT-1/LI-1 is presented in Attachment 5.

I6.2 LS-2/LT-2/LI-2

The burrito water level probe has been removed. See discussion in Section I3.1.

I7.0 Methane Detection System

The methane detection system has been removed. See discussion in Section I4.3.

I8.0 Routine Inspections and Rounds

I8.1 LCRS Inspection

The LCRS inspection should be conducted at least monthly and currently is being conducted biweekly during burrito water removal. This inspection is intended to check the status of the equipment specifically related to the sump and level monitoring equipment and verify that all equipment associated with the LCRS is working properly. This includes noting level instrument display readouts. The LCRS inspection round sheet is presented in Attachment 5.

I8.2 Equipment Maintenance

Equipment corrective and preventive maintenance should be performed as needed in accordance with the manufacturers' recommendations. The equipment manuals are located in the LCRS Support Building and in the main Administrative Building.

I9.0 Notifications and Reporting

I9.1 Metropolitan St. Louis Sewer District Reports

The reporting requirements for leachate hauled to MSD are described in Attachment 2. In general, WSS is required to present analytical data, volume hauled information, and radioactive content data for the leachate hauled during the reporting period. WSS is also required to track the sources and the total volume of purge water sent with any shipment of leachate to MSD.

I9.2 NPDES Reporting

A revised NPDES permit was issued on March 5, 2004 (Attachment 4). This permit expired on July 13, 2005, but continues to be statused as active since the DOE applied for permit renewal with the state of Missouri 6 months prior to the expiration date. A renewed permit is scheduled to be issued during early 2008. The reporting provisions for the new permit will be implemented as soon as it becomes final.

I9.3 Emergency Points of Contact

The current contractor staff located at the Weldon Spring will be responsible for providing the local, state or federal notifications in the event of an emergency in accordance with the LTS&M Plan.

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Attachment 1

LCRS Drawing

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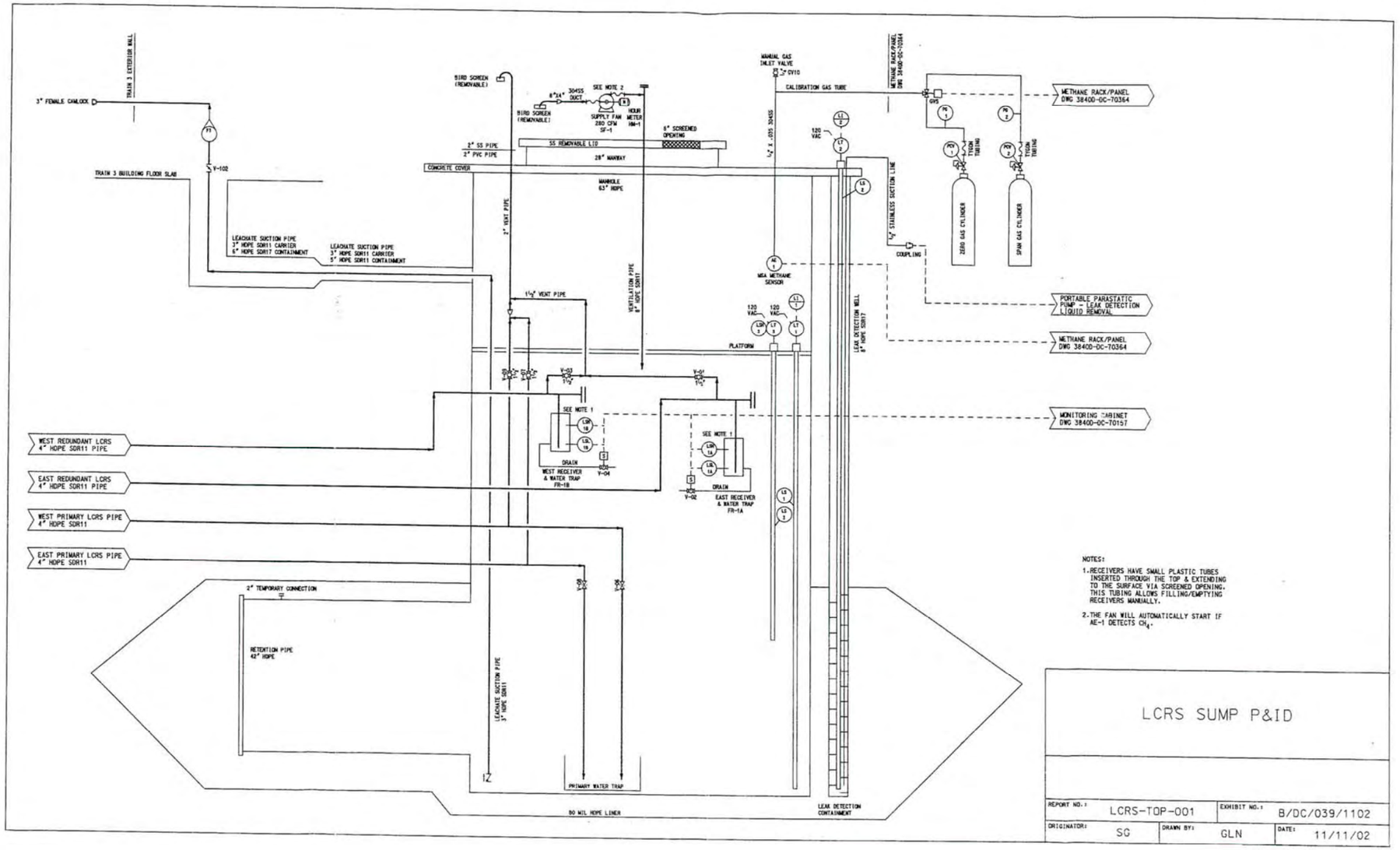
Schematic of the Leachate Collection and Removal System (LCRS)



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Attachment 2

MSD Letters

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Initial MSD Approval Letter

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

December 21, 2001

Thomas Pauling
U.S. Department of Energy
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

We have reviewed your application dated October 24, 2001 requesting approval to discharge up to 15,000 gallons of wastewater per month to the Metropolitan St. Louis Sewer District. This wastewater is leachate from the covered storage cell at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. The storage cell contains waste associated with the remediation activities of former TNT production and uranium processing at the site.

Based on the analytical results, this material meets our criteria for acceptance as a hauled waste and is approved for discharge at the Bissell Point Hauled Waste Receiving Station. The material may be discharged only by a hauler having a valid MSD identification number and presenting an original, completed Hauled Waste Receipt (form HWR-S). The annual allocation for radioactivity from the WSSRAP storage cell discharging at the MSD Bissell Point Hauled Waste Receiving Station is 0.15 milliCuries (0.15 mCi/year). This approval is valid for 5 years from the date of this letter. As a condition of this approval, you must notify us of any changes which would affect the characteristics of this discharge.

You must submit monthly self-monitoring reports, analyzing for the following parameters:

Total Uranium	Total suspended solids
Thorium-228	Volatile organic priority pollutants
Thorium-230	Arsenic
Thorium-232	Barium
Radium-226	Copper
Radium-228	Iron
Americium-241	Lead
Neptunium-237	Chromium
Plutonium-238	Mercury
Plutonium-239/240	Nickel
Technetium-99	Selenium
Gross alpha	Silver
Chemical oxygen demand	Zinc

We will require that each batch of wastewater be analyzed for all the radionuclides listed above plus gross alpha. We will only require one batch of wastewater be analyzed per month for the remaining parameters. Self-monitoring reports are due 28 days after the end of each month. The frequency of the self-monitoring may be reduced in the future if the analytical results warrant.

A monthly sum of the ratios must be calculated for all radionuclides listed above, and the result must be less than 1.0 according to the Nuclear Regulatory Commission regulations in 10 CFR 20. These calculations must be included with the self-monitoring reports.

To demonstrate the solubility of the radioactive materials, as required by 10 CFR 20, you will need to provide the results of one filtered versus unfiltered test for total uranium using a 0.45 micrometer (0.45 micron) filter. This information must be included with the self-monitoring reports.

In addition to the monthly self-monitoring reports, the MSD Radioactive Materials Discharge Report (attached) must also be completed and certified. This report lists the total radioactivity discharged during the current calendar quarter to ensure compliance with the 0.15 milliCurie per year limit. These reports are due 28 days after the end of the calendar quarter.

This discharge has been approved based upon the information and sample analysis you provided, and is subject to the conditions stated above. This approval may be revoked by the District at any time if any of the information is found to be incorrect, or if the conditions of this approval are violated. Also, if the discharge causes any operational or maintenance problem within the District's collection or treatment system, or results in violations of any conditions of the District's NPDES permit, MK-Ferguson Corporation and the property owner, U.S. Department of Energy, will be considered responsible for damages.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

bv

pc Bernie Rains
Doug Mendoza
Fabian Grabski
Ed Cope
Darin Lewis
Paul Taylor
Thomas M. Siegel, P.E. Chief, Permits and Engineering – MO DNR

File: SD, Weldon Springs Site Remedial Action Plan

METROPOLITAN ST. LOUIS SEWER DISTRICT
INDUSTRIAL USER RADIOACTIVE MATERIALS DISCHARGE REPORT

PART I: IDENTIFYING INFORMATION

Company Name: _____

Permit No: _____

Premise Address: _____

Reporting Period: ☐(JAN-MAR) ☐(APR-JUNE) ☐(JULY-SEPT) ☐(OCT-DEC)

PART II: RECORD OF DISPOSAL OF RADIOACTIVE MATERIALS TO THE SEWER SYSTEM

RADIONUCLIDE	ACTIVITY DISCHARGED (millicuries)
TOTAL ACTIVITY DISCHARGED:	

PART III: CERTIFICATION STATEMENTS

Place your initials in the box under item A.
Everyone must complete the information under items A & B and sign this report.

A. CERTIFICATION OF COMPLIANCE WITH STATE AND FEDERAL REGULATIONS

☐ I certify that to the best of my knowledge & belief, all requirements of 10 CFR Part 20.2003 and 19 CSR Part 20-10.090 governing disposal by release into sanitary sewage for material regulated by the Nuclear Regulatory Commission and the Missouri Department of Health, respectively, have been met for the period covered by this report.

B. RADIOACTIVE MATERIALS DISCHARGE REPORT CERTIFICATION

I certify under penalty of Law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print/type name of signing official: _____

Title: _____ Telephone: _____

Signature: _____ Date: _____

radrpt.doc 2/

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Purge Water Approval Letter from MSD

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

May 17, 2002

Steven D. Warren
MK-FERGUSON CORPORATION
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Warren:

We have reviewed your application dated April 23, 2002 requesting approval to discharge up to 200 gallons of wastewater per month to the Metropolitan St. Louis Sewer District. This wastewater is monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. We understand that the purge water is generated from the following monitoring wells related to the former TNT production and uranium processing at the site.

Monitoring well identification numbers:

1002	1015	OW05	2049	3028	4028
1004	1016	OW06	2050	3029	4029
1005	1027	2003	2051	3030	4030
1006	1032	2006	2052	3034	4039
1007	1048	2012	2053	3037	S004
1008	OW01	2013	2054	3038	
1009	OW02	2033	2055	3039	
1013	OW03	2045	3023	4001	
1014	OW04	2046	3024	4015	

Based on the historical analytical results of samples collected from the above referenced monitoring wells, this material meets our criteria for acceptance as a hauled waste and is approved for discharge at the Bissell Point Hauled Waste Receiving Station. The material may be discharged only by a hauler having a valid MSD identification number and presenting an original, completed Hauled Waste Receipt (form HWR-S). We understand that the purge water will be included with the leachate which is currently approved for discharge at the Bissell Point Hauled Waste Receiving Station. The annual allocation for radioactivity from the WSSRAP leachate and monitoring well purge water discharging at the MSD Bissell Point Hauled Waste Receiving Station is 0.15 milliCuries (0.15 mCi/year). This approval will expire on December 21, 2006. As a condition of this approval, you must notify us of any changes which would affect the characteristics of this discharge.

Since the monitoring well purge water will be included with the leachate, we understand that future WSSRAP self-monitoring reports will include composite sample data representing both waste streams and will identify the volumes attributable to purge water and leachate. Based on this information, all self-monitoring conditions of the December 21, 2001 leachate special discharge will remain in effect and apply to the monitoring well purge water.

This discharge has been approved based upon the information and sample analysis you provided, and is subject to the conditions stated above. This approval may be revoked by the District at any time if any of the information is found to be incorrect, or if the conditions of this approval are violated. Also, if the discharge causes any operational, maintenance or other problem within the District's collection or treatment system, or results in violations of any conditions of the District's NPDES permit, MK-Ferguson Corporation and the property owner, U.S. Department of Energy, will be considered responsible for damages or mitigative actions.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

bv

pc Bernie Rains
Darin Lewis
Paul Taylor

File: SD, Weldon Springs Site Remedial Action Plan

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

June 28, 2002

Pamela Thompson
U.S. DEPARTMNT OF ENERGY
WELDON SPRING SITE REMEDIAL ACTION PROJECT OFFICE
7295 Highway 94 South
St. Charles, MO 63304

Dear Ms. Thompson:

We have reviewed your letter dated June 17, 2002 requesting approval to add seven monitoring wells (2014, 5303, 4006, 5304, 4031, 6301, and 4036) to the special discharge permit originally approved on May 17, 2002. The original approval was for monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri.

Based on the historical analytical results of samples collected from the above referenced monitoring wells, your request is granted. All other conditions of the original approval remain in effect.

If you have any questions, please call me at (314)436-8742.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Associate Engineer

FILE: SD, Weldon Spring Site Remedial Action Project (WSSRAP), 7295 Highway 94 South, St. Charles, Missouri

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Monthly Volume Increase Approval Letter

Metropolitan
St. Louis Sewer
District

Office of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

96684

September 13, 2004

Thomas C. Pauling
DEPARTMENT OF ENERGY
WELDON SPRINGS SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

We have reviewed your letter dated September 10, 2004 requesting a volume increase and change in self-monitoring reporting to the special discharge permits approved in our letters dated December 21, 2001, May 17, 2002, and April 15, 2004. The approvals were for the covered storage cell leachate and monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri.

Based on the information you provided and historical analytical results, your request to increase the monthly volume to 25,000 gallons and remove the volatile organics from the list of required monitoring parameters is granted. In addition, your request to change from composite truck sampling to one sample per hauling event is approved. All other conditions of the above referenced approvals remain in effect.

Please contact me at (314) 436-8742 with questions or comments.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Assistant Engineer

FILE: SD, Weldon Spring Remedial Action project, 7295 Highway 94 South, St. Charles, Missouri

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Extension Approval from Metropolitan St. Louis Sewer District

Metropolitan
St. Louis Sewer
District

Division of Environmental Compliance
10 East Grand Avenue
St. Louis, MO 63147-2913
(314) 436-8710
FAX (314) 436-8753

December 14, 2006

Thomas C. Pauling
DEPARTMENT OF ENERGY
WELDON SPRINGS SITE REMEDIAL ACTION PROJECT
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Pauling:

We have reviewed your letter dated November 3, 2006 for extension of the special discharge originally approved on December 21, 2001 and subsequent letters dated May 17, 2002, June 28, 2002, February 18, 2003, April 15, 2004, and September 13, 2004. The original approval was for storage cell leachate and monitoring well purge water at the Weldon Spring Site Remedial Action Project (WSSRAP) located at 7295 Highway 94 South, St. Charles, Missouri. You have requested a five-year extension of your current approval.

Your request for an extension is granted. This approval will expire on December 21, 2011. As a condition of this approval, you must notify us of any changes which would affect the characteristics of this discharge. The self-monitoring reporting requirements and all other conditions of the above referenced approval letters remain in effect.

Please contact me at (314) 436-8742 with questions or comments.

Sincerely,
METROPOLITAN ST. LOUIS SEWER DISTRICT

Roland A. Biehl
Environmental Specialist

pc: Doug Mendoza
Darin Lewis
Steve Grace

FILE: SD, WELDON SPRINGS (WSSRAP) [SOUR053000], 7295 Highway 94 South, St. Charles, MO
SP805 & SP806

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Attachment 3

Leachate Characterization Data

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Leachate Characterization Data

Leachate Sump Data (DC10) from January 2002 to December 2004

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
ANIONS					
CHLORIDE	mg/L	31.10	38.80	33.80	6
FLUORIDE	mg/L	0.24	0.28	0.27	6
NITRATE-N	mg/L	ND (0.05)	3.80	0.68	6
SULFATE	mg/L	49.70	80.10	67.93	6
METALS					
ALUMINUM	µg/L	ND (16.5)	65.40	31.28	14
ANTIMONY	µg/L	ND (1.6)	ND (16.0)	NC	14
ARSENIC	µg/L	ND (1.2)	9.90	4.66	14
BARIUM	µg/L	509.00	1090.00	806.50	14
BERYLLIUM	µg/L	ND (0.19)	1.40	0.58	14
CADMIUM	µg/L	ND (0.31)	ND (2.0)	NC	14
CALCIUM	µg/L	144000.00	188000.00	165142.86	14
CHROMIUM	µg/L	ND (0.73)	ND (3.8)	NC	14
COBALT	µg/L	8.10	23.50	14.19	14
COPPER	µg/L	ND (1.4)	7.70	5.96	14
IRON	µg/L	4540.00	27900.00	15160.00	14
LEAD	µg/L	ND (0.93)	ND (2.1)	NC	14
LITHIUM	µg/L	ND (6.4)	23.90	10.87	14
MAGNESIUM	µg/L	51000.00	57800.00	55185.71	14
MANGANESE	µg/L	2360.00	6290.00	3904.29	14
MERCURY	µg/L	ND (0.01)	0.46	0.12	14
MOLYBDENUM	µg/L	ND (4.9)	7.40	6.55	14
NICKEL	µg/L	ND (6.9)	12.00	10.81	14
POTASSIUM	µg/L	3230.00	6960.00	5405.71	14
SELENIUM	µg/L	ND (1.2)	ND (2.4)	NC	14
SILVER	µg/L	ND (0.8)	ND (7.0)	NC	14
SODIUM	µg/L	62200.00	77100.00	70092.86	14
STRONTIUM	µg/L	599.00	719.00	653.79	14
THALLIUM	µg/L	ND (2.2)	4.90	3.03	14
VANADIUM	µg/L	ND (0.88)	2.30	1.96	14
ZINC	µg/L	3.50	27.70	13.96	14
MISCELLANEOUS					
ALKALINITY	mg/L	604.00	682.00	640.80	5
BIOCHEMICAL OXYGEN DEMAND	mg/L	ND (5.0)	10.00	6.00	5
CHEMICAL OXYGEN DEMAND	mg/L	15.00	36.00	27.43	14
CYANIDE, AMENABLE	mg/L	ND (5.0)	ND (5.0)	NC	5
CYANIDE, TOTAL	mg/L	ND (5.0)	6.10	5.22	5
PHOSPHORUS, TOTAL	mg/L	ND (0.03)	0.17	0.07	5
TOTAL DISSOLVED SOLIDS	mg/L	784.00	883.00	820.17	6
TOTAL ORGANIC CARBON	mg/L	8.40	11.20	9.60	6
TOTAL SUSPENDED SOLIDS	mg/L	12.00	68.00	37.64	14
NITROAROMATICS					
1,3,5-TRINITROBENZENE	µg/L	ND (0.03)	ND (0.06)	NC	6
1,3-DINITROBENZENE	µg/L	ND (0.05)	ND (0.18)	NC	6
2,4,6-TRINITROTOLUENE	µg/L	ND (0.03)	ND (0.08)	NC	6
2,4-DINITROTOLUENE	µg/L	ND (0.04)	ND (0.08)	NC	6

Leachate Sump Data (DC10) from January 2002 to December 2004

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
2,6-DINITROTOLUENE	µg/L	ND (0.06)	ND (0.12)	NC	6
NITROBENZENE	µg/L	ND (0.03)	ND (0.08)	NC	6
RADIOCHEMICAL					
GROSS ALPHA	pCi/L	16.80	66.70	43.98	14
GROSS BETA	pCi/L	13.20	30.80	19.80	6
RADIUM-226	pCi/L	ND (0.07)	0.51	0.32	14
RADIUM-228	pCi/L	ND (0.01)	1.81	0.65	14
THORIUM-228	pCi/L	ND (0.01)	0.43	0.15	14
THORIUM-230	pCi/L	ND (0.07)	0.78	0.32	14
THORIUM-232	pCi/L	ND (0.01)	0.38	0.14	14
URANIUM, TOTAL	pCi/L	16.00	57.30	37.88	14
AMERICIUM-241	pCi/L	ND (0.015)	0.749	0.28	13
NEPTUNIUM-237	pCi/L	ND (0.035)	1.010	0.34	13
PLUTONIUM-238	pCi/L	ND (0.007)	0.445	0.15	13
PLUTONIUM-239-240	pCi/L	ND (0.024)	0.975	0.18	13
TECHNETIUM-99	pCi/L	ND (0.122)	2.230	0.98	13
SEMI-VOLATILES					
1,2,4-TRICHLOROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
1,2-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
1,2-DIPHENYLHYDRAZINE	µg/L	ND (10.0)	ND (10.0)	NC	5
1,3-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
1,4-DICHLOROBENZENE	µg/L	ND (5.0)	ND (20.0)	NC	5
2,4,6-TRICHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DICHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DIMETHYLPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2,4-DINITROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
2,4-DINITROTOLUENE	µg/L	ND (10.0)	ND (20.0)	NC	6
2,6-DINITROTOLUENE	µg/L	ND (10.0)	ND (20.0)	NC	6
2-CHLORONAPHTHALENE	µg/L	ND (10.0)	ND (20.0)	NC	5
2-CHLOROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
2-NITROPHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
3,3'-DICHLOROBENZIDINE	µg/L	ND (50.0)	ND (100)	NC	6
4,6-DINITRO-2-METHYLPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
4-BROMOPHENYL PHENYL ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
4-CHLORO-3-METHYL PHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
4-CHLOROPHENYL PHENYL ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
4-NITROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
ACENAPHTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ACENAPHTHYLENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZIDINE	µg/L	ND (100)	ND (200)	NC	5
BENZO(A)ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(A)PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(B)FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(G,H,I)PERYLENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BENZO(K)FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
BIS(2-CHLOROETHOXY)METHANE	µg/L	ND (10.0)	ND (20.0)	NC	6
BIS(2-CHLOROETHYL)ETHER	µg/L	ND (10.0)	ND (20.0)	NC	6
BIS(2-CHLOROISOPROPYL)ETHER	µg/L	ND (10.0)	ND (20.0)	NC	5
BIS(2-ETHYLHEXYL)PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6

Leachate Sump Data (DC10) from January 2002 to December 2004

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
BUTYLBENZYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
CHRYSENE	µg/L	ND (5.0)	ND (20.0)	NC	6
DIBENZO(A,H)ANTHRACENE	µg/L	ND (5.0)	ND (20.0)	NC	6
DIETHYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DIMETHYLPHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DI-N-BUTYL PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
DI-N-OCTYL PHTHALATE	µg/L	ND (10.0)	ND (20.0)	NC	6
FLUORANTHENE	µg/L	ND (5.0)	ND (20.0)	NC	6
FLUORENE	µg/L	ND (5.0)	ND (20.0)	NC	6
HEXACHLOROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
HEXACHLOROBUTADIENE	µg/L	ND (10.0)	ND (20.0)	NC	6
HEXACHLOROCYCLOPENTADIENE	µg/L	ND (50.0)	ND (100)	NC	6
HEXACHLOROETHANE	µg/L	ND (10.0)	ND (20.0)	NC	6
INDENO(1,2,3-CD)PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
ISOPHORONE	µg/L	ND (10.0)	ND (20.0)	NC	6
NAPHTHALENE	µg/L	ND (5.0)	ND (20.0)	NC	6
NITROBENZENE	µg/L	ND (10.0)	ND (20.0)	NC	6
N-NITROSODIMETHYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	5
N-NITROSO-DI-N-PROPYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	6
N-NITROSODIPHENYLAMINE	µg/L	ND (10.0)	ND (20.0)	NC	6
PENTACHLOROPHENOL	µg/L	ND (50.0)	ND (100)	NC	6
PHENANTHRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
PHENOL	µg/L	ND (10.0)	ND (20.0)	NC	6
PYRENE	µg/L	ND (5.0)	ND (20.0)	NC	6
VOLATILES					
1,1,1-TRICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1,2,2-TETRACHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1,2-TRICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1-DICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,1-DICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
1,2-DICHLOROETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROETHENE (TOTAL)	µg/L	ND (5.0)	ND (5.0)	NC	14
1,2-DICHLOROPROPANE	µg/L	ND (5.0)	ND (5.0)	NC	14
1,3-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
1,4-DICHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	5
2-CHLOROETHYL VINYL ETHER	µg/L	ND (50.0)	ND (50.0)	NC	14
ACROLEIN	µg/L	ND (100)	ND (100)	NC	14
ACRYLONITRILE	µg/L	ND (5.0)	ND (5.0)	NC	14
BENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMODICHLOROMETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMOFORM	µg/L	ND (5.0)	ND (5.0)	NC	14
BROMOMETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
CARBON TETRACHLORIDE	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROBENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
CHLOROFORM	µg/L	ND (5.0)	ND (5.0)	NC	14
CHLOROMETHANE	µg/L	0.67	ND (10.0)	NC	14
CIS-1,3-DICHLOROPROPENE	µg/L	ND (5.0)	ND (5.0)	NC	14
DIBROMOCHLOROMETHANE	µg/L	ND (5.0)	ND (5.0)	NC	14

Leachate Sump Data (DC10) from January 2002 to December 2004

PARAMETER	Units	MINIMUM	MAXIMUM	AVERAGE	NUMBER OF SAMPLES
ETHYL BENZENE	µg/L	ND (5.0)	ND (5.0)	NC	14
METHYLENE CHLORIDE	µg/L	1.30	6.90	3.76	14
TETRACHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TOLUENE	µg/L	0.66	ND (5.0)	NC	14
TRANS-1,2-DICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	6
TRANS-1,3-DICHLOROPROPENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TRICHLOROETHENE	µg/L	ND (5.0)	ND (5.0)	NC	14
TRICHLOROFLUOROMETHANE	µg/L	ND (10.0)	ND (10.0)	NC	14
VINYL CHLORIDE	µg/L	ND (10.0)	ND (10.0)	NC	14
XYLENES, TOTAL	µg/L	ND (5.0)	ND (5.0)	NC	14
PESTICIDE/PCBS					
4,4'-DDD	µg/L	ND (0.05)	0.210	0.08	5
4,4'-DDE	µg/L	ND (0.05)	0.068	0.05	5
4,4'-DDT	µg/L	ND (0.025)	ND (0.05)	NC	5
ALDRIN	µg/L	ND (0.025)	ND (0.05)	NC	5
ALPHA-BHC	µg/L	ND (0.025)	ND (0.05)	NC	5
ALPHA-CHLORDANE	µg/L	ND (0.025)	ND (0.05)	NC	5
AROCLOR-1016	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1221	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1232	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1242	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1248	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1254	µg/L	ND (0.5)	ND (1.0)	NC	6
AROCLOR-1260	µg/L	ND (0.5)	ND (1.0)	NC	6
BETA-BHC	µg/L	0.10	0.150	0.08	5
DELTA-BHC	µg/L	0.035	0.061	0.05	5
DIELDRIN	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN I	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN II	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDOSULFAN SULFATE	µg/L	ND (0.025)	ND (0.05)	NC	5
ENDRIN	µg/L	0.15	0.210	0.10	5
ENDRIN ALDEHYDE	µg/L	ND (0.025)	ND (0.05)	NC	5
GAMMA-BHC (LINDANE)	µg/L	ND (0.025)	0.062	0.05	5
GAMMA-CHLORDANE	µg/L	ND (0.025)	ND (0.05)	NC	5
HEPTACHLOR	µg/L	0.10	0.310	0.19	5
HEPTACHLOR EPOXIDE	µg/L	ND (0.05)	0.110	0.06	5
TOXAPHENE	µg/L	ND (0.5)	ND (2.0)	NC	5

NOTES:

ND (Value) = Not Detected, Detection Limit given in parentheses
NC = Not Calculated. The average is calculated using all values. Where a ND value exists for both the minimum and maximum, an average could not be calculated

Untreated Leachate Sump Data (DC10) June 2005 to June 2007

Parameter	Concentrations				
	June 2005	December 2005	June 2006	December 2006	June 2007
Chloride (mg/L)	35.9	35.1	37.0	34.6	35.6
Fluoride (mg/L)	0.25	0.23	0.28	0.22	0.26
Nitrate-N (mg/L)	0.0027	0.408	1.38	1.52	1.33
Sulfate (mg/L)	33.3	32.8	48.7	42.7	37.5
Arsenic (mg/L)	0.0045	0.0027	0.0037	0.0024	0.0048
Barium (mg/L)	1.020	.743	0.799	0.768	0.781
Chromium (mg/L)	ND	ND	ND	ND	ND
Cobalt (mg/L)	0.0051	0.0023	ND	ND	ND
Iron (mg/L)	4.20	1.67	1.200	3.010	4.130
Lead (mg/L)	ND	ND	ND	ND	ND
Manganese (mg/L)	0.949	0.433	0.514	0.369	0.389
Nickel (mg/L)	0.0084	0.0073	ND	ND	0.0064
Selenium (mg/L)	ND	0.0027	ND	ND	ND
Thallium (mg/L)	ND	0.0013	0.0028	ND	ND
COD (mg/L)	31.0	38.0	37.0	27.0	69.0
TDS (mg/L)	749	633	683	619	725
TOC (mg/L)	10.37	12.3	ND	ND	12.0
1,3,5-TNB (µg/L)	ND	ND	ND	ND	ND
1,3-DNB (µg/L)	ND	ND	ND	ND	ND
2,4,6-TNT (µg/L)	ND	ND	ND	ND	ND
2,4-DNT (µg/L)	ND	ND	ND	ND	ND
2,6-DNT (µg/L)	ND	ND	ND	ND	ND
Nitrobenzene (µg/L)	ND	ND	ND	ND	ND
Radium-226 (pCi/L)	0.36	0.37	0.79	ND	0.56
Radium-228 (pCi/L)	0.74	ND	0.74	ND	0.79
Thorium-228 (pCi/L)	ND	ND	ND	ND	ND
Thorium-230 (pCi/L)	0.43	0.19	0.25	0.46	ND
Thorium-232 (pCi/L)	ND	ND	ND	ND	ND
Uranium (pCi/L)	15.8	24.2	20.2	24.7	17.1
PCBs/PAHs (µg/L)	ND	ND	ND	ND	ND

ND Nondetect.

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Attachment 4

NPDES Permit

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NPDES Permit No. MO-0107701
Weldon Spring Site Chemical Plant Area

USDOE, Weldon Springs Chemical Plant
MO-0107701, St. Charles County

STATE OF MISSOURI

APR 2 5 2008

Matt Blunt, Governor • Doyle Childers, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

US Department of Energy (USDOE)
7295 Highway 94 South
Weldon Springs, MO 63304

Dear Permittee:

Pursuant to the Federal Water Pollution Control Act, under the authority granted to the State of Missouri and in compliance with the Missouri Clean Water Law, we have issued and are enclosing your State Operating Permit to discharge from USDOE, Weldon Springs Chemical Plant.

Please read your permit and attached Standard Conditions. They contain important information on monitoring requirements, effluent limitations, sampling frequencies and reporting requirements.

Monitoring reports required by the special conditions must be submitted on a periodic basis. Copies of the necessary report forms are enclosed and should be mailed to the regional office listed below. Please contact that office for additional forms.

This permit is both your Federal NPDES Permit and your new Missouri State Operating Permit and replaces all previous State Operating Permits issued for this facility under this permit number. In all future correspondence regarding this facility, please refer to your State Operating Permit number and facility name as shown on page one of the permit.

If you were adversely affected by this decision, you may be entitled to an appeal before the administrative hearing commission pursuant to 10 CSR 20-1.020 and Section 621.250, RSMo. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the administrative hearing commission. Contact information for the AHC is as follows:

Administrative Hearing Commission
Truman State Office Building, Room 640
301 W. High Street
P.O. Box 1557
Jefferson City, Missouri 65102
Phone: 573-751-2422
Fax: 573-751-5018
Website: www.oa.mo.gov/ahc

Please be aware that this facility may also be subject to any applicable county or other local ordinances or restrictions.

If you have any questions concerning this permit, please do not hesitate to contact the St. Louis Regional Office at 7545 S. LindberghSuite 210, St. Louis, MO 63125 (314) 416-2960.

Sincerely,

ST. LOUIS REGIONAL OFFICE

Mike Struckhoff

Mike Struckhoff
Regional Director

MS:

Enclosure

c:

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STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo. as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No.	MO-0107701
Owner: Address:	U.S. Department of Energy (USDOE) 7295 Highway 94 South, Weldon Spring, MO 63304
Continuing Authority: Address:	Same as above Same as above
Facility Name: Facility Address:	USDOE, Weldon Spring Chemical Plant 7295 Highway 94 South, Weldon Spring, MO 63304
Legal Description: Latitude/Longitude:	SW ¼, NW ¼, Sec. 08 projected, T45N, R3E, St. Charles County +3840158 / -09043193
Receiving Stream: First Classified Stream and ID: USGS Basin & Sub-watershed No.:	Missouri River (P) Missouri River (P) (#1604), 303(d) List (10300200-190003)

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION

Outfall #007 - Radioactive waste disposal facilities, SIC #4953
Leachate Collection and Retention System for Disposal Facility Leachate and monitoring well purge water. Disposal Facility Leachate is filtered and passed through an Ion Exchange Resin. Monitoring Well Purge water is passed through a carbon absorption system prior to placement in the Disposal Facility Leachate Collection and Retention System
Design flow is 25,000 gallons per day.
Actual flow is 200 gallons per day.

This permit authorizes only wastewater discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System; it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

April 25, 2008
Effective Date

Doyle Childers
Doyle Childers, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

April 24, 2013
Expiration Date
MO 780-0041 (10-93)

Mike Struckhoff
Mike Struckhoff, Director, St. Louis Regional Office

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS	PAGE NUMBER 2 of 6 PERMIT NUMBER MO-0107701

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #007						
Flow	MGD	*		*	Once/Discharge Event	24 hr Estimate
pH – Units	SU	**		**	Once/Discharge Event	Grab
Antimony, Total	µg/L	66		26	Once/Discharge Event	Grab
Cyanide, Amenable to Chlorination	µg/L	188		93	Once/Discharge Event	Grab
Gross Alpha	pCi/L	167		80	Once/Discharge Event	Grab
Phenol	µg/L	825		425	Once/Discharge Event	Grab
MONITORING REPORTS SHALL BE SUBMITTED YEARLY; THE FIRST REPORT IS DUE OCTOBER 28, 2008. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.						
Whole Effluent Toxicity (WET) test	% Survival	See Special Conditions			Once/year	24 hr. composite
MONITORING REPORTS SHALL BE SUBMITTED YEARLY; THE REPORT IS DUE OCTOBER, 28 2008						

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Parts I, & III STANDARD CONDITIONS DATED October 1, 1980 and August 15, 1994, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

MO 780-0010 (8/91)

* Monitoring requirement only.
** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.5-9.0 pH units.

C. SPECIAL CONDITIONS

1. This permit may be reopened and modified, or alternatively revoked and reissued, to:
   (a) Comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a) (2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:
      (1) contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
      (2) controls any pollutant not limited in the permit.
   (b) Incorporate new or modified effluent limitations or other conditions, if the result of a waste load allocation study, toxicity test or other information indicates changes are necessary to assure compliance with Missouri's Water Quality Standards.
   (c) Incorporate new or modified effluent limitations or other conditions if, as the result of a watershed analysis, a Total Maximum Daily Load (TMDL) limitation is developed for the receiving waters which are currently included in Missouri's list of waters of the state not fully achieving the state's water quality standards, also called the 303(d) list.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Clean Water Act then applicable.

2. All outfalls must be clearly marked in the field.

3. Permittee will cease discharge by connection to area-wide wastewater treatment system within 90 days of notice of its availability.

4. Changes in Discharges of Toxic Substances

   The permittee shall notify the Director as soon as it knows or has reason to believe:
   (a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:"
      (1) One hundred micrograms per liter (100 µg/L);
      (2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,5 dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
      (3) Five (5) times the maximum concentration value reported for the pollutant in the permit application;
      (4) The level established in Part A of the permit by the Director.
   (b) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant, which was not reported in the permit application.

5. Report as no-discharge when a discharge does not occur during the report period.

6. Water Quality Standards
   (a) Discharges to waters of the state shall not cause a violation of water quality standards rule under 10 CSR 20-7.031, including both specific and general criteria.
   (b) General Criteria. The following general water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions:
      (1) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses;
      (2) Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
      (3) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses;
      (4) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life;
      (5) There shall be no significant human health hazard from incidental contact with the water;
      (6) There shall be no acute toxicity to livestock or wildlife watering;
      (7) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community;
      (8) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to section 260.200-260.247.

C. SPECIAL CONDITIONS (continued)

7. The permittee shall comply with any applicable requirements listed in 10 CSR 20-8 and 10 CSR 20-9. The monitoring frequencies contained in this permit shall not be construed by the permittee as a modification of the monitoring frequencies listed in 10 CSR 20-9. If a modification of the monitoring frequencies listed in 10 CSR 20-9 is needed, the permittee shall submit a written request to the department for review and, if deemed necessary, approval.

8. Whole Effluent Toxicity (WET) tests shall be conducted as follows:

SUMMARY OF WET TESTING FOR THIS PERMIT				
OUTFALL	A.E.C. %	FREQUENCY	SAMPLE TYPE	MONTH
007	10 %	YEARLY	24 hr. composite	First Discharge of Year

(a) Test Schedule and Follow-Up Requirements

(1) Perform a SINGLE-dilution test in the months and at the frequency specified above. For tests which are successfully passed, submit test results USING THE DEPARTMENT'S WET TEST REPORT FORM #MO-780-1899 along with complete copies of the test reports as received from the laboratory, including copies of chain-of-custody forms within 30 calendar days of availability to the WATER PROTECTION PROGRAM, P.O. Box 176, Jefferson City, MO 65102. If the effluent passes the test, do not repeat the test until the next test period.

(a) For discharges of stormwater, samples shall be collected within three hours from when discharge first occurs.

(b) Samples submitted for analysis of stormwater discharges shall be collected as a grab.

(c) For discharges of non-stormwater, samples shall be collected only when precipitation has not occurred for a period of forty-eight hours prior to sample collection. In no event shall sample collection occur simultaneously with the occurrence of precipitation excepting for stormwater samples.

(d) A twenty-four hour composite sample shall be submitted for analysis of non-stormwater discharges.

(e) Upstream receiving water samples, where required, shall be collected upstream from any influence of the effluent where downstream flow is clearly evident.

(f) Samples submitted for analysis of upstream receiving water may be collected as either a grab or twenty-four-hour composite as appropriate to the nature of the discharge.

(g) Chemical and physical analysis of the upstream control and effluent sample shall occur immediately upon being received by the laboratory, prior to any manipulation of the effluent sample beyond preservation methods consistent with federal guidelines for WET testing that are required to stabilize the sample during shipping.

(h) Any and all chemical or physical analysis of the effluent sample performed in conjunction with the WET test shall be performed at the 100% Effluent concentration in addition to analyses performed upon any other effluent concentration.

(i) All chemical analyses included in the Missouri Department of Natural Resources WET test report form #MO-780-1899 shall be performed and results shall be recorded in the appropriate field of the report form.

(j) Where flow-weighted composite sample is required for analysis, the samples shall be composited at the laboratory where the test is to be performed.

(k) Where in stream testing is required downstream from the discharge, sample collection shall occur immediately below the established Zone of Initial Dilution in conjunction with or immediately following a release or discharge.

(l) Samples submitted for analysis of downstream receiving water may be collected as either a grab or twenty-four-hour composite as appropriate to the nature of the discharge.

(m) All instream samples, including downstream samples, shall be tested for toxicity at the 100% concentration in addition to any other assigned AEC for in-stream samples.

(2) All failing test results along with complete copies of the test reports as received from the laboratory, INCLUDING THOSE TESTS CONDUCTED UNDER CONDITION (3) BELOW, shall be reported to the WATER PROTECTION PROGRAM, P.O. Box 176, Jefferson City, MO 65102 within 14 calendar days of the availability of the results.

(3) If the effluent fails the test, a multiple dilution test shall be performed within 30 calendar days and biweekly thereafter, until one of the following conditions are met:

(a) THREE CONSECUTIVE MULTIPLE-DILUTION TESTS PASS. No further tests need to be performed until next regularly scheduled test period.

(b) A TOTAL OF THREE MULTIPLE-DILUTION TESTS FAIL.

(4) Failure of at least two multiple-dilution tests during any period of accelerated monitoring violates the permit narrative requirement for aquatic life protection.

(5) The permittee shall submit a concise summary of all test results for the test series to the WATER PROTECTION PROGRAM, P.O. Box 176, Jefferson City, MO 65102 within 14 calendar days of the third failed test.

(6) Additionally, the following shall apply upon failure of the third MULTIPLE DILUTION test: A toxicity identification evaluation (TIE) or toxicity reduction evaluation (TRE) is automatically triggered. The permittee shall contact THE WATER PROTECTION PROGRAM within 14 calendar days from availability of the test results to ascertain as to whether a TIE or TRE is appropriate. The permittee shall submit a plan for conducting a TIE or TRE to the WATER PROTECTION PROGRAM within 60 calendar days of the date of DNR's direction to perform either a TIE or TRE. This plan must be approved by DNR before the TIE or TRE is begun. A schedule for completing the TIE or TRE shall be established in the plan approval.

(7) Upon DNR's approval, the TIE/TRE schedule may be modified if toxicity is intermittent during the TIE/TRE investigations. A revised WET test schedule may be established by DNR for this period.

(8) If a previously completed TIE has clearly identified the cause of toxicity, additional TIEs will not be required as long as effluent characteristics remain essentially unchanged and the permittee is proceeding according to a DNR approved schedule to complete a TRE and reduce toxicity. Regularly scheduled WET testing as required in the permit, without the follow-up requirements, will be required during this period.

(9) When WET test sampling is required to run over one DMR period, each DMR report shall contain a copy of the Department's WET test report form that was generated during the reporting period.

(10) Submit a concise summary in tabular format of all test results with the annual report.

(b) PASS/FAIL procedure and effluent limitations:

(1) To pass a single-dilution test, mortality observed in the AEC test concentration shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the upstream receiving-water control sample. Where upstream receiving water is not available mortality observed in the AEC test concentration shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the laboratory control. The appropriate statistical tests of significance shall be consistent with the most current edition of METHODS FOR MEASURING THE ACUTE TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO FRESHWATER AND MARINE ORGANISMS or other Federal guidelines as appropriate or required.

(2) To pass a multiple-dilution test:

(a) For facilities with a computed percent effluent at the edge of the zone of initial dilution, Allowable Effluent Concentration (AEC), OF 30% OR LESS THE AEC must be less than three-tenths (0.3) of the LC_{50} concentration for the most sensitive of the test organisms; **OR**,

(b) For facilities with an AEC greater than 30% the LC50 concentration must be greater than 100%; **AND**,

(c) all effluent concentrations equal to or less than the AEC must be nontoxic. Mortality observed in all effluent concentrations equal to or less than the AEC shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the upstream receiving-water control sample. Where upstream receiving water is not available mortality observed in the AEC test concentration shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the laboratory control. The appropriate statistical tests of significance shall be consistent with the most current edition of METHODS FOR MEASURING THE ACUTE TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO FRESHWATER AND MARINE ORGANISMS or other federal guidelines as appropriate or required. Failure of one multiple-dilution test may be considered an effluent limit violation.

(c) Test Conditions

(1) Test Type: Acute Static non-renewal.

(2) All tests, including repeat tests for previous failures, shall include both test species listed below.

(3) Test species: Ceriodaphnia dubia and Pimephales promelas (fathead minnow). Organisms used in WET testing shall come from cultures reared for the purpose of conducting toxicity tests and cultured in a manner consistent with the most current USEPA guidelines. All test animals shall be cultured as described in the most current edition of METHODS FOR MEASURING THE ACUTE TOXICITY OF EFFLUENTS AND RECEIVING WATERS TO FRESHWATER AND MARINE ORGANISMS.

(4) Test period: 48 hours at the "Acceptable Effluent Concentration" (AEC) specified above.

(5) When dilutions are required, upstream receiving stream water shall be used as dilution water. If upstream water is unavailable or if mortality in the upstream water exceeds 10%, "reconstituted" water will be used as dilution water. Procedures for generating reconstituted water will be supplied by the MDNR upon request.

(6) Single-dilution tests will be run with:

(a) Effluent at the AEC concentration;

(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and

(c) reconstituted water.

(7) Multiple-dilution tests will be run with:

(a) 100%, 50%, 25%, 12.5%, and 6.25% effluent, unless the AEC is less than 25% effluent, in which case dilutions will be 4 times the AEC, two times the AEC, AEC, 1/2 AEC and 1/4 AEC;

(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and

(c) reconstituted water.

(8) If reconstituted-water control mortality for a test species exceeds 10%, the entire test will be rerun.

(9) If upstream control mortality exceeds 10%, the entire test will be rerun using reconstituted water as the dilutant.

STANDARD CONDITIONS FOR NPDES PERMITS
ISSUED BY
THE MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION
Revised
October 1, 1980

PART I - GENERAL CONDITIONS
SECTION A - MONITORING AND REPORTING

1. **Representative Sampling**
   a. Samples and measurements taken as required herein shall be representative of the nature and volume, respectively, of the monitored discharge. All samples shall be taken at the outfall(s), and unless specified, before the effluent joins or is diluted by any other body of water or substance.
   b. Monitoring results shall be recorded and reported on forms provided by the Department, postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to the respective Department Regional Office, the Regional Office address is indicated in the cover letter transmitting the permit.

