Visible, Durable, Enforceable Institutional Controls: Weldon Spring Site - A 10-Year Journey - 13190

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ABSTRACT

The DOE Office of Legacy Management's (LM's) mission is to manage the DOE's post-closure responsibilities and ensure the future protection of human health and the environment. LM has control and custody of legacy land, structures, and facilities and is responsible for maintaining them at levels suitable for their long-term use. This includes all engineered and institutional controls (ICs) designed as another level of assurance to prevent exposure to residual contamination and waste. The development and management of ICs has been, and continues to be, a critical component to the success of LM surveillance and maintenance activities.

Many major federal laws, Executive Orders, regulations, and various other drivers influence the establishment and use of ICs at LM sites. LM uses a wide range of ICs to appropriately limit access to, or uses of, land, facilities, and other real and personal properties; protect the environment; maintain the physical safety and security of DOE facilities; and prevent or limit inadvertent human and environmental exposure to residual contaminants and other hazards.

The ICs at the Weldon Spring, Missouri, Site were developed in close coordination with federal and state regulators. An *Explanation of Significant Differences* (ESD) was issued in February 2005, which clarified the use restrictions necessary for the remedial actions specified in the Records of Decision for the separate operable units to remain protective over the long-term. The operable units included the Chemical Plant Operable Unit, the Chemical Plant Groundwater Operable Unit, and the Quarry Residuals Operable Unit. The ESD clarified specific requirements for each site area that needed use restrictions and established how DOE would implement, maintain, and monitor the specific requirements.

DOE developed the *Long-Term Surveillance and Maintenance Plan for the U.S. Department of Energy Weldon Spring, Missouri, Site* (LTS&M Plan) that addressed the full scope of the site management activities necessary to ensure that the Weldon Spring Site remains protective over the long-term. The LTS&M Plan is revised periodically to ensure its applicability to changing site, regulatory, or procedural conditions. In addition to addressing such activities as long-term groundwater monitoring and disposal cell maintenance, the LTS&M Plan was developed and issued to ensure that the use restrictions identified in the ESD were properly imposed and maintained. The LTS&M Plan included a detailed IC Implementation Plan, which includes a process for evaluating and identifying specific IC mechanisms that best accomplish the objectives set out in the ESD. Consistent with EPA guidance on selecting ICs, various IC mechanisms were evaluated, including government controls, proprietary controls, enforcement tools, and informational devices. Where appropriate, redundant mechanisms were employed to increase the effectiveness of the ICs.

Information in the IC Implementation Plan includes: (1) a discussion of 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); (2) the objectives of, or performance expectations for, the use restrictions; (3) specific ICs already in place and additional mechanisms identified for implementation; (4) a schedule for implementing additional ICs; (5) procedures for maintaining the ICs and for conducting periodic inspections; and (6) general provisions for the implementing ICs for the site. The actual agreements and

documentation of the various ICs are included in an appendix of the LTS&M Plan. These documents are also available via the internet from the authorizing agencies (County, Missouri Department of Natural Resources, EPA, etc.)

The Weldon Spring Site personnel have been successful in finalizing each of the ICs that were established for the site. The planning, establishment, and implementation of the ICs was a long and detailed process with several lessons-learned that were identified along the way.

INTRODUCTION

Site Description

The Weldon Spring Site (Figure 1) is located in St. Charles County, Missouri, about 48 km (30 miles) west of St. Louis. The site comprises two geographically distinct, DOE-owned properties: (1) the Weldon Spring Chemical Plant and Raffinate Pit Sites (Chemical Plant) and (2) the Weldon Spring Quarry (Quarry). The Quarry is located about 6.4 km (4 miles) southwest of the Chemical Plant.

The present footprint of the Chemical Plant and Quarry areas totals 92.33 hectares (228.16 acres). The Chemical Plant property is located on 88.83 hectares (219.50 acres) and the Quarry occupies 3.5 hectares (8.66 acres).