2. **Schedule of Compliance**
   No later than fourteen (14) calendar days following each date identified in the "Schedule of Compliance", the permittee shall submit to the respective Department Regional Office as required therein, either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirements, or if there are no more scheduled requirements, when such noncompliance will be corrected. The Regional Office address is indicated in the cover letter transmitting he permit.

3. **Definitions**
   Definitions as set forth in the Missouri Clean Water Law and Missouri Clean Water Commission Definition Regulation 10 CSR 20-2.010 shall apply to terms used herein.

4. **Test Procedures**
   Test procedures for the analysis of pollutant shall be in accordance with the Missouri Clean Water Commission Effluent Regulation 10 CSR 20-7015.

5. **Recording of Results**
   a. For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:
      (i) the date, exact place, and time of sampling or measurements;
      (ii) the individual(s) who performed the sampling or measurements;
      (iii) the date(s) analyses were performed;
      (iv) the individual(s) who performed the analyses;
      (v) the analytical techniques or methods used; and
      (vi) the results of such analyses.
   b. The Federal Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six (6) months per violation, or both.
   c. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

6. **Additional Monitoring by Permittee**
   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monitoring Report Form. Such increased frequency shall also be indicated.

7. **Records Retention**
   The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recording for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the Department at any time.

SECTION B - MANAGEMENT REQUIREMENTS

1. **Change in Discharge**
   a. All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant not authorized by this permit or any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit.
   b. Any facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants shall be reported by submission of a new NPDES application at least sixty (60) days before each such changes, or, if they will not violate the effluent limitations specified in the permit, by notice to the Department at least thirty (30) days before such changes.

2. **Noncompliance Notification**
   a. If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum effluent limitation specified in this permit, the permittee shall provide the Department with the following information, in writing within five (5) days of becoming aware of such conditions:
      (i) a description of the discharge and cause of noncompliance, and
      (ii) the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.
   b. Twenty-four hour reporting. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally with 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided with five (5) days of the time the permittee becomes aware of the circumstances. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

3. **Facilities Operation**
   Permittees shall operate and maintain facilities to comply with the Missouri Clean Water Law and applicable permit conditions. Operators or supervisors of operations at publicly owned or publicly regulated wastewater treatment facilities shall be certified in accordance with 10 CSR 209.020(2) and any other applicable law or regulation. Operators of other wastewater treatment facilities, water contaminant source or point sources, shall, upon request by the Department, demonstrate that wastewater treatment equipment and facilities are effectively operated and maintained by competent personnel.

4. **Adverse Impact**
   The permittee shall take all necessary steps to minimize any adverse impact to waters of the state resulting from noncompliance with any effluent limitations specified in this permit or set forth in the Missouri Clean Water Law and Regulations (hereinafter the Law and Regulations), including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. **Bypassing**
   a. Any bypass or shut down of a wastewater treatment facility and tributary sewer system or any part of such a facility and sewer system that results in a violation of permit limits or conditions is prohibited except:
      (i) where unavoidable to prevent loss of life, personal injury, or severe property damages; and
      (ii) where unavoidable excessive storm drainage or runoff would catastrophically damage any facilities or processes necessary for compliance with the effluent limitations and conditions of this permit;
      (iii) where maintenance is necessary to ensure efficient operation and alternative measures have been taken to maintain effluent quality during the period of maintenance.
   b. The permittee shall notify the Department in writing of all bypasses or shut down that result in a violation of permit limits or conditions. This section does not excuse any person from liability, unless such relief is otherwise provided by the statute.

6. **Removed Substances**
   Solids, sludges, filter backwash, or any other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutants from entering waters of the state unless permitted by the Law, and a permanent record of the date and time, volume and methods of removal and disposal of such substances shall be maintained by the permittee.

7. **Power Failures**
   In order to maintain compliance with the effluent limitations and other provisions of this permit, the permittee shall either:
   a. in accordance with the "Schedule of Compliance", provide an alternative power source sufficient to operate the wastewater control facilities; or,
   b. if such alternative power source is not in existence, and no date for its implementation appears in the Compliance Schedule, halt or otherwise control production and all discharges upon the reduction, loss, or failure of the primary source of power to the wastewater control facilities.

8. **Right of Entry**
   For the purpose of inspecting, monitoring, or sampling the point source, water contaminant source, or wastewater treatment facility for compliance with the Clean Water Law and these regulations, authorized representatives of the Department, shall be allowed by the permittee, upon presentation of credentials and at reasonable times;
   a. to enter upon permittee's premises in which a point source, water contaminant source, or wastewater treatment facility is located or in which any records are required to be kept under terms and conditions of the permit;
   b. to have access to, or copy, any records required to be kept under terms and conditions of the permit;
   c. to inspect any monitoring equipment or method required in the permit;
   d. to inspect any collection, treatment, or discharge facility covered under the permit; and
   e. to sample any wastewater at any point in the collection system or treatment process.

9. **Permits Transferable**
   a. Subject to Section (3) of 10 CSR 20-6.010 an operating permit may be transferred upon submission to the Department of an application to transfer signed by a new owner. Until such time as the permit is officially transferred, the original permittee remains responsible for complying with the terms and conditions of the existing permit.
   b. The Department, within thirty (30) days of receipt of the application shall notify the new permittee of its intent to revoke and reissue or transfer the permit.

10. **Availability of Reports**
    Except for data determined to be confidential under Section 308 of the Act, and the Law and Missouri Clean Water Commission Regulation for Public Participation, Hearings and Notice to Governmental Agencies 10 CSR 20-6.020, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by statute, effluent data shall not be considered confidential. Knowingly making any false statement on any such report shall be subject to the imposition of criminal penalties as provided in Section 204.076 of the Law.

11. **Permit Modification**
    a. Subject to compliance with statutory requirements of the Law and Regulations and applicable Court Order, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:
       (i) violation of any terms or conditions of this permit or the Law;
       (ii) having obtained this permit by misrepresentation or failure to disclose fully any relevant facts;
       (iii) a change in any circumstances or conditions that requires either a temporary or permanent reduction or elimination of the authorized discharge, or
       (iv) any reason set forth in the Law and Regulations.
    b. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

12. **Permit Modification - Less Stringent Requirements**
    If any permit provisions are based on legal requirements which are lessened or removed, and should no other basis exist for such permit provisions, the permit shall be modified after notice and opportunity for a hearing.

13. **Civil and Criminal Liability**
    Except as authorized by statute and provided in permit conditions on "Bypassing" (Standard Condition B-5) and "Power Failures" (Standard Condition B-7) nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

14. **Oil and Hazardous Substance Liability**
    Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act, and the Law and Regulations. Oil and hazardous materials discharges must be reported in compliance with the requirements of the Federal Clean Water Act.

15. **State Laws**
    Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state statute or regulations.

16. **Property Rights**
    The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, no does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

17. **Duty to Reapply**
    If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for a new permit 180 days prior to expiration of this permit.

18. **Toxic Pollutants**
    If a toxic effluent standard, prohibition, or schedule of compliance is established, under Section 307(a) of the Federal Clean Water Act for a toxic pollutant in the discharge of permittee's facility and such standard is more stringent than the limitations in the permit, then the more stringent standard, prohibition, or schedule shall be incorporated into the permit as one of its conditions, upon notice to the permittee.

19. **Signatory Requirement**
    All reports, or information submitted to the Director shall be signed (see 40 CFR-122.6).

20. **Rights Not Affected**
    Nothing in this permit shall affect the permittee's right to appeal or seek a variance from applicable laws or regulations as allowed by law.

21. **Severability**
    The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

STANDARD CONDITIONS FOR NPDES PERMITS
ISSUED BY
THE MISSOURI DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION
AUGUST 15, 1994

PART III - SLUDGE & BIOSOLIDS FROM DOMESTIC WASTEWATER TREATMENT FACILITIES

SECTION A - GENERAL REQUIREMENTS

1. This permit pertains to sludge requirements under the Missouri Clean Water Law and regulations and incorporates applicable federal sludge disposal requirements under 40 CFR 503. The Environmental Protection Agency (EPA) has principal authority for permitting and enforcement of the federal sludge regulations under 40 CFS 503 until such time as Missouri is delegated the new EPA sludge program. EPA has reviewed and accepted these standard sludge conditions. EPA may choose to issue a separate sludge addendum to this permit or a separate federal sludge permit at their discretion to further address federal requirements.
2. These PART III Standard Conditions apply only to sludge and biosolids generated at domestic wastewater treatment facilities, including public owned treatment works (POTW) and privately owned facilities.
3. Sludge and Biosolids Use and Disposal Practices.
   a. Permittee is authorized to operate the sludge and biosolids treatment, storage, use, and disposal facilities listed in the facility description of this permit.
   b. Permittee shall not exceed the design sludge volume listed in the facility description and shall not use sludge disposal methods that are not listed in the facility description, without prior approval of the permitting authority.
   c. Permittee is authorized to operate the storage, treatment or generating sites listed in the Facility Description section of this permit.
   d. A separate operating permit is required for each operating location where sludge or biosolids are generated, stored, treated, or disposed, unless specifically exempted in this permit or in 10 CSR 20, Chapter 6 regulations. For land application, see section H, subsection 3 of these standard conditions.
4. Sludge Received From Other Facilities
   a. Permittees may accept domestic wastewater sludge from other facilities including septic tank pumpings from residential sources as long as the design sludge volume is not exceeded and the treatment facility performance is not impaired.
   b. The permittee shall obtain a signed statement from the sludge generator or hauler that certifies the type and source of the sludge.
   c. Sludge received from out-of-state generators shall receive prior approval of the permitting authority and shall be listed in the facility description or special conditions section of the permit.
5. These permit requirements do not supersede nor remove liability for compliance with county and other local ordinances.
6. These permit requirements do not supersede nor remove liability for compliance with other environmental regulations such as odor emissions under the Missouri Air Pollution Control Law and regulations.
7. This permit may (after due process) be modified, or alternatively revoked and reissued, to comply with any applicable sludge disposal standard or limitation issued or approved under Section 405(d) of the Clean Water Act or under Chapter 644 RsMo.
8. In addition to these STANDARD CONDITIONS, the department may include sludge limitations in the special conditions portion or other sections of this permit.
9. Alternate Limits in Site Specific Permit.
   Where deemed appropriate, the department may require an individual site specific permit in order to authorize alternate limitations:
   a. An individual permit must be obtained for each operating location, including application sites.
   b. To request a site specific permit, an individual permit application, permit fees, and supporting documents shall be submitted for each operating location. This shall include a detailed sludge/biosolids management plan or engineering report.
10. Exceptions to these Standard Conditions may be authorized on a case-by-case basis by the department, as follows:
    a. The department will prepare a permit modification and follow permit public notice provisions as applicable under 10 CSR 20-6.020, 40 CFR 124.10, and 40 CFR 501.15(a)(2)(ix)(E). This includes notification of the owners of property located adjacent to each land application site, where appropriate.
    b. Exceptions cannot be granted where prohibited by the federal sludge regulations under 40 CFR 503.
11. Compliance Period
    Compliance shall be achieved as expeditiously as possible but no later than the compliance dates under 40 CFR 503.2.

SECTION B - DEFINITIONS

1. Biosolids means an organic fertilizer or soil amendment produced by the treatment of domestic wastewater sludge. Untreated sludge or sludge that does not conform to the pollutants and pathogen treatment requirements in this permit is not considered biosolids.
2. Biosolids land application facility is a facility where biosolids are spread onto the land at agronomic rates for production of food or fiber. The facility includes any structures necessary to store the biosolids until soil, weather, and crop conditions are favorable for land application.
3. Class A biosolids means a material that has met the Class A pathogen reduction requirements or equivalent treatment by a Process to Further Reduce Pathogens (PFRP) in accordance with 40 CFR 503.
4. Class B biosolids means a material that has met the Class B pathogen reduction requirements or equivalent treatment by a Process to Significantly Reduce Pathogens (PFRP) in accordance with 40 CFR 503.
5. Domestic wastewater means wastewater originating from the sanitary conveniences of residences, commercial buildings, factories and institutions; or co-mingled sanitary and industrial wastewater processed by a public owned treatment works (POTW) or privately owned facility.
6. Mechanical treatment plants are wastewater treatment facilities that use mechanical devices to treat wastewater, including septic tanks, extended aeration, activated sludge, contact stabilization, trickling filters, rotating biological discs, and other similar facilities. It does not include unaerated wastewater treatment lagoons and constructed wetlands for wastewater treatment.
7. Operating location as defined in 10 CSR 20-2.010 is all contiguous lands owned, operated or controlled by one (1) person or by two (2) or more persons jointly or as tenants in common.
8. Plant Available Nitrogen (PAN) is the nitrogen that will be available to plants during the next growing season after biosolids application.
9. Sinkhole is a depression in the land surface into which surface water flows to join an underground drainage system.
10. Site Specific Permit is a permit that has alternate limits developed to address specific site conditions for each land application site or storage site.
11. Sludge is the solid, semisolid, or liquid residue removed during the treatment of wastewater. Sludge includes septage removed from septic tanks.
12. Sludge lagoon is an earthen basin that receives sludge that has been removed from a wastewater treatment facility. It does not include a wastewater treatment lagoon or sludge treatment units that are not a part of a mechanical wastewater treatment facility.
13. Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamp, marshes, bogs, and similar areas. Wetlands do not include constructed wetlands used for wastewater treatment.

SECTION C - MECHANICAL WASTEWATER TREATMENT FACILITIES

1. Sludge shall be routinely removed from the wastewater treatment facilities and handled according to the permit facility description and sludge conditions in this permit.
2. The permittee shall operate the facility so that there is no sludge loss into the discharged effluent in excess of permit limits, no sludge bypassing, and no discharge of sludge to waters of the state.
3. Mechanical treatment plants shall have separate sludge storage compartments in accordance with 10 CSR 20, Chapter 8. Failure to remove sludge from these storage compartments on the required design schedule is a violation of this permit.

SECTION D - SLUDGE DISPOSED AT OTHER TREATMENT FACILITY OR CONTRACT HAULER

1. This section applies to permittees that haul sludge to another treatment facility for disposal or use contract haulers to remove and dispose of sludge.
2. Permittees that use contract haulers are responsible for compliance with all the terms of this permit including final disposal, unless the contract hauler has a separate permit for sludge or biosolids disposal issued by the department; or the hauler transports the sludge to another permitted treatment facility.
3. The permittee shall require documentation from the contractor of the disposal methods used and permits obtained by the contractor.
4. Testing of sludge, other than total solids content, is not required if sludge is hauled to a municipal wastewater treatment facility or other permitted wastewater treatment facility.

SECTION E - WASTEWATER TREATMENT LAGOONS AND STORMWATER RETENTION BASINS

1. Sludge that is retained within a wastewater treatment lagoon is subject to sludge disposal requirements when the sludge is removed from the lagoon or when the lagoon ceases to receive and treat wastewater.
2. If sludge is removed during the year, an annual sludge report must be submitted.
3. Storm water retention basins or other earthen basins, which have been used as sludge storage for a mechanical treatment system is considered a sludge lagoon and must comply with Section G of this permit.

SECTION F - INCINERATION OF SLUDGE

1. Sludge incineration facilities shall comply with the requirements of 40 CFR 503 Subpart E; air pollution control regulations under 10 CSR 10; and solid waste management regulations under 10 CSR 80.
2. Permittee may be authorized under the facility description of this permit to store incineration ash in lagoons or ash ponds. This permit does not authorize the disposal of incineration ash. Incineration ash shall be disposed in accordance with 10 CSR 80; or if the ash is determined to be hazardous waste, shall be disposed in accordance with 10 CSR 25.
3. In addition to normal sludge monitoring, incineration facilities shall report the following as part of the annual report, quantity of sludge incinerated, quantity of ash generated, quantity of ash stored; and ash use or disposal method, quantity, and location. Permittee shall also provide the name of the disposal facility and the applicable permit number.
4. Additional limitations, monitoring, and reporting requirements may be addressed in the Special Conditions sections of this permit.

SECTION G - SURFACE DISPOSAL SITES AND SLUDGE LAGOONS

1. Surface disposal sites shall comply with the requirements in 40 CFR 503 Subpart C, and solid waste disposal regulations under 10 CSR 80.
2. Additional limitations, monitoring, and reporting requirements may be addressed in the Special Conditions section of this permit.
3. Effective February 19, 1995, a sludge lagoon that has been in use for more than two years without removal of accumulated sludge, or that has not been properly closed shall comply with one of the following options:
   a. Permittee shall obtain a site specific permit to address surface disposal requirements under 40 CFR 503, ground water quality regulations under 10 CSR 20, Chapter 7 and 8, and solid waste management regulations under 10 CSR 80;
   b. Permittee shall clean out the sludge lagoon to remove any sludge over two years old and shall continue to remove accumulated sludge at least every two years or an alternate schedule approved under 40 CFR 503.20(b). In order to avoid damage to the lagoon seal during cleaning, the permittee may leave a layer of sludge on the bottom of the lagoon, upon prior approval of the department; or
   c. Permittee shall close the lagoon in accordance with Section 1.

SECTION H - LAND APPLICATION

1. The permittee shall not land apply sludge or biosolids unless land application is authorized in the Facility Description or special conditions section of the permit.
2. This permit replaces and terminates all previous sludge management plan approvals by the department for land application of sludge or biosolids.
3. Land application sites within a 20 mile radius of the wastewater treatment facility are authorized under this permit when biosolids are applied for beneficial use in accordance with these standard conditions unless a site specific permit is required under Section A, Subsection 9.
4. Biosolids shall not be applied unless authorized in this permit or exempted under 10 CSR 20, Chapter 6.
   a. This permit does not authorize the land application of sludge except when sludge meets the definition of biosolids.
   b. This permit authorizes AClass A or B≡ biosolids derived from domestic wastewater sludges to be land applied onto grass land, crop land, timber land or other similar agricultural or silviculture lands at rates suitable for beneficial use as organic fertilizer and soil conditioner.
5. Public Contact Sites.
   Permittees who wish to apply Class A biosolids to public contact sites must obtain approval from the department. Applications for approval shall be in the form of an engineering report and shall address priority pollutants and dioxin concentrations. Authorization for land applications must be provided in the special conditions section of this permit or in a separate site-specific permit.

6. Agricultural and Silvicultural Sites.
In addition to specified conditions herein, this permit is subject to the attached Water Quality Guides numbers WQ 422 through 426 published by the University of Missouri, and hereby incorporated as though fully set forth herein. The guide topics are as follows:

WQ 422	Land Application of Septage
WQ 423	Monitoring Requirements for Biosolids Land Application
WQ 424	Biosolids Standards for Pathogens and Vectors
WQ 425	Biosolids Standards for Metals and Other Trace Substances
WQ 426	Best Management Practices for Biosolids Land Application

SECTION I - CLOSURE REQUIREMENTS

1. This section applies to all wastewater treatment facilities (mechanical and lagoons) and sludge or biosolids storage and treatment facilities and incineration ash ponds. It does not apply to land application sites.
2. Permittees who plan to cease operation must obtain department approval of a closure plan which addresses proper removal and disposal of all residues, including sludge, biosolids, and ash. Permittee must maintain this permit until the facility is properly closed per 10 CSR 20-6.010 and 10 CSR 20-6.015.
3. Residuals that are left in place during closure of a lagoon or earthen structure shall not exceed the agricultural loading rates as follows:
   a. Residuals shall meet the monitoring and land application limits for agricultural rates as referenced in Section H of these standard conditions.
   b. If a wastewater treatment lagoon has been in operation for 15 years or more, the sludge in the lagoon qualifies for Class B with respect to pathogens (see WQ 424, Table 3), and testing for fecal coliform is not required. For other lagoons, testing for fecal coliform is required to show compliance with Class B limitations. See WQ 423 and 424.
   c. The allowable nitrogen loading that may be left in the lagoon shall be based on the plant available nitrogen (PAN) loading. See WQ 426 for calculation procedures. For a grass cover crop, the allowable PAN is 300 pounds/acre.
4. When closing a wastewater treatment lagoon with a design treatment capacity equal or less than 150 persons, the residuals are considered Aseptage≅ under the Asimilar treatment works≅ definition. See WQ 422. Under the septage category, residuals may be left in place as follows:
   a. Testing for metals or fecal coliform is not required.
   b. If the wastewater treatment lagoon has been in use for less than 15 years, mix lime with the sludge at the rate of 50 pounds of hydrated lime per 1000 gallons (134 cubic feet) of sludge.
   c. The amount of sludge that may be left in the lagoon shall be based on the plant available nitrogen (PAN) loading. 100 dry tons/acre of sludge may be left in the basin without testing for nitrogen. If more than 100 dry tons/acre will be left in the lagoon, test for nitrogen and determine the PAN in accordance with WQ 426. Allowable PAN loading is 300 pounds/acre.
5. Residuals left within the lagoon shall be mixed with soil on at least a 1 to 1 ratio, the lagoon berms shall be demolished, and the site shall be graded and vegetated so as to avoid ponding of storm water and provide adequate surface water drainage without creating erosion.
6. Lagoon closure activities shall obtain a storm water permit for land disturbance activities that equal or exceed five acres in accordance with 10 CSR 20-6.200.
7. If sludge exceeds agricultural loading rates under Section H or I, a landfill permit or solid waste disposal permit shall be obtained to authorize on-site sludge disposal under the Missouri Solid Waste Management Law and regulations per 10 CSR 80, and the permittee must comply with the surface disposal requirements under 40 CFR 503, Subpart C.

SECTION J - MONITORING FREQUENCY

1. At a minimum, sludge or biosolids shall be tested for volume and percent total solids on a frequency that will accurately respresent sludge quantities produced and disposed.
2. Testing for land application is listed under Section H, Subsection 6 of these standard conditions (see WQ 423). Once per year is the minimum test frequency. Additional testing shall be performed for each 100 dry tons of sludge generated or stored during the year.
3. Additional testing may be required in the special conditions or other sections of this permit. Permittees receiving industrial wastewater may be required to conduct additional testing upon request from the department.
4. Monitoring requirements shall be performed in accordance with, APOTW Sludge Sampling and Analysis Guidance Document≅, United States Environmental Protection Agency, August 1989, and subsequent revisions.

SECTION K - RECORD KEEPING AND REPORTING REQUIREMENTS

1. The permittee shall maintain records on file at the facility for at least five years for the items listed in these Standard Conditions and any additional items in the Special Conditions section of this permit. This shall include dates when the sludge facility is checked for proper operation, records of maintenance and repairs and other relevant information.
2. Reporting Period
   a. By January 28th of each year, an annual report shall be submitted for the previous calendar year period for all mechanical wastewater treatment facilities, sludge lagoons, and sludge or biosolids disposal facilities.
   b. Permittees with wastewater treatment lagoons shall submit the above annual report only when sludge or biosolids are removed from the lagoon during the report period or when the lagoon is closed.
3. Report Forms. The annual report shall be submitted on report forms provided by the department or equivalent forms approved by the department.
4. Report shall be submitted as follows:
   Major facilities (those serving 10,000 persons or 1 million gallons per day) shall report to both the department and EPA. Other facilities need to report only to the department. Reports shall be submitted to the addresses listed as follows:

   DNR regional office listed in your permit
   (See cover letter of permit)

   EPA Region VII
   Water Compliance Branch (WACM)
   Sludge Coordinator
   726 Minnesota Ave.
   Kansas City, KS 66101

5. Annual Report Contents. The annual report shall include the following:
   a. Sludge/biosolids testing performed. Include a copy or summary of all test results, even if not required by this permit.
   b. Sludge or Biosolids quantity shall be reported as dry tons for quantity generated by the wastewater treatment facility, the quantity stored on site at end of year, and the quantity used or disposed.
   c. Gallons and % solids data used to calculate the dry ton amounts.
   d. Description of any unusual operating conditions.
   e. Final disposal method, dates, and location, and person responsible for hauling and disposal.
      (1) This must include the name, address and permit number for the hauler and the sludge facility. If hauled to a municipal wastewater treatment facility, sanitary landfill, or other approved treatment facility, give the name and permit number of that facility.
      (2) Include a description of the type of hauling equipment used and the capacity in tons, gallons, or cubic feet.
   f. Contract Hauler Activities.
      If contract hauler, provide a copy of a signed contract or billing receipts from the contractor. Permittee shall require the contractor to supply information required under this permit for which the contractor is responsible. The permittee shall submit a signed statement from the contractor that he has complied with the standards contained in this permit, unless the contract hauler has a separate sludge disposal or biosolids use permit.
   g. Land Application Sites.
      (1) Report the location of each application site, the annual and cumulative dry tons/acre for each site, and the landowners name and address. The location for each spreading site shall be given as legal description for nearest 3, 3, Section, Township, Range, and County, or as latitude and longitude.
      (2) If biosolids application exceeds 2 dry tons/acre/year, report biosolids nitrogen results. Plant Available Nitrogen (PAN) in pounds/acre, crop nitrogen requirement, available nitrogen in the soil prior to biosolids application, and PAN calculations for each site.
      (3) If the ALow Metals≅ criteria is exceeded, report the annual and cumulative pollutant loading rates in pounds per acre for each applicable pollutant, and report the percent of cumulative loading which has been reached at each site.
      (4) Report the method used for compliance with pathogen and vector attraction requirements.
      (5) Report soil test results for pH, CEC, and phosphorus. If none was tested during the year, report the last date when tested and results.

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MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM - WATER POLLUTION BRANCH

DISCHARGE MONITORING REPORT FOR STORM WATER AND WASTE WATER DISCHARGES UNDER GENERAL PERMIT

THIS REPORT COVERS THE PERIOD FROM (MONTH/YEAR)	THROUGH (MONTH/YEAR)
/	/

PART I: FACILITY INFORMATION

FACILITY NAME	COUNTY	PERMIT #
		MO-

PART II: MONITORING INFORMATION

SAMPLES COLLECTED BY	PHONE NUMBER	NUMBER OF SAMPLES	LABORATORY (NAME AND ADDRESS)
FIRM		ANALYSIS PERFORMED BY: PLEASE TYPE OR PRINT	

PART III: ANALYTICAL RESULTS

OUTFALL #		001		002		003				SAMPLE TYPE	ANALYTICAL METHOD
DATE AND TIME OF SAMPLE COLLECTION		DATE	ANALYSIS DATE	DATE	ANALYSIS DATE	DATE	ANALYSIS DATE	DATE	ANALYSIS DATE		
Parameter	Unit	TIME		TIME		TIME		TIME			
Rainfall Amount	in.										
Flow	MGD										
pH	Units										
Settleable Solids	mL/L/hr										
Oil & Grease	mg/L										
Other (list)											

NAME OF INDIVIDUAL PREPARING REPORT (PLEASE TYPE OR PRINT)	FIRM
SIGNATURE OF INDIVIDUAL PREPARING REPORT	PHONE NUMBER
REPORT APPROVED BY OWNER	PHONE NUMBER / DATE

MO 780-1560 (7-04)

INSTRUCTIONS

Report should be typed or neatly printed.

PART I:

1. Fill in facility information and permit number.

PART II:

2. Give the name of the individual who actually collected the sample. Indicate whether samples were collected by owner or by personnel of the lab performing the analysis. Indicate the number of samples taken.

PART III:

3. Report results for those parameters listed in Part A of your permit. Write N.A. (Not Applicable) if your permit does not require one of the pre-printed parameters. List under "Other" any additional sampling results required by your permit.

   If a storm water sample, indicate the amount of rainfall for the rainfall event in which the sample was taken and write the source of this data (e.g., rain gauge, weather data, etc.) under "Analytical Method" column. If not a storm water discharge, write N.A. in the "Rainfall Amount" column.

4. File a report even if no discharge occurred during the monitoring period. Complete the Facility Information section, write "ND" (no discharge) in the Flow column in Part III, and sign the report. NOTE: If a discharge of storm water occurs at any time during the monitoring period, it must be reported.

5. Record Sample Types as G, C, M or E. G = grab, C = composite, M = measured, and E = estimate. See permit for type of sample required for each parameter.

6. Narrative monitoring requirements for "chemicals stored outside", "soluble bulk materials stored outside", etc. are required only if specifically requested by the department in written form. If you have questions about these requirements, contact the Water Protection Program.

7. Add pages if reporting for additional outfalls or sampling dates is needed.

8. Report must be signed by owner and individual preparing the report. Please provide a phone number where each can be reached. Print the name of the individual who prepared the report.

9. Mail to the appropriate DNR regional office as noted in your permit cover letter.

Note: This form is a universal reporting form for General Permits for storm water and waste water discharges with a permit number beginning MO-R or MO-G. Industries and individuals who have report forms designed for their specific needs may substitute their forms. A suitable substitute must meet the following specifications:
(a) Form must be 8½" by 11".
(b) Report must show all of the information indicated on the standard form.

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Attachment 5

Procedures

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SECONDARY CONTAINMENT (BURRITO) WATER TRANSFER AND MEASUREMENT PROCEDURE

STEP	ACTION
1	Place a 55 gallon barrel adjacent to the sump cover, measure the static water level and record data on the LCRS Roundsheet.
2	Connect the inlet tubes from a dual head peristaltic pump to the burrito dip tubes.
3	Place the peristaltic outlet tubes into the barrel.
	NOTE: Secure hoses to barrel to prevent them from falling out.
4	Pump the burrito until the drum is full, measure the water in the barrel and record the reading on the LCRS round sheet.
5	Place a submersible pump in the barrel and pump the burrito water to the sump.
6	Remove the sump pump.
7	Repeat steps 3 through 6 until the pump no longer is pumping water.
8	Remove and store equipment.
9	Total and record the volumes and complete the LCRS Round Sheet

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LEACHATE TREATMENT AND HAULING PROCEDURE

Background: Water in the sump must be removed on a schedule that will prevent the water from submerging sensitive equipment or overflowing the sump. The water will be vacuumed from the sump or inside storage tanks using a vacuum truck and hauled to Metropolitan St. Louis Sewer District (MSD) Bissell Point Facility. The hauling is performed by a specialty subcontractor. Currently, the leachate in the sump is hauled to MSD approximately once every 4 or 5 months. However, the daily accumulation is expected to continually decrease over time, decreasing the frequency of hauling to MSD.

CAUTION
The maximum level of water in the LCRS is 47 inches. If the level exceeds 53 inches, electrical equipment will be submerged and may be damaged.

NOTE: The maximum amount of water that can be hauled to MSD monthly is 25,000 gallons. This limit has been set by MSD.

The following steps shall be followed to treat and transfer LCRS water to the MSD Bissell Point Facility.

LEACHATE TREATMENT PROCEDURE

STEP	ACTION
1	Obtain a compressor from a rental company.
2	Connect the hoses from the sump to the diaphragm pump, from the pump to the filter inlet, from the filter outlet to the ion exchange inlet and from the ion exchange outlet to the effluent tank inlet. **Caution: Ensure fittings are locked and pinned to prevent leaks.**
3	Open all the valves on the system with the Ion Exchange Column outlet valve slightly opened.
4	Record the initial flowmeter reading on the LCRS round sheet.
5	Record the east and west secondary and primary sump level readings from the panel onto the LCRS round sheet.
6	Measure the burrito and sump static water level and record it on the LCRS Round Sheet.
7	Connect the air hose to the compressor and diaphragm pump. **Caution: Ensure that the connections are pinned to prevent accidental disconnection.**
8	Check that the air supply valves on the pump and the compressor are closed
9	Start the compressor according to the instructions for the compressor.
10	Open the air supply valve on the compressor fully.
11	Open the air supply valve on the pump slightly and adjust the air valve (on the pump) and the outlet valve of the Ion Exchange Column to allow approximately 25 gpm flow with the water pressure fluctuating between 10-30 psi on the filter vessel gages.

STEP	ACTION
12	Bleed air from the top valves of the filters and the Ion Exchange Column at the start of pumping and periodically afterwards
13	Monitor the filling of the main tank to avoid overflow
14	During treatment collect samples required by MSD or this plan in accordance with approved LTS&M Plan sampling procedure.
15	Pump and treat only until the sump water level reaches 16.0 inches (Below this level may introduce air into the system.)
16	When the main tank is full, turn the air compressor off and close the valve to the large effluent tank inlet, and the Ion Exchange outlet valve
17	Disconnect the Ion Exchange outlet hose from the effluent tank and place it securely in the smaller effluent tank **Caution: Disconnect slowly to avoid excess splashing.**
18	Open the outlet valve from the Ion Exchange Column and resume treatment as above until the smaller effluent tank is filled or the minimum sump level is reached
19	Stop treatment by closing butterfly valve to the sump
20	Loosen the camlock fitting at the sump connection outside the building and pump water out of the sump line, pump, and filter vessels
21	Shut the compressor down
22	Close all water valves
23	Record the final flow meter reading on the LCRS Round Sheet
24	Remove the airline and store it in the LCRS building
25	Disconnect the hoses while minimizing water release
26	Store the hoses in the LCRS building
27	Cap or plug open fitting ends
28	Drain the pump and store it in the LCRS building
29	Complete the LCRS round sheet
30	Return the compressor to the rental company after refueling it

HAULING WHILE TREATING LEACHATE PROCEDURE

NOTE: If, in the future, MSD will accept leachate without pretreatment the following procedure will be followed.

STEP	ACTION
1	Hauling takes place when the tanks are full and leachate is again being treated. The first truckload is hauled from the large tank before treatment starts to allow room for treated leachate.
2	Mark the water level on the sight tube of the large tank before removal begins.
3	The vacuum truck operator will attach the vacuum line to the large effluent tank and to the truck, open the outlet valve from the large tank and begin removal.
4	When the truck is full mark the water level on the sight tube.
5	If water removal takes place during treatment account for water added during treatment and record the load volume in the LCRS Round Sheet.
6	When removal is complete, the driver will close the outlet valve from the large effluent tank and (typically) leave the vacuum hose in place for subsequent loads. **Note: Place hose to prevent escape of water.**
7	When the last load is removed from the large effluent tank the driver will close the outlet valve from the tank and remove the hose allowing the vacuum to remove water from the hose.
8	The driver will then use additional hose to reach the smaller tank and vacuum it dry. **Caution: Make sure hose is held in place to prevent it from falling out of the tank.**
9	The driver will complete the manifest for each load and sign it.
10	An operator will sign manifest and keep the generator copy.
11	Normally about 6 loads are required for each treatment session (tanks and treated water). If the 6th load is less than 1500 gallons, hold water for next event.

HAULING DIRECTLY FROM THE SUMP PROCEDURE

STEP	ACTION
1	Record the flow meter reading on the LCRS Round Sheet
2	Record the sump water level from the control cabinet on the LCRS Round Sheet
3	Record east and west secondary leachate collection system counts on the LCRS Round Sheet
4	The truck driver will connect the vacuum truck suction line to the 3 inch camlock fitting on the south side of the LCRS Building **Caution: Ensure fittings are locked and pinned to prevent leaks.**
5	The vacuum truck driver will begin pulling a vacuum on the sump dip tube
6	Slowly open the sump valve
7	Monitor the flow at the flow meter
8	Request that the driver load the truck to near capacity
9	Ensure that a sample is collected for required MSD parameters if necessary
10	As the vacuum truck nears its capacity, slowly close the sump valve
11	The truck driver will close the inlet valve on the vacuum truck but maintain a vacuum within the tank truck
12	The driver will loosen the camlock fitting at the LCRS building connection and slowly pull the hose away from the LCRS building connection while opening the vacuum truck inlet valve. This allows most of the water in the hose and in the building piping to be vacuumed into the truck
13	The driver will close the vacuum truck inlet valve and shut off the vacuum truck pump
14	The driver will remove the hose from the vacuum truck and cap the vacuum truck inlet connection
15	Plug the sump line at the building
16	Record the flow meter reading
17	Complete the shipping manifest required by MSD
18	Keep the generator copy of the shipping manifest and ensure the driver keeps the shipping manifest in the truck
19	Repeat steps 4 through 18 until the desired sump level is reached (under these circumstances the sump may be pumped dry).
20	Record the final sump level on the LCRS Round Sheet
21	Record the final flow meter reading on the LCRS Round Sheet
22	Complete the LCRS round sheet

DISCHARGE TO MISSOURI RIVER (NPDES OUTFALL 007) PROCEDURE

NOTE: Before pumping water through the pipeline to the Missouri River, the NPDES permit must be reviewed to ensure that all criteria including sampling, notifications, and treatment requirements are met.

Background Information:

The pipeline to the Missouri River is an HDPE pipeline with a nominal maximum working pressure of 100 psi. The maximum flow rate through the pipe has been established as 400 gpm due to a 3 inch diameter constriction at a manhole located at Station 9+75. See Drawing 0284D-CP-5112 (this drawing is located at the Weldon Spring Site).

Notable features and facts on the pipeline are:

1) The pipeline is 4 inches in diameter from the Train 3 building to the gate valve located at the South end of the WSSRAP property. (See Drawing 0284D-CP-5124) (this drawing is located at the Weldon Spring Site). At this location, the pipe diameter increases to 6 inches.

2) There is a gate valve that must be opened for the pipeline to flow. The valve is located at the South end of the WSSRAP Property. See Drawing 0284D-CP-5124 (this drawing is located at the Weldon Spring Site).

3) A portion of the pipeline was placed on the surface of the ground and then covered with several feet of soil, as indicated on Drawing 0284D-CP-5123 (this drawing is located at the Weldon Spring Site). The earth mound is located along the Hamburg Hike and Bike Trail. The pipeline was placed on the ground and covered at this location because the line crossed a wooden TNT wastewater line that was thought to be potentially explosive. The TNT line was removed from beneath the water line by the Army, as part of the Weldon Spring Ordnance Works remedial activities.

4) Within the earth mound a manhole containing a vacuum breaker was constructed. The vacuum breaker was disabled, due to repeated problems. Therefore, it is imperative that vacuum relief be provided inside the LCRS Building.

5) The 6-inch pipe reduces to a 3-inch pipe (see Drawing 0284D-CP-5112) (this drawing is located at the Weldon Spring Site). This was to improve performance of a flow meter that has been removed. Debris that enters the line may bridge this constriction.

6) The outfall structure for the pipeline is located near the Hamburg Quarry. The structure should be inspected for damage and vandalism before it is used. Signs indicating the purpose of the pipe are present and face the River.

STEP	ACTION
1	Confirm that all NPDES requirements for discharge to the river have been met.
2	Open the gate valve located at the south end of the WSSRAP property.
3	Check the vacuum breaker valve in Manhole #4, along the Hamburg Trail, to ensure that it is valved closed.
4	Walk or drive the line to ensure that excavations, vandalism and/or flooding have not affected the system.
5	Provide vacuum relief for the pipeline at the connection in the Northeast corner of the Train 3 Building.
6	Provide flow measuring capability at the pipeline connection in the Northeast corner of the Train 3 Building. (Vacuum relief should be downstream of the flow meter).
7	Connect the pumping system to the flowmeter.
8	Begin pumping to the river at a flow rate below 100 gpm.
9	Over a period of 10 minutes, the flow rate may be ramped up to the maximum rate of 400 gpm. **Caution: Do not exceed 100 psi working pressure.**
10	Walk or drive the line to check for problems.

PROCEDURE FOR SHUTTING DOWN FLOW TO THE MISSOURI RIVER:

STEP	ACTION
1	Shut off the pumping system.
2	Close the gate valve located at the south end of the Weldon Spring Site property and the gate valve at the outlet of the effluent tank.
3	Record the final totalizer flow meter reading.

PROCEDURE FOR PNEUMATIC BLOW DOWN OF THE PIPELINE:

For long term shutdown of the pipeline, it may be desired that the line be blown dry with an air compressor.

The following steps have proven to be effective and successful in blowing down the pipeline.

STEP	ACTION
1	Follow all the steps to discharge water to the Missouri River listed in the section above.
2	Station an individual at the outfall to the river if the discharge is not covered with river water. This individual must be in radio or telephone contact with personnel in the LCRS Building. He/she is responsible for keeping the public away from the connection during blow down and for ordering a shut down of the operation if the action at the river is too violent. **Caution: Do not stand downstream of the discharge and no closer than 50 feet to the discharge.**
3	Connect a pressure-regulated airline to the pipeline flange fitting in the LCRS Building. **Caution: Ensure that the connection is properly pinned to prevent accidental disconnection.**
4	Slowly apply pressurized air to the line until 25 psi is reached. Maintain this pressure for a minimum of 10 minutes.
5	Over a 10 minute period, increase air pressure at the head of the line to 50 psi. Reduce pressure if violent air or water surging occurs at the discharge to the river.
6	Maintain 50 psi air pressure at the head of the line until satisfied that the line is as clear as desired. A minimum of 20 minutes at 50 psi is recommended to clear the line of most of the water.

CALIBRATION PROCEDURE FOR LS-1/LT-1/LI-1

Allow the LCRS sump to fill to at least 40 inches, as measured manually, at the sump. The greater the depth of the water, the more accurate the calibration will be. However, do not allow the sump to exceed the maximum depth of 50 inches, as damage to instrumentation will result. The depth of the sump as measured from the top of the manway ring is 189.5 inches. Because the top of the manway ring is not perfectly level, measurements shall be taken at the North side of the ring, adjacent to the West ladder rail.

STEP	ACTION
1	Subtract the distance from the top of the manway ring to the sump water level from 189.5 inches to obtain the height of the water level in the sump. (189.5 inches – distance between top of manway ring and top of water). **Note: Secure glasses and remove hats and items from shirt pockets to avoid dropping them in the sump.** **Caution: Use proper lifting technique to remove sump cover.**
2	Remove the cover from the LT 1 junction box by turning the cover counter clockwise. Once the cover is completely unscrewed, lift straight up on the cover to ensure that LT 1 is not damaged. **Caution: Remove items from shirt pockets, hats, etc. to prevent them from falling into the cabinet and damaging components.**
3	Follow the directions in the LT 1 O&M Manual to program the measurement taken in Step 1 into LT 1 as the new high level.
4	Pump the LCRS sump down to between 10 and 15 inches. This can be done over one or two days.
5	Measure the sump manually, as described above.
6	Program the value determined in Step 5 into LT 1 as the low point calibration.
7	Insert a loop calibrator into the LT 1 4-to-20 milliamp loop.
8	Follow the directions in the LT 1 O&M Manual to drive the loop from 4-to-20 milliamps.
9	Use the loop calibrator to check the current flow through the LT 1 4-to-20 milliamp loop. At 4 milliamps, the red LT 1 LED indicator should read 4.7, and at 20 milliamps, the LED indicator should read 53.0.
10	Likewise, at 4 milliamps, Chart Recorder CR 1 should read 4.7, and at 20 milliamps, Chart Recorder CR 2 should read 53.0.
11	Follow the O&M Manual directions to calibrate the LED indicator and Chart Recorder CR 1 so that these instruments match the LCD indication on LT 1.

NOTE: The accuracy of the sensor probe in the sump diminishes below 10 inches, so lower levels are not recommended. The minimum indication programmed into LT 1 is 4.7. Even if no water is in the sump, LT 1 will give this indication. This was done because a portion of the bottom portion of the probe must be covered before the probe can begin to give an indication

GENERAL ROUNDSHEET COMPLETION FOR LCRS FACILITY

STEP	ACTION
1	Initiate an LCRS round sheet.
2	Check the Methane J Vent for obstructions.
3	Operate the methane ventilation unit (fan) for approximately 5 minutes.
4	Check the sump manhole cover for integrity. Ensure that it is locked.
5	Open the sump manhole cover and look inside for any obvious problems.
6	Check for indications that the sump secondary solenoid valve is leaking. Listen for dripping water and look for rings on the surface of the water in the sump.
7	Check the LCRS sump area for proper labeling, signs of vandalism, loose or missing bolts, no smoking signs, etc.
8	Enter the LCRS Building.
9	Operate and log the status of the building fans.
10	Open the LCRS monitoring cabinet.
11	Log the values indicated by LT 1 and secondary leachate counters Leachate Counter East (LCE) and Leachate Counter West (LCW).
12	If the level indicated by LT 1 is forty inches or greater, schedule an LCRS pump out as necessary to keep the water level in the sump from exceeding 47 inches.
13	Open the inner door of the LCRS cabinet and check for signs of problems.
14	Check the breakers in the breaker panel and note any that are tripped or in the off position in the comments section of the round sheets (spare breakers excluded).
15	Close the breaker panel door, the inner door and the outer door of the LCRS monitoring cabinet.
16	Tour the building. Check for signs of electrical problems, leaks, storm damage, vandalism, animal intrusion and proper operation of the electric heaters.

LCRS Inspection Form

Date:_____

LCRS SUMP – LT-1	
INITIAL SUMP LEVEL–inches(gallons)	FINAL SUMP LEVEL–inches(gallons)

EAST SECONDARY SYSTEM			
Previous 403 Counter Date:	Current 403 Counter	Number of Counts	Total Gallons Counts X 0.58

WEST SECONDARY SYSTEM			
Previous 401 Counter Date:	Current 401 Counter	Number of Counts	Total Gallons Counts X 0.5

Notes/Truckload Information

BURRITO – SECONDARY CONTAINMENT		PURGE WATER
Initial Static Water Level (inches)	Volume Pumped to Sump Gallons	Transferred to Sump Gallons

VOLUME OF LEACHATE TREATED	
Final Flow Meter Reading	
Initial Flow Meter Reading	
Total Gallons	

SAMPLES COLLECTED (TIME)		
LW-DC10 (Leachate)	LW-DC11 (After Filter)	LW-DC12 (Pre-Treated)

Total Volume Shipped to MSD:_____

Building/Sump Ventilation Status:_____

COMMENTS:

SIGNED:_____

Appendix J

LCRS/Train 3 Treatment Contingency Plan

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J1.0 Contingency Plan Overview

J1.1 Background

The disposal cell at the Weldon Spring Site generates approximately 114 gallons of leachate per day, as of December 2007. The LCRS sump capacity is approximately 11,000 gallons, or 96 days of storage at the current flow rate. The uranium activity in the leachate is currently below the discharge goal stated in the NPDES permit; however, the leachate is currently being hauled to the Metropolitan St. Louis Sewer District (MSD) Bissell Point Treatment Plant after being pretreated at the LCRS facility to reduce the uranium concentration. The leachate is hauled by a commercial hauler for disposal and final treatment under an approval granted to DOE on December 21, 2001, by the MSD. The original agreement expired on December 21, 2006 and was renewed with an expiration date of December 14, 2011.