Site History

In 1941, the U.S. government acquired 6,974 hectares (17,232 acres) 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. From 1941 to 1945, the U.S. Army manufactured trinitrotoluene (TNT) and dinitrotoluene 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, groundwater, and some offsite springs.

Following a considerable amount of explosives decontamination of the facility by the Army and the Atlas Powder Company, 83 hectares (205 acres) 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 6.02 hectares (14.88 acres) 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 was also produced. Wastes generated during these operations were stored in four unlined raffinate pits located on the Chemical Plant property (Figure 2). These uranium-processing operations resulted in the radiological contamination in many of the same locations previously contaminated by former Army operations.

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

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 (both drummed and uncontained) from the Chemical Plant.

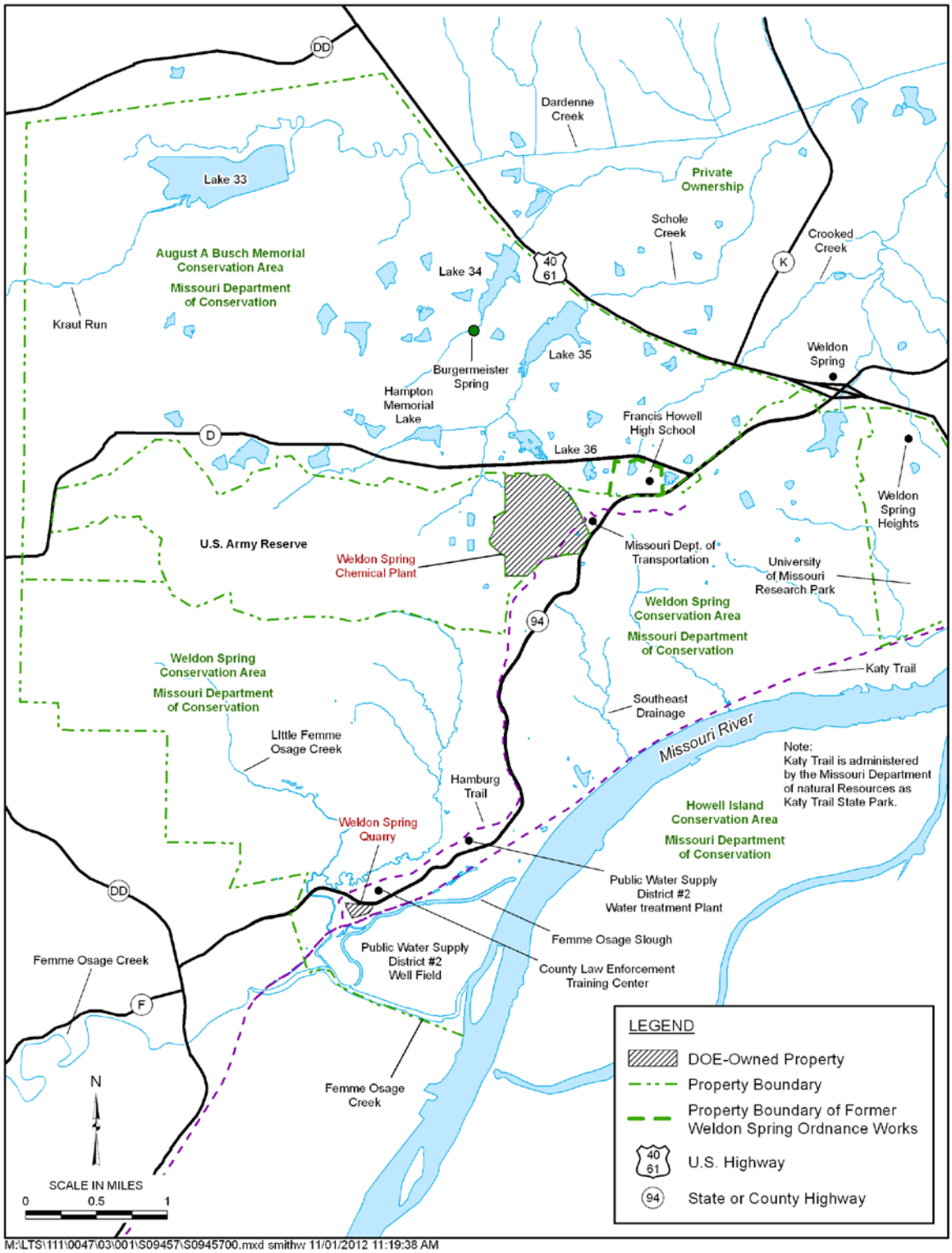


Figure 1. Weldon Spring Site Location.