The contingency plan for managing leachate is to use the dedicated pipeline to the NPDES permitted outfall at the Missouri River. The original plan to manage leachate was to treat the leachate on-site and then discharge the treated leachate through a dedicated pipeline to an NPDES permitted outfall at the Missouri River. This original plan was required because of Manganese concentrations above the NPDES permit limits. However, during final construction of the LCRS facility the MSD approved disposal of the leachate at their facility and construction was suspended on the then LCRS (formerly known as Train 3 treatment) facility. A metal industrial building was already under construction, and the major equipment required for the treatment process had already been purchased. The DOE decided to complete the building construction and store or surplus the process equipment that remained. The original contingency plan was to treat the leachate in the event that the primary leachate management option (i.e., hauling to the MSD treatment facility) was no longer available. The objective was to use as much of the existing equipment as possible in a configuration that would support a rapid start-up, if needed.

Prior to August 2004, the leachate was hauled to MSD without any pretreatment requirements. Beginning in September 2004, the Weldon Spring Site initiated a pretreatment process to reduce the uranium concentration in the leachate to below 30 µg/L. This was in order to comply with a new MSD requirement for the uranium concentration in the leachate to be below drinking water standards prior to acceptance. The treatment process includes filtration and ion exchange. The process successfully reduces uranium to below the MSD acceptance criteria. The Weldon Spring Site anticipates continuing to pretreat the leachate until uranium concentrations consistently fall below 20 pCi/L for shipment to MSD, should the contingency plan be implemented the pretreatment of leachate would continue to be required by the NPDES permit.

J1.2 Current State

The LCRS support building is completed and operational. The building is heated, and roof-mounted ventilation fans are installed and operational. There is adequate electrical service to support all operational needs. No potable water is supplied to the building. The building currently houses electrical equipment to support the LCRS operation, four fiberglass reinforced plastic (FRP) tanks (1,250, 4,500, 4,500, and 7,600 gallon), two ion exchange vessels, four

cartridge filter housings, and miscellaneous related equipment. The tanks (with the exception of the 1,250 gallon FRP tank) were anchored in their permanent locations during the building construction. The ion exchange vessels and cartridge filter housings were recovered from other treatment processes that were used at WSS and are in good condition. Ion exchange resin and filter cartridges are stocked in the building. There is no compressed air supply in the building (an air compressor is rented to provide an air supply when needed). One Ion Exchange vessel and two filter housings have been used to assemble the current treatment system as described in section J1.1 and operational procedures are detailed in Appendix I.

The building was modified to facilitate haul truck loading of leachate by installing piping that penetrates the south wall and is equipped with a quick disconnect fitting that is compatible with the leachate haulers hoses. This piping connects the leachate influent piping located inside the building to the exterior of the building.

The building is visited routinely by Weldon Spring staff currently pump water biweekly from the burrito. Purge water generated from certain monitoring wells is passed through granular activated carbon and then transferred to the leachate sump after treatment for ultimate disposal at MSDs facility.

J1.3 Operational Philosophy

The original treatment process for the leachate was designed for removal of manganese and uranium prior to discharge to waters of the state under an NPDES permit. With leachate flows, manganese and uranium levels rapidly declining the option to haul the leachate to MSD was selected and continues to be used. The current contingency plan, should MSD no longer be willing to accept the leachate, is to discharge to the Missouri River, through the existing pipeline, under the NPDES permit. Because the leachate flows and manganese and uranium levels have been greatly reduced the treatment used would be the currently used pretreatment system that consists of a two unit filter, an ion exchange unit and effluent tanks. If the contingency plan is implemented, and uranium levels of untreated leachate are consistently under the permitted limit, consideration may be given to requesting that the permit be revised to allow bypassing of the ion exchange unit.

J1.4 Process Overview

The treatment process will be accomplished by pumping leachate from the sump with an air-driven diaphragm pump. The leachate will be pumped through the two-unit filter followed by the ion exchange unit and into the storage tank in one continuous process. This equipment is currently set up and operating in this scenario so there would be no setup required for the treatment. The treated leachate would then be discharged through the effluent pipeline to the Missouri River in accordance with the NPDES permit. Connection of the effluent line to the effluent storage tank will be required.

J1.5 Process Startup

Because the treatment system is currently set up and in operation the only task requiring completion is connection to the effluent pipeline to allow discharge to the Missouri River. Piping to connect the effluent tank to the effluent pipe must be installed. A flow meter may be required to measure discharge if measuring tank volumes is not sufficient. A pump may also be required if the tank will not gravity drain. Appendix I contains the procedure for operation of the existing treatment plant.

J1.6 Transfer of Treated Leachate to the Missouri River (Tentative)

The procedure for pumping water to the Missouri River is located in Appendix I – Procedures.

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Appendix K

Disposal Cell Groundwater Monitoring Plan

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K1.0 Introduction

K1.1 Scope

This plan describes the disposal cell groundwater monitoring program for the U.S. Department of Energy's (DOE) Weldon Spring Site, which is being conducted according to the substantive requirements of 40 CFR 264, Subpart F, and 10 CSR 25-7.264(2)(F). This plan includes a description of the sampling locations, frequency, parameters, and associated analysis and sampling procedures. A discussion about the data evaluation and the development of the evaluation approach are also included.

K1.2 Purpose

The purpose of this plan is to summarize the disposal cell groundwater monitoring program. The following specific elements are addressed: the design of the monitoring network; the results of baseline monitoring; the long-term monitoring program, which includes detection monitoring, compliance monitoring, and corrective action; and data review and reporting.

K1.3 Applicable or Relevant and Appropriate Requirements

In the *Record of Decision for the Chemical Plant Area of the Weldon Spring Site* (DOE 1993), the substantive requirements of 40 CFR 264, Subpart F of the Resource Conservation and Recovery Act (RCRA), and 10 CSR 25-7.264(2)(F) of the Missouri Hazardous Waste Regulations, were identified as applicable or relevant and appropriate requirements (ARARs) for the selected remedy (i.e., construction and operation of an engineered disposal cell). Table K−1 provides a summary of these ARARs and indicates the sections of this plan that discuss the strategy for meeting each requirement. In addition to these ARARs, relevant portions of 10 CSR 80-3.010(8) were also used as guidance in developing this monitoring plan.

K1.4 Background

Previously, this plan was documented in the *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan*, Revision 2 (DOE 2004). That revision will be superceded by this appendix to the LTS&M Plan. Any future revisions to the monitoring program for the disposal cell will be documented in this appendix.

Groundwater at the chemical plant is contaminated with trichloroethylene (TCE), nitrate, uranium, and nitroaromatic compounds. The groundwater contamination originated with the Raffinate Pits and other source areas of the chemical plant site and former ordnance works area, that have been removed. Contamination is primarily limited to the weathered portion of the uppermost bedrock unit, the Burlington-Keokuk Limestone. Nitroaromatic compounds are present east and north of the disposal cell and is elevated in several of the disposal cell monitoring wells. Nitrate is present north and west of the disposal cell and is elevated in several of the disposal cell monitoring wells. Uranium is present southwest of the disposal cell; however, elevated levels are not observed in any of the disposal cell monitoring wells. TCE is also present southwest of the disposal cell, but elevated levels are not observed in any of the disposal cell monitoring wells.

Table K–1. ARARs Summary for Disposal Cell Groundwater Monitoring

Summary of Regulation	Pertinent Section of Monitoring Plan
40 CFR 264.90 Applicability Specifies the applicability requirements and exemptions for owners or operators of facilities that treat, store, or dispose of hazardous waste.	Section K1.3, Applicable or Relevant and Appropriate Requirements
40 CFR 264.91 Required Programs Specifies the criteria for determining which monitoring and response program (i.e., detection monitoring, compliance monitoring, or corrective action) should be instituted at a regulated facility.	Section K4.0, Detection Monitoring Program Section K5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.92 Groundwater Protection Standard Requires compliance with certain conditions when hazardous constituents are detected in groundwater underlying a regulated unit.	Section K5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.93 Hazardous Constituents Specifies the criteria for defining "hazardous constituents" to which the groundwater protection standard applies.	Section K5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.94 Concentration Limits Specifies the criteria for establishing concentration limits for hazardous constituents detected in the groundwater underlying a regulated unit.	Section K3.4.2, Revised Baseline Tolerance Limits
40 CFR 264.95 Point Of Compliance Defines the point of compliance at which the groundwater protection standard applies and monitoring must be conducted.	Section K2.2, Groundwater Monitoring Wells
40 CFR 264.96 Compliance Period Defines the compliance period during which the groundwater protection standard applies.	Section K5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.97 General Groundwater Monitoring Requirements Specifies general requirements for the groundwater monitoring program, such as well installation, sampling and analysis procedures, determination of groundwater surface elevation, and statistical methods to be used.	Section K2.0, Monitoring Network Design Section K3.4.2, Revised Baseline Tolerance Limits Section K4.4, Groundwater Elevation Measurements Section K6.0, Quality Control
40 CFR 264.98 Detection Monitoring Program Specifies requirements for detection monitoring programs, including monitoring parameters, sampling frequency, determination of groundwater flow, determination of statistically significant evidence of contamination, and required response to positive evidence of contamination.	Section K4.0, Detection Monitoring Program
40 CFR 264.99 Compliance Monitoring Program Specifies requirements for compliance monitoring programs, including monitoring parameters, sampling frequency, determination of groundwater flow, determination of statistically significant evidence of contamination, and required response to exceedance of the groundwater protection standard.	Section K5.0, Compliance Monitoring and Corrective Action Programs
40 CFR 264.100 Corrective Action Specifies requirements for corrective actions to be instituted to ensure compliance with the groundwater protection standard.	Section K5.0, Compliance Monitoring and Corrective Action Programs
10 CSR 25-7.264(2)(F) Releases From Solid Waste Management Units Specifies that efforts made to monitor groundwater or implement corrective action be documented, and that daily precipitation be measured. Also requires a surface water monitoring program to represent the quality of surface water hydrologically downgradient of the facility.	Section K2.3, Surface Water Monitoring Location Section K4.5, Precipitation Data Section K4.8, Detection Monitoring Reporting Section K5.0, Compliance Monitoring and Corrective Action Programs

K2.0 Monitoring Network Design

Groundwater monitoring requirements under 40 CFR 264, Subpart F, of RCRA specify that the monitoring system for a regulated unit must "consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that: (1) represent the quality of background water that has not been affected by leakage from the regulated unit…; (2) represent the quality of groundwater passing the point of compliance; and (3) allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer." The disposal cell monitoring network at the Weldon Spring Site has been designed to meet these requirements, as described below.

K2.1 Basis of Design

The following criteria constitute the basis for design of the disposal cell groundwater monitoring network at the Weldon Spring Site:

- Regulatory requirements,
- Potentiometric surface of the shallow groundwater beneath the disposal cell,
- Design aspects of the disposal cell, and
- Physical site conditions.

The Subpart F regulations of RCRA specify that groundwater monitoring must be conducted at the point of compliance, which consists of a vertical surface that is located hydraulically downgradient of the waste management area and extends down into the uppermost aquifer. The RCRA regulations provide flexibility regarding the number, spacing, and depths of monitoring wells; however, the Missouri Sanitary Landfill regulations in 10 CSR 80-3.010, specify a minimum of one upgradient and three downgradient wells for landfills. The disposal cell network was designed to incorporate one upgradient and four downgradient wells, allowing for the possibility that wells could be added or removed as necessary. Since the original network was installed, two wells have been added and two have been eliminated. Thus, the current network still consists of one upgradient well and four downgradient wells. The location of these wells is discussed in Section K2.2.

To supplement groundwater monitoring, Missouri Hazardous Waste regulations in 10 CSR 25-7.264(2)(F) require that a surface water component be included in monitoring releases from waste management units. The surface water monitoring system must "consist of a sufficient number of points at appropriate locations to yield surface water samples that: (a) represent the quality of background surface water that has not been affected by any contamination from the facility…; and (b) represent the quality of surface water hydrologically downgradient of the facility or regulated units." The surface water monitoring location incorporated in this plan is discussed in Section K2.3.

The potentiometric surface of the shallow groundwater indicates that the flow gradient beneath the disposal cell is generally to the north and northwest, as shown in Figure K−1. The general direction of groundwater flow has remained relatively unchanged since the cell monitoring system was designed, throughout remediation of the site and construction of the disposal cell.

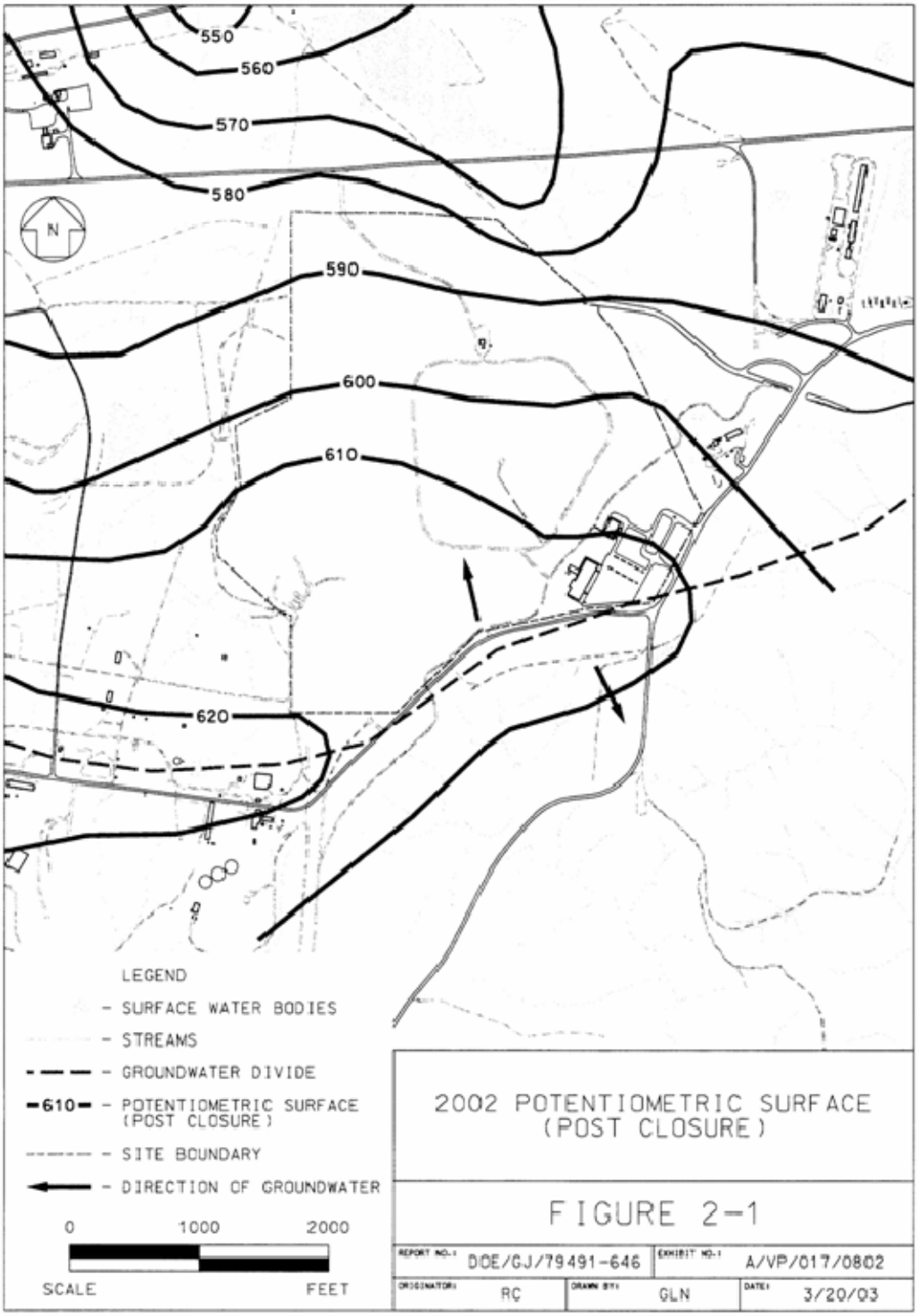

Figure K–1. 2002 Potentiometric Surface (Post Closure)

However, since construction of the disposal cell and previous remedial activities, the groundwater elevation has decreased due to dewatering of ponds/basins and diversion of surface water flow and reduced infiltration (recharge) to the shallow aquifer.

Design aspects of the disposal cell that were considered in determining the original locations of the monitoring wells included the locations of the clean fill dikes and leachate collection sump, the 1% to 1.5% northward slope along the base of the cell, and the double liner/leachate collection system. Since the monitoring network was installed while physical site conditions were undergoing frequent change due to remediation and construction activities, existing and planned locations of excavations, roads, structures, surface water bodies, staging areas, and the footprint of the disposal cell were also considered to ensure availability and access to the planned monitoring locations.

K2.2 Groundwater Monitoring Wells

The original disposal cell monitoring network was established in 1996. It included five wells: one upgradient well (MW-2048) and four downgradient wells (MW-2032, MW-2045, MW-2046, and MW-2047). The well locations, which are shown in Figure K−2, were chosen based on the criteria discussed above. Well MW-2048 was installed south of the cell to monitor water quality upgradient of the disposal cell. Wells MW-2045, MW-2046, and MW-2047 were installed northeast, north, and northwest of the cell, respectively, to monitor potential groundwater impacts downgradient of the disposal cell. Well MW-2032 was an existing well that was retained to monitor potential groundwater impacts downgradient (i.e., north) of the leachate sump. Figure K−3 provides a cross-sectional view of the monitoring system, in relation to the disposal cell and leachate sump.

While the original monitoring network consisted of five wells, it was the intent of the plan to provide flexibility for reacting to the dynamics of the system being monitored. The heterogeneous nature of the fractured bedrock aquifer and the complexities associated with monitoring a previously contaminated groundwater system created uncertainty in the actual performance of the proposed monitoring wells. Additional wells were to be incorporated into the network on an as-needed basis during both the active life and the post-closure period to replace or supplement data from poorly performing wells. Thus, since MW-2045 demonstrated consistently poor hydraulic performance and yielded widely variable analytical data, a fifth downgradient well (MW-2051) was installed in 2001 northeast of the disposal cell, as shown in Figure K–2. Under the present revision of this plan, MW-2051 replaces MW-2045 as the monitoring location for the northeast side of the disposal cell. Monitoring well MW-2051 exhibits higher hydraulic conductivities and will better represent the shallow groundwater system than MW-2045.

The original upgradient well, MW-2048 was damaged during construction activities in 2001. This well was determined to be damaged beyond repair, which led to its abandonment and installation of a replacement well shortly thereafter. The new well, MW-2055, is located approximately 20 feet upgradient (i.e., south) of MW-2048 and has replaced it as the upgradient monitoring well (see Figure K–2). Data review conducted for both monitoring wells indicated comparable upgradient water quality. No polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs) or nitroaromatic compounds were detected at either location. Concentration ranges of anions, metals, radiological and indicator parameters were similar,

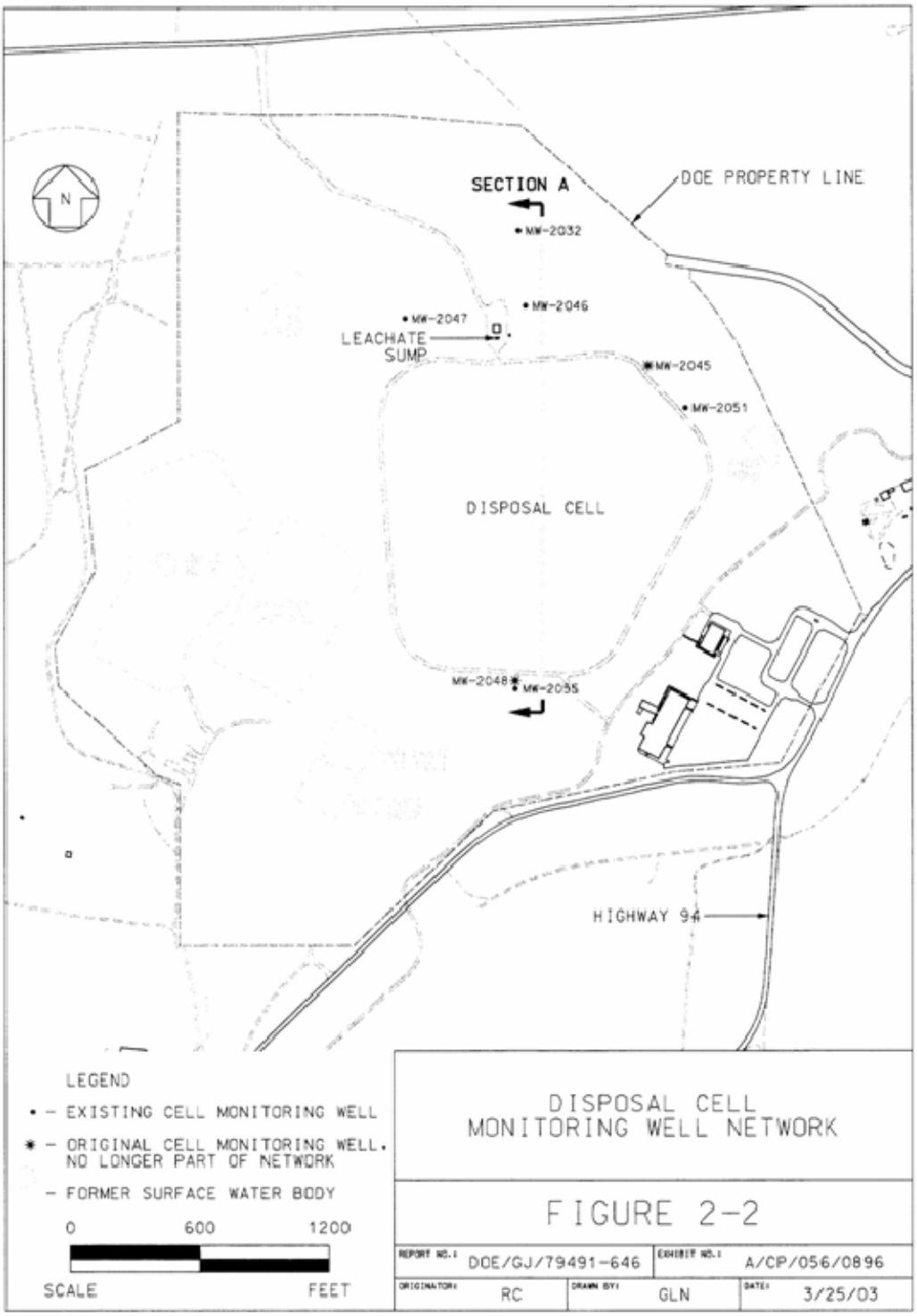

Figure K–2. Disposal Cell Monitoring Well Network

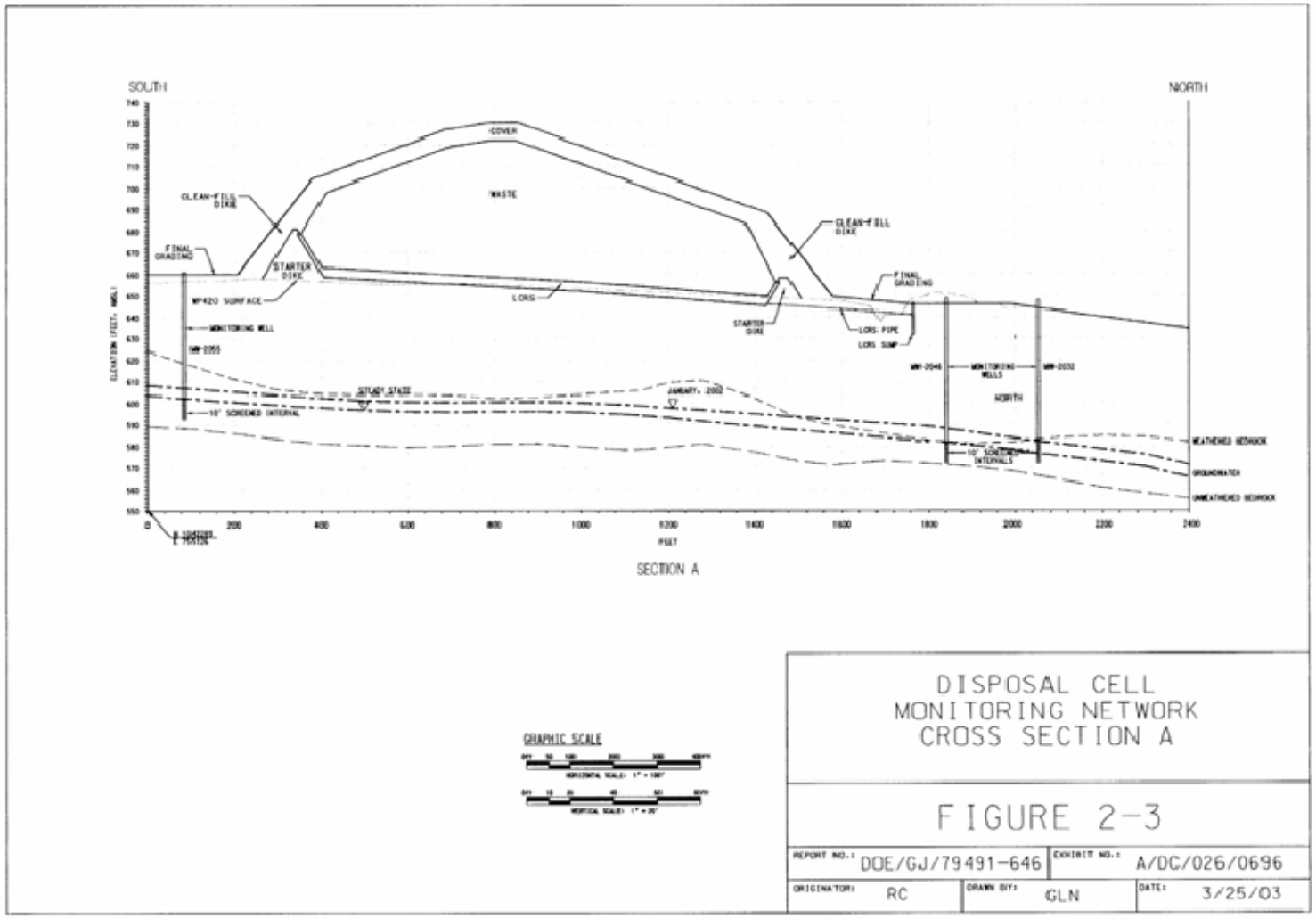

Figure K–3. Disposal Cell Monitoring Network Cross Section A

with the exception of three metals (iron, manganese, and nickel) and one indicator parameter (total organic carbon). However, the concentrations are within typical ranges for the groundwater in the weathered Burlington-Keokuk Limestone.

All wells in the disposal cell monitoring network were installed and developed in accordance with 10 CSR 23, Missouri Water Well Construction Code. Each well is constructed of 2-inch ID Grade 316 stainless steel casing, with a 10-foot length of 0.010-inch slotted screen. Total depths of the wells range from approximately 45 to 75 feet below ground surface, depending on the respective depth to water at each location. Borehole logs, well diagrams, packer test calculations, and well development forms for the original wells are contained in the *WSSRAP Disposal Cell Monitoring Well Program Installation Report* (MK-Environmental Services 1997). Attachment A of this plan contains the well diagrams for all disposal cell wells.

K2.3 Surface Water Monitoring Location

The surface water location used to detect downgradient impacts from the disposal cell is Burgermeister Spring (SP-6301) (see Figure K−4). Historical dye tests have indicated that this spring is the primary localized point of emergence for groundwater from the vicinity of the chemical plant (ANL 1997). Thus, sampling of Burgermeister Spring will yield results that are representative of both surface water and groundwater hydraulically downgradient of the disposal cell. Burgermeister Spring represents the first surface water impacted by groundwater originating from the site, including the disposal cell area. Downstream Lake 34 was not chosen as a monitoring point as Burgermeister Spring represents the worst case conditions for surface water and Lake 34 does not receive surface water contribution from the chemical plant area. It is common practice in aquifer systems dominated by fracture or conduit flow to supplement the monitoring well system by sampling springs that are hydraulically connected to the uppermost aquifer and that have shown a connection to the facility (EPA 1992). This spring was monitored routinely since 1987 under the *Environmental Monitoring Plan* (MK-F and JEG 2001a), and is a long-term monitoring location for the Groundwater Operable Unit. The spring in now monitored under this plan and the Long-Term Surveillance and Maintenance Plan. There is no upgradient surface water body included in this monitoring plan. The disposal cell is situated near both the regional surface water and groundwater divides; therefore, no surface water bodies are located upgradient of the disposal cell.

Ecological evaluations (including toxicity testing) for Burgermeister Spring have been conducted previously under site environmental monitoring and remedial investigation programs, and these results may be used for a determination of baseline ecological conditions for this plan. Results of ecological studies conducted for Burgermeister Spring as part of the *Remedial Investigation for the Groundwater Operable Unit* (ANL 1997) indicate that current conditions within the surface water and sediments in Burgermeister Spring, while exhibiting above background concentrations of both nitrate and uranium, have not measurably affected the biological community that uses the drainage. Therefore, while sampling for both radiological and chemical constituents will be conducted at Burgermeister Spring as specified in this plan, routine monitoring of biological activity will not be incorporated.

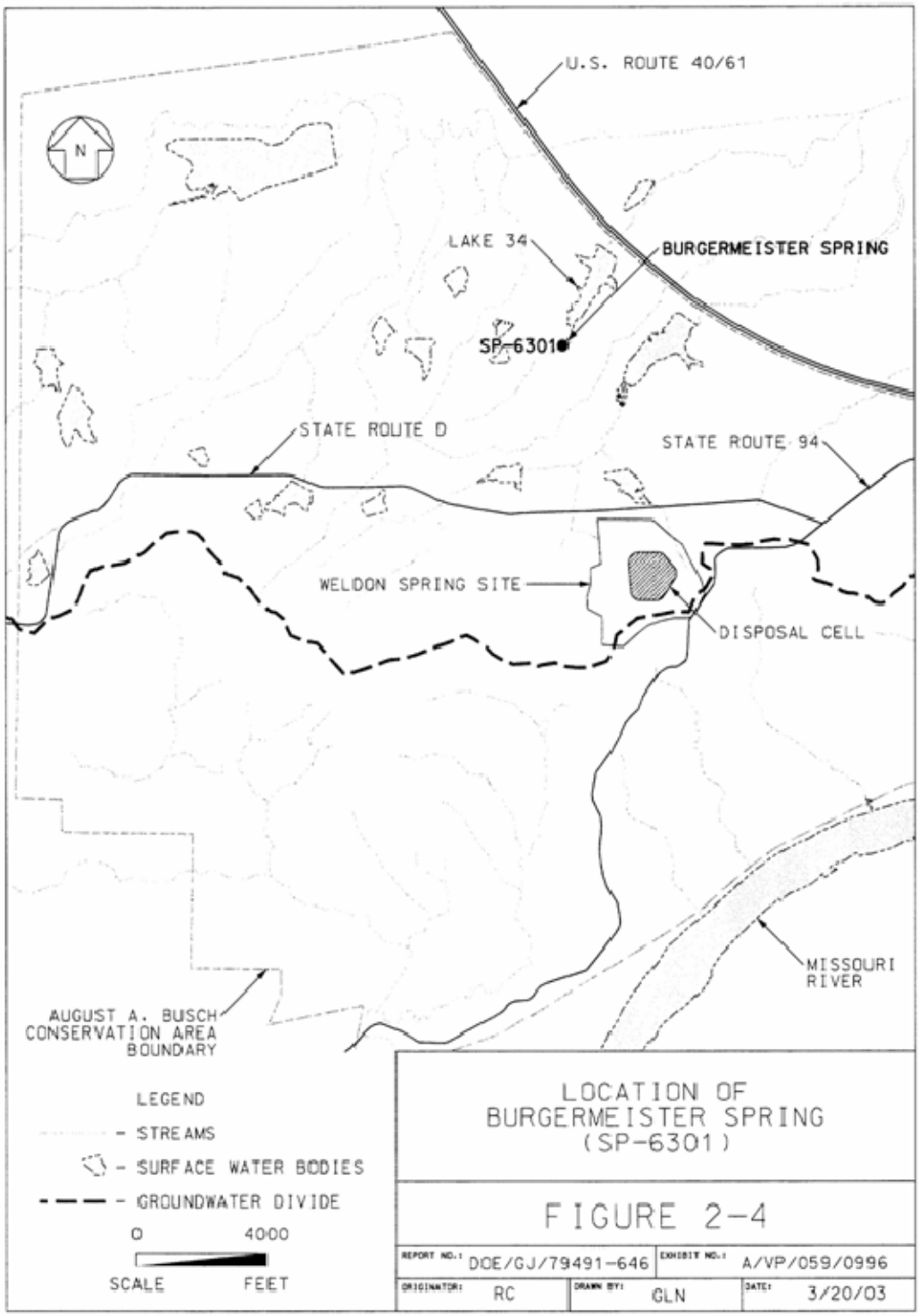

Figure K–4. Location of Burgermeister Spring (SP-6301)

K3.0 Baseline Monitoring

In accordance with 40 CFR 264.97, baseline monitoring was conducted to obtain data that represents the quality of groundwater that has not been affected by leakage from the disposal cell. The intent was to establish a baseline data set that could be used in statistical comparisons with detection monitoring data, in accordance with regulatory requirements, to detect and characterize hazardous constituents in the uppermost aquifer that may be due to leakage from the disposal cell.

Review of the initial approach to baseline monitoring and the groundwater system beneath the chemical plant has indicated that in some cases an established baseline may not be appropriate for monitoring of the disposal cell at the Weldon Spring site. The shallow aquifer beneath the chemical plant has been impacted by previous operation of the former ordnance works and the uranium feeds material plant. This limits the reliability of results obtained using the statistical methods specified in the Subpart F regulations to evaluate long term monitoring data, which is discussed further in Section K4.7 and Attachment B. It is expected that groundwater conditions for the contaminants of concern for the Groundwater Operable Unit (nitrate, uranium, trichloroethylene, and nitroaromatic compounds) will improve over time due to source removal activities. Baseline values established for these contaminants using prior data may be biased high due to existing groundwater contamination or contamination resulting from contaminated soil remediation. Later comparisons to this baseline may mask trends in the groundwater.

K3.1 Initial Baseline Monitoring

Baseline monitoring of locations MW-2032, MW-2045 through MW-2048, and SP-6301 was conducted throughout 1997 and early 1998, prior to waste placement activities. Four replicate samples were obtained from each location on a quarterly basis for approximately 1 year (i.e., five separate sampling events resulting in 20 individual samples per well). The initial baseline data indicated a large degree of temporal and spatial variability in water quality at the monitoring locations, as evidenced by the wide range of mean concentrations among monitoring locations and the high standard deviations calculated for many of the parameters. This variability is due to several contributing factors, such as the heterogeneity of the naturally occurring geochemistry, the variations in historical contaminant distribution throughout the site, and the unpredictable flow patterns in the fractured bedrock environment. Thus, the baseline conditions represented by the data were actually an indication of the groundwater quality at a particular location over a particular time period, and not a definitive characterization of background as intended by the Subpart F regulations.

Baseline monitoring of wells MW-2051 and MW-2055 began in 2001 and 2002, respectively. Samples from these wells are considered to be representative of water quality not impacted by the disposal cell since previous groundwater and leachate monitoring have indicated no reason to suspect leakage from the cell. Elements of the baseline sampling at these two wells have been similar to those listed above for the original six locations, except that the sampling events have consisted of a single sample (i.e., no replicates other than for quality control [QC] purposes).

K3.2 Previous Leachate Monitoring Evaluation

Regulations contained in 40 CFR 264.301 require leachate to be monitored during the active operation and post-closure period of a hazardous waste landfill. Although not specifically addressed by groundwater monitoring regulations, leachate monitoring is discussed in this plan because of the need to correlate the two programs to effectively monitor the potential migration of contaminants from the disposal cell.

Leachate production and analytical data have been collected routinely since waste placement activities began, in accordance with the Disposal Cell Leachate Monitoring Plan (Bennett 1998), the *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan* (DOE 2004) and now this appendix to the LTS&M Plan. Samples were collected at least quarterly and analyzed for the entire list of parameters shown in Table K−2. A summary of the average and maximum concentrations of analytical constituents detected in the leachate since the sump was completed (2000) is also presented in Table K−2. Current data are reported in the Annual Site Environmental Reports.

Table K–2. Leachate Monitoring Data (10/18/00 to 5/8/02)

Parameter	Units	Concentration in Leachate (10-18-2000 to 5-8-2002)	
		Average	Maximum
Chloride[a]	(mg/L)	30.40	38.80
Fluoride[a]	(mg/L)	0.24	0.29
Nitrate-N[a]	(mg/L)	0.56	3.10
Sulfate[a]	(mg/L)	94.63	163.00
Aluminum	(µg/L)	33.12	70.50
Antimony	(µg/L)	ND	ND
Arsenic[a]	(µg/L)	3.73	9.36
Barium[a]	(µg/L)	606.88	832.00
Beryllium	(µg/L)	0.41	0.92
Cadmium	(µg/L)	ND	ND
Calcium	(mg/L)	176.25	198.00
Chromium[a]	(µg/L)	ND	ND
Cobalt[a]	(µg/L)	17.23	25.90
Copper	(µg/L)	3.48	9.90
Iron[a]	(µg/L)	12,083.00	22,100.00
Lead[a]	(µg/L)	ND	ND
Lithium	(µg/L)	7.99	13.20
Magnesium	(mg/L)	52.41	55.70
Manganese[a]	(µg/L)	5,396.00	9,970.00
Mercury	(µg/L)	ND	ND
Molybdenum	(µg/L)	5.82	7.75
Nickel[a]	(µg/L)	9.71	14.70
Potassium	(mg/L)	5.40	6.29
Selenium[a]	(µg/L)	1.24	3.95
Silver	(µg/L)	ND	ND
Sodium	(mg/L)	69.49	77.10
Thallium[a]	(µg/L)	3.45	10.60
Vanadium	(µg/L)	0.99	2.00
Zinc	(µg/L)	22.76	40.90
C.O.D. [a]	(mg/L)	28.60	35.00

Table K–2 (continued). Leachate Monitoring Data (10/18/00 to 5/8/02)

Parameter	Units	Concentration in Leachate (10-18-2000 to 5-8-2002)	
		Average	Maximum
Cyanide	(µg/L)	2.91	6.10
T.D.S. [a]	(mg/L)	867.20	970.00
T.O.C. [a]	(mg/L)	9.42	10.50
1,3,5-TNB[a]	(µg/L)	ND	ND
1,3-DNB[a]	(µg/L)	ND	ND
2,4,6-TNT[a]	(µg/L)	ND	ND
2,4-DNT[a]	(µg/L)	ND	ND
2,6-DNT[a]	(µg/L)	ND	ND
Nitrobenzene[a]	(µg/L)	ND	ND
Gross alpha	(pCi/L)	66.44	180.00
Gross beta	(pCi/L)	28.56	59.60
Ra-226[a]	(pCi/L)	0.32	0.68
Ra-228[a]	(pCi/L)	0.60	1.37
Th-228[a]	(pCi/L)	0.10	0.34
Th-230[a]	(pCi/L)	0.23	0.36
Th-232[a]	(pCi/L)	0.09	0.25
Total Uranium[a]	(pCi/L)	75.54	278.00
Pesticides	(µg/L)	ND[b]	0.26
PCBs[a]	(µg/L)	ND	ND
PAHs[a]	(µg/L)	ND	ND
VOCs	(µg/L)	ND[b]	5.20

Notes: ND = non-detect
[a]These parameters are retained for leachate analysis as of the date of this plan.
[b]All data were reported as non-detect, except for 3 or 4 isolated detections of individual compounds.

K3.3 Evaluation of Baseline Data

The original disposal cell monitoring plan specified that groundwater and surface water samples obtained under the plan be analyzed for all constituents presented in Table K−3. This comprehensive list included general water quality indicator parameters (e.g., pH, temperature, total organic carbon), chemical and radiological contaminants, and naturally occurring constituents. The list included many parameters in addition to those that would be considered "hazardous constituents" under 40 CFR 264.93, and provided the basis for a thorough assessment of groundwater quality in the vicinity of the cell.

It was anticipated that the original list of analytical parameters would be evaluated periodically and modified as necessary to eliminate constituents that could provide no conclusive information regarding the presence of hazardous constituents due to a potential breach in the cell liner system. The first such modification was instituted in December 1999, after the initial baseline data had been evaluated and the detection monitoring program had begun (Steffen 1999a). Several parameters were eliminated from the list due to the lack of measurable detections in either the groundwater or the leachate, or because they were naturally occurring parameters that were not site contaminants of concern (see footnote "a" on Table K−2).

Table K–3. Baseline Monitoring Constituents for Groundwater and Surface Water

General Indicator Parameters	Contaminants				
	Metals	Nitroaromatic Compounds	Radiological	Inorganic Ions	Other
pH[b] Temperature[b] Specific Conductance[b] COD[b] Cyanide[c] TDS[b] TOC[b] TOX[c]	Aluminum[c] Antimony[c] Arsenic[b] Barium[b] Beryllium[a] Cadmium[a] Calcium[a] Chromium[b] Cobalt[b] Copper[c] Iron[a b] Lead[b] Lithium[c] Magnesium[c] Manganese[a b] Mercury[a] Molybdenum[c] Nickel[b] Potassium[a] Selenium[b] Silver[c] Sodium[a] Thallium[a b] Vanadium[c] Zinc[c]	1,3,5-TNB[b] 1,3-DNB[b] 2,4,6-TNT[b] 2,4-DNT[b] 2,6-DNT[b] Nitrobenzene[a b]	Radium-226[b] Radium-228[b] Thorium, Isotopic[b] Uranium, Total[b]	Chloride[b] Fluoride[b] Nitrate-N[b] Sulfate[b]	PCBs[a b] PAHs[a b] VOCs[a] Pesticides[c]

COD Chemical Oxygen Demand
TDS Total Dissolved Solids
TOC Total Organic Carbon
VOCs Volatile Organic Compounds
TOX Total Organic Halogen

PCBs Polychlorinated Biphenyls: Aroclor 1248, 1254, 1260
PAHs Polyaromatic Hydrocarbons: benz(a)anthracene, benzo(b)fluorancene, benzo(k)fluorancene, benzo(a)pyrene, chrysene, indeno(1,2,3-cd)pyrene

[a]These parameters were deleted from the list in December 1999 because either they had not been detected previously in any measurable quantities or they were naturally occurring parameters that were not contaminants of concern (Steffen 1999a).
[b]These parameters are retained or reinstated for groundwater and surface water analysis in the second revision (DOE 2004).
[c]These parameters are eliminated in the second revision.

K3.3.1 Identification of Long-Term Monitoring Parameters

The second revision to this plan further modified the list of groundwater monitoring parameters based on a review of the Chemical Plant and Quarry Bulk Waste Operable Units contaminants of concern, materials known to be present in the disposal cell waste, and leachate analytical data. The following contaminants of concern were identified in wastes from the chemical plant and/or the quarry bulk waste: arsenic, chromium, lead, nickel, selenium, thallium, nitroaromatic compounds (specifically 2,4,6-DNT), radium, thorium, uranium, PCBs, and PAHs (DOE 1993 and DOE 1990). In addition, barium, manganese, and selenium were determined to be present in the water treatment processing wastes during the remediation of contaminated surface water. As more leachate analytical data became available, the following constituents were identified as being present at relatively higher concentrations in the leachate than in the underlying groundwater: arsenic, barium, cobalt, iron, manganese, uranium, and chemical oxygen demand

(COD). These parameters were important to the cell monitoring network because a breach of the cell liner system could result in detectable increases in the levels of these constituents in the groundwater.

K3.3.2 Identification of Signature Parameters

Detection monitoring data obtained from the cell well network from 1998 through 2001 were evaluated in the second revision of this plan using several of the suggested statistical methods in an attempt to identify statistically significant evidence of contamination due to the disposal cell. Results of these evaluations, which are summarized in Attachment B, demonstrate the uncertainties associated with applying the prescribed methods to data from an aquifer with preexisting contamination and where a high degree of spatial variation in contaminant distribution exists among the monitoring wells. Each type of evaluation resulted in numerous "false positive" statistical failures that, rather than providing reliable and conclusive evidence of cell leakage, were attributable to fluctuations in preexisting groundwater contamination.

The list of monitoring parameters in Table K−3 includes indicator parameters and waste constituents that for an uncontaminated aquifer would provide a reliable indication of the presence of hazardous constituents in groundwater due to leakage from the disposal cell. However, most of these parameters are already present in the groundwater at higher levels than in the leachate, either naturally or due to historical contamination, or are not present in either the groundwater or the leachate at concentrations above the detection limit. Thus, most of the parameters on this list are not able to provide conclusive evidence of cell leakage since impacts from the leachate would not cause detectable changes in the underlying groundwater.

The most reliable means of detecting potential impacts due to leakage of the disposal cell is to focus on parameters that exist at significantly higher concentrations in the leachate than in the groundwater. An increasing trend in these parameters in the groundwater would be detectable and, most likely, attributable to cell leachate since all other sources have been remediated.

To this end barium, uranium, iron, and manganese were identified as "signature parameters" for the disposal cell detection monitoring program in the second revision to this plan (DOE 2004). All four of these parameters have been detected at concentrations at least an order of magnitude higher in the leachate (Table K−2) than in the underlying groundwater or Burgermeister Spring (with the exception of uranium), which enhances the reliability of any conclusions that are drawn based on fluctuations in groundwater constituents. Increasing trends of these four parameters in the groundwater would be considered a signature of cell leachate that has migrated to the underlying aquifer and additional actions will be taken as described in Section K4.7. Also, these four parameters are naturally occurring and with the exception of uranium should not change via attenuation overtime. Uranium, a contaminant of concern for the Groundwater Operable Unit, is expected to attenuate with time where uranium impact occurs. However, the activity measured in the disposal cell monitoring wells is similar to background and likely will not change substantially over time. It was anticipated that the list of signature parameters may be modified, as necessary, based on future changes in leachate and/or groundwater concentrations.

It should be noted that the uranium concentrations in Burgermeister Spring can be similar or higher than those exhibited in the leachate. This location is impacted by not only contaminated groundwater originating from the Raffinate Pit area, but also residual contamination that is

present in the losing stream segment that extends from the Ash Pond area of the site to Burgermeister Spring. Increasing trends in uranium should not be used as the only indicator of possible leakage from the disposal cell.

K3.4 Statistical Analysis of Data

K3.4.1 Distribution of Data

The data for the signature parameters at the cell wells locations were examined to determine whether the data is normal or log-normal (Attachment B). The data shows a stronger evidence of log-normality than normality. However, to demonstrate that there is little difference in the method used to calculate the baseline tolerance limits, values were calculated for the signature parameters at three of the locations using six methods. The methods used were: U.S. Environmental Protection Agency (EPA) guidance suggested method on normal and log-normal data, tolerance limits on normal and log-normal data, and the mean plus 3 standard deviations on normal and log-normal data. All of the data from each location was used in this evaluation. The values calculated using the six methods yielded similar values for each of the signature parameters. Based on the evaluation (Attachment B), it is recommended to maintain the existing methodology of calculating baseline tolerance limits for the signature parameters and assume the data is distributed normally. Every 5 years, likely in conjunction with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 5-year reviews, the distribution of the data will be reevaluated.

K3.4.2 Revised Baseline Tolerance Limits

Tolerance limits for signature parameters were calculated using the dataset from 1997 through 2002, using 95% confidence and 95% coverage, based on the assumption that the data are normally distributed. In the case of the newer wells (MW-2051 and MW-2055), the available data used is fairly small: however the tolerance limits for these wells are representative of groundwater conditions at these locations. Every 5 years, likely in conjunction with the CERCLA five-year reviews, the baseline tolerance limits will be recalculated.

In calculating the baseline tolerance limit (BTL), results reported as non-detect (ND) or less than the detection limit (DL) were assigned a value of one-half the DL. Estimated values less than the DL, when reported, were used rather than one-half the DL.

In accordance with the EPA guidance on Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (EPA 1989b), the following formula was used to calculate BTLs:

$$BTL = x + k (s)$$

where: x = arithmetic mean of the baseline data
s = standard deviation of the baseline data
k = one-sided normal tolerance factor, based on number of values in the data set

The original tolerance limits for each location using data collected through December 2002 is included in Attachment B. One-sided tolerance factors can be found in Table 5 - Appendix B of the EPA guidance (EPA 1989b) and are also included in Attachment B.

K4.0 Detection Monitoring Program

The goal of the detection monitoring program is to be able to detect releases of hazardous constituents from the disposal cell to the underlying aquifer. Detection monitoring is conducted in accordance with 40 CFR 264.98 throughout the life of the disposal cell to allow for the detection of hazardous constituents that may be migrating from the disposal cell.

The detection monitoring program, which began at this site in June 1998, has evolved since its inception as additional groundwater and leachate data have been obtained and evaluated in light of the relevant regulatory requirements. Resulting modifications to the plan have been incorporated through correspondence (Steffen 1999a and Steffen 1999b), annual revisions to the site *Environmental Monitoring Plan* (MK-F and JEG 2001a), and through revisions to this appendix of the LTS&M. An evaluation of the groundwater and leachate data collected through 2007 is included in Attachment C and includes rationale for modifications to the detection monitoring program.

K4.1 Sampling Locations

Samples will be collected from monitoring wells MW-2032, MW-2046, MW-2047, MW-2051, and MW-2055. Samples will also be collected from Burgermeister Spring (SP-6301).

K4.2 Groundwater Monitoring

Samples collected from the monitoring wells and Burgermeister Spring will be analyzed for the list of parameters given in Table K−4. Based on a review of groundwater and leachate data, the list of monitoring parameters has been reduced to only those that have been identified as COCs for either the chemical plant and/or quarry bulk wastes or generated during water treatment processes. Quality control sampling is discussed in Section K6.

Table K–4. Detection Monitoring Parameter List for Groundwater and Surface Water

Radiological	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Th-228 Th-230 Th-232 Uranium, Total[a]	Arsenic Barium[a] Chromium Lead Manganese Nickel Selenium Thallium	1,3,5-TNB 1,3-DNB 2,4,6-TNT 2,4-DNT 2,6-DNT Nitrobenzene	PCBs PAHs	pH Temperature Specific Conductance

[a]Signature parameters (see Section K3.3.2)

K4.3 Sampling Frequency

Each monitoring well and Burgermeister Spring will be sampled on a semiannual frequency. Samples will be collected during June and December of each year. This sampling frequency will provide an adequate dataset for use in developing a moving baseline for each location

(Section K3.3), and assists in eliminating the spatial and temporal variability seen in earlier datasets. Burgermeister Spring will be sampled during baseflow conditions, which is the stage of spring discharge when the water is least influenced by active surface runoff. Samples will be collected no sooner than 1 week following the end of a precipitation event of sufficient intensity to result in surface runoff. The flow rate of the spring will be estimated and recorded at each sampling event.

The original disposal cell groundwater monitoring plan called for collecting four replicates at each monitoring location on a semi-annual basis. In 1999, the monitoring frequency was reduced to a single sample collected semi-annually from each location since independent replicates could not be collected within a short time period because of slow groundwater flow rates.

K4.4 Groundwater Elevation Measurements

Groundwater elevations will be measured semiannually at each of the disposal cell monitoring well locations prior to each sampling event. Groundwater flow rates and flow directions will be evaluated annually and reported in the Annual Site Environmental Report.

K4.5 Precipitation Data

To support leachate monitoring activities at a regulated unit, Missouri Hazardous Waste regulations require the collection of local precipitation data. An onsite meteorological station was used to monitor daily and hourly precipitation until December 2001, as described in the *Environmental Monitoring Plan* (MK-F and JEG 2001a). More recent and future regional precipitation data (e.g., from the Spirit of St. Louis Airport in Chesterfield, Missouri) is obtained as needed through the National Oceanographic and Atmospheric Administration at the following internet address: http://weather.noaa.gov.

K4.6 Leachate Monitoring

Regulations contained in 40 CFR 264.301 require leachate to be monitored during the active operation and post-closure period of a hazardous waste landfill. Although not specifically addressed by groundwater monitoring regulations, leachate monitoring is discussed in this plan because of the need to correlate the two programs to effectively monitor the potential migration of contaminants from the disposal cell.

The leachate monitoring parameters will be a larger set than that monitored in the groundwater. This larger set has been selected because of the potential for changes in the composition of leachate over time. The leachate will continue to be monitored semiannually for the parameters outlined in Table K−5. Samples will be collected in June and December of each year.

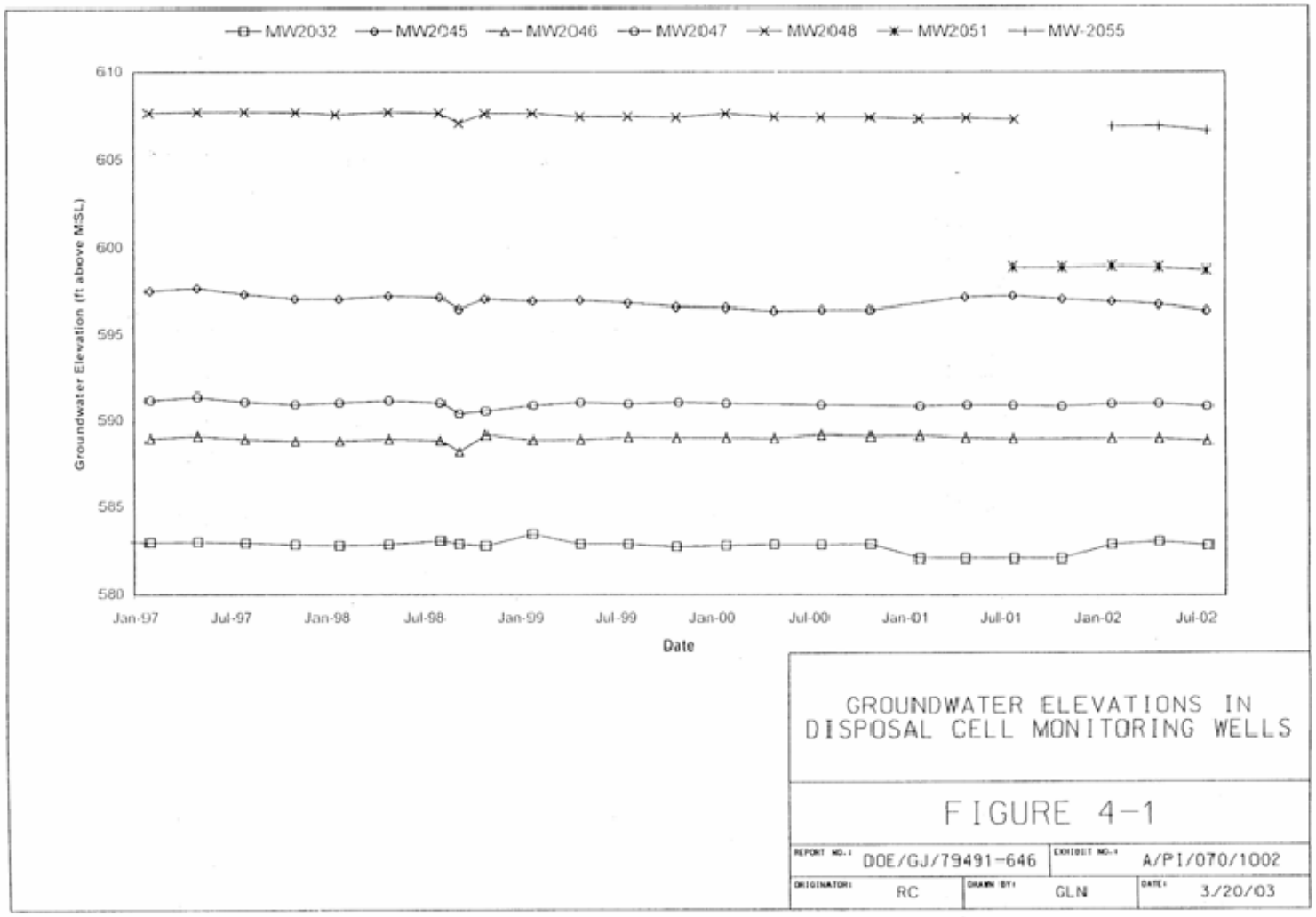

Figure K–5. Groundwater Elevations in Disposal Cell Monitoring Wells

Table K–5. Monitoring Parameter List for Leachate

Radiological	Inorganic Ions	Metals	Nitroaromatic Compounds	Other	General Indicator Parameters
Radium-226 Radium-228 Thorium, Isotopic Uranium, Total[a]	Chloride Fluoride Nitrate (as N) Sulfate	Arsenic Barium[a] Chromium Cobalt Iron[a] Lead Manganese[a] Nickel Selenium Thallium	1,3,5-TNB 1,3-DNB 2,4,6-TNT 2,4-DNT 2,6-DNT Nitrobenzene	PCBs PAHs	pH Temperature Specific Conductance COD TDS TOC Turbidity

[a]Signature parameters (see Section K3.3.2)

K4.7 Detection Monitoring Data Review

K4.7.1 Signature Parameters

Under the detection monitoring program, data for only the signature parameters from each monitoring event will be compared to baseline tolerance limits (Table K−6) to track general changes in groundwater quality and determine whether statistically significant increases in these parameters has occurred. Tolerance limits for signature parameters were calculated using the methodology presented in Section K3.4. Tolerance limits have been calculated for barium and uranium using data from 1997 through 2007.

Table K–6. Baseline Tolerance Limits for Signature Parameters in Groundwater and Surface Water

Location	Signature Parameter	
	Barium (µg/L)	Uranium (pCi/L)
MW-2032	325	5.3
MW-2046	255	1.4
MW-2047	440	2.2
MW-2051	230	2.1
MW-2055	49	4.2
SP-6301	163	100

For signature parameters (barium and uranium) that are determined to exceed the baseline tolerance limits, the following actions will be taken:

- The location will be resampled to confirm the exceedence. If the exceedence is not confirmed, detection monitoring will continue and no further action is necessary.
- If resampling results confirm the exceedence, a thorough evaluation will be performed to determine whether it is due to leakage from the disposal cell. This evaluation may include an assessment of groundwater gradients, review of leachate production and analytical data, review of sitewide monitoring data, and additional sampling. If it is shown that the upward trend is not due to leakage from the cell, a demonstration report will be prepared in

accordance with the substantive requirements of 40 CFR 264.98, and detection monitoring will continue.

K4.7.2 Other Parameters

The data from the remainder of the parameters will be reviewed to evaluate the general groundwater quality in the vicinity of the disposal cell and to determine if changes are occurring in the groundwater system. Data will be compared to the 3 most recent years of data to determine if statistically significant increases or trends in concentrations are present. A "moving average" approach, as discussed in the October 11, 1989, Federal Register (EPA 1989a), is used to better reflect naturally occurring changes in site hydrogeology, minimize temporal variations, and account for the natural attenuation of contaminants in the shallow aquifer. Data will be considered statistically significant if it is greater than the arithmetic mean plus 3 times the standard deviation for each location.

Data that are determined to be statistically significant will be evaluated as follows:

- The location will be resampled to confirm the exceedence. If the exceedence is not confirmed, no further action is necessary.
- If results of the resampling confirm the exceedence, the data will be compared to the leachate data. If the leachate data do not indicate that the exceedence could be the result of leakage from the cell (parameter is not elevated in the leachate), an assessment of the analytical data and review of sitewide monitoring data will be performed. If the exceeding parameter is a contaminant of concern for the Groundwater Operable Unit (nitrate, nitroaromatic compounds, or trichloroethylene), this information will be evaluated under the monitoring program for the Groundwater Operable Unit at the chemical plant.
- If results of the resampling confirm the exceedence, the data will be compared to the leachate data. If the leachate data indicate that the exceedence could be the result of leakage from the cell (parameter is also elevated in the leachate), the entire disposal cell monitoring network will be sampled for the full list of parameters shown in Table K–3. A revised monitoring plan, which incorporates the results of the enhanced sampling and outlines the specific details of the compliance monitoring program (Section K5.0), and an engineering feasibility plan for corrective action will be prepared in accordance with substantive requirements of 40 CFR 264.99.

K4.7.3 Leachate

Analytical data from the leachate will be compared to the analytical data from the monitoring well network to determine the adequacy of the signature parameters for this plan. If the composition of the leachate changes substantially, a parameter may be included or removed from the parameter list. If the concentration of a parameter decreases so that it is not distinguishable from concentrations (similar in concentrations) in groundwater, that parameter will be removed from the signature parameter list. Conversely, if the concentration of a parameter increases to a level that distinguishable from the concentrations in groundwater (order of magnitude greater), it would warrant its inclusion in the signature parameter list. This evaluation will be performed annually.

K4.8 Detection Monitoring Reporting

K4.8.1 Annual Reporting

Disposal cell monitoring data are reported annually in the Weldon Spring Site Environmental Reports (MK-F and JEG1999, MK-F and JEG 2000, MK-F and JEG 2001b, MK-F and JEG 2002, DOE 2005, DOE 2006a, and DOE 2007). Data to be reported includes all detectable analytical results, as well as groundwater flow rate and direction. However, since only analytical results were reported prior to 2002, groundwater flow rates and direction for the years 1998 through 2002 are included in Attachment D of this plan.

Confirmed exceedances of signature parameters are investigated further by evaluating water levels and precipitation data and reviewing historical analytical and field monitoring data to determine the likely cause and contributing factors. A summary of the exceedances and results of the investigations are reported in the annual site environmental report.

K4.8.2 Demonstration Reporting

A demonstration report will be prepared if it is shown that an upward trend in a signature parameter is not due to leakage from the cell. This report will document the evaluation used to derive the conclusion that leakage has not occurred from the disposal cell. This evaluation may include an assessment of data quality, groundwater gradients, review of leachate production and analytical data, review of sitewide monitoring data, and additional sampling.

K5.0 Compliance Monitoring and Corrective Action Programs

If it is determined that leakage from the cell has resulted in deterioration of the groundwater at the chemical plant, a review of the remedy will be necessary. This is based on the condition that the remedy is not behaving as expected and may no longer be protective of human health and the environment. Modifications or actions would be documented under CERCLA and would be consistent with 40 CFR 264.100, if appropriate. Identification of ARARs would be make at that time and my include groundwater protection standards as outlined in 40 CFR 264.92, if appropriate. At that time, a modification of this program would be documented in collaboration with EPA–Region VII and the Missouri Department of Natural Resources. The monitoring program will continue as prescribed in Section K4 and the nature and extent of the release will be investigated.

K6.0 Quality Control

All sampling, quality, and data verification will be conducted in accordance with the LTS&M Plan and the current version of the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351).

K7.0 References

ANL (Argonne National Laboratory), 1997. *Remedial Investigation for the Groundwater Operable Units at the Chemical Plant Area and the Ordnance Works Area, Weldon Spring, Missouri*, DOE/OR/21548-571, prepared for the U.S. Department of Energy, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, July.

DOE (U.S. Department of Energy), 1990. *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry*, Weldon Spring, Missouri, September.

DOE (U.S. Department of Energy), 1993. *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site*, DOE/OR/21548-376, Oak Ridge Field Office, St. Charles, Missouri, September.

DOE (U.S. Department of Energy), 2002. *Long-Term Stewardship Plan for the Weldon Spring, Missouri, Site*, GJO-2002-342-TAC, Grand Junction Office, Grand Junction, Colorado, August.

DOE (U.S. Department of Energy), 2005. *Weldon Spring Site Environmental Report for Calendar Year 2004*, DOE-LM/GJ879-2005, prepared for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado, July.

DOE (U.S. Department of Energy), 2006b. *Weldon Spring Site Environmental Report for Calendar Year 2005*, DOE-LM/GJ1213-2006, prepared for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado, July.

DOE (U.S. Department of Energy), 2007. *Weldon Spring Site Environmental Report for Calendar Year 2006,* DOE-LM-1486-2007, prepared for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado, August.

EPA (U.S. Environmental Protection Agency), 1989a. Federal Register, Part II. 40 CFR Part 264, Statistical Methods for Evaluating Ground-Water Monitoring from Hazardous Waste Facilities, Final Rule, October.

EPA (U.S. Environmental Protection Agency), 1989b. *Waste Management Division. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance* EPA/530-SW-89-026, Office of Solid Waste, Washington, D.C., April.

EPA (U.S. Environmental Protection Agency), 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*, EPA/530-R-93-001, Office of Solid Waste, Washington, D.C., November.

MK-Environmental Services, 1997. *WSSRAP Disposal Cell Monitoring Well Program Installation Report,* Rev. 0, Technical Memorandum No. 3840TM-7220-0, prepared for MK-Ferguson Group, February.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 1999. *Weldon Spring Site Environmental Report for Calendar Year 1998*, Rev. 0, DOE/OR/21548-773, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2000. *Weldon Spring Site Environmental Report for Calendar Year 1999*, Rev. 0, DOE/OR/21548-845, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2001a. *Environmental Monitoring Plan*, Rev. 9, DOE/OR/21548-424, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, St. Charles, Missouri, December.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2001b. *Weldon Spring Site Environmental Report for Calendar Year 2000*, Rev. 0, DOE/OR/21548-886, prepared for the U.S. Department of Energy, Oak Ridge Operations Office. Weldon Spring, Missouri. July.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2002. *Weldon Spring Site Environmental Report for Calendar Year 2001*, Rev. 0, DOE/OR/21548-917, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

D. Steffen, 1999a. Disposal Cell Detection Monitoring Status, letter from D. Steffen to S. McCracken, December 3.

D. Steffen, 1999b. Disposal Cell Detection Monitoring Status—Update, letter from D. Steffen to S. McCracken, December 21.

J. Bennett, 1998. Disposal Cell Leachate Monitoring Plan, interoffice memorandum from J. Bennett to Distribution, June 22.

Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites, LMS/PLN/S04351, continually updated, prepared by S.M. Stoller Corporation for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado.

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Attachment A

Monitoring Well Installation Logs

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WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

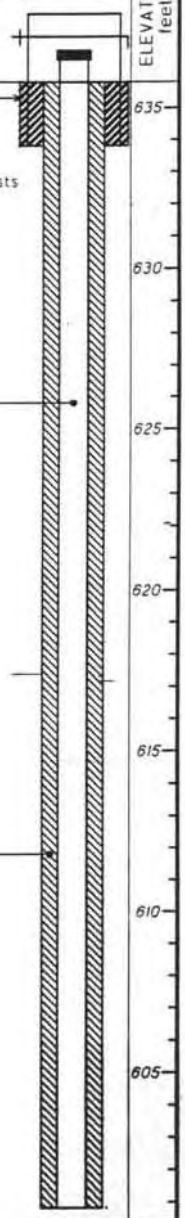
HOLE NUMBER	MW-2032
SHEET 1 OF 2	
NORTH (Y):	1044508.74
EAST (X):	755016.39
TOC ELEVATION	637.48
GROUND ELEVATION	635.81
STICKUP	1.67
HYDR CONDUCTIVITY (cm/sec)	K= N/A

WELL STATUS/COMMENTS	ACTIVE
LOCATION	27'SW MW2023, 30' SE MW2024 (AEC)
DRILLING CONTRACTOR	HANIBAL TESTING LABS
DRILL RIG MAKE & MODEL	CME 55/75, NQ WIRELINE
HOLE SIZE & METHOD	7 5/16 "O.D. 4 1/4" I.D.
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD) (DEPTH (FT.) FROM GROUND ELEV. TO)	60.0
DRILL FLUIDS & ADDITIVES	WATER
CASING TYPE, DEPTH, SIZE	2" PVC
BEDROCK	48.5
DATE START	08-11-1989
DATE FINISH	07-15-1989
WATER LEVELS & DATES	▽12-04-92 ▼05-31-91

LITHOLOGY BY A.BENFER

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
	SS-1	10/18"	7	ML	CLAYEY SILT, dark gray to brownish yellow, low plasticity, damp, medium stiff, MnOx & FeOx.	Qlv
5	ST-2	27/30"		CL	SILTY CLAY, brownish yellow, medium plastic, 20% sand, trace rounded gravel, moist, very stiff. Becomes mottled with light gray and MnOx at 9 feet. Light yellowish brown with caliche, very stiff with silt pockets at 12.5.	Qct
	SS-3	15/18"	10			
10	ST-4	26/30"				
	SS-5	16/18"	9			
15	ST-6	24/30"				
	SS-7	18/18"	14		SILTY CLAY, brownish yellow, medium plasticity, 10% sand, fine gravel, stringers of light gray and MnOx, damp, hard. ft.	
20	ST-8	30/30"				
	SS-9	18/18"	16	CH	SILTY CLAY, as above, highly plastic	
25	ST-10	11/12"		ML CL	SILT to SILTY CLAY, light brownish gray, medium plasticity, moist, very stiff. Minor gravel, angular, up to 1.5 inches at 30 feet.	
	SS-11	18/18"	13	CH	CLAY, brownish yellow, highly plastic, moist, very stiff, contains 5% sand, 15% fine gravel and MnOx.	
30	ST-12	18/18"	34		Minor gravel, angular, up to 1.5 inches at 30 feet.	
	SS-13	13/18"	18			
35	SB-14	16/18"	33	ML		

WELL DIAGRAM



ELEVATION feet

Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2032

SHEET 2 OF 2

NORTH (Y): 1044508.74

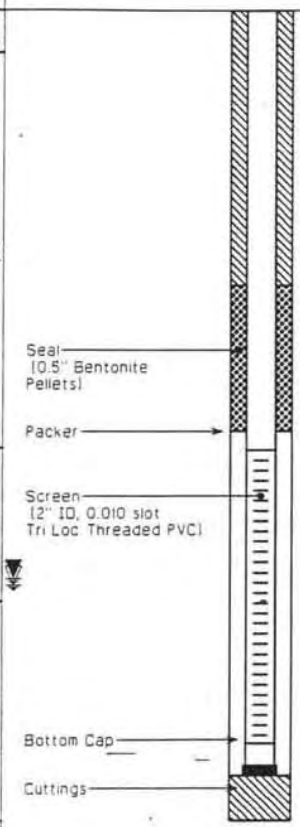
EAST (X): 755016.39

WELL STATUS/COMMENTS: ACTIVE

LOCATION: 27'SW MW2023, 30' SE MW2024 (AEC)

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
		16/18"			ML	SILT, reddish yellow, low plasticity, abundant FeOx, minor gravel, very soft.	Qct
	SS-15	16/18"	24		GC	CLAYEY GRAVEL, yellowish red, angular white chert gravel, plastic, moist, dense, hard.	
40	SB-16	12/18"	39			Highly fractured and weathered chert and 25% clay, very moist at 40 feet. Stiff at 45 feet.	pPr
45	SS-17	18/18"	15				
	NQ-1	7/54"	10		GC chrt	CHERT fragments, white, weathered, minor MnOx and FeOx.	Mbksw
50	NQ-2	66/66"	64		lms	LIMESTONE, yellow, silty, moderately weathered, contains finely disseminated oxidized pyrite. Chert, white, fresh.	
55						LIMESTONE and CHERT, as above, 50% chert distributed throughout providing a breccia appearance. Chert, white to bluish to pinkish.	Mbkw
	NQ-3	18/18"	57				
60						Total depth 60.0 feet.	
65							
70							
75							

WELL DIAGRAM



ELEVATION feet: 600, 595, 590, 585, 580, 575, 570, 565

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

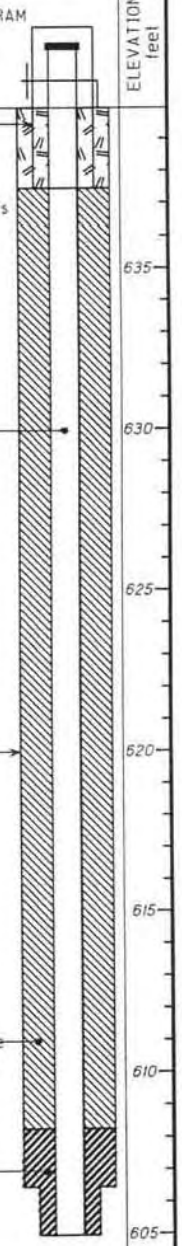
BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER	MW-2045 (C2)
SHEET 1 OF 2	
NORTH (Y):	1043883.98
EAST (X):	755615.24
TOC ELEVATION	641.82
GROUND ELEVATION	639.95
STICKUP	1.87
HYDR CONDUCTIVITY (cm/sec)	K= 1.44x10^{-3} (Packer Test)
WELL STATUS/COMMENTS	ACTIVE
LOCATION	Downgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC.
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 33.5' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD)	50.0
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
BEDROCK	33.5
DATE START	10-15-1996
DATE FINISH	11-1-1996
WATER LEVELS & DATES	

LITHOLOGY BY P. PATCHIN/S. VINCENT

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT UNIT
	CME-1	42/42"		TS	0-.2' TOPSOIL, brownish gray with roots.	Gp
				CL ML	.2 - 1.0' SILTY CLAY/CLAYEY SILT, mottled yellowish brown (10YR 5/6) with minor brownish yellow (10YR 6/8), non-plastic to low plasticity, slightly moist, very stiff (pp=3.0), roots.	Grx
				CH	1.0 - 1.9' SILTY CLAY/CLAYEY SILT color as above, nonplastic, dry to damp, hard (pp=4.0+), minor MnOx stain, roots, FeOx blebs.	Glv
5	CME-2	60/60"		CL	1.9 - 5.8' SILTY CLAY, mottled yellowish brown (10YR 5/8), and minor grayish brown (10YR 5/2), medium to high plasticity, slightly moist, very stiff (pp=2.75), minor (<5%) angular chert gravel to 1/2".	
10	CME-3	60/60"			5.8 - 18.0' SILTY, SANDY CLAY with GRAVEL, yellowish brown (10YR 5/8) with minor light brownish gray leaching along fractures, low plasticity, dry, hard (pp=4.5+), very sandy (v.fine) with approx. 5-10% gravel (v.fine to 2"+) which is rounded (igneous) and angular (limestone and chert), very fractured with abundant MnOx along fracts., gray granular CaCO3 in thin lenses at 15.0' and 17.5'	Gct
15	CME-4	60/60"				
20	CME-5	48/48"		CL CH	18.0 - 20.0' CLAY, strong brown (7.5 YR 4/6) with minor reddish mottling, medium to high plasticity, slightly moist hard (pp=4.5+), little to no sand or gravel, grayish silty pockets (occasional), abund. FeOx nodules, abund. MnOx on fractures.	
				CL	20.0 - 22.2' CLAY, slightly silty, mottled dark red (2.5YR 4/6) and minor light brownish gray (2.5YR 6/2), low plasticity, damp to slightly moist, very stiff (pp=2.25-3.25), very crumbly and blocky structure, waxy, with silty pockets from 21.0 - 22.2'.	
	SS-6	11/11"	+50	GC	22.2' CLAYEY GRAVEL, color as above but with weathered chert gravel (60%-70%) to >2", very angular and "shattered". Chert gravel is generally white (10YR 8/1), hard to very hard, moderately weathered. Interstitial clay is as above, damp to slightly moist.	
25	SS-7	12/24"	43	CL GC	GRAVELLY CLAY/CLAYEY GRAVEL, (alternating broken chert gravel and clay with gravel), clays is strong brown (10YR 4/6), med. to high plasticity, slightly moist, very stiff, with minor fine chert gravel as above.	pPr
30					Top of Bedrock @ 33.5 ft.	Mdksw
35	RUN-1	78/120"	30	lms chrt	33.5 - 43.7' ARGILLACOUS LIMESTONE AND CHERT, interbedded and brecciated (approximately 60/40). Limestone is grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), mottled with	

WELL DIAGRAM



Sample Interval No Sample Taken minimum maximum average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2045 (C2)

SHEET 2 OF 2

WSMLOG-C

NORTH (Y): 1043883.98

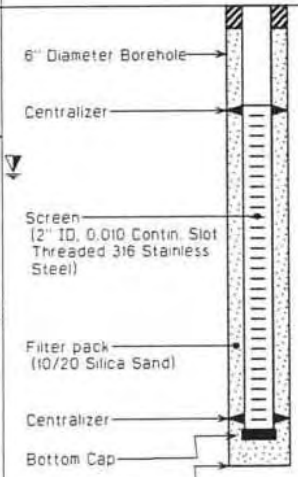
EAST (X): 755615.24

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Downgradient of Disposal Cell

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
						lms chrt	very light gray (N8) chert. Limestone is fine to medium-grained, very argillaceous, thin-bedded, mod. hard, mod. weathered with vugs pinpoint to 1", abundant FeOx staining and closely fractured. Minor stylolites and fossils. Chert is brecciated and interbedded with limestone and as nodules (to 5"), very hard, fossiliferous with MnOx staining on micro-fractures and in matrix. "Strongly Weathered Burlington-Keokuk Limestone" from 34.0-39 ft. then "Weathered Burlington-Keokuk Limestone" to total depth.	MDksw
40						lms chrt		MDkw
45		RUN-2	70/72"	70			43.7 - 49.1' ARGILLACEOUS LIMESTONE AND CHERT, as above but increased clay content and very fine grained (micritic), less chert (approx. 30%), moderate to high porosity.	
							Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS 37.3 to 44.0 ft. K=1.4E-3 cm/sec 39.6 to 50.0 ft. k=8.8E-4 cm/sec	
50						chrt	49.1 - 50.0' CHERT, mottled very light gray (N8) and brownish gray (5YR 4/1), very hard, slightly weathered, closely fractured with heavy FeOx staining on fracture surfaces.	
							Total cored depth 50.0 feet. Switched to 6" air rotary and reamed hole to 49.2'.	
55							Note: Soil and rock color are indexed on the Muncell soil color chart.	
60								
65								
70								
75								

WELL DIAGRAM



ELEVATION (feet): 600, 595, 590, 585, 580, 575, 570, 565

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSMLOG-C

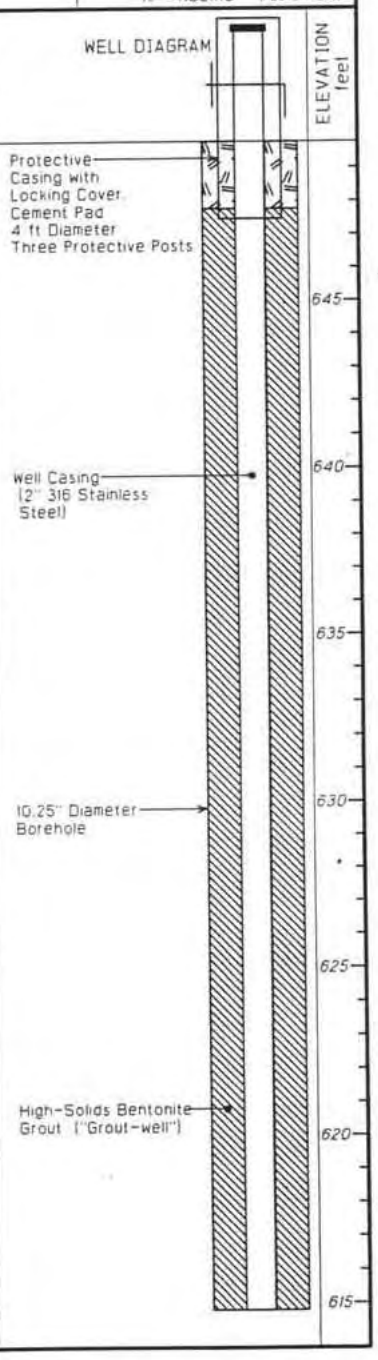
HOLE NUMBER	MW-2046 (C3)
SHEET 1 OF 2	
NORTH (Y):	1044158.17
EAST (X):	755046.76
TOC ELEVATION	653.54
GROUND ELEVATION	649.77
STICKUP	3.77
HYDR CONDUCTIVITY (cm/sec)	K= 4.85×10^{-6} (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	Upgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 51.8' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD) (DEPTH (FT.) FROM GROUND ELEV. TO)	74.0
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
BEDROCK	51.8
DATE START	11-5-1996
DATE FINISH	11-15-1996
WATER LEVELS & DATES	

LITHOLOGY BY SEAN VINCENT/PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or ROD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				Fill	0 - 1.5' FILL, gravel drill pad (3" minus rock)	Fill
	SS-1	18/24"	19	CL ML CH	SILTY CLAY/CLAYEY SILT, yellowish brown (10YR 5/6), low plasticity, slightly moist, very stiff (pp=3.0).	Qrx
5	SS-2	19/24"	16		1.5 - 13.8' CLAY, mottled yellowish brown (10YR 5/4) and grayish brown (10YR 5/2), medium to high plasticity, slightly moist, very stiff (pp=2.75).	
	SS-3	24/24"	12			Qlv
	SS-4	24/24"	17		CLAY, as above, black MnOx staining is common.	
10	SS-5	24/24"	20		CLAY, as above, very stiff (pp=3.5).	
	SS-6	24/24"	25	CL CH	13.8 - 32.0' SILTY CLAY, yellowish brown (10YR 5/8) with light greenish gray (5GY 7/1) along fractures, medium to high plasticity, approx. 5% angular chert gravel to 1" with trace subrounded to rounded igneous gravel, hard (pp=4.5), grading to higher silt and fine sand content with depth.	
15	SS-7	24/24"	19			
	SS-8	24/24"	27			
20	SS-9	24/24"	32			
	SS-10	24/24"	32	CL	SILTY CLAY, as above, medium plasticity, waxy appearance, hard (pp=4.0).	Qct
25	SS-11	24/24"	27			
	SS-12	24/24"	28			
30	SS-13	24/24"	28		32.0 - 34.0' SILTY CLAY, as above but with red (2.5YR 5/6) color and includes occasional subangular to angular chert fragments.	
	SS-14	24/24"	29		34.0 - 37.5' SILTY CLAY, as above but color is yellowish brown (10YR 5/6) with light gray (10YR 7/2) silt in fractures, occasional FeOx nodules	
35						

WELL DIAGRAM



ELEVATION feet

Sample Interval No Sample Taken minimum maximum average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2046 (C3)

SHEET 2 OF 2

NORTH (Y): 1044158.17

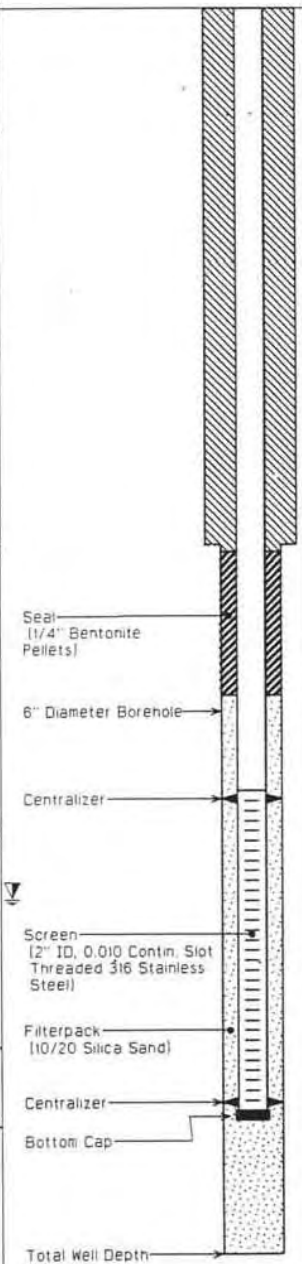
EAST (X): 755046.76

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
	SS-15	24/24"	16	CL	slightly moist, very stiff (pp=3.5). 37.5 – 38.6' SILTY CLAY, weak red (2.5YR 6/4) some fine sand, soft (pp=1.75).	Qct
40	SS-16	11/11"	87+	GC Chrt	38.6 – 41.5' CLAYEY GRAVEL, dry, relict angular chert fragments, matrix is predominantly silt and fine sand.	pPr
	SS-17	24/24"	70		41.5 – 46.5' CLAYEY GRAVEL, angular white chert fragments to 2", hard to very hard, interstitial clay is dark red (2.5YR 4/8), moist.	
45	SS-18	24/24"	51		46.5 – 51.8' CLAYEY GRAVEL, as above but strong brown (7.5YR 5/8), increased weathering of chert gravel (coarse sand size to 1").	
	SS-19	22/24"	19			
50	SS-20	20/24"	22			
	SS-21	4/4"	>50		Top of Bedrock @ 51.8 ft.	
	RUN-1	60/72"	52	lms. chrt	51.8 – 65.6' ARGILLACEOUS LIMESTONE (65%) AND CHERT (35%), brecciated and interbedded together. Limestone is grayish orange (10YR 7/4), very fine-grained, thin to very thin-bedded, moderately hard, moderately weathered with occasional vugs, slight to moderate porosity, slightly fossiliferous, closely fractured with FeOx staining. Chert is very light gray (N8), very hard, very fossiliferous. "Weathered Burlington-Keokuk Limestone"	Mdkw
55						
	RUN-2	53/60"	60		Increased vugginess below 58.5 feet.	
60					Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS 55.2 to 63.5 ft. K < test method quantitation limit 60.0 to 70.0 ft. k=4.9E-6 cm/sec	
	RUN-3	78/78"	59			
65					65.6 – 70.0' ARGILLACEOUS LIMESTONE AND CHERT, as above but with less chert (25%), color is grayish orange (10YR 7/4) increased porosity and softer rock with silt on fractures. Chert is brecciated in "shattered"-looking schards. "Weathered Burlington- Keokuk Limestone"	
70					Total cored depth 70.0 feet. Switched to 6" air rotary and reamed hole to 74.0'. Note: Soil and rock color are indexed on the Muncell soil color chart. Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results qualitative.	
75						

WELL DIAGRAM



ELEVATION feet: 610, 605, 600, 595, 590, 585, 580, 575

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSM.OG-C

HOLE NUMBER	MW-2047 (C4)
SHEET 1 OF 2	
NORTH (Y):	1044105.67
EAST (X):	754487.53
TOC ELEVATION	640.30
GROUND ELEVATION	637.48
STICKUP	2.82
HYDR CONDUCTIVITY (cm/sec)	K= 8.03x10^{-6} (Packer Test)

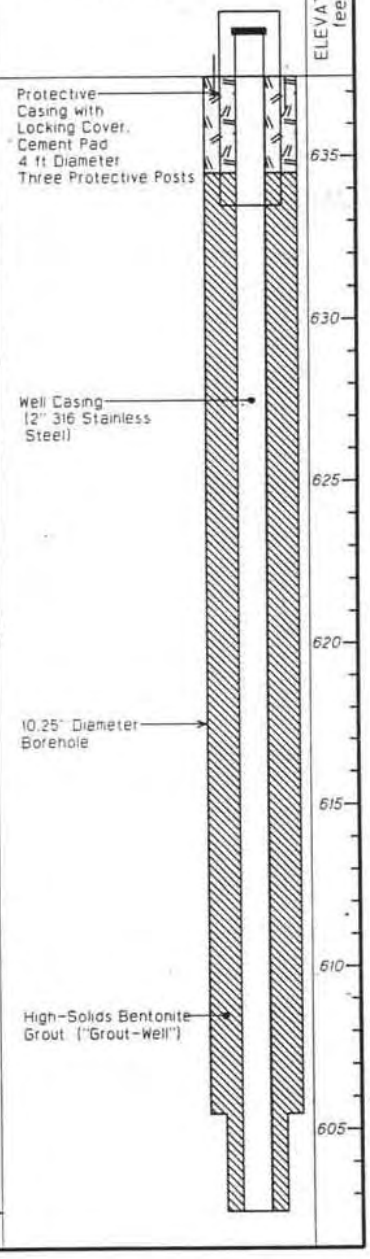
WELL STATUS/COMMENTS	ACTIVE
LOCATION	Upgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 32.0' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD)	60.2
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
BEDROCK	44.5
DATE START	12-3-1996
DATE FINISH	12-10-1996
WATER LEVELS & DATES	

DEPTH (FT.) FROM GROUND ELEV. 10.