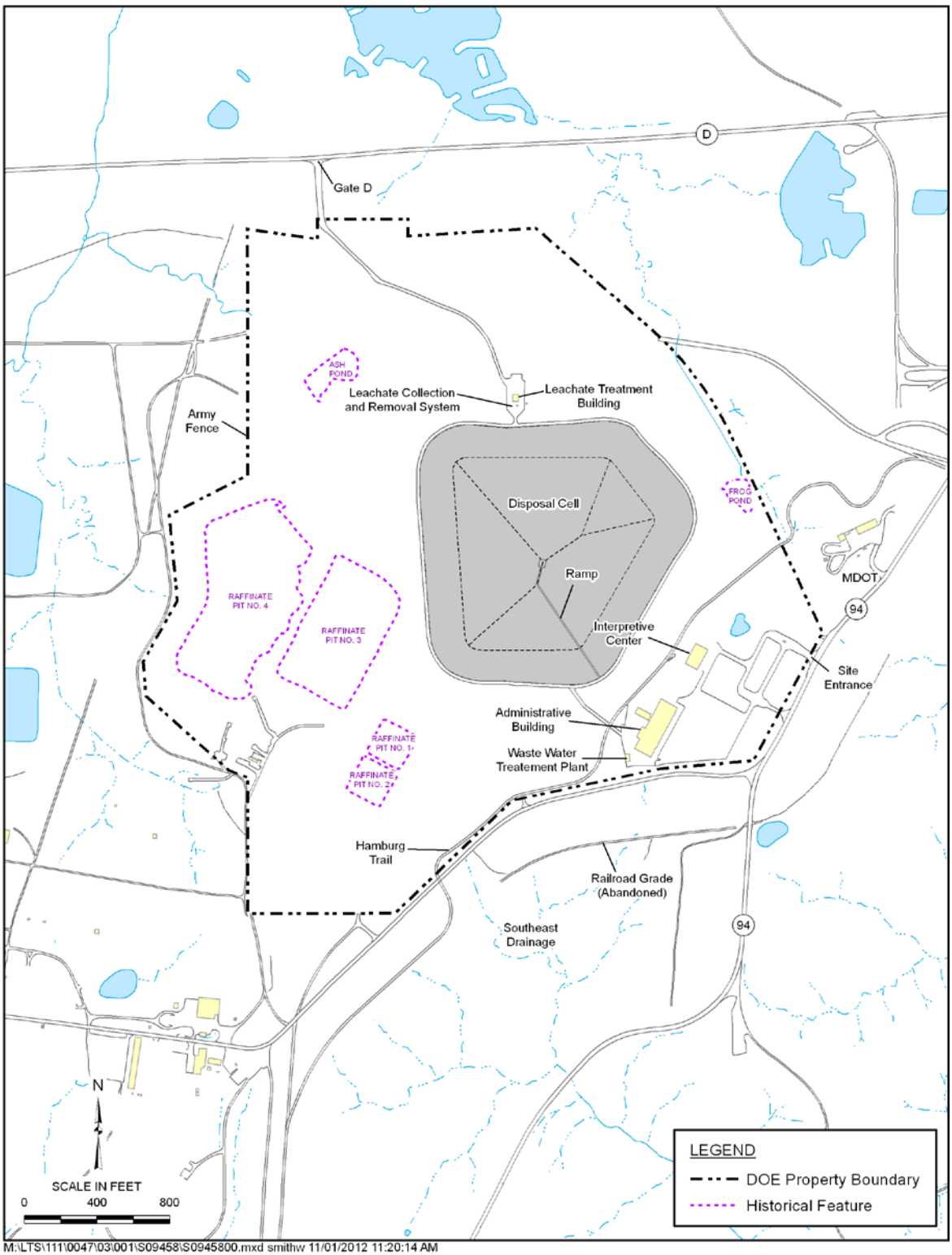


Figure 2. Raffinate pits and other historical features at the Weldon Spring Site.

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-production process, the Army removed equipment and materials from some of the buildings and disposed of them principally in Raffinate Pit Number 4. The defoliant project was canceled before any process equipment was installed, and the Army transferred 20.50 hectares (50.65 acres) of land encompassing the raffinate pits back to AEC while retaining the Chemical Plant. No defoliants were ever produced at this site. 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 determined that the decontamination and remediation of the Chemical Plant, raffinate pits, and Quarry was a major project.

EPA placed the Quarry and Chemical Plant areas on the National Priorities List in 1987 and 1989, respectively. Remediation of the Weldon Spring Site was administratively divided into four operable units (OUs): the Quarry Bulk Waste OU, the Quarry Residuals OU (QROU), the Chemical Plant OU (CPOU), and the Groundwater OU (GWOU). The Southeast Drainage was remediated as a separate action through an Engineering Evaluation/Cost Analysis and Action Memorandum administrative process. The major component of the Chemical Plant OU included disposal of wastes removed from the Chemical Plant and stored Quarry bulk wastes in an engineered onsite disposal facility. Construction of the engineered disposal cell on the Weldon Spring Chemical Plant property began in 1997, and disposal activities were completed in 2001. The cell encompasses an area of 16.6 hectares (41 acres) and contains 1.13 million cubic meters (1.48 million cubic yards) of contaminated waste.

Current land use of the former Ordnance Works Site includes the Chemical Plant and Quarry, the U.S. Army Reserve (training area), the Missouri Department of Conservation, the Missouri Department of Natural Resources - Division of State Parks, the Francis Howell High School, the Missouri Department of Transportation (maintenance facility), the Public Water Supply District #2 (water treatment facility), law enforcement training center, the village of Weldon Spring Heights, and the University of Missouri (research park).