LITHOLOGY BY PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or ROD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				Fill	0 - 4.5' FILL, 3/4" crushed rock to 1 ft, 3" clean rock to 3.5', then silty clay fill with limestone gravel to 4.5'.	Fill
5	SS-1	17/24"	31	ML	SILT, light gray (2.5Y7/2), nonplastic, dry, hard (pp=4.5+) minor FeOx mottling.	Qpl
	SS-2	14/24"	24	ML	CLAYEY SILT, mottled yellowish brown (10YR5/6) and light brownish gray (2.5Y 6/2), low plasticity, slightly moist, hard (pp=4.5+), minor FeOx and MnOx.	Qrx
10	SS-3	16/24"	18	CL	SILTY CLAY, mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6), low to medium plasticity, slightly moist, very stiff to hard (pp=4.5), minor silt as lenses in clay and minor fine chert gravel, FeOx nodules and MnOx streaking (fracture fill).	Qlv
	SS-4	20/24"	22	CL	SANDY CLAY with GRAVEL, mottled yellowish brown (10YR 5/8) (primary) and minor light brownish gray (10YR 6/2), slightly moist, sandy with approx. 10% gravel (very fine to 2"), mostly angular chert with minor subrounded igneous, abundant FeOx and MnOx stain, very stiff to hard (pp= 3.75-4.5+) with near-vertical fractures exhibiting leaching (gray color) and MnOx staining.	Qct
15	SS-5	20/24"	16			
	SS-6	21/24"	22	CL CH	SILTY CLAY, distinctive yellowish-red (5YR 4/6) moderate to high plasticity, slightly moist, no gravel or sand, soapy, very hard (pp=4.5+) stiff (pp=3.0).	
20	SS-7	23/24"	65	GC	Harder drilling @ 19.0 ft.	
	SS-8	7/7"	>50		CLAYEY GRAVEL, approx. 75 - 80% angular chert gravel with plastic interstitial clay and minor sand pockets. Gravel is exclusively chert until approx. 28.0' then includes very weathered (to powder) limestone. Interstitial clay is dusky red (2.5YR 4/4), high plasticity, slightly moist, with pockets of distinctive yellow fine sand, abundant FeOx and minor MnOx stain on gravel, very dense.	pPr
	SS-9	11/11"	>50			
25					Very hard drilling @ 27 ft.	
	SS-10	22/24"	43		CLAYEY GRAVEL, as above, with weathered limestone pieces and powder.	
30					Sampler refusal @31.9 ft. Weathered limestone in sampler. Auger refusal @ 32.0 ft. Started NQ wireline coring.	
	RUN-1	37/102"	8	chrt	32.0 - 35.6' CHERT, brecciated with minor argillaceous limestone and as nodules to .5' (minor) chert is light gray (N7) to minor mottled medium gray (N5), slightly weathered, very hard, very fossiliferous, closely fractured. Minor limestone is grayish- orange (10YR 7/4), argillaceous, moderately hard, brecciated, moderately	
35						

WELL DIAGRAM



Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2047 (C4)

SHEET 2 OF 2

NORTH (Y): 1044105.67

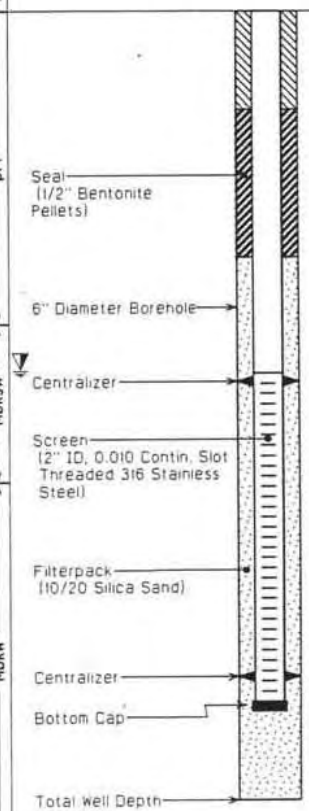
EAST (X): 754487.53

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
						chrt	weathered, with FeOx stain, vuggy.	
						CL GC	35.6 - 44.4' GRAVELLY CLAY/CLAYEY GRAVEL, (Residuum), most of clay /gravel in interval not recovered in core barrel.	
40		RUN-2	17/48"	0				pPr
							44.4 - 44.5' CHERT, very light gray (N8), very hard, moderately weathered.	
45		RUN-3	72/72"	55		chrt lms chrt	Top of Bedrock @ 44.5 ft.	
							44.5 - 49.8' ARGILLACEOUS LIMESTONE (60%) and CHERT (40%), brecciated and interbedded. Limestone is grayish orange (10YR 7/4) with minor dark yellowish orange (10YR 6/6), very argillaceous, very fine-grained, very thin-bedded (interbedding) and irregular brecciation with chert, moderate to high porosity, medium hardness, moderately to highly weathered, closely fractured, some secondary calcite. Chert is very light gray (N8) to pale orange (10YR 8/2), brecciated in thin irregular "beds" with limestone, slightly weathered, very hard, very fractured with MnOx infilling. "Strongly Weathered Burlington-Keokuk Limestone"	Mbksw
50		RUN-4	116/116"	73		chrt lms chrt		
							49.8 - 50.2' CHERT, mottled grayish orange (10YR 7/2) and very light gray (N8), very shattered and brecciated, very hard.	
55							50.2 - 60.2' ARGILLACEOUS DOLOMITIC LIMESTONE (70%) and CHERT (30%), in brecciated texture. Limestone is as above but is dolomitic with thicker bedding (thin-bedded), high porosity, and chert exhibiting a very angular, brecciated and "shattered" texture. Color change (gradual) to more olive color and vuggy (bone-marrow) texture at about 58.5'. Overall, moderately hard, moderate to highly weathered, with MnOx commonly lining fractures in chert. " Weathered Burlington- Keokuk Limestone"	Mbkw
60							Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TEST 46.0 to 60.2 ft. K=8.0E-6 cm/sec	
							Total cored depth 60.2 feet. Switched to 6" air rotary and reamed hole to 59.0'.	
65							Note: Soil and rock color are indexed on the Muncell soil color chart. Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results are qualitative.	
70								
75								

WELL DIAGRAM



ELEVATION feet: 600, 595, 590, 585, 580, 575, 570, 565

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

MSMLOG-C

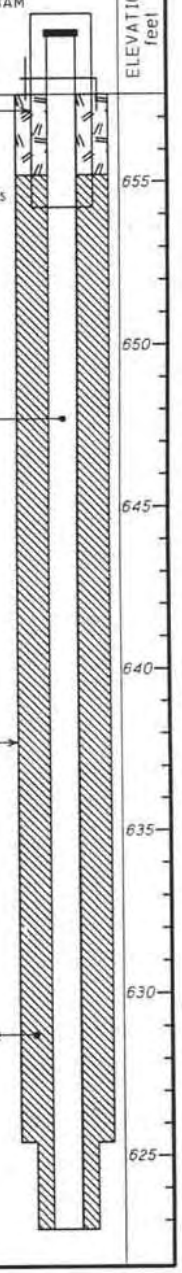
HOLE NUMBER	MW-2048 (C1)
SHEET 1 OF 2	
NORTH (Y):	1042435.46
EAST (X):	755000.96
TOC ELEVATION	659.85
GROUND ELEVATION	657.72
STICKUP	2.13
HYDR CONDUCTIVITY (cm/sec)	K= 7.91x10^{-4} (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	Upgradient of Disposal Cell
DRILLING CONTRACTOR	GEOTECHNOLOGY INC.
DRILL RIG MAKE & MODEL	CME 750, HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	10 1/4" HSA to 32.3' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	90
BOTTOM OF HOLE (TD) (DEPTH (FT.) FROM GROUND ELEV. 10)	60.0
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316 STAINLESS STEEL
BEDROCK	32.3
DATE START	12-12-1996
DATE FINISH	12-19-1996
WATER LEVELS & DATES	

LITHOLOGY BY PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				Fill	FILL, silty clay, dark brown, damp.	Fill
5	SS-1	15/24"	8	CL	SILTY CLAY, light brownish gray (2.5Y 6/2) with minor yellowish brown (10Y 5/6) mottling, medium plasticity, slightly moist, very stiff (pp=3.25), abundant FeOx nodules (2mm) and MnOx streaks.	Glv
	SS-2	14/24"	19	CH	CLAY, as above but with increased plasticity (high) and yellowish brown mottling, very stiff (pp=3.0), decrease in silt content and no gravel.	
10	SS-3	21/24"	16		CLAY, as above, very stiff (pp=3.0).	
	SS-4	23/24"	13		CLAY, as above, very stiff (pp=2.75), minor coarse sand-size chert at bottom.	
15	SS-5	22/24"	12	CL CH	SILTY CLAY, as above, increase in yellowish brown color, MnOx streaking, and coarse sand and fine gravel content at bottom of sample, very stiff (pp=3.0).	
	SS-6	23/24"	19	CL	SANDY CLAY with GRAVEL, yellowish brown (10YR 5/8) with minor light brownish gray (2.5Y 6/2) mottling, medium plasticity, slightly moist, hard (pp=4.5+), contains approx. 10% angular weathered chert gravel (coarse sand size to 1"), abundant MnOx streaks and FeOx stain.	Dct
20	SS-7	24/24"	16		SANDY CLAY with GRAVEL, as above, increased moisture (moist), very stiff (pp=2.75), with minor softer zones.	
	SS-8	24/24"	15	CL CH	CLAY, mottled strong brown (7.5YR 5/6) and dark red (2.5YR 4/6), medium to high plasticity, moist, no sand, trace v. fine gravel, abundant MnOx, streaks.	
25	SS-9	24/24"	18	CL CH	CLAY with GRAVEL, strong brown (7.5YR 5/6) with minor light gray, medium to high plasticity, slightly moist, very stiff (pp=3.5+), contains no sand and approx. 10-15% very fine to 1.5" gravel (chert and igneous), abundant MnOx streaks (increasing with depth), last 5' very gravelly with very abundant MnOx and FeOx nodules.	
	SS-10	19/24"	30	CL	GRAVELLY CLAY, strong brown (7.5 YR 5/6), high plasticity, approx. 40% angular chert gravel and minor limestone gravel, clay is moist with FeOx nodules and MnOx streaks and conspicuous calcareous sand pocket (decomposed rock?) at 26.5-27.0'.	pPr
30	SS-11	9/14"	+91			
	SS-12	11/18"	24	CL GC	GRAVELLY CLAY, as above but siltier and sandier, contains decomposed limestone, chert, hard, damp.	
	RUN-1	36/78"	9	lms. chrt	GRAVELLY CLAY/CLAYEY GRAVEL, as above but increased gravel (approx. 50%), hard, damp.	
					Top of Bedrock @ 32.3 ft.	Mdksm
35					32.3 - 41.8' ARGILLACOUS LIMESTONE AND CHERT, interbedded and brecciated. Approximately 70% limestone which is grayish orange (10YR 7/4) fine-grained, thin-bedded, slightly to highly	

WELL DIAGRAM



ELEVATION feet

Sample Interval No Sample Taken minimum maximum average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2048 (C1)

SHEET 2 OF 2

WSMLOG-C

NORTH (Y): 1042435.46

EAST (X): 755000.96

WELL STATUS/COMMENTS: ACTIVE

LOCATION: Upgradient of Disposal Cell

DEPTH (feet)	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	WELL DIAGRAM	ELEVATION feet
40		RUN-2	18/34"	0		lms chrt	weathered, moderately hard to hard, with weathered pyrite crystals in matrix and locally heavy FeOx staining and vugginess. Closely to very closely fractured with minor clay, stylolites, and fossils. Chert is brecciated and interbedded with limestone and in beds up to 8". Color varies from white (N9) to grayish orange (10YR 7/4) to light bluish gray (5B 7/1), generally very hard, cryptocrystalline, fossiliferous with sealed fractures and MnOx infilling. Entire interval has numerous small void zones (bit drops) with a void from 40.5–41.2' showing very weathered residual chert gravel and clay. Overall, slight to moderate porosity. "Strongly weathered Burlington–Keokuk Limestone"		6" Diameter Borehole	620
		RUN-3	60/64"	49		GC chrt	41.8 – 43.0' CHERT GRAVEL, (void fill) with minor clay. Chert is very weathered and vuggy providing a breccia appearance. Chert, white to bluish to pinkish.		Seal (1/4" Bentonite Pellets)	615
45						CL chrt				
						lms chrt	43.0 – 44.5 SILTY CLAY with GRAVEL, brown (10YR 5/3), void fill.			
		RUN-4	12/24"	20			44.5 – 59.3 ARGILLACEOUS LIMESTONE and CHERT, as above. Limestone exhibits stronger iron oxide staining (color to dark yellowish orange 10YR 6/6), moderate to high porosity, abundant solution features (vugs) pinpoint to 1/2", numerous small voids (bit drops) to approx. 51.5. Less vugs below 53.5. Minor intervals of medium crystalline limestone. Some secondary calcite in matrix. Chert is brecciated, bedded (to 5'), and nodular. "Strongly Weathered Burlington–Keokuk Limestone"	Mdksw	Centralizer	610
50		RUN-5	54/60"	54					Screen (2" ID, 0.010 Contin. Slot Threaded 316 Stainless Steel)	605
55		RUN-6	60/60"	66			Kp = CONSTANT HEAD SINGLE PACKER PRESSURE TESTS 35.5 to 47.3 ft. K=7.8E-4 cm/sec 48.4 to 59.3 ft. K=6.8E-4 cm/sec		Filter pack (10/20 Silica Sand)	
									Centralizer	600
									Bottom Cap	
60							Total cored depth 59.3 feet. Switched to 6" air rotary and reamed hole to 60.0.		Total Well Depth 60.0 feet	595
65							Note: Split spoon sampler is 3" O.D., 2-1/2" I.D., therefore SPT results are qualitative. Soil and rock colors are indexed on the Muncell soil color chart.			590
70										585
75										

Sample Interval ☐ No Sample Taken minimum maximum average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSMLOG-C

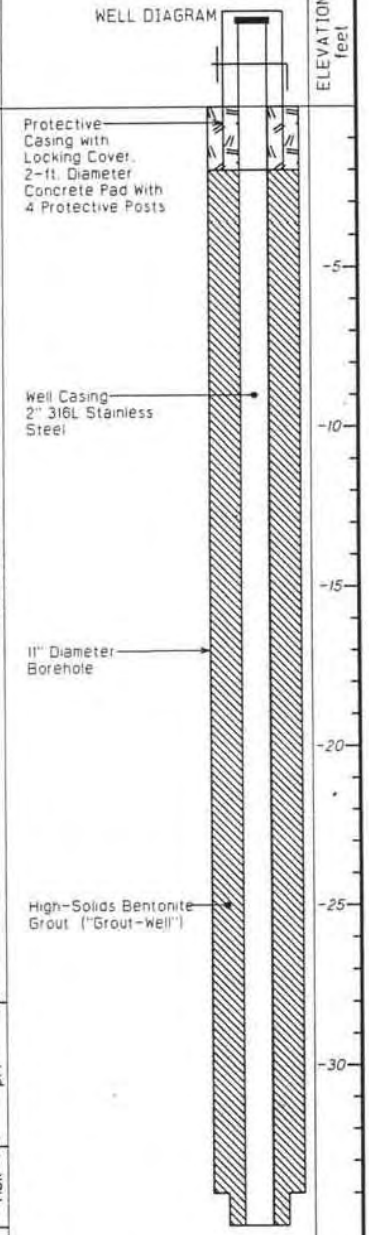
HOLE NUMBER	MW-2048 (a)
SHEET 1 OF 2	
NORTH (Y):	
EAST (X):	
TOC ELEVATION	
GROUND ELEVATION	
STICKUP	
HYDR CONDUCTIVITY (cm/sec)	K= 7.91x10^{-4} (Packer Test)
WELL STATUS/COMMENTS	ACTIVE
LOCATION	SO. OF DISPOSAL CELL; PERIMETER WELL
DRILLING CONTRACTOR	LAYNE WESTERN Inc.
DRILL RIG MAKE & MODEL	CME-750 HSA/NQWL; I-R TH-60 AIR ROTARY
HOLE SIZE & METHOD	9" HSA-34; NQ-62; 6" AIR-63
ANGLE FROM HORIZONTAL & BEARING	Vertical
BOTTOM OF HOLE (TD)	63.0, 62.0 Mon. Well
DRILL FLUIDS & ADDITIVES	Water core; Air ream
CASING TYPE, DEPTH, SIZE	2" 316 SS Mon. Well
BEDROCK	32.5
DATE START	11-9-01
DATE FINISH	12-5-01, Mon. Well
WATER LEVELS & DATES	

DEPTH (FT.) FROM GROUND ELEV. TO

LITHOLOGY BY ALAN BENFER

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery (0–100)	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
							Soil not sampled or logged from the surface to 28.0-ft.	Qct/Qtc undift.
5								
10								
15								
20								
25								
30		SPT-1		9		CH	CLAY, high plasticity, ~40% angular chert and weathered limestone gravel, mostly yellow brown, moist, firm CH. Residuum.	pPr
		SPT-2		14			CLAY, gravelly to clayey gravel, high plasticity clay, reddish brown, moist, hard, CH-GC. Residuum.	
		SPT-3		76+				
35		NQ-1	31/66"	15		CHRT LMS	LIMESTONE, weathered, white to yellowish brown, dry, hard. Auger refusal at 34.0-ft. Continue with NQ core. NQ-1, 34.0'– 39.5'. Poor recovery, loss zones unknown. Lost circulation at 34.5' permanently.	Mbk

WELL DIAGRAM



ELEVATION feet: -5, -10, -15, -20, -25, -30

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER **MW-2048 (a)**

SHEET 2 OF 2

NORTH (Y):

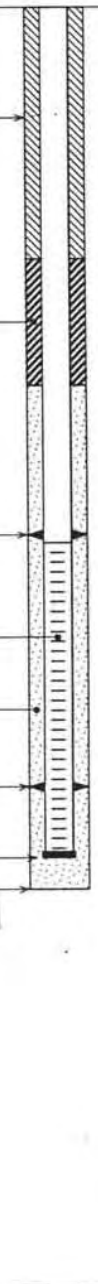
EAST (X):

WELL STATUS/COMMENTS: ACTIVE

LOCATION: SO. OF DISPOSAL CELL; PERIMETER WELL

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
						CHRT LMS	LIMESTONE, slightly weathered, crystalline-grained, locally argillaceous, with specks and thin streaks of MnOx, fossiliferous, light gray to light yellowish brown, vugs up to 1" near bottom of core, some interbedded light gray chert. Rock is relatively fresh, hard, with minimal oxidation. Two clay seams near core bottom; one is 3-1/2" thick with angular chert fragments, lower one is 6" of massive clay with some fine gravel, high plasticity, yellow brown, minor MnOx. Burlington-Keokuk Limestone.	MDk
40		NQ-2	28/40"	62			@ 39.5'- 42.8'. LIMESTONE as above, becoming oxidized at ~39.7', some styolites, ~30% scattered chert, appears brecciated, fossiliferous, mostly light gray. Up to 4+ fractures per foot, rough, open, oxidized.	
		NQ-3	52/70"	13			@ 41.5'. Scattered oxidized sulfides, increased limestone weathering at 42.7'. Bit dropped at ~41.8' to ~42.5'. Weathered Burlington- Keokuk Limestone.	MDkW
45							@ 43.5'- 44.1'. CHERT, hard, white, light and blue gray.	MDkSW
							@44.6'- 45.0'. Silty clay with limestone fragments.	
		NQ-4	58/67"	54			@ 45.4'- 48.6'. LIMESTONE, moderately weathered, moderate solutioning with vugs up to 1", generally coarse-grained, some argillaceous, FeOx staining with thin streaks of MnOx, mostly light yellow brown, with ~ 30% scattered interbedded chert, generally light gray.	
50							@ 48.2'- 52.0'. CHERT, hard, with thin streaks of MnOx, fracture surfaces oxidized, white to pale yellow, with up to ~25% thinly interbedded limestone, strongly weathered at 49.2-ft., soft, argillaceous, dark yellowish orange. At 50.1 to 52.0-ft., limestone is very vuggy along bedding; clayey. One to 4+ fractures per foot, rough; broken. Strongly Weathered Burlington-Keokuk Limestone.	
		NQ-5	61/94"	77				
55							@ 52.0'- 53.8'. CHERT, hard, bluish gray with ~40% limestone, strongly weathered, argillaceous, generally interbedded, a few vugs, yellowish orange.	
							@ ~53.7'. Cut fast. Very vuggy at 53.8-ft.	
60							CHERT AND LIMESTONE as above, ~40% limestone, strongly weathered, locally can be scratched with fingernail, a few vugs. Chert is bluish gray, locally fossiliferous. One to 3+ fractures per foot, rough, open, some broken.	
							@ 60.5'. 1/2" patch of oxidized pyrite.	
							Total cored depth 62.0', 11-15-01. Hole reamed to 6" diameter to 63.0' and a 2" monitoring well was constructed.	
65							Packer testing was not performed.	
70								
75								

WELL DIAGRAM



ELEVATION feet: 40, 45, 50, 55, 60, 65, 70

Sample Interval | No Sample Taken | minimum | maximum | average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER	MW-2051
SHEET 1 OF 2	
NORTH (Y):	1042175.97
EAST (X):	753129.19
TOC ELEVATION	639.77
GROUND ELEVATION	636.43
STICKUP	3.34
HYDR CONDUCTIVITY (cm/sec)	K= 8.7×10^{-3} (Packer Test)

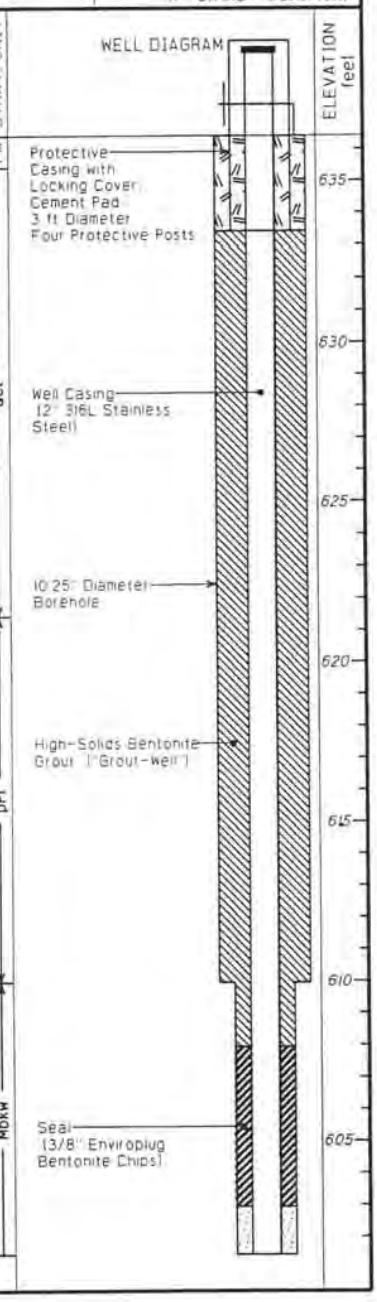
WELL STATUS/COMMENTS	ACTIVE
LOCATION	NORTHEAST EDGE OF DISPOSAL CELL
DRILLING CONTRACTOR	LAYNE WESTERN Inc.
DRILL RIG MAKE & MODEL	CME-750ATV HSA/NQWL CORE/SCHRAMM AIR ROT.
HOLE SIZE & METHOD	7 1/4" Auger to 26.5' then 6" Air
ANGLE FROM HORIZONTAL & BEARING	vertical
BOTTOM OF HOLE (TD)	49.0
DRILL FLUIDS & ADDITIVES	WATER/AIR
CASING TYPE, DEPTH, SIZE	2" 316L Stainless Steel
BEDROCK	26.5
DATE START	5-2-2000
DATE FINISH	5-30-2000
WATER LEVELS & DATES	

DEPTH (FT.) FROM GROUND ELEV TO

LITHOLOGY BY ALAN BENFER/PAUL PATCHIN

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
				fill	FILL, (silty clay)	Fill
				CH	CLAY, high plasticity, mottled yellow brown and light gray, approx. 10% fine white sand, moderate black MnOx, firm, moist, CH.	
	SPT-2		5	CH	CLAY, high plasticity with some sand and gravel (angular), MnOx, mottled yellow brown and light gray and black, moist, hard, CH.	
	SPT-3		12		Lenses of clean fine sand between 5 and 6 ft.	
5	SPT-4		18		CLAY, as above, approx. 10% fine sand and some fine gravel, hard, MnOx on vertical fracture surfaces, CH.	
	SPT-5		12			Qct
10	SPT-6		14			
	SPT-7		23	CL	SILTY CLAY, low plasticity, with weathered FeOx nodules, light gray, moist, hard, CL	
	SPT-8		14	CH	CLAY, high plasticity, FeOx nodules, trace fine gravel, mottled light brown and light gray, moist, hard, CH.	
15				CH	CLAY, as above but more reddish brown, high plasticity, with some angular chert gravel, CH	
	SPT-9		10			
	SPT-10		8			
20	SPT-11		7			pPr
	SPT-12		15			
	SPT-13		19			
25					Sampler refusal at 25.9 ft. Augered to top of rock at 26.5 ft. (auger refusal)	
	RUN-1	38/60"	8	chrt lms	26.5' – 35.3' CHERT AND ARGILLACEOUS LIMESTONE (approx 65%/35%). Chert is very light gray (N8) to minor medium light gray (N5), brecciated to very thinly bedded with limestone, very hard, slightly to moderately weathered, fossiliferous, with MnOx and FeOx staining (MnOx on microfractures in chert). Limestone is grayish orange (10YR7/4), mod. weathered, mod. hard, with vugs pinpoint to 3 mm, fine grained, very thinly bedded (interbedded with chert), slightly fossiliferous with FeOx staining (particularly in possible void zones at 28.0' – 28.5' and 34.0'–34.7').	
30	RUN-2	47/60"	46		Lost circulation at 29.0'	MDkw
35					Possible voids from 34.0 – 34.7'	

WELL DIAGRAM



Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2051

SHEET 2 OF 2

MSMLOG-C

NORTH (Y): 1042175.97

EAST (X): 753129.19

WELL STATUS/COMMENTS: ACTIVE

LOCATION: NORTHEAST EDGE OF DISPOSAL CELL

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT	WELL DIAGRAM	ELEVATION feet
		RUN-3	43/60"	48		chrt lms/ lms chrt	35.3' - 43.7' ARGILLACEOUS LIMESTONE (70%) and CHERT (30%) as above but increased limestone. Inreased vugs (to 1") parallel with bedding, moderately weathered. Probable voids @34.0' - 34.7' and 36.5' - 38.0' with heavy FeOx staining and residual chert gravel. Semi-fresh pyrite specks @33.5'. MnOx specks @39.5' with increased FeOx and weathering. Yellowish coloring (clay) at 40.3' - 41.5' with hematite blebs.	MDkW	---Static Water Level @ 36.9 ft.	600
40									Screen 2" (10 Slot) 316L SS Continuous Wrap	
		RUN-4	46/90"	37			41.5 - 43.2' Core loss possibly caused by caved material grinding core.		Filterpack (10/20 Silica Sand)	595
45						lms chrt	43.7' - 49.0' ARGILLACEOUS LIMESTONE, as above but color to more gray and porosity increase with CHERT (<30%) brecciated but also as large 4" irregular nodules, very fossiliferous, occasional calcite-rich (as medium grained crystals), bands to 1.5", occasional vugs, slightly weathered, abundant MnOx specks.		Centralizer	590
									Bottom Cap	
									Total Well Depth 47.2 feet.	
50							Total cored depth 49.0'. Reamed hole to 6" to 47.2' and installed 2" monitoring well. Note: Color is from the GSA rock color chart.		3" Core hole to 49.0 feet.	585
							CONSTANT HEAD SINGLE PACKER TEST RESULTS: 30.5 - 41.5 ft. K=8.7E-3 cm/sec; 36.1 - 49.0 ft. K=7.2E-3 cm/sec			
55										580
60										575
65										570
70										565
75										

Sample Interval No Sample Taken minimum maximum average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

WSWLOG-C

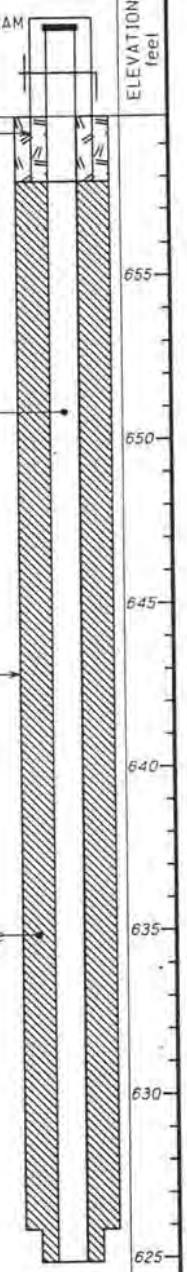
HOLE NUMBER	MW-2055
SHEET 1 OF 2	
NORTH (Y):	1042419.92
EAST (X):	755000.58
TOC ELEVATION	662.62
GROUND ELEVATION	659.86
STICKUP	2.76
HYDR CONDUCTIVITY (cm/sec)	K= 1.5x10^{-3} (Packer Test)

WELL STATUS/COMMENTS	ACTIVE
LOCATION	SO. OF DISPOSAL CELL, PERIMETER WELL
DRILLING CONTRACTOR	LAYNE WESTERN Inc.
DRILL RIG MAKE & MODEL	CME-750 HSA/NQWL; I-R TH-60 AIR ROTARY
HOLE SIZE & METHOD	9" HSA-34, NQ-62; 6" AIR-63
ANGLE FROM HORIZONTAL & BEARING	Vertical
BOTTOM OF HOLE (TD) (DEPTH (FT.) FROM GROUND ELEV. TO)	63.0
DRILL FLUIDS & ADDITIVES	Water core; Air ream
CASING TYPE, DEPTH, SIZE	2" 316 SS Mon. Well
BEDROCK	32.5
DATE START	11-9-01
DATE FINISH	12-5-01, Mon. Well
WATER LEVELS & DATES	

LITHOLOGY BY ALAN BENFER

DEPTH feet	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
						Soil not sampled or logged from the surface to 28.0-ft.	Qct/Qfc undiff.
30	SPT-1		9		CH	CLAY, high plasticity, ~40% angular chert and weathered limestone gravel, mostly yellow brown, moist, firm CH. Residuum	pPr
	SPT-2		14			CLAY, gravelly to clayey gravel, high plasticity clay, reddish brown, moist, hard, CH-GC. Residuum.	
	SPT-3		76+		CHRT LMS	LIMESTONE, weathered, white to yellowish brown, dry, hard.	Mbk
	NQ-1	31/66"	15			Auger refusal at 34.0-ft. Continue with NQ core. NQ-1, 34.0'- 39.5'. Poor recovery, loss zones unknown. Lost circulation at 34.5' permaently.	

WELL DIAGRAM



ELEVATION feet

Sample Interval ☐ No Sample Taken ▽minimum ▼maximum ▼average

WELDON SPRING SITE REMEDIAL ACTION PROJECT

BOREHOLE AND WELL COMPLETION LOG

HOLE NUMBER: MW-2055

SHEET 2 OF 2

NORTH (Y): 1042419.92

EAST (X): 755000.58

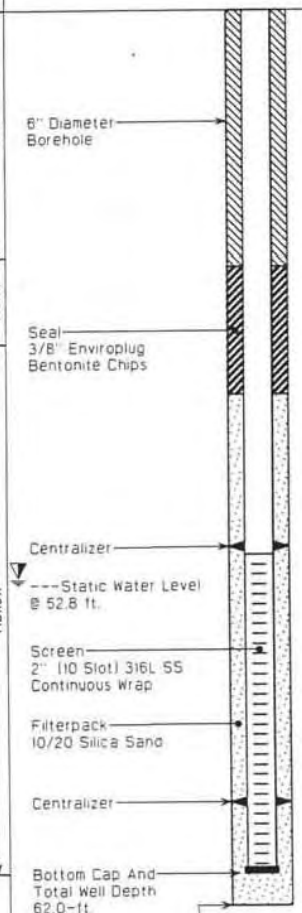
WSMLOG-C

WELL STATUS/COMMENTS: ACTIVE

LOCATION: SO. OF DISPOSAL CELL; PERIMETER WELL

DEPTH feet	SAMPLE	SAMPLE/RUN Number	PERCENT Recovery	N# or RQD	GRAPHIC LOG	SOIL/ROCK class	DESCRIPTION AND REMARKS	STRAT. UNIT
						CHRT LMS	LIMESTONE, slightly weathered, crystalline-grained, locally argillaceous, with specks and thin streaks of MnOx, fossiliferous, light gray to light yellowish brown, vugs up to 1" near bottom of core, some interbedded light gray chert. Rock is relatively fresh, hard, with minimal oxidation. Two clay seams near core bottom; one is 3-1/2" thick with angular chert fragments, lower one is 6" of massive clay with some fine gravel, high plasticity, yellow brown, minor MnOx. Burlington-Keokuk Limestone.	Mdk
40		NQ-2	28/40"	62			@ 39.5'- 42.8'. LIMESTONE as above, becoming oxidized at ~39.7', some styolites, ~30% scattered chert, appears brecciated, fossiliferous, mostly light gray. Up to 4+ fractures per foot, rough, open, oxidized.	
		NQ-3	52/70"	13			@ 41.5'. Scattered oxidized sulfides, increased limestone weathering at 42.7'. Bit dropped at ~41.8' to ~42.5'. Weathered Burlington- Keokuk Limestone.	MDkW
45							@ 43.5'- 44.1' CHERT, hard, white, light and blue gray.	
							@44.6'- 45.0'. Silty clay with limestone fragments.	
		NQ-4	58/67"	54			@ 45.4'- 46.6'. LIMESTONE, moderately weathered, moderate solutioning with vugs up to 1", generally coarse-grained, some argillaceous, FeOx staining with thin streaks of MnOx, mostly light yellow brown, with ~ 30% scattered interbedded chert, generally light gray.	
50							@ 48.2'- 52.0'. CHERT, hard, with thin streaks of MnOx, fracture surfaces oxidized, white to pale yellow, with up to ~25% thinly interbedded limestone, strongly weathered at 49.2-ft., soft, argillaceous, dark yellowish orange. At 50.1 to 52.0-ft., limestone is very vuggy along bedding; clayey. One to 4+ fractures per foot, rough; broken. Strongly weathered Burlington-Keokuk Limestone.	MDkSW
		NQ-5	91/94"	77			@ 52.0'- 53.8'. CHERT, hard, bluish gray with ~40% limestone, strongly weathered, argillaceous, generally interbedded, a few vugs, yellowish orange.	
55							@ ~53.7'. Cut fast. Very vuggy at 53.6-ft.	
60							CHERT AND LIMESTONE as above, ~40% limestone, strongly weathered, locally can be scratched with fingernail, a few vugs. Chert is bluish gray, locally fossiliferous. One to 3+ fractures per foot, rough, open, some broken.	
							@ 60.5'. 1/2" patch of oxidized pyrite.	
							Total cored depth 62.0', 11-15-01. Hole reamed to 6" diameter to 63.0' and a 2" monitoring well was constructed.	
65							Packer testing was not performed.	
70								
75								

WELL DIAGRAM



ELEVATION feet: 620, 615, 610, 605, 600, 595, 590, 585

Sample Interval | No Sample Taken | minimum | maximum | average

Attachment B

Statistical Evaluation of Detection Monitoring Data (1998 to 2001)

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B.1 Evaluation Summary – 1998 through 2001

Under the original version of this plan, the elements of the detection monitoring program included:

- Collecting four replicate samples at each location on a semiannual basis,
- Measuring groundwater elevation at each well location, as well as flow rate for the spring, on a quarterly schedule and immediately prior to each semiannual sampling event,
- Analyzing for the entire list of constituents presented in Table K–3 of the main text of this report, and noting any unusual colors, odors, or turbidity,
- Evaluating analytical data in comparison with background levels to identify statistically significant increases that may indicate an impact from the disposal cell, and
- For parameters that appear to exceed background levels: reviewing analytical results for potential errors, evaluating cell leachate volume data to confirm liner integrity, and resampling individual locations for the suspect parameters.

The detection monitoring data obtained from 1998 to 2001 were evaluated in accordance with the EPA guidance on *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA 1989). This document provides guidance on conducting various types of statistical analyses under the RCRA groundwater monitoring regulations (40 CFR 264, Subpart F). The foundational assumption of each statistical method is that the waste management unit is situated on an uncontaminated aquifer and that the only source of increases in contaminant concentrations in the groundwater is leakage from the waste management unit. The guidance cautions against the use of the prescribed methods in evaluating data from wells that have shown evidence of preexisting contamination or where a high degree of spatial variation exists between the background wells and compliance wells, both of which are true for the Weldon Spring Site.

In the absence of regulatory guidance on more appropriate statistical methods for use at a site with preexisting groundwater contamination, detection monitoring data have been evaluated by several different methods, as discussed below.

B.1.1 1998 Results

Detection monitoring data from 1998 were evaluated by means of both parametric and nonparametric analysis of variances (ANOVA) analyses. Results of these analyses, which are presented in the *Weldon Spring Site Environmental Report for Calendar Year 1998* (MK-F and JEG 1999), are based on a comparison of data from the compliance wells, MW-2032 and MW-2045 through MW-2047, with data from the upgradient (i.e., “background”) well, MW-2048. These analyses resulted in a large number of statistical failures which, if they had been based on data from a previously uncontaminated aquifer, would have provided evidence of groundwater impact due to the disposal cell.

Many of the test failures were determined to be attributable to preexisting concentrations of certain parameters being higher in the compliance wells than in the upgradient well prior to waste placement (March 1998). However, after disregarding the parameters in which this was the case, the following parameters still failed at least one of the statistical tests:

- MW-2032 Chromium, silver, thallium

- MW-2045 Calcium, radium-228
- MW-2046 Silver, vanadium, TOX
- MW-2047 Vanadium, zinc, 1,3,5-TNB

The monitoring data for parameters that failed the interwell comparisons were further evaluated by means of ANOVA procedures based on intrawell comparisons with baseline data from the same locations. This testing resulted in the following statistical failures:

- MW-2045 Calcium
- MW-2046 Vanadium
- MW-2047 Vanadium, 1,3,5-TNB

All of the above statistical failures were attributed to natural fluctuations in the existing groundwater quality. It was not reasonable to consider these test failures to be indicators of cell leakage because waste placement, and subsequent leachate production, began only a few months before the first 1998 detection monitoring event, and contaminant fate and transport analyses had predicted a 53-year interval before contaminants leaking from the cell would be detected in the monitoring wells (Tomasko et al. 1996). In addition, the use of the upgradient well, MW-2048, as a "background" well was determined to be inappropriate since several constituents were already higher in this well than in any of the compliance wells before waste placement began.

B.1.2 1999 Results

The detection monitoring program was modified in 1999, after review of the previous 2 years of groundwater and leachate data. Several parameters were eliminated from the monitoring list. Also, the monitoring frequency was reduced to a single sample obtained semiannually from each location instead of the four replicates previously collected.

In an effort to derive a more reliable means of evaluating data, an intrawell tolerance interval approach was used to evaluate the 1999 data instead of the ANOVA procedures used the previous year. A intrawell tolerance limit approach was considered the preferred method of evaluating data because this approach resulted in fewer false positive results that any of the other types of statistical analyses performed to date. Also, due to the heterogeneous nature of the aquifer it can be expected that each well would act independently because it monitors a discrete portion of the aquifer. By this method, each monitoring location (including the upgradient well) was considered to be a point of compliance, and "background" conditions were described by the contaminant concentrations measured at each location during baseline monitoring. Tolerance limits were calculated for each parameter at each monitoring location according to the methodology in S*tatistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA 1989).

Using the baseline data collected prior to waste placement, upper tolerance limits were established based on the assumptions of a normal data distribution and a 95% level of confidence. Data from the two semiannual monitoring events were compared to the baseline values, and any exceedances were investigated through the data verification process, sample reanalysis, and/or resampling. All confirmed exceedances were reported as statistically significant increases. The *Weldon Spring Site Environmental Report for Calendar Year 1999*

(MK-F and JEG 2000b) summarizes the results of statistical analysis of the 1999 data, in which the following parameters exceeded baseline for at least one of the sampling events:

- MW-2032 Chemical oxygen demand (COD), chromium, nickel
- MW-2045 Arsenic, chromium, molybdenum, nickel
- MW-2046 Aluminum, barium, chromium, magnesium, nickel, COD
- MW-2047 COD
- MW-2048 Magnesium, sulfate

As in the previous 2 years, the above statistical failures were attributed to natural fluctuations in the existing groundwater quality. However, in accordance with the original version of this plan, a thorough study of the monitoring network was conducted in 2000 to confirm that the recurring baseline exceedances were not true indicators of cell leakage. This study was documented in the *Weldon Spring Site Cell Groundwater Monitoring Demonstration Report* (MK-F and JEG 2000a). It included an evaluation of historical site-wide groundwater quality, review of leachate flow rate and analytical data, analysis of groundwater elevation fluctuations, comparison of filtered and unfiltered samples for metals analysis, and review of cell well construction and performance information.

The demonstration report concluded that the baseline exceedances were not due to contaminant migration from the cell, but rather were the result of variations in previously existing groundwater contamination compounded by poor hydraulic performance of some of the wells. The following actions were recommended to alleviate the recurrence of similarly false positive results in future sampling events:

- Attempt to improve the flow rate and clarity of groundwater in MW-2045 by redeveloping it prior to the next sampling event,
- Install an additional compliance well in the vicinity of MW-2045 to provide supplemental monitoring on the northeast side of the disposal cell, and
- Recalculate the upper tolerance limit for the baseline values of each parameter at each well. The new limits should be based on the assumption that the four replicates obtained during each quarterly baseline event were not truly independent samples but represented a single event.

Results of the filtered metals analyses confirmed that most of the metals exceedances coincided with high turbidity and likely resulted from metals adhering to suspended clay particles in the groundwater. Although the filtering of groundwater samples for metals analyses is an acceptable sampling procedure, it was not listed as a recommendation in the demonstration report because baseline values were already established using unfiltered samples.

B.1.3 2000 Results

The recommendations from the demonstration report were implemented, and the 2000 data were evaluated using the tolerance interval approach with the recalculated tolerance limits. The *Weldon Spring Site Environmental Report for Calendar Year 2000* (MK-F and JEG 2000)

contains the results of this evaluation, in which the following parameters exceeded the new baseline tolerance limits during at least one of the semiannual sampling events:

- MW-2045 Chromium, molybdenum
- MW-2046 Molybdenum
- MW-2047 Chromium
- MW-2048 Chromium, magnesium, molybdenum, sulfate

B.1.4 2001 Results

Results of the 2001 detection sampling, which were evaluated in the same manner as in the previous year, are presented in the *Weldon Spring Site Environmental Report for Calendar Year 2001* (MK-F and JEG 2001). The following parameters were identified as exceeding baseline tolerance limits during at least one of the semiannual sampling events:

- MW-2045 Chromium, molybdenum, nickel
- MW-2046 Nickel, 2,4,6-TNT
- MW-2048 Sulfate

Two new wells were installed and one was abandoned under the disposal cell monitoring program in 2001. MW-2051 and MW-2055 were installed and MW-2048 was abandoned. Baseline monitoring data was collected from these wells in 2001 and 2002, and they were added to the detection monitoring program in 2002.

B.2 Evaluation Summary–2004

In response to a comment from the Missouri Department of Natural Resources regarding the distribution of the groundwater data from the disposal cell wells, a statistical evaluation of the data was performed. This analysis consisted of a determination of the data distribution and the appropriateness of the baseline tolerance limits for evaluation of the detection monitoring data.

B.2.1 Data Distribution

The data for the signature parameters at locations MW-2032, MW-2046, MW-2047, MW-2051, MW-2055, and SP-6301 were reexamined to determine whether the data is Normal or log-Normal. Testing for Normality or log-Normality were done by three different methods, as suggested as alternative tests in the EPA *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* – Addendum to Interim Final Guidance (EPA 1992). These tests were:

- Probability Plot Correlation Coefficient
- Shaprio-Wilk Test of Normality ($n<50$) or Shaprio-Francia Test of Normality ($n>50$)
- Coefficient of Skewness

The tests were performed for both the non-transformed data and log-transformed data for each of the four signature parameters at each location. Each of the signature parameters at each of the locations passed at least one of the three tests for Normality and log-Normality. For example, at location MW-2051 the results were:

Analyte	Test Method					
	PPCC	CS	SW/SF	PPCC	CS	SW/SF
	Non-transformed Data			Log-transformed Data		
Barium	N		N	N	N	N
Iron		N			N	
Manganese	N	N	N	N	N	N
Uranium	N		N	N	N	N

PPCC – Probability Plot Correlation Coefficient
CS – Coefficient of Skewness
SW – Shapiro-Wilk Test of Normality (n<50)
SF – Shapiro-Francia Test of Normality (n>50)
N – Criteria for Normality met

The other locations show similar results. Although the data shows a slightly stronger evidence of log-Normality than Normality, the data can be treated as Normal because of the difficulty in calculating the mean and variance/standard deviation for a log-Normal distribution.

B.2.2 Review of Baseline Tolerance Limits

All the available data was used in calculating baseline tolerance limits. Data points that may have been compromised in some manner should be excluded. Compromised data may include data collected after any disturbance of the sub-surface such as by drilling, excavation, soil sampling, etc. that may dramatically increase the mobility/solubility of some contaminants.

To demonstrate that there is little difference in the method used to calculate the baseline tolerance limit, values for the signature parameters at three of these locations were calculated using six methods (Table B−1). All of the data for each location were used in the calculations.

The method outlined in the EPA Guidance (EPA 1989 and EPA 1992) is designed to treat below detection limit values differently from other methods of calculating a benchmark or baseline tolerance limit where below detection limit values are typically set at one-half the detection limit. However, the EPA Guidance method assumes that all the below detection limit values have the same detection limit, which is seldom the case and complicates the analysis.

The values in the table for MW-2051 show more variation than the other locations, particularly for iron, manganese, and uranium. This is likely due to the small data sets, where only five or six values for each of the signature parameters have been collected, and one or two extreme or outlier values can skew the calculated value.

Table B−1. Calculated Baseline Tolerance Limits for MW-2032, MW-2046, and MW-2051

Location	Method	Ba (µg/L)	Fe (µg/L)	Mn (µg/L)	U (pCi/L)
MW-2032	EPA Guidance – Normal Data[a]	338.8	889.9	45.2	5.60
	Tolerance Limit – Normal Data[b]	376.7	1125.2	56.6	6.42
	xbar+3s – Normal Data	389.9	117.8	56.3	6.73
	EPA Guidance – log-Normal Data[a,c]	334.2	926.7	45.7	6.96
	Tolerance Limit – log-Normal Data[b,c]	370.7	1178.1	57.4	9.35
	xbar+3s – log-Normal Data[c]	383.4	1170.3	57.0	9.89
MW-2046	EPA Guidance – Normal Data[a]	256.5	1238.6	147.7	1.67
	Tolerance Limit – Normal Data[b]	276.7	1577.5	186.9	1.76
	xbar+3s – Normal Data	287.0	1566.9	185.7	1.84
	EPA Guidance – log-Normal Data[a,c]	249.9	1156.0	151.2	1.48
	Tolerance Limit – log-Normal Data[b,c]	268.3	1464.2	191.9	1.92
	xbar+3s – log-Normal Data[c]	277.6	1454.6	190.7	2.02
MW-2051	EPA Guidance – Normal Data[a]	253.2	2200.8	205.5	3.68
	Tolerance Limit – Normal Data[b]	285.3	2895.9	265.4	4.51
	xbar+3s – Normal Data	236.4	1657.9	158.7	3.12
	EPA Guidance – log-Normal Data[a,c]	248.5	1384.8	286.7	3.27
	Tolerance Limit – log-Normal Data[b,c]	278.9	1799.4	374.9	4.64
	xbar+3s – log-Normal Data[c]	232.6	1061.0	217.8	3.20

[a]Calculated by method outlined in EPA Addendum to Interim Final Guidance for Statistical Analysis of Ground-Water Monitoring at RCRA Facilities.
[b]Bowker, Albert H. and Gerald J. Liberman, Engineering Statistics, Section 8.12 and 8.13.
[c]Mean and standard deviation for log-Normal calculated by method from Gilbert, Richard O., Statistical Methods for Environmental Pollution Monitoring, Section 13.1.1.

Comparison of the six different calculation methods yielded the following conclusions:

1. There is not much difference in the EPA Guidance Normal Data values and the EPA Guidance log-Normal Data values except for iron and manganese at MW-2051. Although the below detection limit values are treated the same in both these calculations, the difference is likely due to small sample size and outlier values as noted above.

2. The EPA Guidance Normal Data values and the Tolerance Limit Normal Data show some variation in many cases. The difference is probably attributable to the difference in the treatment of below detection limit values. The same argument can be stated for the EPA Guidance log-Normal Data values and the Tolerance Limit log-Normal Data values.

3. The Tolerance Limit Normal Data values and the “xbar+3s” Normal Data values are very similar, except at MW-2051. This is expected because the only difference is the tolerance factor multiplier. The Tolerance Limit is calculated as “xbar+ks”, where the tolerance factor multiplier ‘k’ is from a table depending on the sample size and the probability that the calculated interval contains a give percent of the distribution. For the “xbar+3s” method the multiplier factor is always 3. The range for this factor is from approximately 2.2 to 10.5. As the sample size decrease the tolerance factor multiplier increases. This accounts for the difference in the values at MW-2051. The same argument can be stated for the Tolerance Limit log-Normal Data values and the “xbar+3s” log-Normal values.