DISCUSSION

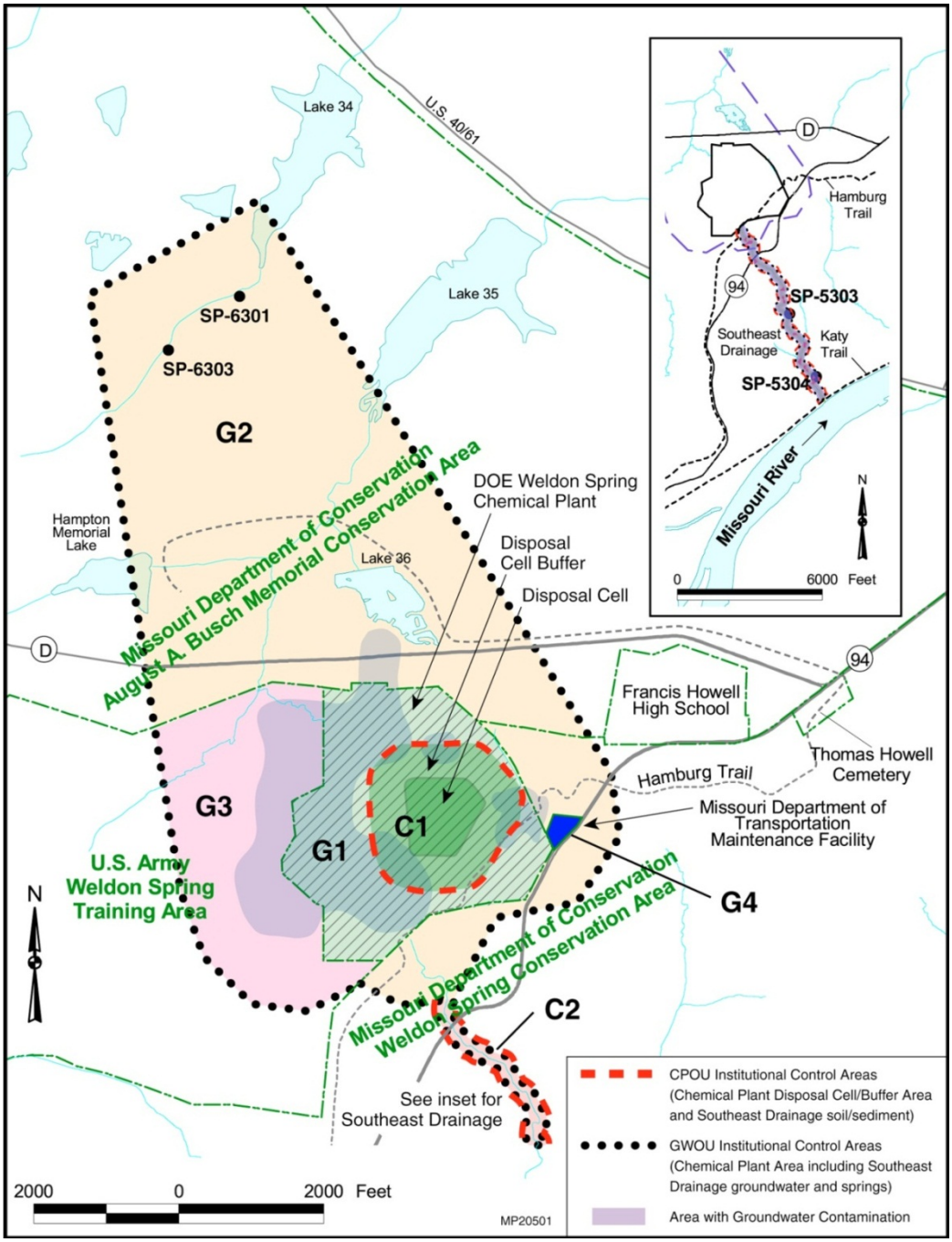
The objective for implementing institutional controls (ICs) for the Weldon Spring Site was twofold: (1) to protect remedies that are in place to ensure protection of human health and the environment and (2) to restrict land and groundwater use until a time that site residual soil and/or groundwater contaminant concentrations are at levels that would allow unrestricted use and unlimited exposure.

The Record of Decisions for the CPOU, QROU, and GWOU stipulated implementation of ICs to support the selected remedies. The overall remediation goal for the Weldon Spring Site is to provide protection consistent with current and reasonable future land use. For the CPOU, soil cleanup was designed to remove contamination to “as low as reasonably achievable” levels. For the QROU, cleanup was performed to achieve recreational land use criteria that is consistent with current and foreseeable future land use at the Quarry area. For the GWOU, cleanup standards were based on drinking water standards, although the contaminated aquifer could not practicably be used for drinking water purposes.

Summary of Institutional Controls

For the CPOU, the primary need for implementing ICs is to protect the remedy in place, mainly the disposal cell and its buffer area. Soil concentrations within the boundaries of the Chemical Plant (including those within the cell footprint) are comparable to background and should allow for uses similar

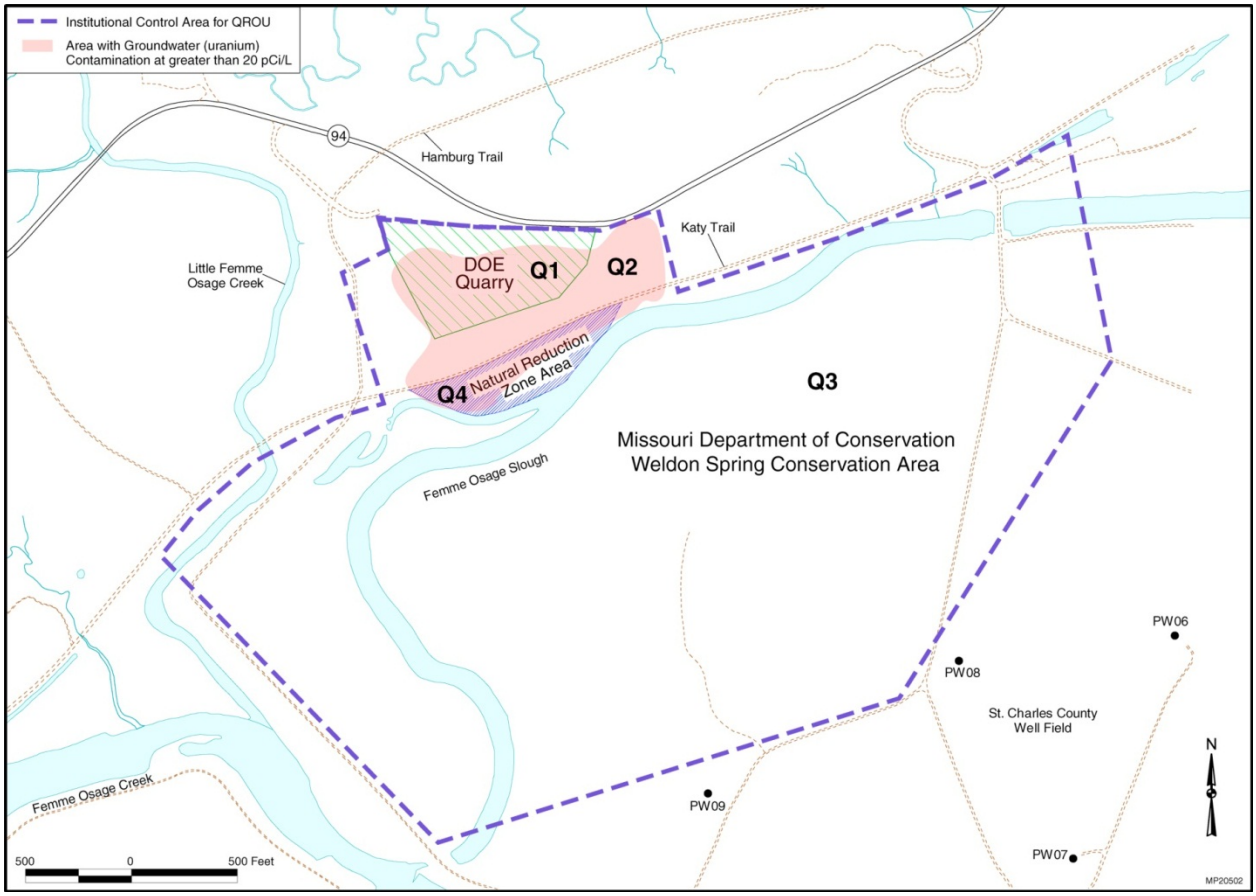
to those elsewhere outside the site. Soil or sediment concentrations within the Southeast Drainage remain at levels that do not allow for unrestricted use and unlimited exposure. A 200-foot corridor along the Southeast Drainage has been identified, providing an adequate buffer. Figure 3 illustrates the areas that are to be restricted at the Chemical Plant and the Southeast Drainage as part of the ICs planned for the CPOU.



C1: Chemical Plant disposal cell and buffer area; C2: Southeast Drainage; G1: Chemical Plant property groundwater restricted area; G2: Missouri Department of Conservation property groundwater restricted area; G3: U.S. Army property groundwater restricted area; G4: Missouri Department of Transportation property groundwater restricted area

Figure 3. IC restrictions for the Chemical Plant Area at the Weldon Spring Site.