Based on the analysis discussed above, it was not recommend to change the method currently used (tolerances limits) for calculation of benchmarks for the signature parameters. All of the available data that has not been compromised should be used. In addition, the 'arithmetic mean plus 3 standard deviations' is appropriate for the non-signature parameters since they are not a concern in the leachate.

B.5 References

EPA (U.S. Environmental Protection Agency), 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance*, EPA/530-SW-89-026, Office of Solid Waste, Waste Management Division,Washington, D.C., April.

EPA (U.S. Environmental Protection Agency), 1992. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities - Interim Final Guidance,* EPA/530-SW-93-001, Office of Solid Waste, Waste Management Division,Washington, D.C., November.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 1999. *Weldon Spring Site Environmental Report for Calendar Year 1998*, Rev. 0, DOE/OR/21548-773, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2000a. *Weldon Spring Site Cell Groundwater Monitoring Demonstration Report*, Rev. 0, DOE/OR/21548-864, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, St. Charles, Missouri, November.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2000b. *Weldon Spring Site Environmental Report for Calendar Year 1999,* Rev. 0, DOE/OR/21548-845, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

MK-F and JEG (MK-Ferguson Company and Jacobs Engineering Group), 2001. *Weldon Spring Site Environmental Report for Calendar Year 2000*, Rev. 0, DOE/OR/21548-886, prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring, Missouri, July.

Tomasko, D., J.J. Quinn, L.A. Durham, 1996. *Groundwater Flow at the Chemical Plant Area of the Weldon Spring Site: Simulations of the Effect of the Disposal Cell on the Flow Field*, prepared by Argonne National Laboratory, Environmental Assessment Division, Argonne, Illinois, October.

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Attachment C

Review of Groundwater and Leachate Data—2007

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It was determined that periodic review of the groundwater and leachate data should be performed in order to evaluate possible changes in groundwater quality and composition of the leachate that could impact the monitoring program. Also, it was determined that every 5 years, the baseline tolerance limits for the signature parameters would be recalculated.

The following are general discussions regarding the groundwater and leachate data. Summary statistics for the groundwater and leachate are presented in Table C−1. Specific discussions regarding the groundwater and seep data are presented in the annual reports.

C.1 Groundwater

From 2003 through 2007, the cell wells and Burgermeister Spring have been sampled semiannually. The general groundwater quality has been stable and has shown little variation over time. During the time period of 2003 through 2007, the concentrations of the signature parameters in the cell wells and Burgermeister Spring have been less than the baseline tolerance limits, with the exception of iron and manganese in MW-2032. Increases in iron and manganese, as well as other parameters in this well were attributed to biodegradation of natural organic material (ants) in the well as discussed in the *Cell Groundwater Monitoring Demonstration Report for the December 2004 Sampling Event* (DOE 2005). This well exhibited a conversion from fully oxidizing to chemically reducing due to the decay of ants in the well. After implementation of corrective action, the geochemistry of the well as returned to normal in 2006.

C.2 Leachate

In general, the composition of the leachate has remained stable over time, with the exception of iron, manganese, and uranium. These three constituent have shown a general decline over time. Increasing concentrations over time have not been identified in any of the monitored constituents in the leachate.

C.3 Evaluation of Signature Parameters

It was anticipated during development of the detection monitoring program that the list of signature parameters may be modified, as necessary, based on future changes in leachate and/or groundwater concentrations. Barium, iron, manganese, and uranium were identified in the *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan, Revision 2* (DOE 2004) as "signature parameters" for the disposal cell detection monitoring program. Based on data collected from 2000 through 2002, all four of these parameters had been detected at concentrations at least an order of magnitude higher in the leachate than in the underlying groundwater or Burgermeister Spring (with the exception of uranium), which enhances the reliability of any conclusions that are drawn based on fluctuations in groundwater constituents. It was determined that increasing trends of these four parameters in the groundwater would be considered a signature of cell leachate that has migrated to the underlying aquifer.

A comparison of the annual averages for each signature parameters in the leachate and cells wells or Burgermeister Spring indicates that the concentrations of iron (Figure C−1) and manganese (Figure C−2) in the leachate have decreased to levels that no longer exceed those detected in the groundwater by an order of magnitude. Although the levels of uranium in the leachate have decreased over time (Figure C−3), the levels are still an order of magnitude greater

than those detected in groundwater. Barium concentrations in the leachate (Figure C−4) have remained stable in the leachate and continue to be greater in the leachate than in the groundwater.

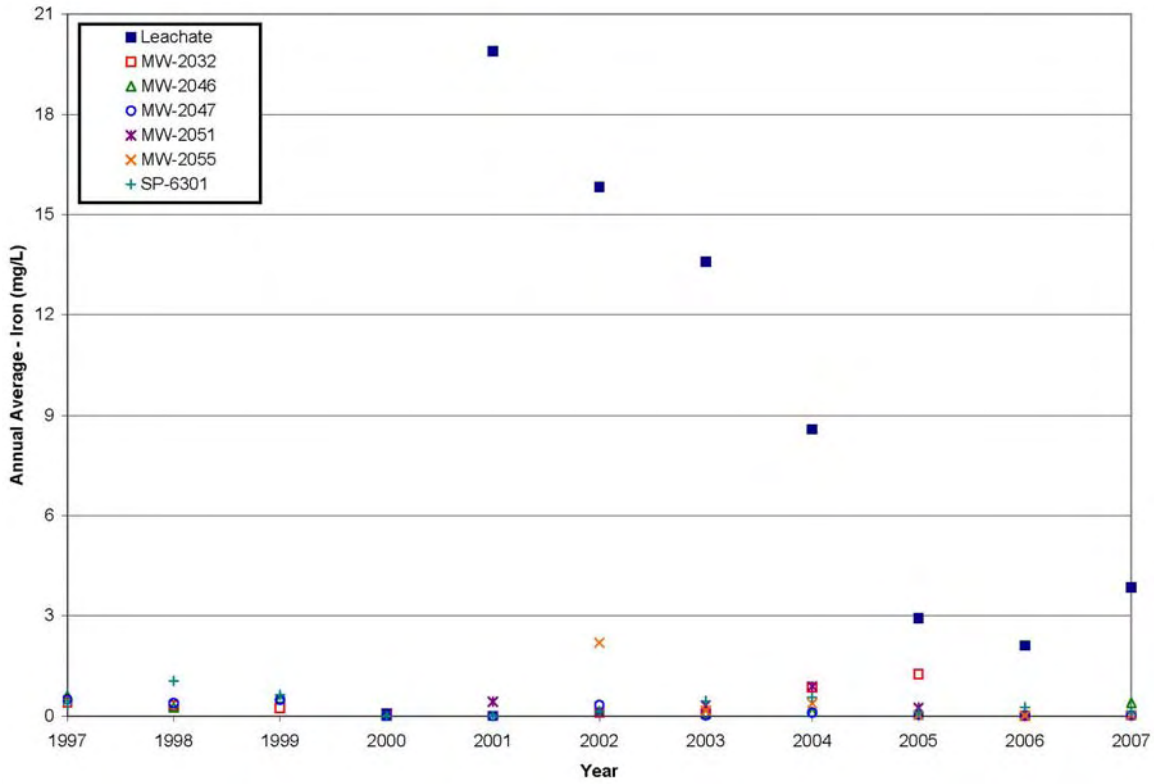

Figure C−1. Annual Averages for Iron in Leachate and Cell Monitoring Network

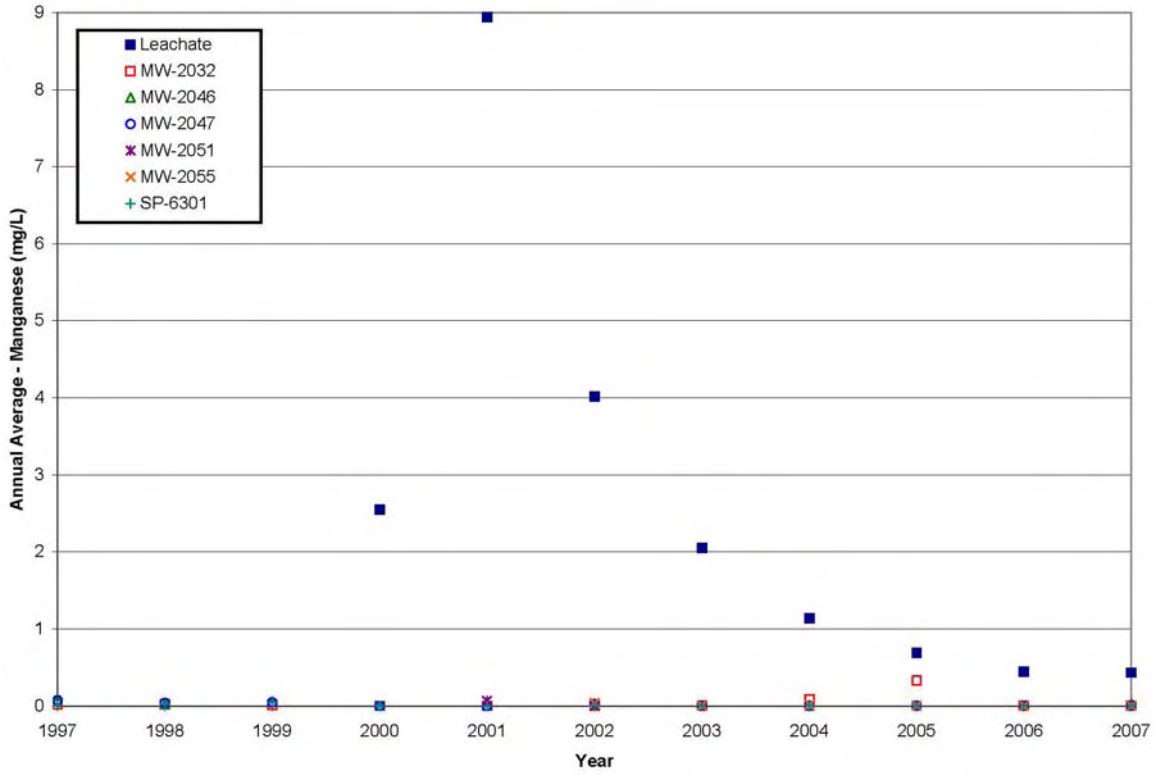

Figure C–2. Annual Averages for Manganese in Leachate and Cell Monitoring Network

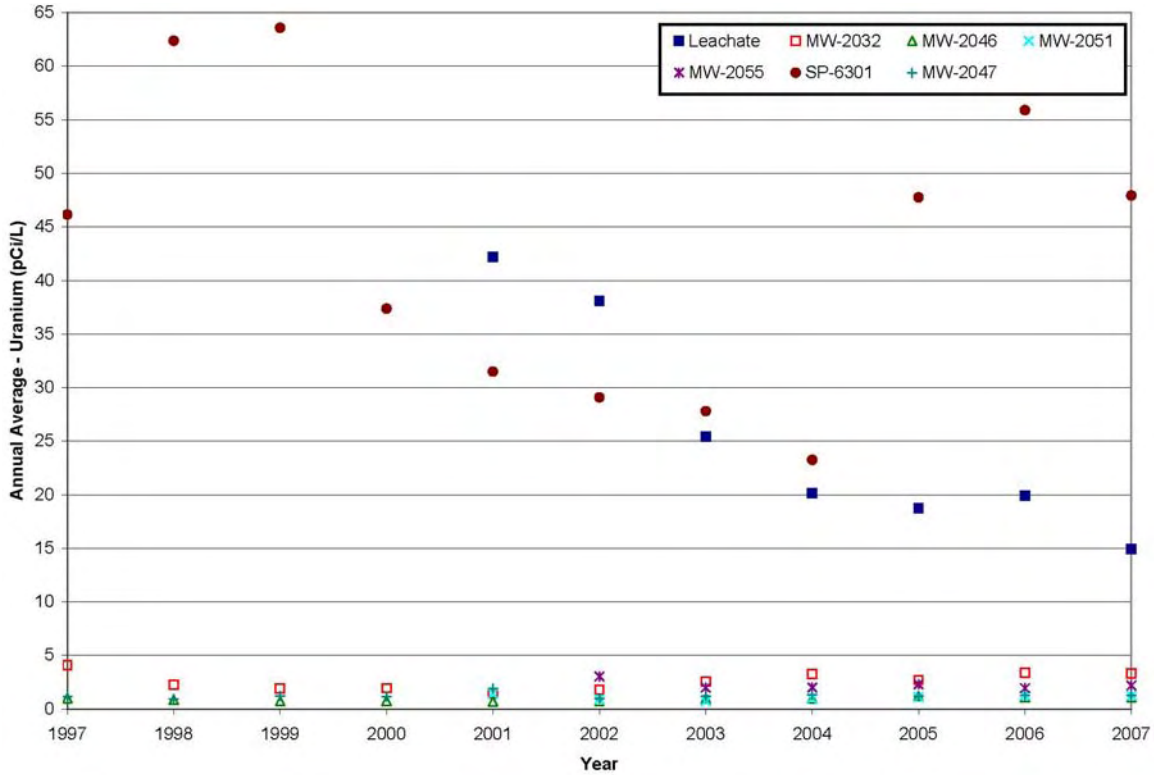

Figure C–3. Annual Averages for Uranium in Leachate and Cell Monitoring Network

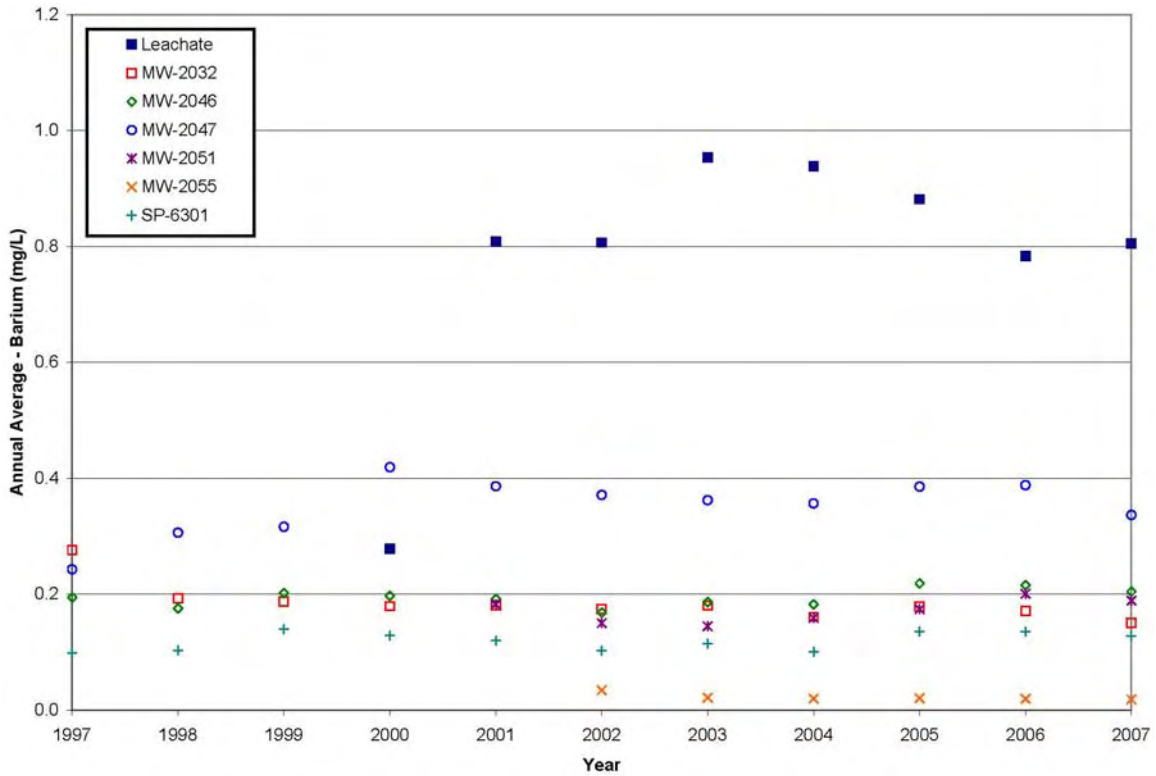

Figure C–4. Annual Averages for Barium in Leachate and Cell Monitoring Network

Based on the evaluation of the concentrations of the signature parameters in the leachate and the groundwater, it is concluded that barium and uranium will continue to be monitored as signature parameters under the baseline monitoring program. New baseline tolerance limits will be calculated for the 5 disposal cell monitoring wells and Burgermeister Spring. Iron and manganese will no longer be used as signature parameters. The concentrations of these two parameters have decreased over time to levels that no longer distinguish possible cell leakage from the natural groundwater chemistry.

C.4 Evaluation of Long-Term Monitoring Parameters

The monitoring program must include those constituents that have been detected in the groundwater and that are reasonably expected to be in or derived from waste in the disposal cell. Based on the review of the groundwater and leachate data, the following contaminants will continue to be monitored in the five disposal cell wells and Burgermeister Spring: arsenic, barium, chromium, lead, manganese, nickel, selenium, thallium, nitroaromatic compounds, radium-226/228, thorium-228/230/232, PAHs, and PCBs. These constituents have been identified as COCs for either the chemical plant and/or bulk wastes or were generated during water treatment processes.

The leachate will continue to be monitored for the present list or parameters. If changes are identified in the composition of the leachate, monitoring parameters for the groundwater will be evaluated.

Average of RESULT		LOCATION_CODE						
ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Arsenic	1997		0.00275	0.00253	0.00262			0.00309
	1998		0.00236	0.00230	0.00228			0.00252
	1999		0.00200	0.00202	0.00200			0.00206
	2000	0.00150	0.00145	0.00185	0.00185			0.00165
	2001	0.00873	0.00210	0.00250	0.00215	0.00167		0.00205
	2002	0.00493	0.00220	0.00220	0.00220	0.00220	0.00214	0.00205
	2003	0.00335	0.00024	0.00011	0.00011	0.00014	0.00011	0.00033
	2004	0.00370	0.00104	0.00057	0.00057	0.00057	0.00057	0.00057
	2005	0.00360	0.00180	0.00150	0.00155	0.00150	0.00180	0.00255
	2006	0.00305	0.00190	0.00190	0.00190	0.00190	0.00190	0.00180
	2007	0.00335	0.00190	0.00190	0.00190	0.00190	0.00190	0.00190
Chemical Oxygen Demand	1997		4.37750	4.71875	4.62813			6.88063
	1998		4.97563	5.98563	4.63500			21.89700
	1999		9.28000	9.14000	7.94000			4.39400
	2000		16.66667	16.66667	17.00000			14.50000
	2001	30.60000	4.28500	3.37000	4.37000	6.66667		5.64500
	2002	27.92308	5.00000	5.00000	5.00000	5.00000	5.80000	5.00000
	2003	27.90000	9.00000	8.50000	5.00000	9.00000	11.00000	13.75000
	2004	29.83333	28.00000	4.80000	3.30000	3.30000	3.30000	7.44000
	2005	34.50000	7.00000	6.00000	3.00000	7.50000	4.00000	4.00000
	2006	32.00000	11.00000	7.20000	9.70000	6.20000	2.40000	6.60000
	2007	84.00000	59.00000	41.50000	59.50000	49.00000	44.30000	66.33333
Chloride	1997		10.88063	17.45000	8.13563			13.12500
	1998		5.70063	18.15625	6.45125			8.58769
	1999		5.84800	17.50000	6.13800			15.09778
	2000	18.60000	2.75000	14.35000	6.70000			17.58750
	2001	28.40000	4.38000	14.95000	7.06500	25.93333		17.41667
	2002	34.75000	8.50000	19.55000	7.10000	37.05000	4.18600	19.75000
	2003	34.06667	7.78000	25.96667	7.57500	36.55000	5.11000	13.28000
	2004	34.45000	6.00000	28.75000	8.05000	28.65000	4.55000	9.50000
	2005	35.50000	4.95000	31.10000	8.10000	22.25000	5.15000	20.00000
	2006	35.80000	3.05000	42.40000	7.95000	16.00000	5.40000	16.50000
	2007	37.15000	2.45000	40.00000	7.50000	11.95000	4.45000	25.80000

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Chromium	1997		0.00206	0.00316	0.00269			0.00431
	1998		0.00448	0.00326	0.00334			0.00272
	1999		0.00514	0.00600	0.00416			0.00244
	2000	0.00080	0.00518	0.00308	0.00870			0.00251
	2001	0.00062	0.00565	0.00345	0.00375	0.00140		0.00082
	2002	0.00170	0.00410	0.00215	0.00455	0.00190	0.00902	0.00161
	2003	0.00097	0.00280	0.00098	0.00370	0.01480	0.00455	0.00100
	2004	0.00175	0.00370	0.00245	0.00520	0.12705	0.01905	0.00228
	2005	0.00260	0.00380	0.00265	0.00605	0.04015	0.00850	0.00260
	2006	0.00310	0.00495	0.00310	0.00650	0.00700	0.00750	0.00310
	2007	0.00250	0.00250	0.00300	0.00355	0.00250	0.00400	0.00250
Cobalt	1997		0.00095	0.00138	0.00159			0.00331
	1998		0.00283	0.00264	0.00264			0.00244
	1999		0.00220	0.00238	0.00220			0.00097
	2000	0.00300	0.00249	0.00249	0.00249			0.00264
	2001	0.02540	0.00185	0.00225	0.00121	0.00149		0.00091
	2002	0.01459	0.00119	0.00119	0.00119	0.00119	0.00352	0.00160
	2003	0.00807	0.00100	0.00100	0.00115	0.00110	0.00100	0.00100
	2004	0.00570	0.00157	0.00025	0.00025	0.00077	0.00070	0.00024
	2005	0.00370	0.00167	0.00166	0.00166	0.00166	0.00052	0.00166
	2006	0.00500	0.00266	0.00267	0.00273	0.00266	0.00267	0.00500
	2007	0.00505	0.00500	0.00500	0.00500	0.00500	0.00500	0.00500
Dissolved Oxygen	2001	1.09000	5.20000	5.68667	5.45333	4.93000		6.45000
	2002		4.95250	4.91000	4.62500	6.19200	4.86200	6.85500
	2003	2.78000	8.24000	8.58000	7.93500	9.67500	7.70500	7.97857
	2004	4.31800	5.60000	7.62500	6.91500	8.99000	10.26500	8.85200
	2005	5.27333	2.49250	8.33667	6.84000	10.22667	7.18500	8.98000
	2006	4.67429	4.89250	7.60000	5.84500	8.24000	6.02500	6.86000
	2007	3.20714	4.50000	6.96500	5.26000	8.27000	6.83000	8.05667
Fluoride	1997		0.27125	0.05844	0.16794			0.18650
	1998		0.26825	0.35113	0.40163			0.28738
	1999		0.19800	0.33000	0.25100			0.25067
	2000	0.20000	0.21000	0.13500	0.12500			0.39475
	2001	0.21650	0.19450	0.08550	0.08700	0.29000		0.25640
	2002	0.26600	0.27000	0.34000	0.19500	0.36000	0.12400	0.26667
	2003	0.17907	0.12715	0.19710	0.01875	0.15670	0.16110	0.13805
	2004	0.29000	0.18000	0.11000	0.10800	0.15500	0.10950	0.08300
	2005	0.24000	0.20500	0.10150	0.10500	0.17500	0.13500	0.19000
	2006	0.25000	0.17000	0.10350	0.09650	0.17000	0.10900	0.15667
	2007	0.22500	0.16000	0.11500	0.06850	0.13500	0.08950	0.14000

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Lead	1997		0.00156	0.00161	0.00158			0.00193
	1998		0.00159	0.00166	0.00163			0.00173
	1999		0.00140	0.00150	0.00140			0.00166
	2000	0.00160	0.00200	0.00440	0.00200			0.00188
	2001	0.00121	0.00122	0.00257	0.00122	0.00128		0.00122
	2002	0.00152	0.00205	0.00170	0.00205	0.00205	0.00259	0.00197
	2003	0.00067	0.00050	0.00141	0.00028	0.00038	0.00037	0.00045
	2004	0.00069	0.00110	0.00110	0.00110	0.00110	0.00110	0.00110
	2005	0.00084	0.00084	0.00084	0.00084	0.00084	0.00057	0.00084
	2006	0.00160	0.00105	0.00105	0.00105	0.00105	0.00105	0.00160
	2007	0.00240	0.00240	0.00240	0.00240	0.00240	0.00240	0.00240
Nickel	1997		0.00358	0.00786	0.01946			0.00493
	1998		0.01099	0.00975	0.00991			0.00680
	1999		0.00728	0.02386	0.01156			0.00184
	2000	0.00290	0.00883	0.02518	0.01020			0.00120
	2001	0.01390	0.00386	0.03975	0.00595	0.02407		0.00201
	2002	0.01072	0.00505	0.02713	0.00700	0.00830	0.02088	0.00365
	2003	0.00754	0.00345	0.01005	0.00315	0.03230	0.02785	0.00097
	2004	0.00943	0.01950	0.01080	0.00685	0.06820	0.03170	0.00288
	2005	0.00785	0.01328	0.01615	0.00620	0.00775	0.01695	0.00310
	2006	0.00750	0.00610	0.01955	0.00790	0.00630	0.01520	0.00750
	2007	0.00775	0.00460	0.00885	0.00460	0.00460	0.01085	0.00460
Nitrate as Nitrogen	1997		64.86875	1.53063	78.95625			7.43722
	1998		15.34375	1.86000	98.23125			4.94417
	1999		9.90000	1.78400	61.48000			10.67000
	2000	3.10000	6.26000	3.02500	86.70000			7.11375
	2001	0.07500	4.33500	2.66000	69.95000	0.58933		10.48500
	2002	0.80900	3.10000	1.45000	42.40000	2.01500	0.65600	3.49267
	2003	0.20800	3.61500	2.09000	69.55000	1.44000	0.96300	3.16013
	2004	0.16820	2.23800	36.58500	68.20000	1.15850	0.79900	2.04500
	2005	0.20535	1.34200	2.21000	90.75000	1.62500	0.90000	5.07000
	2006	1.38000	1.68000	1.96000	77.10000	1.61000	1.03000	2.71000
	2007	1.05200	2.58500	2.44500	80.70000	1.80000	1.37450	4.02800

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Oxidation Reduction Potential	1997		118.45833	134.62500	124.82353			
	1998		115.76471	135.07143	129.69231			
	1999		199.40000	202.00000	169.40000			170.00000
	2000		154.00000	158.00000	187.00000			138.00000
	2001	-83.00000		134.00000	121.00000			159.00000
	2002						179.00000	153.75000
	2003	-66.10000		251.40000	217.30000	248.80000	256.00000	292.63333
	2004	-55.67500	39.55000	206.80000	178.70000	92.65000	183.00000	174.50000
	2005	41.28333	4.85000	226.80000	87.30000	190.30000	252.85000	120.70000
	2006	82.12857	108.47500	252.45000	227.25000	231.85000	240.50000	272.30000
	2007	55.14286	127.13333	177.45000	208.75000	181.95000	194.95000	246.37500
pH	1997		7.18417	7.08125	7.31235			6.94813
	1998		7.55381	7.15556	7.29000			6.95611
	1999		7.35167	7.15500	7.43800			7.20500
	2000		7.48000	7.26500	7.21500			6.77000
	2001	6.74000	7.61500	7.05750	7.19500	7.51667		6.78053
	2002		7.39750	6.85333	7.13500	7.41800	7.10800	6.75091
	2003	6.96778	7.65000	7.25333	7.11500	7.70000	7.72500	6.96571
	2004	6.90333	6.99500	6.89500	7.13500	7.52000	7.34500	7.30400
	2005	6.88500	6.84750	6.81667	7.03500	7.24000	6.95500	6.67000
	2006	6.95714	7.15500	6.78500	7.01500	7.17500	6.93000	6.69500
	2007	6.94429	7.23667	6.93500	6.93500	7.05500	6.96000	7.14500
Radium-226	1997		0.37569	0.37456	0.44675			0.32513
	1998		0.34850	0.27144	0.48000			0.24940
	1999		0.33260	0.26300	0.30900			0.35160
	2000	0.27800	0.23000	0.15500	0.26000			0.15733
	2001	0.83400	0.42800	0.58533	0.49800	0.59367		0.49867
	2002	0.36292	0.18650	0.20150	0.38600	0.35000	0.53040	0.23150
	2003	0.53590	0.11600	0.12500	0.20050	0.31950	0.12450	0.12200
	2004	0.51333	0.21000	0.21500	0.34000	0.32000	0.20500	0.20750
	2005	0.36500	0.33500	0.24500	0.35500	0.23600	0.27000	0.24500
	2006	0.38500	0.15500	0.20500	0.45000	0.19000	0.28000	0.18667
	2007	0.56500	0.24500	0.23000	0.45500	0.25000	0.20500	0.23667

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Radium-228	1997		1.61088	1.15081	0.79266			1.57813
	1998		0.59663	0.68888	0.60944			1.10780
	1999		0.65040	0.62460	0.86180			0.71140
	2000	0.46900	0.75500	0.83500	0.83000			0.95000
	2001	0.72600	0.63100	1.45000	1.30600	1.03333		1.70000
	2002	0.73338	0.37650	0.39650	0.38650	0.58650	0.81560	1.43500
	2003	0.86530	0.87500	0.93000	0.90500	0.92000	0.91500	0.90500
	2004	0.84167	0.94000	0.86500	0.85000	0.86000	0.85500	0.98750
	2005	0.69500	1.03500	0.59000	0.85000	1.27000	1.36000	0.66000
	2006	0.81500	0.80000	0.71000	0.87000	0.69000	0.79500	0.76333
	2007	0.67000	0.51000	0.57500	0.50000	0.52000	0.49000	0.43667
Selenium	1997		0.00474	0.00328	0.00386			0.00363
	1998		0.00309	0.00275	0.00339			0.00316
	1999		0.00320	0.00304	0.00312			0.00370
	2000	0.00220	0.00235	0.00280	0.00445			0.00238
	2001	0.00288	0.00235	0.00393	0.00445	0.00120		0.00235
	2002	0.00152	0.00185	0.00275	0.00265	0.00185	0.01322	0.00207
	2003	0.00080	0.00060	0.00320	0.00275	0.00026	0.01210	0.00032
	2004	0.00237	0.00110	0.00390	0.00325	0.00120	0.01365	0.00110
	2005	0.00235	0.00129	0.00465	0.00230	0.00133	0.01410	0.00133
	2006	0.00320	0.00220	0.00415	0.00300	0.00240	0.01375	0.00320
	2007	0.00370	0.00370	0.00460	0.00370	0.00370	0.01285	0.00370
Specific Conductance	1997		1158.83333	927.68750	1076.47059			499.21875
	1998		690.57143	912.77778	1229.23529			519.00000
	1999		626.33333	938.25000	1228.60000			638.00000
	2000		548.00000	887.50000	1132.00000			1323.66667
	2001		598.50000	904.75000	1233.50000	621.66667		555.17647
	2002		630.03575	942.66667	1225.00000	654.40000	1094.00000	417.63636
	2003	1331.40000	477.50000	861.66667	1108.00000	595.50000	1178.50000	378.14286
	2004	1267.60000	775.00000	967.50000	1137.50000	314.95000	1123.00000	324.00000
	2005	1200.66667	550.50000	992.66667	1242.50000	423.06333	1118.00000	537.50000
	2006	1090.85714	646.00000	959.50000	1213.00000	622.00000	1086.50000	456.50000
	2007	1023.85714	567.33333	949.50000	1184.50000	648.00000	1020.50000	476.00000

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Sulfate	1997		40.87500	54.21875	31.05625			51.17778
	1998		24.39375	51.44375	25.93125			38.74615
	1999		22.90000	48.98000	23.42000			45.74444
	2000	163.00000	18.40000	44.10000	23.90000			31.65000
	2001	84.60000	31.85000	44.90000	26.90000	60.50000		28.54000
	2002	70.47500	43.40000	52.30000	23.70000	52.70000	269.50000	21.50000
	2003	43.73333	55.10000	57.83333	25.90000	48.10000	283.50000	21.72500
	2004	34.10000	100.35000	57.45000	24.50000	36.05000	270.50000	20.60000
	2005	33.05000	100.10000	57.60000	24.40000	28.15000	274.00000	24.60000
	2006	45.70000	79.40000	59.15000	22.70000	20.55000	256.50000	22.00000
	2007	32.25000	33.75000	62.25000	24.60000	18.40000	256.00000	27.20000
Thallium	1997		0.00431	0.00396	0.00397			0.00526
	1998		0.00319	0.00308	0.00297			0.00313
	1999		0.00350	0.00340	0.00326			0.00354
	2000	0.00300						
	2001	0.00770				0.00313		
	2002	0.00304	0.00390	0.00520	0.00420	0.00390	0.00538	0.00660
	2003	0.00215	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
	2004	0.00069	0.00044	0.00044	0.00044	0.00044	0.00044	0.00056
	2005	0.00205	0.00151	0.00161	0.00151	0.00151	0.00059	0.00264
	2006	0.00265	0.00166	0.00231	0.00141	0.00141	0.00141	0.00250
	2007	0.00655	0.00520	0.00520	0.00520	0.00520	0.00520	0.00520
Thorium-228	1997		0.18153	0.14853	0.14626			0.44478
	1998		0.14113	0.13950	0.17775			0.19800
	1999		0.08980	0.09880	0.22680			0.08960
	2000	0.19800	0.03900	0.06050	0.06000			0.42350
	2001	0.12120	0.12650	0.10100	0.12050	0.07033		0.15000
	2002	0.21246	0.07350	0.08550	0.09050	0.10050	0.13280	0.10050
	2003	0.16070	0.10000	0.09600	0.11800	0.11750	0.10500	0.11325
	2004	0.24940	0.20250	0.21050	0.24500	0.23500	0.21000	0.23950
	2005	0.29500	0.24500	0.39000	0.30500	0.38500	0.26000	0.18000
	2006	0.17500	0.20500	0.19500	0.20000	0.17500	0.17500	0.41000
	2007	0.22500	0.21500	0.17500	0.18500	0.16500	0.16500	0.23333

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Thorium-230	1997		0.11584	0.12654	0.17845			0.40773
	1998		0.25890	0.24933	0.20378			0.30955
	1999		0.19720	0.12660	0.19620			0.11078
	2000	0.35500	0.07750	0.13800	0.10250			1.19725
	2001	0.17470	0.13450	0.37350	0.14750	0.13000		0.15050
	2002	0.39377	0.25950	0.27900	0.23100	0.23350	0.24740	0.26350
	2003	0.20310	0.14550	0.13950	0.17900	0.15900	0.16500	0.15225
	2004	0.29400	0.25000	0.23000	0.26000	0.32000	0.21000	0.28250
	2005	0.31000	0.20500	0.26000	0.33500	0.17000	0.21500	0.33000
	2006	0.35500	0.32500	0.25000	0.19000	0.30500	0.22500	0.42667
	2007	0.26000	0.19500	0.26000	0.26000	0.15000	0.33000	0.24000
Thorium-232	1997		0.11408	0.08221	0.08663			0.18968
	1998		0.08174	0.07757	0.10387			0.10785
	1999		0.06700	0.04220	0.05320			0.02644
	2000	0.11100	0.02350	0.03950	0.03900			0.21900
	2001	0.06870	0.10150	0.09050	0.07450	0.07733		0.10450
	2002	0.16592	0.06750	0.10650	0.07650	0.07500	0.10440	0.05150
	2003	0.08060	0.03550	0.03600	0.03750	0.02750	0.03500	0.04675
	2004	0.14000	0.13000	0.14650	0.14500	0.12500	0.12500	0.10500
	2005	0.14000	0.13000	0.19000	0.12000	0.12500	0.10500	0.09350
	2006	0.10350	0.10000	0.09150	0.14000	0.11250	0.07900	0.10567
	2007	0.13500	0.12500	0.10400	0.11500	0.14500	0.10550	0.11433
Total Dissolved Solids	1997		763.31250	547.50000	831.00000			298.87500
	1998		444.81250	533.06250	868.56250			211.00000
	1999		359.80000	534.20000	834.40000			430.60000
	2000		337.50000	523.50000	729.00000			376.50000
	2001	941.50000	356.00000	545.50000	762.00000	399.66667		273.50000
	2002	827.40000	416.50000	575.50000	766.50000	388.50000	779.60000	341.00000
	2003	784.66667	451.50000	581.50000	752.00000	345.00000	780.00000	252.50000
	2004	716.00000	499.50000	579.50000	690.00000	347.00000	763.00000	220.75000
	2005	691.00000	303.50000	419.00000	618.00000	393.00000	764.00000	288.50000
	2006	651.00000	461.00000	589.00000	758.00000	382.00000	722.50000	279.00000
	2007	695.00000	310.00000	617.00000	758.50000	406.00000	747.00000	327.33333

ANALYTE	YEAR	LW-DC10	MW-2032	MW-2046	MW-2047	MW-2051	MW-2055	SP-6301
Total Organic Carbon	1997		6.59250	11.78938	10.41563			7.89438
	1998		1.05206	2.01750	1.26938			3.30500
	1999		0.91820	1.72800	0.88700			2.19800
	2000		0.87500	1.10000	0.86500			1.50000
	2001	9.41000	1.02000	1.91000	1.69000	1.56667		2.55000
	2002	9.58000	0.78500	1.30000	0.82500	0.96000	2.25800	1.40000
	2003	10.06667	1.67667	2.85667	1.60000	1.80000	1.60000	2.72500
	2004	10.05000	6.85000	1.70000	0.83500	1.10500	0.77000	2.17500
	2005	11.33500	1.41000	2.10000	1.20000	0.97000	3.02250	2.10000
	2006	0.47000	23.70000	23.70000	23.70000	24.30000	23.70000	23.70000
	2007	12.75000	0.76000	1.85000	0.83500	0.76000	0.76000	1.53333

Attachment D

Groundwater Flow Rate Determination

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Groundwater flow rates and flow directions will be evaluated annually as specified in Section K4.4 of the main text of this report. Results for 1998 through 2002 are presented in this attachment.

D.1 Groundwater Flow Direction

The groundwater flow direction was determined by constructing a potentiometric surface map of the shallow aquifer using the available wells at the chemical plant (Figure D−1). Potentiometric surface maps (Figures D−2 through D−6) were constructed using the average of the groundwater elevations measured during each year. A summary of the average groundwater elevations for each well is included in this attachment.

The potentiometric surface has remained relatively unchanged from 1998 through 2002. The groundwater flow direction is to the north. A groundwater divide is present along the southern boundary of the chemical plant site.

D.2 Groundwater Flow Rates

The calculation of the average groundwater flow rate (average linear velocity) is a function of the hydraulic conductivity (K), the hydraulic gradient (I) and the effective porosity (ne) of the shallow aquifer:

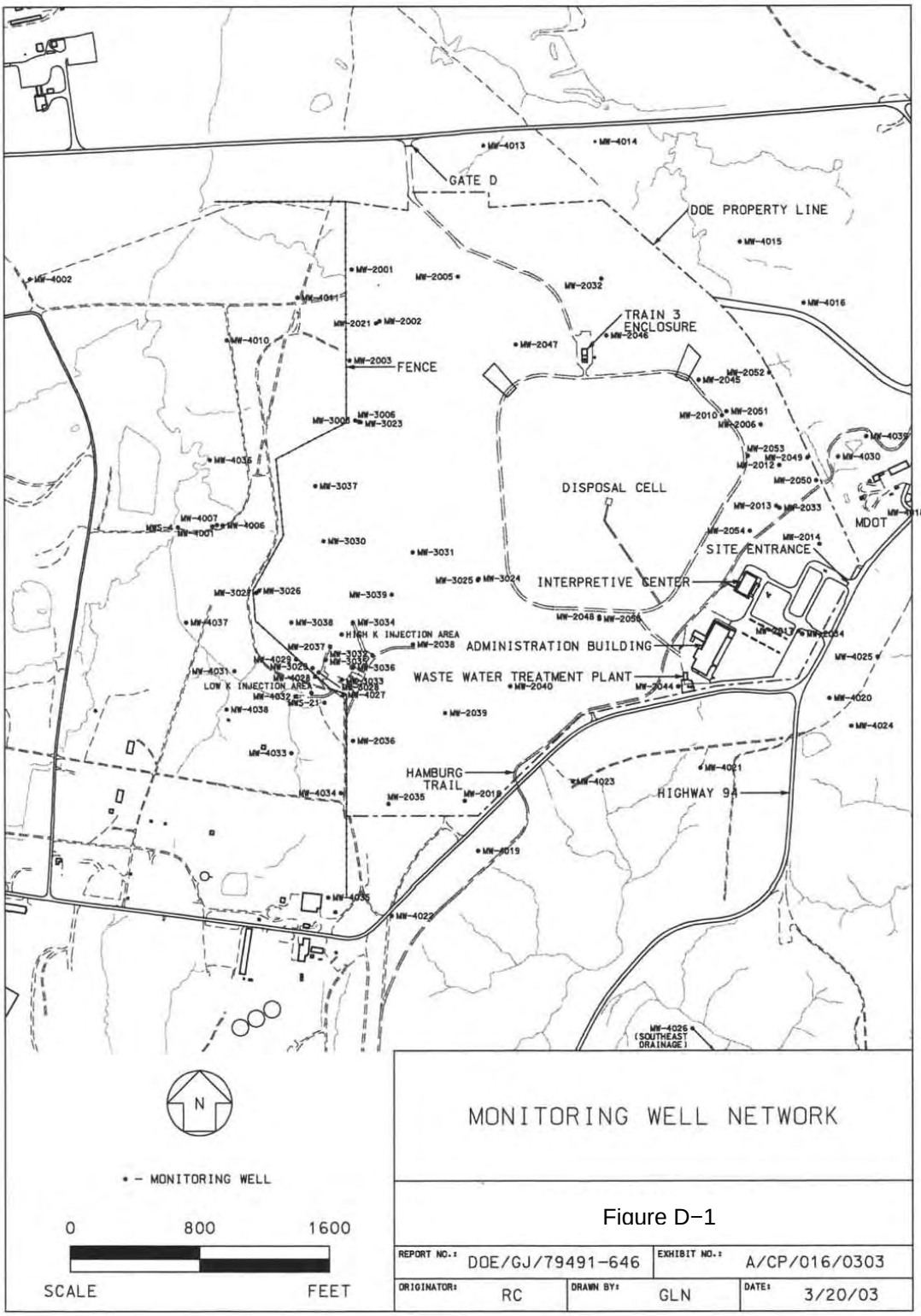
$$v = - Ki / ne$$

The average groundwater flow rate for each year is summarized in Table D−1.

Table D−1. Average Groundwater Flow Rate From 1998 Through 2002

Year	Hydraulic Conductivity (cm/s)[a]	Effective Porosity[b]	GW Elevation		Hydraulic Gradient (ft/ft)[d]	Average Flow Rate (ft/day)
			MW-2048[c]	MW-2032		
1998	0.007	0.10	607.5	582.9	0.012	2.4
1999			607.5	583.0	0.012	2.4
2000			607.5	582.9	0.012	2.4
2001			607.3	582.9	0.012	2.4
2002			606.8	582.9	0.011	2.2

[a]Average hydraulic conductivity using data from the cell monitoring wells.
[b]Value selected to estimate maximum groundwater flow rate.
[c]Groundwater elevation from MW-2055 was used for 2002.
[d]Horizontal distance between MW-2032 and MW-2048 is 2,100 ft.


GATE D
DOE PROPERTY LINE
TRAIN 3 ENCLOSURE
FENCE
DISPOSAL CELL
MDOT
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
HIGH K INJECTION AREA
LOW K INJECTION AREA
HAMBURG TRAIL
HIGHWAY 94
(SOUTHEAST DRAINAGE)
N
• - MONITORING WELL
0
800
1600
SCALE
FEET
MONITORING WELL NETWORK
Figure D-1
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/016/0303
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 3/20/03

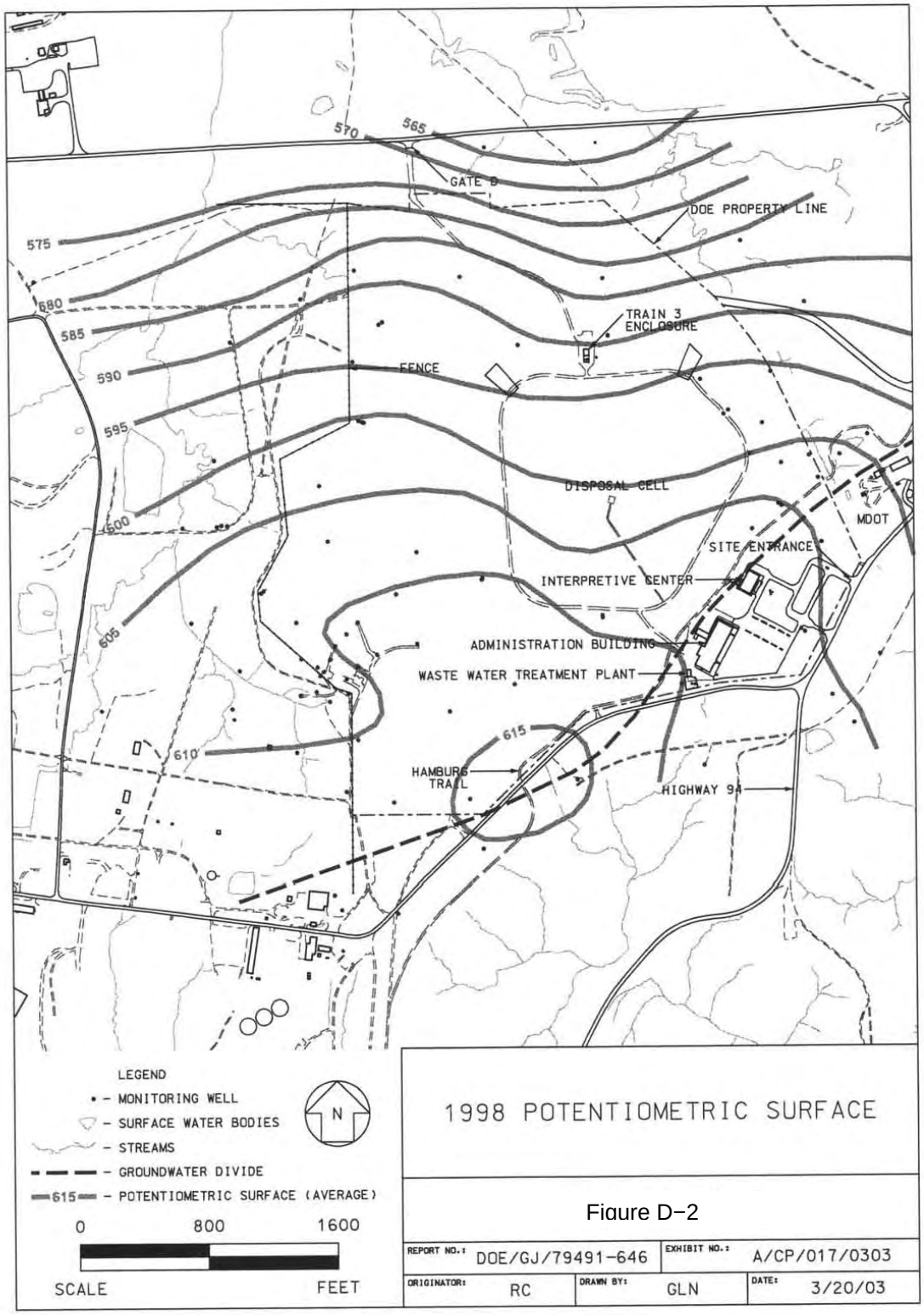
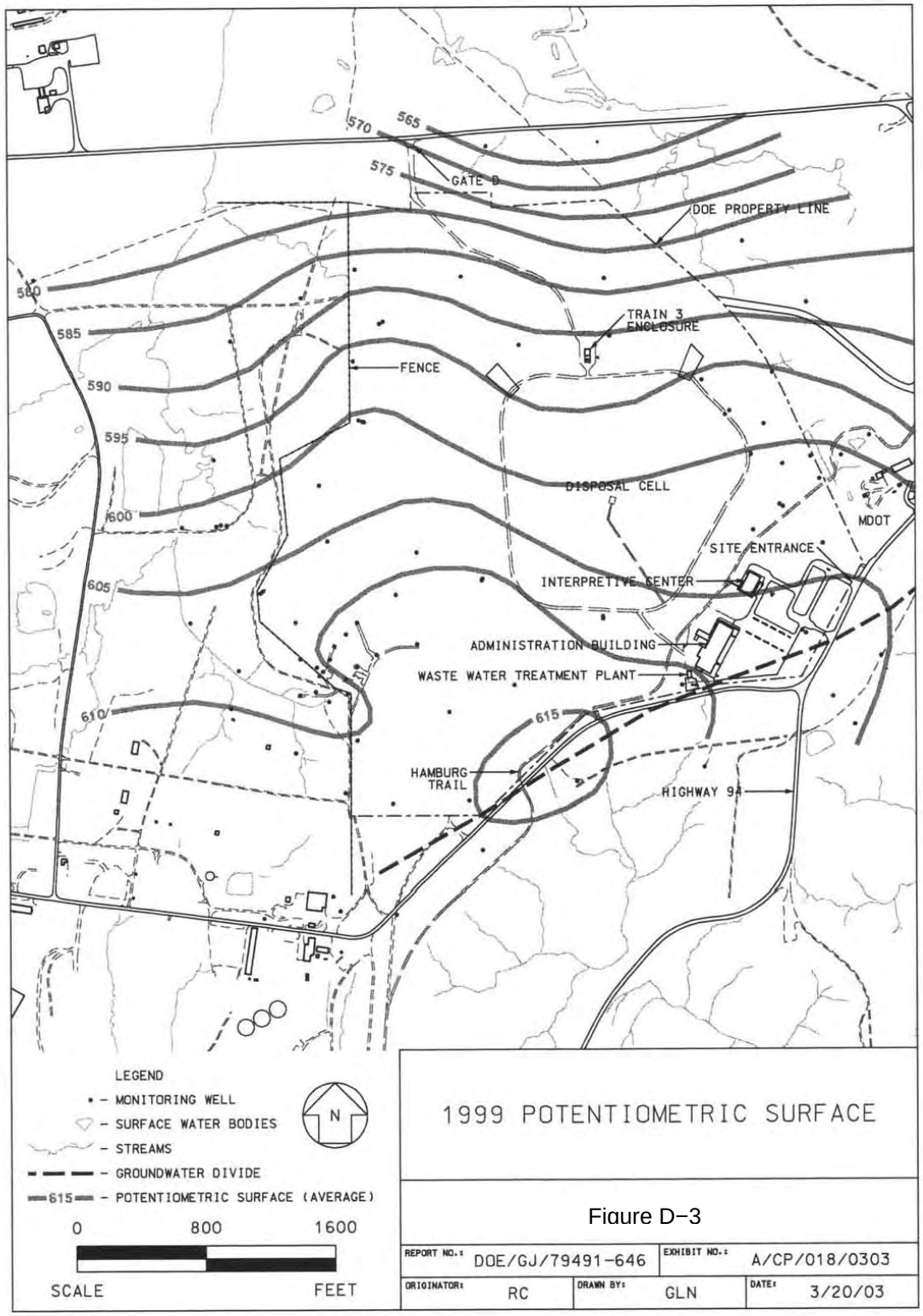
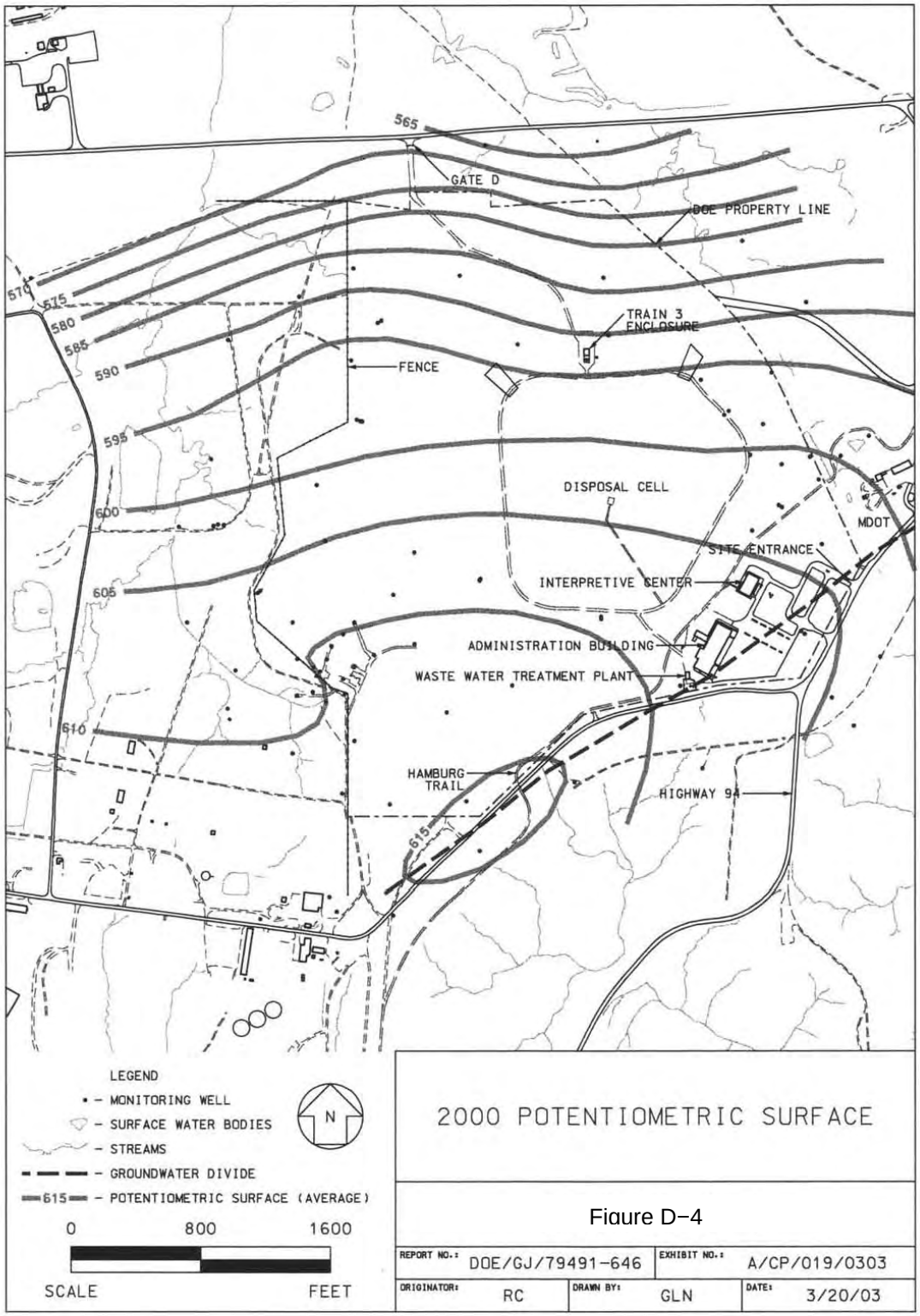

570
565
GATE D
DOE PROPERTY LINE
575
680
585
590
595
600
605
610
615
TRAIN 3
ENCLOSURE
FENCE
DISPOSAL CELL
MDOT
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
HAMBURG
TRAIL
HIGHWAY 94
LEGEND
• - MONITORING WELL
- SURFACE WATER BODIES
- STREAMS
- GROUNDWATER DIVIDE
615 - POTENTIOMETRIC SURFACE (AVERAGE)
N
0
800
1600
SCALE
FEET
1998 POTENTIOMETRIC SURFACE
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/017/0303
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 3/20/03

Figure D−2


570
565
575
GATE D
DOE PROPERTY LINE
580
585
590
595
600
605
610
615
TRAIN 3 ENCLOSURE
FENCE
DISPOSAL CELL
MDOT
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
HAMBURG TRAIL
HIGHWAY 94
LEGEND
• - MONITORING WELL
- SURFACE WATER BODIES
- STREAMS
- GROUNDWATER DIVIDE
615 - POTENTIOMETRIC SURFACE (AVERAGE)
N
0
800
1600
SCALE
FEET
1999 POTENTIOMETRIC SURFACE
Figure D-3
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/018/0303
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 3/20/03


565
GATE D
DOE PROPERTY LINE
570
575
580
585
590
TRAIN 3
ENCLOSURE
FENCE
595
DISPOSAL CELL
600
MDOT
SITE ENTRANCE
605
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
610
HAMBURG
TRAIL
HIGHWAY 94
615
LEGEND
• - MONITORING WELL
- SURFACE WATER BODIES
- STREAMS
- GROUNDWATER DIVIDE
615 - POTENTIOMETRIC SURFACE (AVERAGE)
N
0
800
1600
SCALE
FEET
2000 POTENTIOMETRIC SURFACE
Figure D-4
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/019/0303
ORIGINATOR: RC
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DATE: 3/20/03

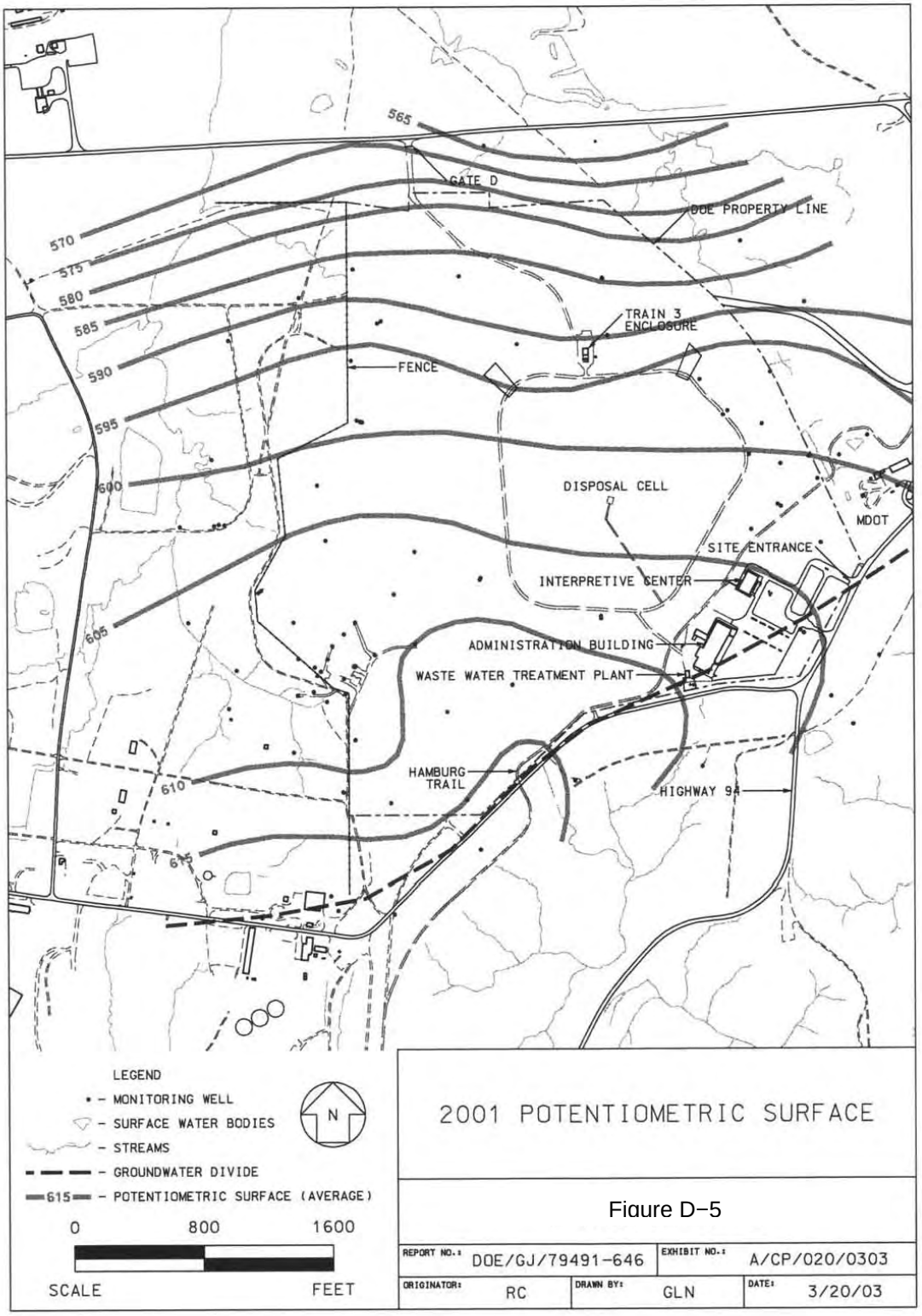
565
570
575
580
585
590
595
600
605
610
615
GATE D
DOE PROPERTY LINE
TRAIN 3 ENCLOSURE
FENCE
DISPOSAL CELL
MDOT
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
HAMBURG TRAIL
HIGHWAY 94
LEGEND
• - MONITORING WELL
- SURFACE WATER BODIES
- STREAMS
- GROUNDWATER DIVIDE
615 - POTENTIOMETRIC SURFACE (AVERAGE)
N
0
800
1600
SCALE
FEET
2001 POTENTIOMETRIC SURFACE
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/020/0303
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 3/20/03

Figure D-5

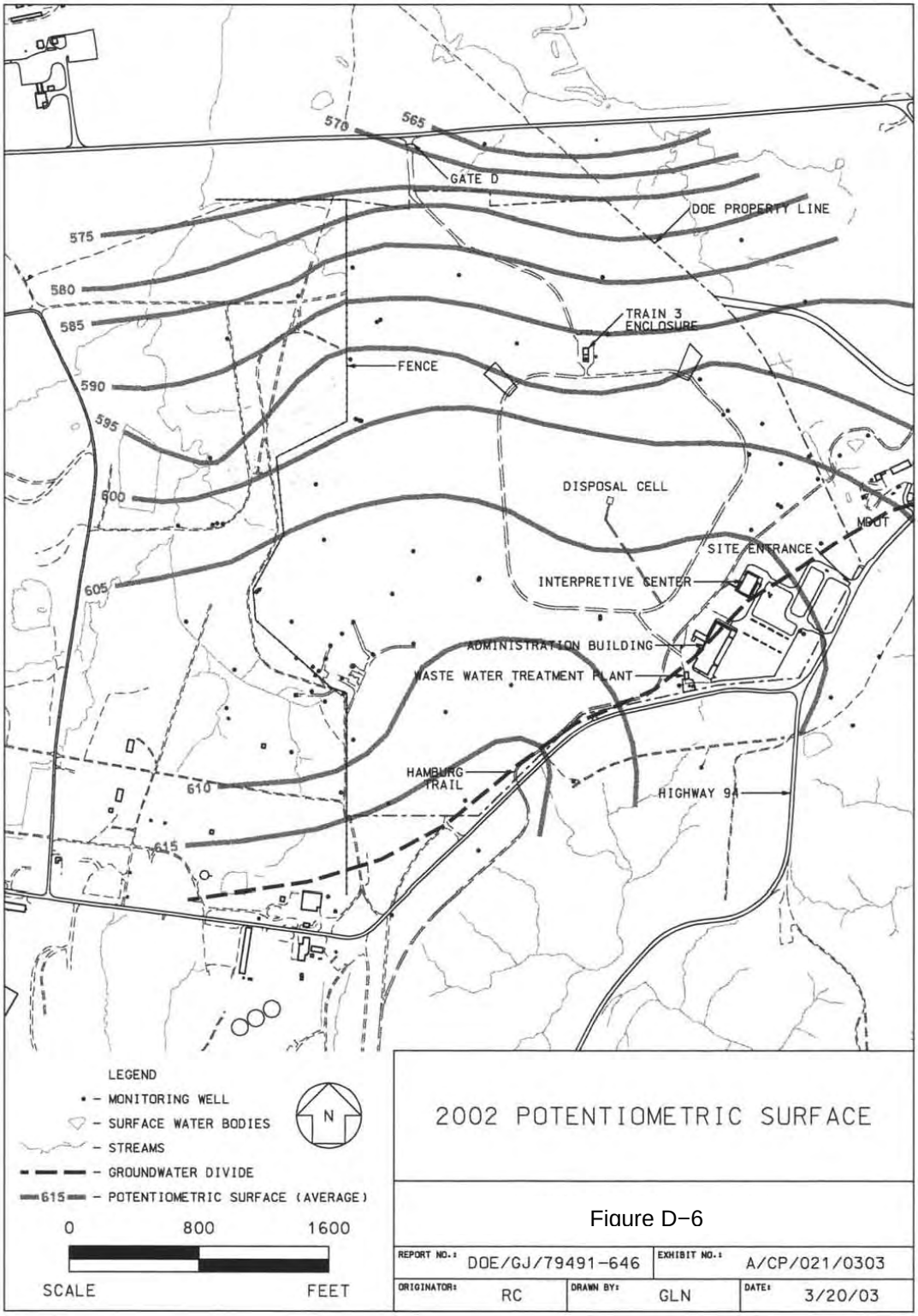
570
565
GATE D
DOE PROPERTY LINE
575
580
585
590
595
600
605
610
615
TRAIN 3 ENCLOSURE
FENCE
DISPOSAL CELL
MDOT
SITE ENTRANCE
INTERPRETIVE CENTER
ADMINISTRATION BUILDING
WASTE WATER TREATMENT PLANT
HAMBURG TRAIL
HIGHWAY 94
LEGEND
• - MONITORING WELL
- SURFACE WATER BODIES
- STREAMS
- GROUNDWATER DIVIDE
615 - POTENTIOMETRIC SURFACE (AVERAGE)
N
0
800
1600
SCALE
FEET
2002 POTENTIOMETRIC SURFACE
REPORT NO.: DOE/GJ/79491-646
EXHIBIT NO.: A/CP/021/0303
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 3/20/03

Figure D-6

		YEAR				
LOCATION_	Data	1998	1999	2000	2001	2002
MW-2001	Average of WATER_ELEVATION	588.115	588.2175	587.9475	587.5625	588.0725
	Max of WATER_ELEVATION	588.73	588.58	588.48	587.69	588.43
	Min of WATER_ELEVATION	587.47	587.78	587.73	587.41	587.84
	Count of WATER_ELEVATION	4	4	4	4	4
MW-2002	Average of WATER_ELEVATION	593.214	592.9025	593.41	591.815	591.86
	Max of WATER_ELEVATION	593.99	593.51	594.3	592.68	592.29
	Min of WATER_ELEVATION	592.53	592.41	592.22	591.36	591.61
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2003	Average of WATER_ELEVATION	597.335	597.4875	597.0975	596.765	597.2525
	Max of WATER_ELEVATION	597.63	597.73	597.6	596.99	597.79
	Min of WATER_ELEVATION	596.98	597.19	596.33	596.47	596.79
	Count of WATER_ELEVATION	4	4	4	4	4
MW-2005	Average of WATER_ELEVATION	587.424	587.6	587.4175	587.233333	595.4425
	Max of WATER_ELEVATION	587.74	587.83	587.47	587.33	612.25
	Min of WATER_ELEVATION	587	587.44	587.38	587.16	589.79
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2006	Average of WATER_ELEVATION	599.094	598.2475	597.62	598.545	598.05
	Max of WATER_ELEVATION	599.59	598.6	597.93	598.67	598.05
	Min of WATER_ELEVATION	598.67	598.01	597.22	598.29	598.05
	Count of WATER_ELEVATION	5	4	3	4	1
MW-2010	Average of WATER_ELEVATION	599.565				
	Max of WATER_ELEVATION	599.76				
	Min of WATER_ELEVATION	599.37				
	Count of WATER_ELEVATION	2				
MW-2012	Average of WATER_ELEVATION	602.936	601.0925	600.5925	600.9375	600.68
	Max of WATER_ELEVATION	604.2	601.28	600.72	601.07	600.81
	Min of WATER_ELEVATION	601.87	600.86	600.51	600.82	600.45
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2013	Average of WATER_ELEVATION	604.518	603.8475	603.1675	604.31	603.3725
	Max of WATER_ELEVATION	604.97	604.27	603.59	604.81	603.71
	Min of WATER_ELEVATION	604.15	603	602.73	604.03	602.72
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2014	Average of WATER_ELEVATION	603.934	603.5825	603.2625	603.7825	603.705
	Max of WATER_ELEVATION	604.2	603.84	603.55	604.05	603.91
	Min of WATER_ELEVATION	603.58	603.38	602.71	603.4	603.5
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2017	Average of WATER_ELEVATION	605.15	605.23	604.615	604.675	604.8425
	Max of WATER_ELEVATION	605.36	605.54	604.84	605.3	605.07
	Min of WATER_ELEVATION	604.71	604.85	604.32	604.06	604.61
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2018	Average of WATER_ELEVATION	615.482				
	Max of WATER_ELEVATION	615.82				
	Min of WATER_ELEVATION	614.87				
	Count of WATER_ELEVATION	5				
MW-2019	Average of WATER_ELEVATION	591.878				
	Max of WATER_ELEVATION	592.26				
	Min of WATER_ELEVATION	591.47				
	Count of WATER_ELEVATION	5				
MW-2021	Average of WATER_ELEVATION	589.256	589.1225	589.3025	588.27	588.6675
	Max of WATER_ELEVATION	589.98	589.66	591.44	588.5	589.21
	Min of WATER_ELEVATION	588.42	588.58	588.48	587.98	588.29
	Count of WATER_ELEVATION	5	4	4	4	4

Disposal Cell Groundwater Monitoing Plan Page 1 of 8 Summary of Groundwater Elevations

MW-2022	Average of WATER_ELEVATION	585.07	585.31	584.99	590.95	586.145
	Max of WATER_ELEVATION	585.67	585.65	585.14	603.07	586.44
	Min of WATER_ELEVATION	584.58	585.07	584.71	584.74	586.01
	Count of WATER_ELEVATION	4	4	4	3	4
MW-2023	Average of WATER_ELEVATION	582.964	583.18	583.075	583.1025	583.19
	Max of WATER_ELEVATION	583.19	583.33	583.18	583.2	583.34
	Min of WATER_ELEVATION	582.4	583.11	582.96	582.99	583.08
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2024	Average of WATER_ELEVATION	566.956	567.255	566.67	566.6925	567.2875
	Max of WATER_ELEVATION	567.66	567.87	567	566.94	567.76
	Min of WATER_ELEVATION	566.2	566.88	566.49	566.16	566.83
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2026	Average of WATER_ELEVATION	590.855				
	Max of WATER_ELEVATION	591.18				
	Min of WATER_ELEVATION	590.53				
	Count of WATER_ELEVATION	2				
MW-2027	Average of WATER_ELEVATION	591.95				
	Max of WATER_ELEVATION	592.24				
	Min of WATER_ELEVATION	591.66				
	Count of WATER_ELEVATION	2				
MW-2032	Average of WATER_ELEVATION	582.886	583.01	582.8675	582.09	582.92
	Max of WATER_ELEVATION	583.09	583.49	582.9	582.09	582.92
	Min of WATER_ELEVATION	582.79	582.74	582.82	582.09	582.92
	Count of WATER_ELEVATION	5	4	4	1	1
MW-2033	Average of WATER_ELEVATION	605.096	604.645	604.52	605.08	604.34
	Max of WATER_ELEVATION	605.55	604.85	604.71	605.27	604.69
	Min of WATER_ELEVATION	604.69	604.32	604.27	604.82	603.44
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2034	Average of WATER_ELEVATION	606.302	606.495	605.61	605.63	605.6725
	Max of WATER_ELEVATION	606.81	606.71	605.68	606.6	606.11
	Min of WATER_ELEVATION	605.69	606.02	605.41	604.77	605.13
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2035	Average of WATER_ELEVATION	613.708	613.7275	613.2475	612.636667	615.7125
	Max of WATER_ELEVATION	614.08	613.97	613.36	612.91	615.79
	Min of WATER_ELEVATION	612.92	613.45	613.19	612.49	615.59
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2036	Average of WATER_ELEVATION	610.552	610.755	609.9875	608.7975	609.4725
	Max of WATER_ELEVATION	611.57	610.91	610.21	610.21	609.61
	Min of WATER_ELEVATION	609.57	610.56	609.42	607.43	609.22
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2037	Average of WATER_ELEVATION	610.422	610.6875	610.19	609.42	609.51
	Max of WATER_ELEVATION	612.21	610.8	610.38	609.86	609.78
	Min of WATER_ELEVATION	608.62	610.53	610.09	608.98	609.17
	Count of WATER_ELEVATION	5	4	4	2	4
MW-2038	Average of WATER_ELEVATION	611.146	612.125	613.025	610.0675	609.9025
	Max of WATER_ELEVATION	611.87	614.65	619.63	611.1	610.06
	Min of WATER_ELEVATION	610.45	611.01	610.66	609.02	609.81
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2039	Average of WATER_ELEVATION	612.602	611.8925	612.45	615.13	611.24
	Max of WATER_ELEVATION	613.05	612.86	612.45	615.13	611.39
	Min of WATER_ELEVATION	611.86	609.6	612.45	615.13	611.05
	Count of WATER_ELEVATION	5	4	1	1	4

MW-2040	Average of WATER_ELEVATION	612.508	612.6325	611.933333	611.1675	611.065
	Max of WATER_ELEVATION	612.76	613.04	612.18	611.53	611.32
	Min of WATER_ELEVATION	612.21	612.31	611.71	610.74	610.91
	Count of WATER_ELEVATION	5	4	3	4	4
MW-2041	Average of WATER_ELEVATION	612.384	612.25	616.06		
	Max of WATER_ELEVATION	612.69	612.43	616.06		
	Min of WATER_ELEVATION	612.21	611.97	616.06		
	Count of WATER_ELEVATION	5	4	1		
MW-2042	Average of WATER_ELEVATION	613.822	613.4975	613.28		
	Max of WATER_ELEVATION	614.12	613.97	613.28		
	Min of WATER_ELEVATION	613.58	613.09	613.28		
	Count of WATER_ELEVATION	5	4	1		
MW-2043	Average of WATER_ELEVATION	611.088	613.2925	613.09		
	Max of WATER_ELEVATION	613.8	613.69	613.09		
	Min of WATER_ELEVATION	601.9	612.98	613.09		
	Count of WATER_ELEVATION	5	4	1		
MW-2044	Average of WATER_ELEVATION	613.805				
	Max of WATER_ELEVATION	613.84				
	Min of WATER_ELEVATION	613.77				
	Count of WATER_ELEVATION	2				
MW-2045	Average of WATER_ELEVATION	597.01	596.8625	596.48	599.355	596.65
	Max of WATER_ELEVATION	597.25	597	596.6	605.88	596.94
	Min of WATER_ELEVATION	596.5	596.64	596.4	597.08	596.44
	Count of WATER_ELEVATION	5	4	4	4	4
MW-2046	Average of WATER_ELEVATION	588.842	589	589.105	589.086667	589.01
	Max of WATER_ELEVATION	589.21	589.08	589.22	589.18	589.06
	Min of WATER_ELEVATION	588.25	588.92	589.02	589.02	588.93
	Count of WATER_ELEVATION	5	4	4	3	4
MW-2047	Average of WATER_ELEVATION	590.878	591.045	595.643333	590.9275	591.01
	Max of WATER_ELEVATION	591.21	591.11	604.91	590.97	591.08
	Min of WATER_ELEVATION	590.43	590.93	590.97	590.89	590.92
	Count of WATER_ELEVATION	5	4	3	4	4
MW-2048	Average of WATER_ELEVATION	607.54	607.51	607.485	607.343333	
	Max of WATER_ELEVATION	607.72	607.66	607.64	607.39	
	Min of WATER_ELEVATION	607.08	607.43	607.42	607.3	
	Count of WATER_ELEVATION	5	4	4	3	
MW-2049	Average of WATER_ELEVATION				599.5225	599.365
	Max of WATER_ELEVATION				599.6	599.47
	Min of WATER_ELEVATION				599.43	599.23
	Count of WATER_ELEVATION				4	4
MW-2050	Average of WATER_ELEVATION				601.1825	601.03
	Max of WATER_ELEVATION				601.35	601.13
	Min of WATER_ELEVATION				600.99	600.9
	Count of WATER_ELEVATION				4	4
MW-2051	Average of WATER_ELEVATION				598.94	598.88
	Max of WATER_ELEVATION				598.95	598.99
	Min of WATER_ELEVATION				598.93	598.79
	Count of WATER_ELEVATION				2	4
MW-2055	Average of WATER_ELEVATION					606.795
	Max of WATER_ELEVATION					606.93
	Min of WATER_ELEVATION					606.66
	Count of WATER_ELEVATION					4

MW-3003	Average of WATER_ELEVATION	598.5175	598.4475	598.05	597.5275	597.72
	Max of WATER_ELEVATION	599.22	598.85	598.11	597.86	597.95
	Min of WATER_ELEVATION	597.88	598.01	597.96	597.17	597.43
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3006	Average of WATER_ELEVATION	592.5375	592.57	592.0475	591.1925	591.77
	Max of WATER_ELEVATION	593.5	593.08	592.74	591.45	592.35
	Min of WATER_ELEVATION	591.85	591.94	591.49	590.78	591.22
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3019B	Average of WATER_ELEVATION	606.37				
	Max of WATER_ELEVATION	606.68				
	Min of WATER_ELEVATION	606.06				
	Count of WATER_ELEVATION	2				
MW-3023	Average of WATER_ELEVATION	600.935	601.17	598.3225	599.4375	599.8675
	Max of WATER_ELEVATION	601.74	601.27	600.34	599.96	599.9
	Min of WATER_ELEVATION	600.19	601.07	592.58	598.23	599.83
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3024	Average of WATER_ELEVATION	601.28	601.74	599.9	600.5425	601.115
	Max of WATER_ELEVATION	601.64	602.38	600.77	600.95	601.65
	Min of WATER_ELEVATION	600.84	601.35	597.49	600.24	600.84
	Count of WATER_ELEVATION	4	3	4	4	4
MW-3025	Average of WATER_ELEVATION	610.1375	610.193333	609.235	608.1475	607.865
	Max of WATER_ELEVATION	610.4	610.33	609.52	608.78	608.06
	Min of WATER_ELEVATION	609.48	609.99	608.88	607.33	607.61
	Count of WATER_ELEVATION	4	3	4	4	4
MW-3026	Average of WATER_ELEVATION	607.3675	606.7475	605.8725	605.26	606.0375
	Max of WATER_ELEVATION	608.49	607.22	606.27	605.36	606.53
	Min of WATER_ELEVATION	606.14	606.39	605.05	605.14	605.67
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3027	Average of WATER_ELEVATION	608.49	608.1425	607.9625	606.6825	607.005
	Max of WATER_ELEVATION	609.59	608.46	609.46	607.41	607.31
	Min of WATER_ELEVATION	607.66	607.89	607.31	606.36	606.7
	Count of WATER_ELEVATION	4	4	4	4	4
MW-3028	Average of WATER_ELEVATION	609.27	610.495	610.055	602.2625	609.2775
	Max of WATER_ELEVATION	610.17	610.62	610.19	609.72	609.45
	Min of WATER_ELEVATION	608.42	610.33	609.95	593.11	608.98
	Count of WATER_ELEVATION	3	4	4	4	4
MW-3029	Average of WATER_ELEVATION	609.146667	610.3725	609.9	607.515	609.15
	Max of WATER_ELEVATION	610.04	610.5	610.04	609.59	609.31
	Min of WATER_ELEVATION	608.3	610.21	609.77	604.89	608.84
	Count of WATER_ELEVATION	3	4	4	4	4
MW-3030	Average of WATER_ELEVATION				607.103333	607.425
	Max of WATER_ELEVATION				607.29	607.55
	Min of WATER_ELEVATION				606.87	607.3
	Count of WATER_ELEVATION				3	4
MW-3031	Average of WATER_ELEVATION				608.76	608.6025
	Max of WATER_ELEVATION				608.93	609.01
	Min of WATER_ELEVATION				608.51	608.01
	Count of WATER_ELEVATION				3	4
MW-3032	Average of WATER_ELEVATION				608.93	609.3525
	Max of WATER_ELEVATION				608.93	609.51
	Min of WATER_ELEVATION				608.93	609.11
	Count of WATER_ELEVATION				1	4

MW-3033	Average of WATER_ELEVATION				585.386667	
	Max of WATER_ELEVATION				587.7	
	Min of WATER_ELEVATION				582.38	
	Count of WATER_ELEVATION				3	
MW-3034	Average of WATER_ELEVATION				608.313333	609.245
	Max of WATER_ELEVATION				610.1	609.46
	Min of WATER_ELEVATION				606.07	608.96
	Count of WATER_ELEVATION				3	4
MW-3035	Average of WATER_ELEVATION				607.773333	609.2975
	Max of WATER_ELEVATION				608.97	609.48
	Min of WATER_ELEVATION				605.59	608.99
	Count of WATER_ELEVATION				3	4
MW-3036	Average of WATER_ELEVATION				607.976667	609.2925
	Max of WATER_ELEVATION				609.61	609.46
	Min of WATER_ELEVATION				605.54	609.01
	Count of WATER_ELEVATION				3	4
MW-3037	Average of WATER_ELEVATION					601.956667
	Max of WATER_ELEVATION					602.09
	Min of WATER_ELEVATION					601.78
	Count of WATER_ELEVATION					3
MW-3038	Average of WATER_ELEVATION					609.303333
	Max of WATER_ELEVATION					609.4
	Min of WATER_ELEVATION					609.16
	Count of WATER_ELEVATION					3
MW-3039	Average of WATER_ELEVATION					608.82
	Max of WATER_ELEVATION					608.89
	Min of WATER_ELEVATION					608.76
	Count of WATER_ELEVATION					3
MW-4001	Average of WATER_ELEVATION	602.814	602.1575	601.5775	601.7725	602.48
	Max of WATER_ELEVATION	603.71	602.72	601.89	602.85	603.83
	Min of WATER_ELEVATION	601.8	601.54	601.28	601.1	601.87
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4002	Average of WATER_ELEVATION	575.842	570.5225	568.86	570.436667	577.0675
	Max of WATER_ELEVATION	584.9	576.37	569.15	573.8	587.56
	Min of WATER_ELEVATION	568.16	568.27	568.71	568.75	568.8
	Count of WATER_ELEVATION	5	4	4	3	4
MW-4003	Average of WATER_ELEVATION	614.318	615.08			
	Max of WATER_ELEVATION	615.28	615.08			
	Min of WATER_ELEVATION	612.61	615.08			
	Count of WATER_ELEVATION	5	1			
MW-4004	Average of WATER_ELEVATION	612.094	612.12			
	Max of WATER_ELEVATION	612.66	612.12			
	Min of WATER_ELEVATION	611.56	612.12			
	Count of WATER_ELEVATION	5	1			
MW-4005	Average of WATER_ELEVATION	610.19	610.31			
	Max of WATER_ELEVATION	610.96	610.31			
	Min of WATER_ELEVATION	609.32	610.31			
	Count of WATER_ELEVATION	5	1			
MW-4006	Average of WATER_ELEVATION	602.938	602.1175	601.61	601.5025	602.26
	Max of WATER_ELEVATION	603.74	602.46	601.84	601.75	603.33
	Min of WATER_ELEVATION	602.27	601.64	601.4	601.14	601.66
	Count of WATER_ELEVATION	5	4	4	4	4

MW-4007	Average of WATER_ELEVATION	596.358	596.0175	594.8825	594.4625	595.325
	Max of WATER_ELEVATION	597.25	596.67	595.01	594.91	596.38
	Min of WATER_ELEVATION	595.68	595.15	594.65	593.93	594.48
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4008	Average of WATER_ELEVATION	597.67	598.1			
	Max of WATER_ELEVATION	598.38	598.1			
	Min of WATER_ELEVATION	597.01	598.1			
	Count of WATER_ELEVATION	5	1			
MW-4009	Average of WATER_ELEVATION	594.2	594.73			
	Max of WATER_ELEVATION	595.45	594.73			
	Min of WATER_ELEVATION	593.21	594.73			
	Count of WATER_ELEVATION	5	1			
MW-4010	Average of WATER_ELEVATION	589.39	590.54			
	Max of WATER_ELEVATION	591.04	590.54			
	Min of WATER_ELEVATION	588.02	590.54			
	Count of WATER_ELEVATION	5	1			
MW-4011	Average of WATER_ELEVATION	592.01	591.935	591.9275	591.5875	592.76
	Max of WATER_ELEVATION	592.79	592.45	592.93	591.86	593.3
	Min of WATER_ELEVATION	591.32	591.3	591.17	591.27	591.76
	Count of WATER_ELEVATION	5	4	4	4	4
MW-4012	Average of WATER_ELEVATION	570.8725	571.08			
	Max of WATER_ELEVATION	571.25	571.08			
	Min of WATER_ELEVATION	570.72	571.08			
	Count of WATER_ELEVATION	4	1			
MW-4013	Average of WATER_ELEVATION	560.2375	560.2525	561.0325	561.0625	560.4125
	Max of WATER_ELEVATION	560.38	560.33	563.2	563.35	560.5
	Min of WATER_ELEVATION	560.16	560.22	560.22	560.29	560.36
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4014	Average of WATER_ELEVATION	560.4875	560.6375	560.5975	560.9825	561.23
	Max of WATER_ELEVATION	561.02	561.06	561.05	561.1	561.66
	Min of WATER_ELEVATION	560.21	560.33	560.07	560.8	561.04
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4015	Average of WATER_ELEVATION	581.39	581.47	580.8175	581.74	581.9575
	Max of WATER_ELEVATION	582.51	582.53	580.98	581.98	583.01
	Min of WATER_ELEVATION	580.65	580.87	580.64	581.51	581.34
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4016	Average of WATER_ELEVATION	589.14	589.25			
	Max of WATER_ELEVATION	589.42	589.25			
	Min of WATER_ELEVATION	588.82	589.25			
	Count of WATER_ELEVATION	4	1			
MW-4018	Average of WATER_ELEVATION	598.095	598.08			
	Max of WATER_ELEVATION	598.56	598.08			
	Min of WATER_ELEVATION	597.46	598.08			
	Count of WATER_ELEVATION	4	1			
MW-4019	Average of WATER_ELEVATION	613.105				
	Max of WATER_ELEVATION	613.26				
	Min of WATER_ELEVATION	612.95				
	Count of WATER_ELEVATION	2				
MW-4020	Average of WATER_ELEVATION	604.9875	605.26	604.2475	604.06	604.6225
	Max of WATER_ELEVATION	605.3	605.73	604.43	604.32	604.89
	Min of WATER_ELEVATION	604.4	604.83	604.02	603.59	604.24
	Count of WATER_ELEVATION	4	4	4	3	4

MW-4021	Average of WATER_ELEVATION	607.516667				
	Max of WATER_ELEVATION	607.65				
	Min of WATER_ELEVATION	607.32				
	Count of WATER_ELEVATION	3				
MW-4022	Average of WATER_ELEVATION	596.65	597.105	594.18	593.3225	594.0825
	Max of WATER_ELEVATION	597.22	597.62	594.67	593.49	595.69
	Min of WATER_ELEVATION	595.6	596.54	593.78	592.95	592.81
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4023	Average of WATER_ELEVATION	615.5125	615.37	614.7725	614.5775	614.5025
	Max of WATER_ELEVATION	615.95	615.64	614.94	615.08	615.07
	Min of WATER_ELEVATION	614.7	614.98	614.58	613.87	613.93
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4024	Average of WATER_ELEVATION	605.09	605.3525	604.2375	603.893333	604.5025
	Max of WATER_ELEVATION	605.45	605.86	604.38	604.18	604.84
	Min of WATER_ELEVATION	604.46	604.89	604.08	603.34	604.04
	Count of WATER_ELEVATION	4	4	4	3	4
MW-4025	Average of WATER_ELEVATION	604.9475	604.87			
	Max of WATER_ELEVATION	605.83	604.87			
	Min of WATER_ELEVATION	604.07	604.87			
	Count of WATER_ELEVATION	4	1			
MW-4026	Average of WATER_ELEVATION	459.89	459.9325	459.6	459.68	459.7525
	Max of WATER_ELEVATION	460.06	460.51	459.82	459.83	460.13
	Min of WATER_ELEVATION	459.65	459.51	459.38	459.53	459.15
	Count of WATER_ELEVATION	6	4	2	2	4
MW-4027	Average of WATER_ELEVATION	609.326667	610.5	610.0575	609.38	609.2825
	Max of WATER_ELEVATION	610.23	610.64	610.22	609.97	609.41
	Min of WATER_ELEVATION	608.41	610.42	609.93	608.79	609.03
	Count of WATER_ELEVATION	3	4	4	2	4
MW-4028	Average of WATER_ELEVATION	609.5025	610.6125	609.785	607.6625	609.34
	Max of WATER_ELEVATION	610.18	611.02	610.03	609.72	609.73
	Min of WATER_ELEVATION	608.57	610.38	609.2	605.22	608.98
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4029	Average of WATER_ELEVATION	609.465	610.435	610.0225	608.0775	609.2475
	Max of WATER_ELEVATION	610.15	610.58	610.19	609.7	609.42
	Min of WATER_ELEVATION	608.55	610.35	609.87	605.85	608.95
	Count of WATER_ELEVATION	4	4	4	4	4
MW-4030	Average of WATER_ELEVATION				597.1625	597.21
	Max of WATER_ELEVATION				597.29	597.36
	Min of WATER_ELEVATION				597.06	597.13
	Count of WATER_ELEVATION				4	4
MW-4031	Average of WATER_ELEVATION				608.366667	609.3725
	Max of WATER_ELEVATION				608.66	609.61
	Min of WATER_ELEVATION				608.03	609.24
	Count of WATER_ELEVATION				3	4
MW-4032	Average of WATER_ELEVATION				608.54	609.5
	Max of WATER_ELEVATION				608.88	609.72
	Min of WATER_ELEVATION				608.2	609.25
	Count of WATER_ELEVATION				2	4
MW-4033	Average of WATER_ELEVATION				608.5	609.3
	Max of WATER_ELEVATION				608.72	609.42
	Min of WATER_ELEVATION				608.28	609.06
	Count of WATER_ELEVATION				2	4

MW-4034	Average of WATER_ELEVATION				610.71	611.1525
	Max of WATER_ELEVATION				610.78	611.21
	Min of WATER_ELEVATION				610.64	611.02
	Count of WATER_ELEVATION				2	4
MW-4035	Average of WATER_ELEVATION				623.24	623.8925
	Max of WATER_ELEVATION				623.42	624.08
	Min of WATER_ELEVATION				623.06	623.43
	Count of WATER_ELEVATION				2	4
MW-4036	Average of WATER_ELEVATION					592.51
	Max of WATER_ELEVATION					593.23
	Min of WATER_ELEVATION					591.63
	Count of WATER_ELEVATION					4
MW-4037	Average of WATER_ELEVATION					608.2525
	Max of WATER_ELEVATION					609.61
	Min of WATER_ELEVATION					607.19
	Count of WATER_ELEVATION					4
MW-4038	Average of WATER_ELEVATION					609.51
	Max of WATER_ELEVATION					609.64
	Min of WATER_ELEVATION					609.23
	Count of WATER_ELEVATION					4
MWS-21	Average of WATER_ELEVATION	609.33875	606.25	609.89	608.44	609.4075
	Max of WATER_ELEVATION	610.28	610.47	609.89	610.28	609.68
	Min of WATER_ELEVATION	608.93	602.03	609.89	606.6	609.19
	Count of WATER_ELEVATION	8	2	1	4	4
MWS-3	Average of WATER_ELEVATION	594.303333	598.915			
	Max of WATER_ELEVATION	594.73	603.11			
	Min of WATER_ELEVATION	593.97	594.72			
	Count of WATER_ELEVATION	3	2			
MWS-4	Average of WATER_ELEVATION	602.581429	602.675	601.39	601.556667	602.41
	Max of WATER_ELEVATION	602.94	602.85	601.39	601.94	603.53
	Min of WATER_ELEVATION	601.62	602.5	601.39	601.12	601.84
	Count of WATER_ELEVATION	7	2	1	3	4

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Appendix L

Well Field Contingency Plan

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L1.0 Planning and Preparation

Under this contingency plan, which supersedes the *Well Field Contingency Plan* (DOE 1992b), any production capacity lost to the existing well field due to confirmed contaminant migration from the Weldon Spring Quarry (Quarry) will be replaced. While it is highly unlikely that such measures will be implemented, this plan defines the minimum planning and preparation required to facilitate a rapid and effective response. Planning and preparation measures include the following:

- Selection of a reliable alternate source of water to replace or supplement the existing well field.
- Preparation of a plan for data collection to facilitate development of the selected alternate source.
- Development of design criteria for use in design and construction of the alternate source infrastructure.

L1.1 Selection of Alternate Source

Criteria and alternatives for contingency planning were developed using modified value engineering principles. Modified value engineering is an alternative evaluation process that parallels the CERCLA philosophy of remedial alternative development that is not based upon cost unless all other criteria (i.e., effectiveness, implementability, etc.) are equal. This process was performed as outlined in *Alternative Evaluation Study Manual* (DOE 2000).

Two broad potential scenarios were considered as part of alternative evaluation: (1) a portion of the well field is threatened, requiring partial replacement of the water supply; and (2) the entire well field is threatened, requiring replacement of the entire water supply from the existing well field.

The criteria used to evaluate the alternatives were effectiveness, technical feasibility, degree of disruption, public acceptance, regulatory requirements, cost, and impact on the present treatment system. By applying these criteria, all but the top three alternatives for each scenario were quickly eliminated (Table L−1). Further evaluation of the remaining alternatives led to the selection of a proposed alternative. The evaluation and selection process is described in the report *St. Charles County Well Field Summary of Alternatives for Contingency Plans* (DOE 1992a).

Table L−1. Alternatives Considered for Water Supply Replacement Scenarios

Alternative	Rank of Alternative	
	Partial Replacement Scenario	Full Replacement Scenario
New well(s) in existing well field	2	7
New well(s) in Darst Bottoms upstream of existing well field	1	1
Modify existing well system	10	10
Change pumping scheme of existing wells	6	9
Utilize existing pipeline from St. Louis	5	11
New pipeline to Howard Bend Plant	4	3
Treat Missouri River surface water	3	2
Find bedrock source of water at another site	7	6
Treat and use contaminated water	11	8
Protect well field with a slurry wall	8	4
Redirection of existing capacities	9	5
No action	Not appropriate	Not appropriate

The selected alternative is the installation of additional water supply wells in the Darst Bottoms to the south of the present well field (Figure L−1). Although this location is within the same aquifer as the present well field, the replacement location is upgradient of the contaminant source, the Quarry. Hence, given that action levels for contaminants are conservative (low), the replacement well field location would be unaffected by contaminant migration either from the Quarry or a potentially tainted well field to the north.

L1.2 Preparation of a Plan for Hydrogeologic Investigation

A plan will be prepared for a hydrogeologic investigation required to obtain the information necessary to develop the alternate source of groundwater. This plan will identify the activities, sampling, and testing required to assess the hydrogeologic characteristics of the replacement well field area. While the hydrogeologic characteristics of the replacement well field location are probably quite similar to the present well field, additional data and testing will be required to ensure an adequate assessment, and to ensure that engineering design is optimized to meet production needs.

L1.3 Design Criteria

Engineering design criteria will be established for use in design and construction of the alternate water supply. Design criteria will address:

- Functional requirements relative to interface with the existing well field and treatment plant.
- Performance requirements relative to production capacity.
- Phased response (requirements for partial versus full replacement).
- Water quality requirements.
- Well sitting and construction.

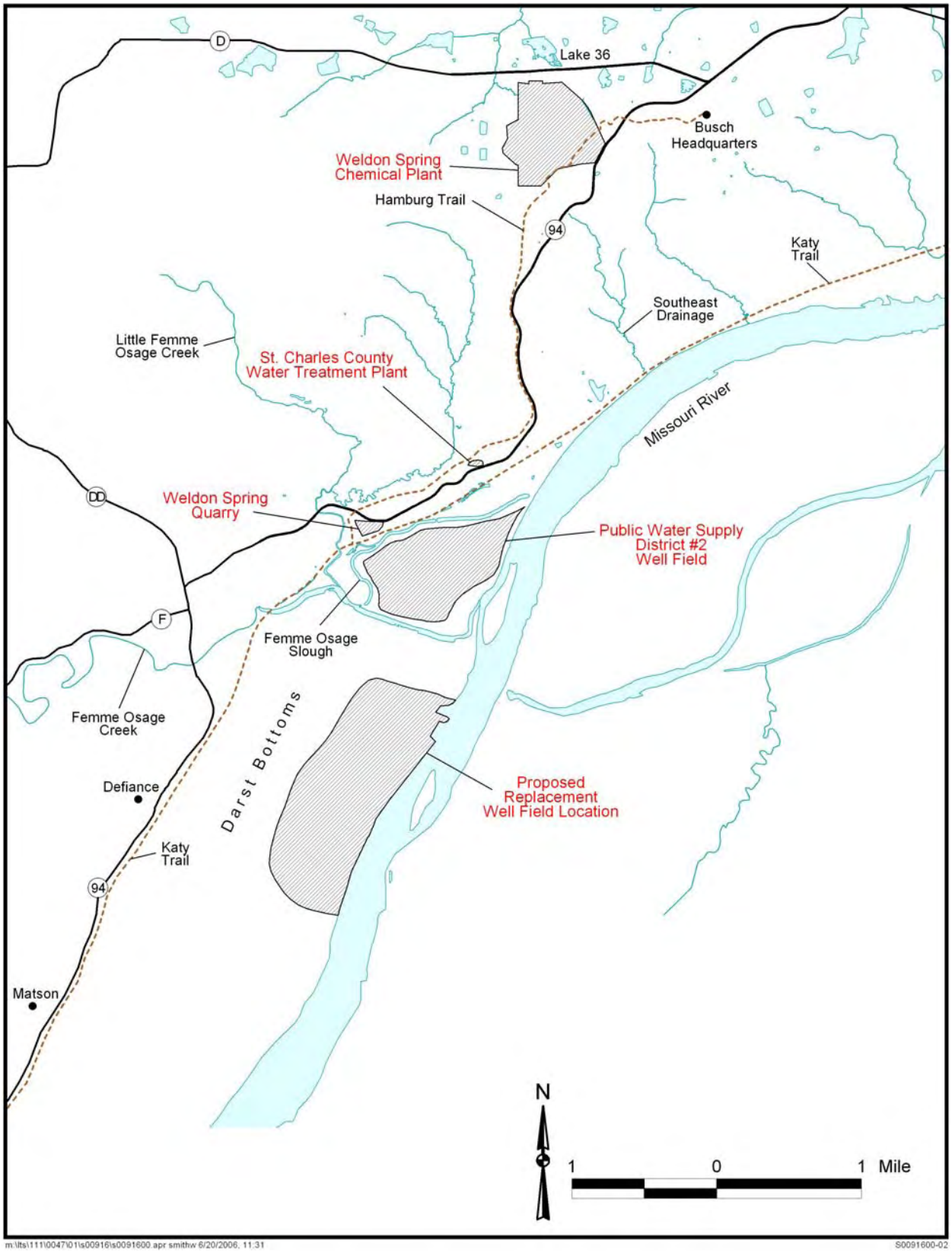

Figure L−1. Proposed Replacement Well Field Location

In the event an alternate source of drinking water is required, engineering design and construction shall proceed based on the design criteria established under this plan.

L1.4 Access

Should the need arise, access for data collection purposes, well installation, and pipe line construction will be coordinated with the affected private landowners and St. Charles County officials. As an interim measure, private landowners who would be affected by construction of a replacement well field were contacted by a U.S. Department of Energy (DOE) representative who explained the contingency plan and outlined the potential for a request for access to be made at some future time.

L1.5 Installation of Replacement Wells

In the event that contaminants from the Quarry are detected above action levels established under this plan, the following steps will be taken to install a replacement well field:

- Access will be obtained from affected landowners.
- Subcontractor services will be procured for drilling of production and test wells and acquisition of other data prescribed as part of the hydrogeologic investigation.
- Field activities will be initiated as detailed in the hydrogeologic investigation plan.
- Design of components necessary to perform drilling, install wells, pumps, and piping, and construct pumping facilities and controls will be accelerated.
- Procurement of materials will be accelerated for pumps, piping, casing, screens, and all appurtenances required to complete construction of the replacement well field to production standards.
- The replacement well field will be installed under the direction of DOE.

L1.6 Permits

Construction permits would be required from the MDNR and St. Charles County as well as a permit from the Darst Bottoms Levee District in order to install the replacement wells. The permit process is estimated to take between 60 and 90 days (DOE 1992b).

L1.7 Schedule

Assuming that construction would proceed on several tasks simultaneously, it is estimated that a minimum of 2 months will be required for construction after permits are obtained. Allowing 60 days for engineering and the preparation of permit applications, about 200 days would be required from the start of engineering through the start up of the pumps (DOE 1992b). The estimated implementation schedule is illustrated in Figure L−2.

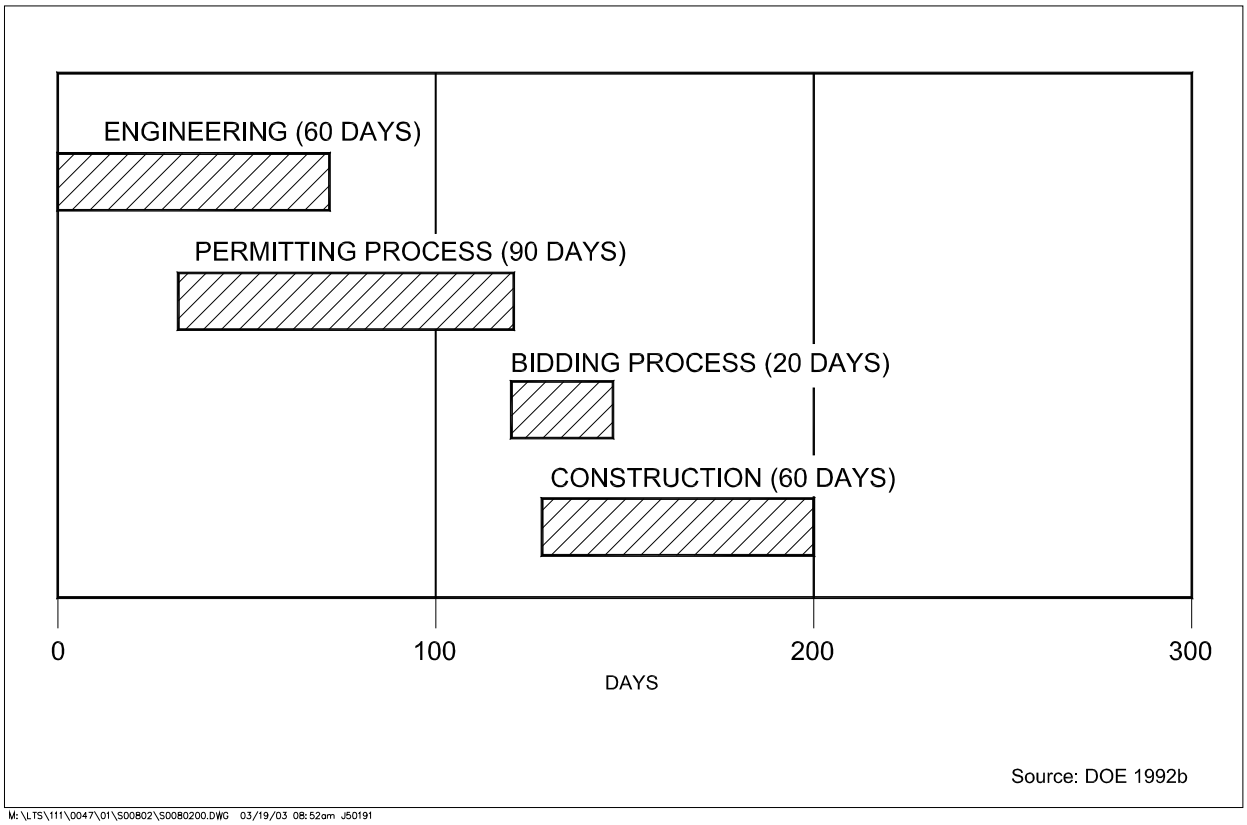

Figure L−2. Estimated Replacement Well Field Installation Schedule

During the period of time required to complete installation of the replacement well field, the present well field would operate without the reserve provided by the affected wells. In a worst case scenario, the present well field might not meet production demands during the period of new well field construction. In this instance, service demands for Public Water Supply District #2 Plant No. 1 would have to be met through an alternate source or rationing (such as water used for lawn care and car washing, etc.) until the replacement well field went on line or demand subsided due to the normal demand cycle.

L1.8 Well Design

Figure L−3 illustrates the preliminary design of the replacement wells.

L2.0 References

DOE (U.S. Department of Energy), 1992a. *St. Charles County Well Field Summary of Alternatives for Contingency Plans,* DOE/OR/21548-285, prepared by L.G. Zambrana Consultants, Inc. and Woodward-Clyde Consultants for the U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, May.

DOE (U.S. Department of Energy), 1992b. *Well Field Contingency Plan,* DOE/OR/21548-340, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, November.

DOE (U.S. Department of Energy), 2000. *Alternative Evaluation Study Manual,* Rev. 1, DOE/OR/21548-640, U.S. Department of Energy Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri, January.

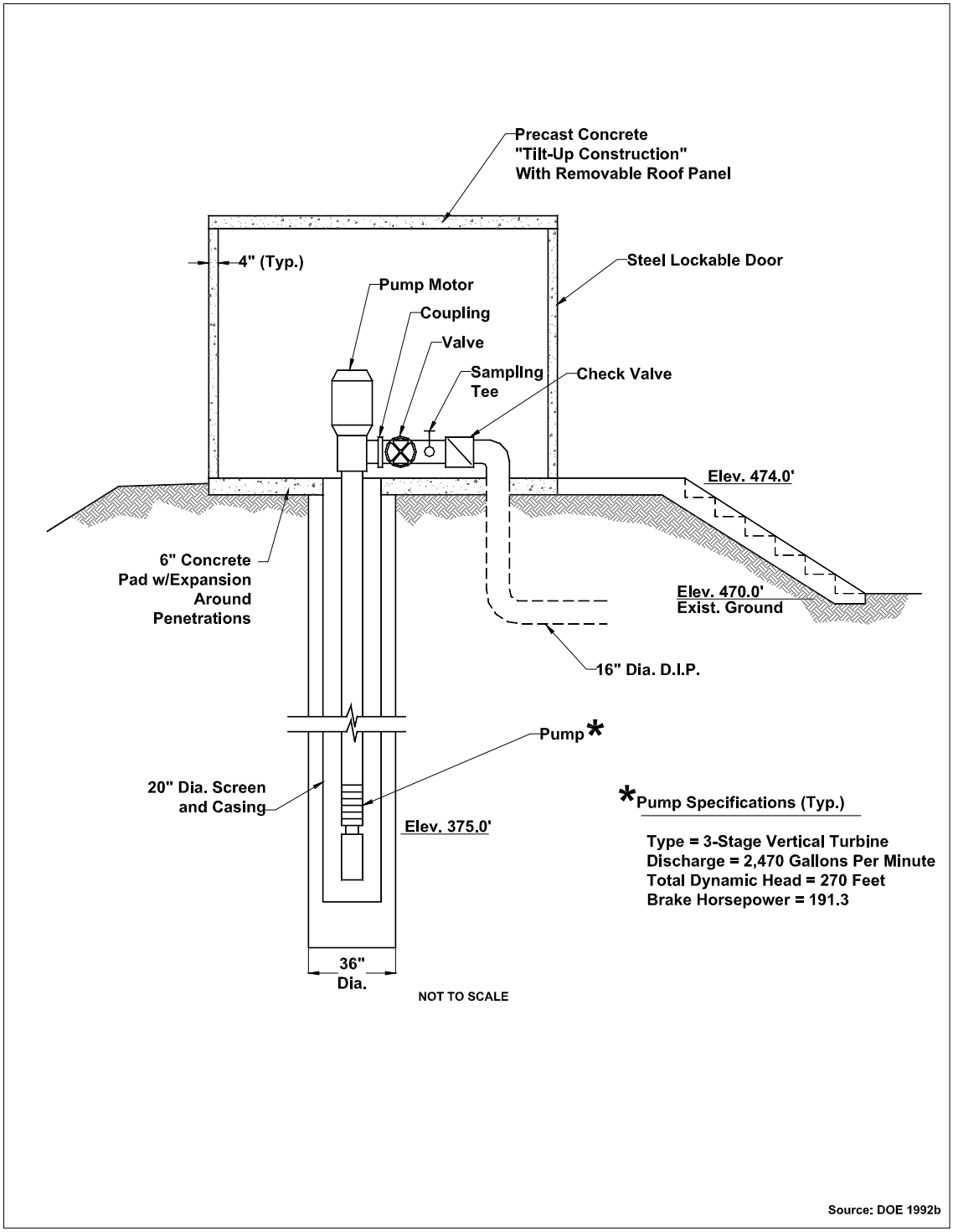

Figure L−3. Proposed Typical Replacement Well Schematic

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Appendix M

Groundwater Operable Unit
Contingency Trees

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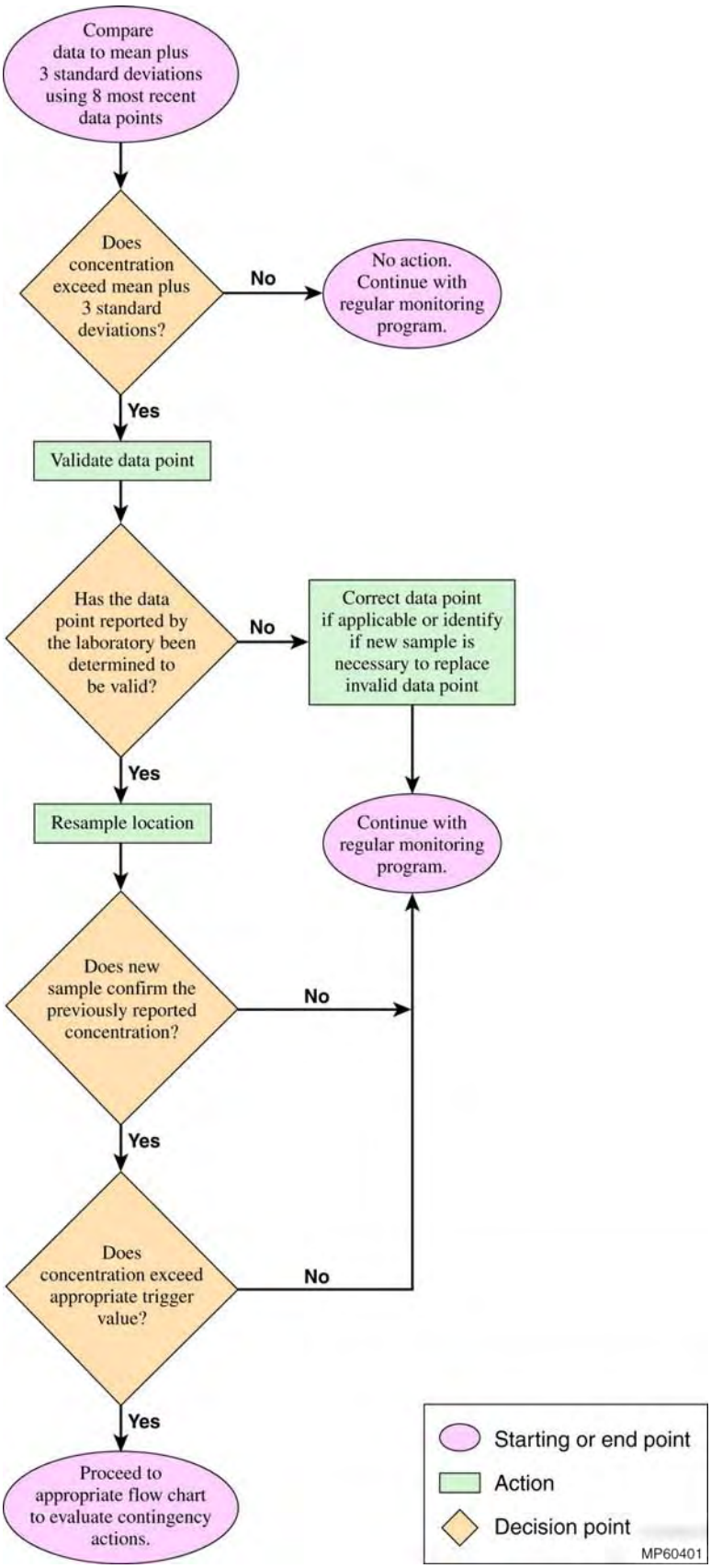

Figure M−1. Validation and Statistical Evaluation Scheme

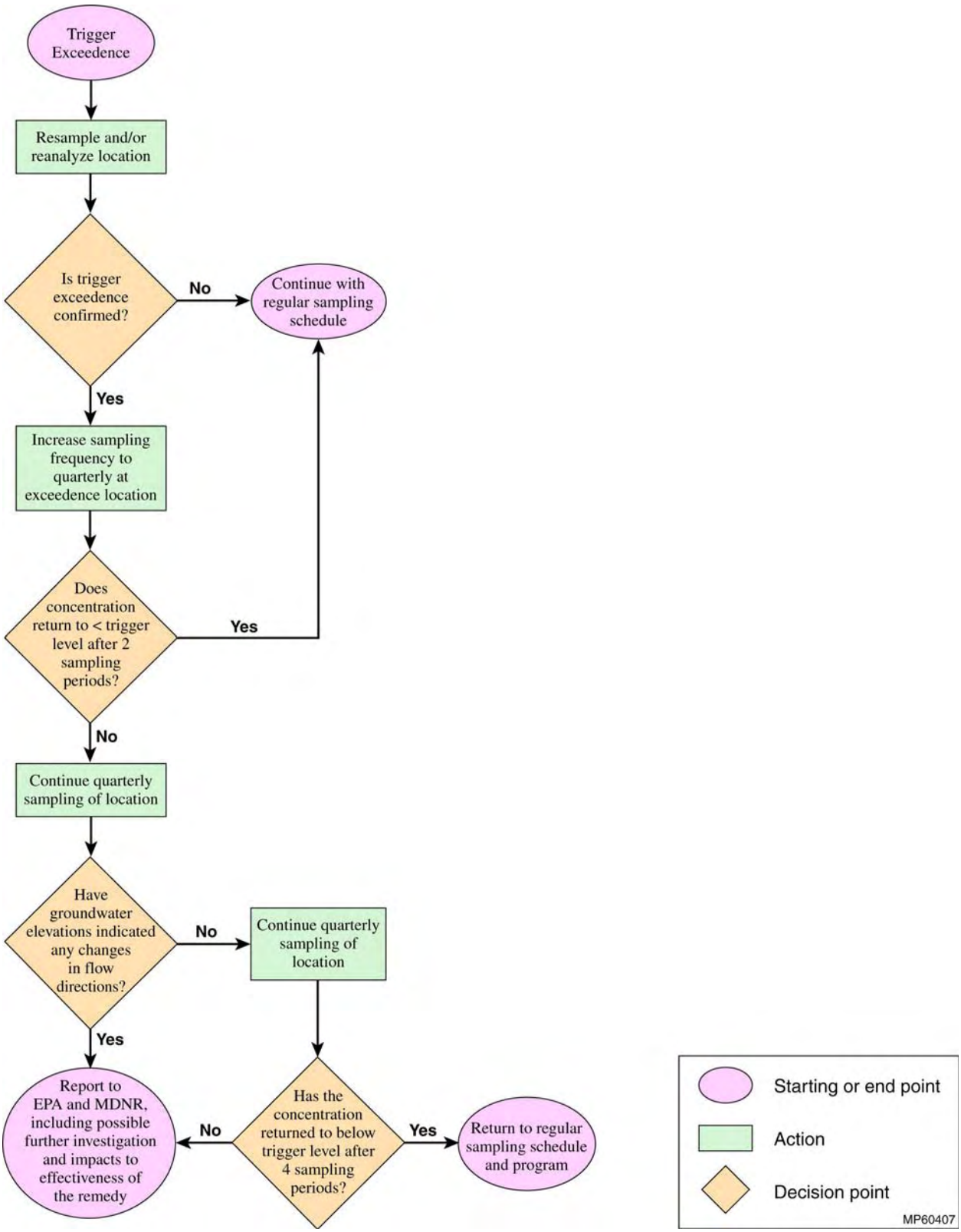

Figure M−2. Decision Tree for Objective 1 Data

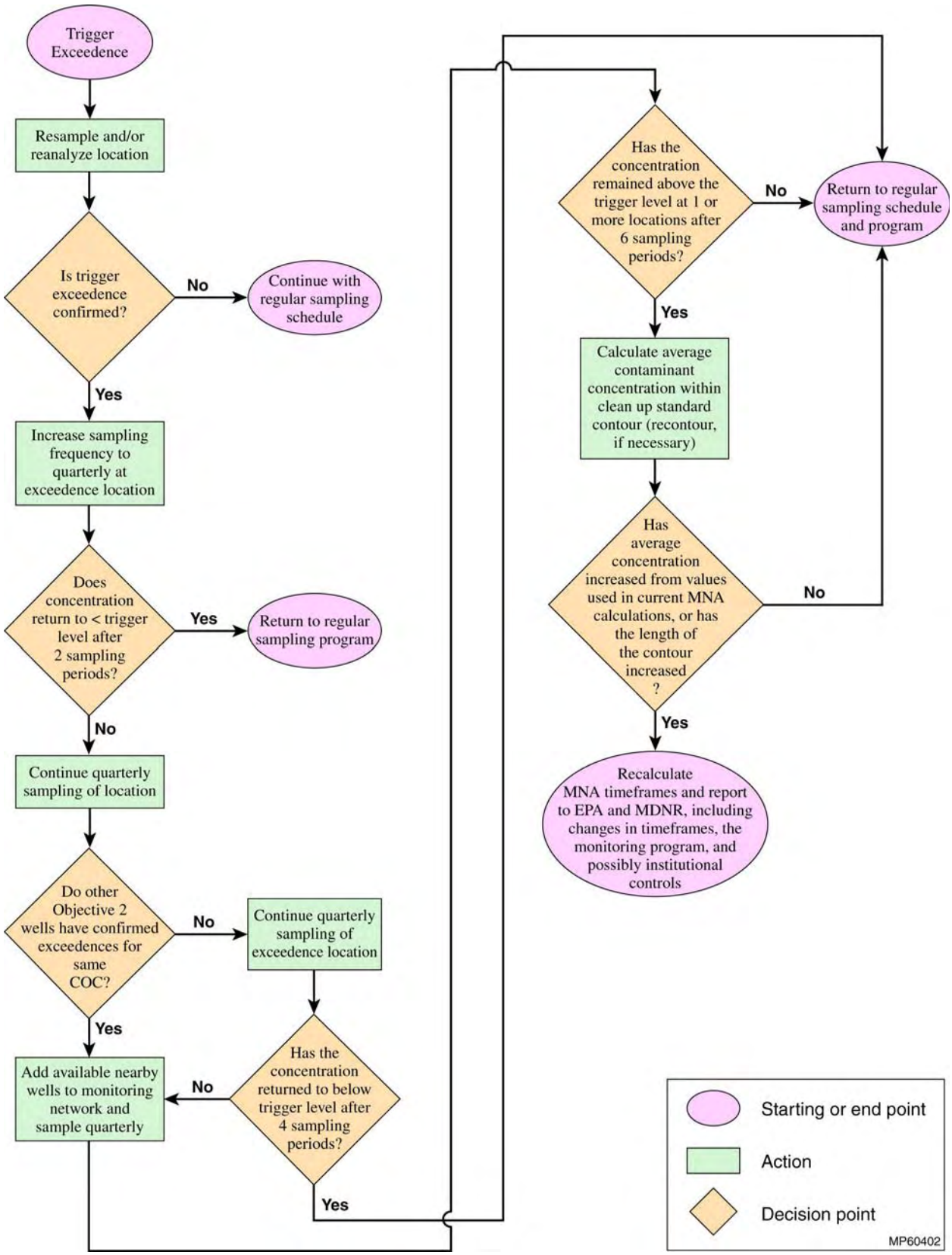

Figure M−3. Decision Tree for Objective 2 Data

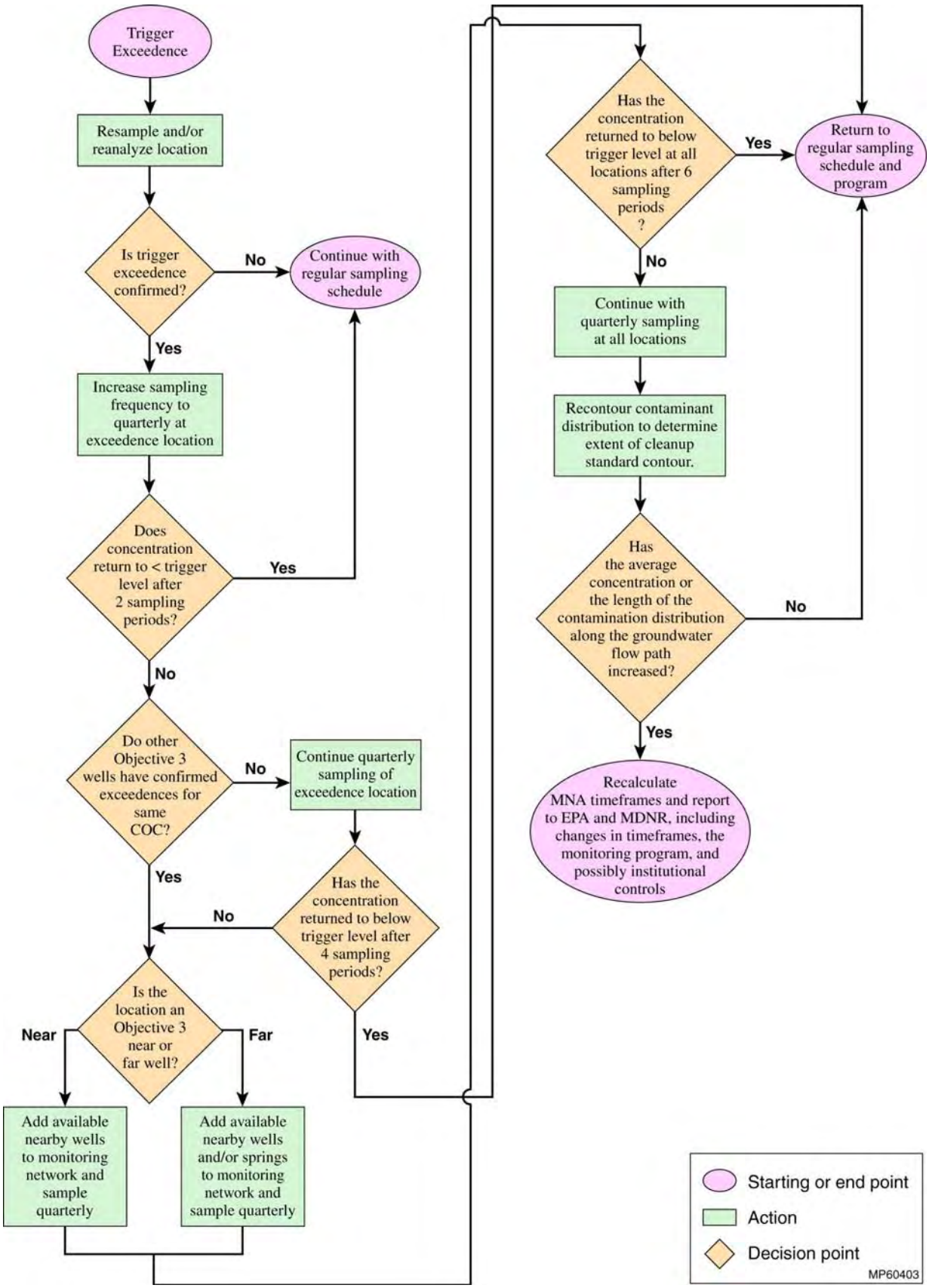

Figure M−4. Decision Tree for Objective 3Data

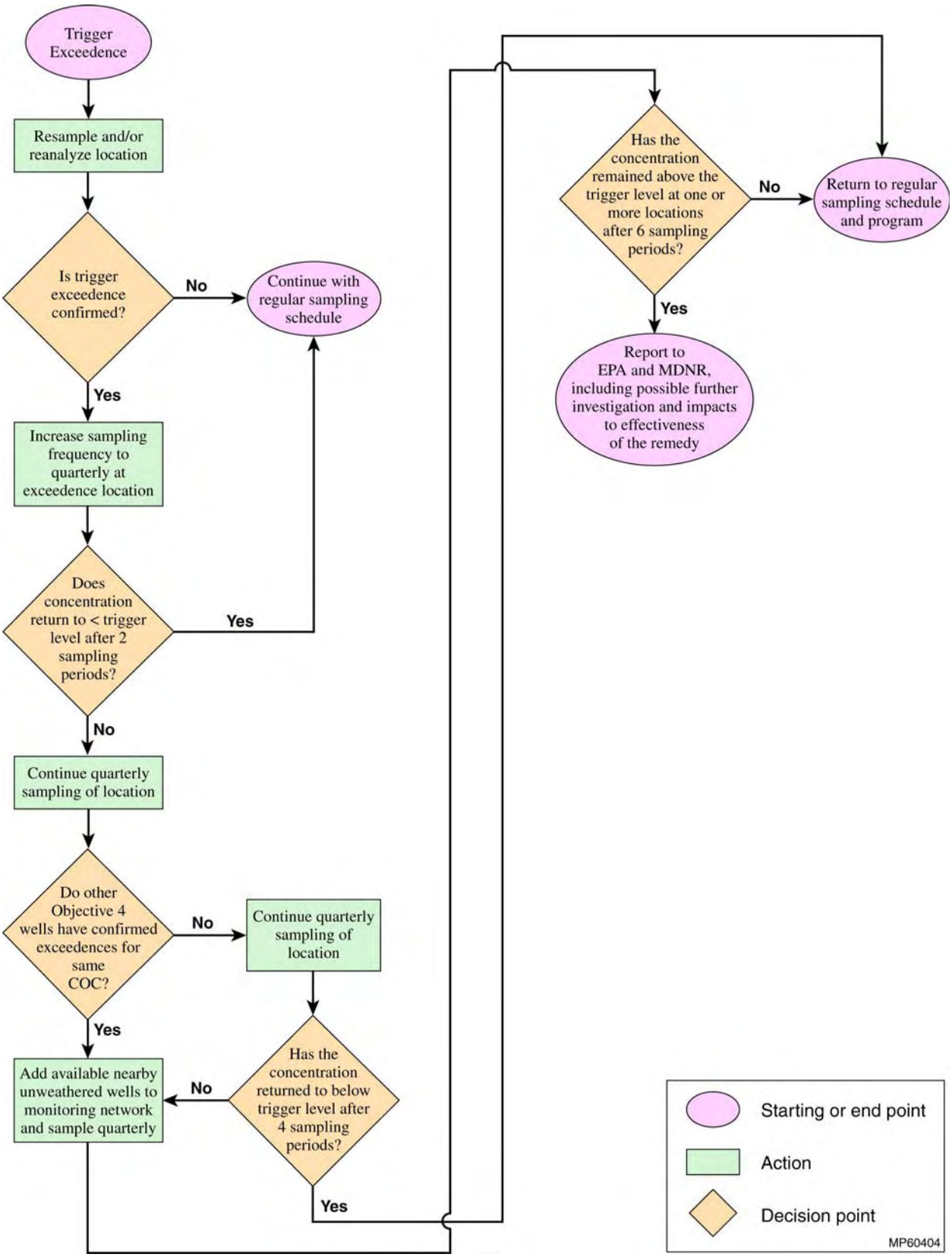

Figure M−5. Decision Tree for Objective 4 Data

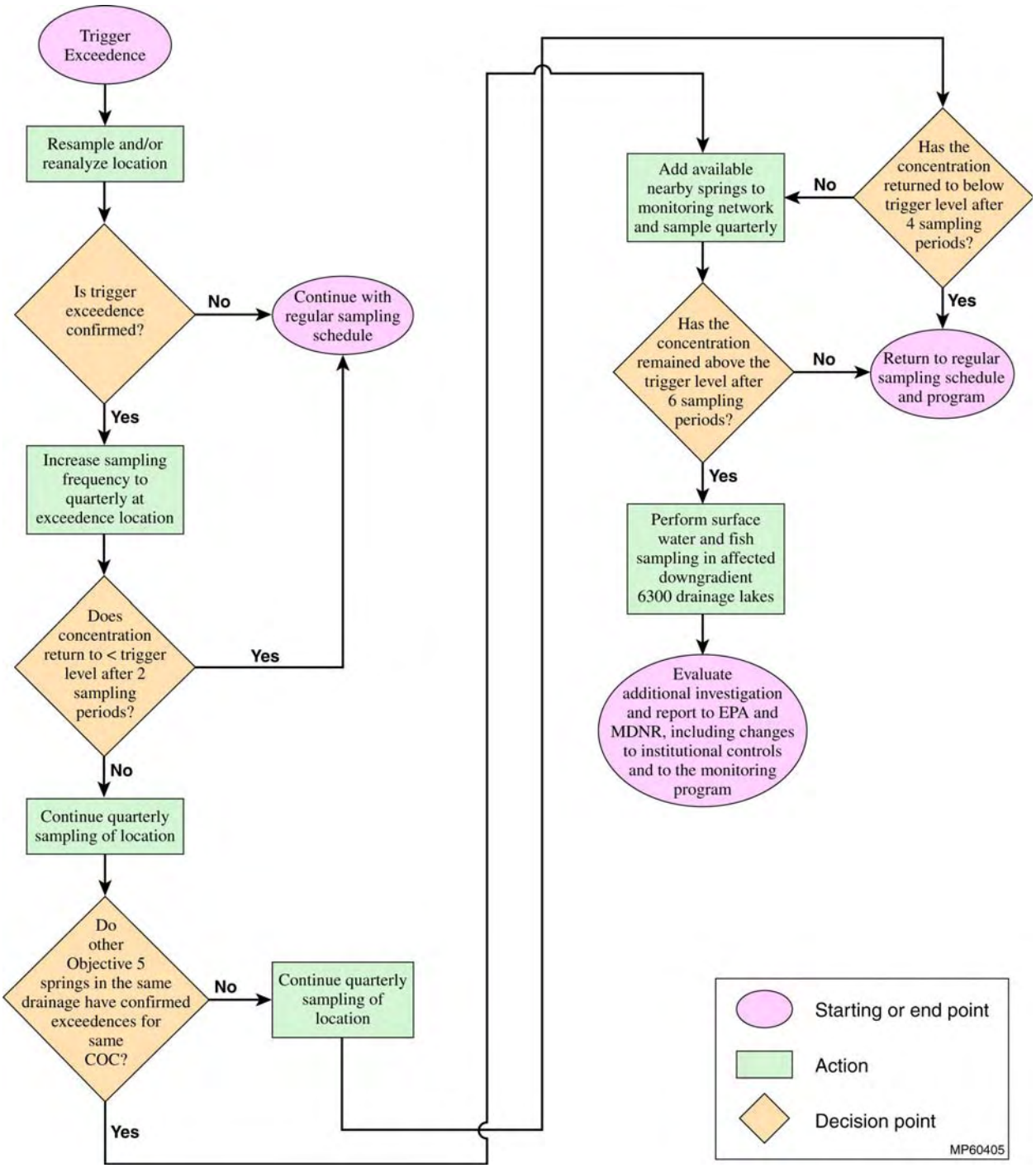

Figure M−6. Decision Tree for Objective 5 Data

Appendix N

Example Historical Marker and Plaque

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The Hamburg Trail

Historical Marker 10

The Hamburg Trail is an eight-mile hiking and biking trail which links the Katy Trail to the August A. Busch Memorial Conservation Area Headquarters. The trail was created as part of a cooperative effort between the Missouri Department of Conservation, the Missouri Department of Natural Resources, and the United States Department of Energy (DOE) during the Weldon Spring Site Remedial Action Project (WSSRAP).

The WSSRAP was responsible for the environmental cleanup of former explosives production and uranium processing facilities that were located in this part of St. Charles County. As the trail winds through the woodlands and prairies of the Weldon Spring Conservation Area, the August A. Busch Memorial Conservation Area, and the Weldon Spring Site, historical markers depict what life was like for the people that lived and worked in this area, commemorate the lost towns of Howell, Hamburg, and Toonerville, and describe different phases of the WSSRAP cleanup.

Groundwater Monitoring

The yellow posts that you may notice along the Katy Trail and in the general vicinity are protective posts called bollards which surround groundwater monitoring wells. These wells have been installed by the U.S. DOE for the purpose of monitoring groundwater in the area of the Weldon Spring Quarry. Groundwater monitoring will continue for the long-term and is designed to ensure the safety of the St. Charles County well field which lies to the south. Damaged wells can be reported by calling (636) 300-0012 during normal business hours or 1-877-695-5322 after hours.

A Weldon Spring Site groundwater monitoring well.

For more information, please visit the Weldon Spring Site Interpretive Center at 7295 Hwy. 94 South. The Interpretive Center is located approximately 3.8 miles north along Hwy. 94 and the Hamburg Trail.

The Weldon Spring Site

Site History

From 1941 to 1945, as part of the World War II defense effort, the U.S. Army produced explosives at the Weldon Spring Ordnance Works, a 17,232-acre facility near Weldon Spring, Missouri. After the war, the government transferred ownership of some of this land to the State of Missouri, which used it to create the August A. Busch Memorial Conservation Area. Another portion went to the University of Missouri, which used it for agricultural purposes and to St. Charles County and the Francis Howell School District. The Army retained the remainder for use as a training area. Currently, about 15,000 acres of the original Ordnance Works facility is owned by the Missouri Department of Conservation comprising the August A. Busch Memorial and Weldon Spring Conservation Areas.

The Weldon Spring Uranium Feed Materials Plant, Circa 1960.

In 1955, the Army transferred some 200 acres to the Atomic Energy Commission for construction of the Weldon Spring Uranium Feed Materials Plant. From 1957 to 1966, this plant processed uranium ore concentrates and a small amount of thorium.

Site Cleanup

Due to the hazards of the wastes that remained on site, in 1986 the DOE created a project office at the Weldon Spring Site and established a cleanup effort known as the Weldon Spring Site Remedial Action Project. Surface remediation activities concluded with construction of a disposal cell as a repository for 1.48 million cubic yards of waste. The disposal cell, which covers about 45 acres, was completed in 2001 and provides long-term isolation and management of the radioactively and chemically contaminated waste materials.

The completed disposal cell. A viewing platform at the top provides a panoramic view of the surrounding area.

For more information about the August A. Busch Memorial and Weldon Spring Conservation Areas, contact the August A. Busch Memorial Conservation Area, 2360 Hwy D, St. Charles, MO 63304.

Mission

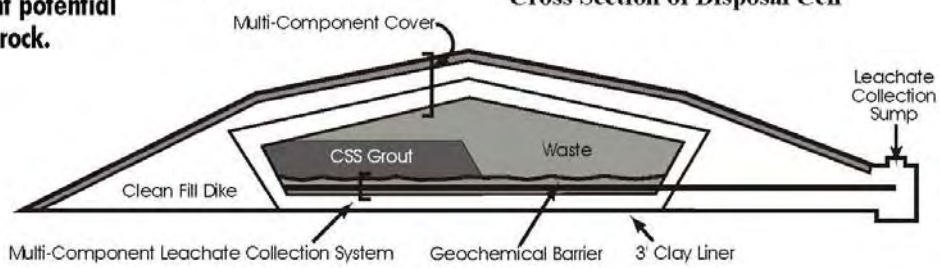
The disposal cell provides long-term isolation and management of waste from the former U. S. Atomic Energy Commission Uranium Feed Materials Plant and the former U. S. Department of the Army Ordnance Works.

Cell Design

The disposal cell constructed at the Weldon Spring Site has been designed to deter the migration of contaminants and to remain stable for 1,000 years. To achieve these goals the following factors were considered:

- Exposed surfaces engineered to resist long-term erosion potential and a precipitation event greater than has occurred in the recorded history of the region.
- Side slopes and waste placement methods designed to withstand a Maximum Credible Earthquake (MCE) that considered the New Madrid fault system earthquake potential.
- A geographic location about one mile from the nearest known ground trace of a capable fault, and a general siting with no capable faults within a 10 mile radius appearing to have experienced movement in the past 8,000 years.
- Located in a geologically stable area with no significant potential for catastrophic collapse due to voids in the soil or bedrock.
- Located outside a designated 100-year flood plain.

Cross Section of Disposal Cell



Cell Components

The cell consists of:

1. The base liner with leachate collection and removal systems designed to prevent leachate migration from the bottom of the cell.

2. The contaminated wastes, consisting of chemically stabilized and solidified (CSS) grout waste and untreated wastes have been placed and stabilized within the cell in a controlled and engineered manner to reduce settling, minimize volume, and retard radon emissions.

3. The clean-fill dike, constructed of compacted clay soil material, surrounds the disposal facility in order to resist erosion, limit infiltration of moisture into the waste, minimize radon emissions, and reduce long-term maintenance.

4. The cover systems armor the top of the cell protecting it from erosion, infiltration, bio intrusion, etc. It consists of multiple layers including (from bottom to top) an infiltration/radon barrier of clay, a geosynthetic liner, a gravel drain, sand filters, and a mixture of cobbles.