For the QROU, restrictions were needed to prevent all access to contaminated groundwater north of the Slough and to prevent access to the cracks and fissures at the Quarry proper. Disturbance at the peapod-shaped land area immediately north of the Slough needed to be prevented to allow naturally occurring reduction of uranium to continue. There was also a need to restrict access to groundwater south of the Slough within the 1,000-foot buffer zone, which was identified on the basis of the maximum hydraulic capture of a well in this area. This buffer zone will prevent the placement of a well, which could draw contaminants toward it. Figure 4 illustrates the areas that are included with restrictions.



Q1: Quarry soil
Q2 and Q3: Quarry area groundwater north and south of Femme Osage Slough
Q4: Reduction zone

Figure 4. IC Restrictions for the Quarry Area at the Weldon Spring Site.

For the GWOU, restrictions are needed to prevent access to the contaminated groundwater in the shallow aquifer for residential uses and for all other uses so that the hydraulic gradient of the area is not disturbed. This will protect the monitored natural attenuation remedy that is in place. The area identified for restrictions (see Figure 3) includes a 1,000-foot buffer area that accounts for the groundwater gradient and flow conditions at the site.

The IC mechanisms identified for consideration were those included in EPA guidance and others that have been implemented and proven to be effective in supporting project activities at the Weldon Spring Site. Impacted areas that require ICs are either federally owned or state-owned properties; no privately owned areas are affected. The IC mechanisms were categorized into the four categories consisting of

governmental controls, proprietary controls, enforcement tools, and informational devices. Multiple mechanisms are being used to provide "layering" for additional durability.

At the time the Long-Term Surveillance & Maintenance (LTS&M) Plan[1] and IC Implementation Plan were developed in 2005, the following institutional controls were in place for the Weldon Spring Site:

- Federal ownership, which provides exclusive jurisdictional control over the Chemical Plant and Quarry.
- DOE is committed to perpetual care of the disposal cell and buffer zone as specified in the Chemical Plant Record of Decision, which is enforceable under the Federal Facility Agreement.
- A notation of land ownership 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.
- The Interpretive Center serves as a community information resource. It depicts the history of the area and details the progression of the cleanup process, and it offers information on the construction of the engineered disposal cell and the residual groundwater contamination. The Interpretive Center hosts field trips almost every day of the week. This informational IC is very useful in informing the community on what occurred and what is left in place at the Weldon Spring Site. The Center hosts over 20,000 visitors per year.
- Historical markers have been placed along the Hamburg Trail and information plaques are accessible at the top of the engineered disposal cell.
- Missouri regulates the construction of wells pursuant to Title 10, Missouri *Code of State Regulations,* Division 23, Chapter 3 (10 CSR 23.3), "Well Construction Code."
- DOE has real estate licenses with the Missouri Department of Conservation (MDC) and the Missouri Department of Natural Resources (MDNR), Division of State Parks (also known as MDNR-Parks), that allow access for monitoring and maintaining groundwater wells, drilling and plugging wells, usage of the land for effluent water pipeline, etc.
- There is an existing Memorandum of Understanding (MOU) with the U.S. Department of the 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 (1) monitoring and maintaining groundwater wells and (2) drilling and plugging wells.
- The use restrictions and the ICs identified in the LTS&M Plan are enforceable under the Federal Facility Agreement.

In addition to the ICs that were already in place, as discussed above, DOE determined that additional ICs should be implemented for a layered protectiveness approach. The ICs that comprise the layered system include (1) easements with various state entities, (2) an updated MOU with the Army, and (3) a Special Area designation under the Missouri Water Well Drillers Act.

Easements

DOE decided to negotiate easements with surrounding affected State agency landowners for implementing use restrictions required on state properties. The State agencies included MDC, MDNR-Parks, and the Missouri Department of Transportation. An easement is a real property interest that conveys certain rights from the grantor (fee simple landowner) to the grantee. In the case of the Weldon Spring Site, DOE was seeking 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 area and at the Quarry site. Initial work in acquiring the easements included: (1) obtaining legal descriptions and surveying the affected properties, (2) conducting a title search for the affected parties, (3) obtaining

preliminary title commitment, (4) obtaining appraisal of affected areas, and (5) negotiating easement language and applicable fees for obtaining the easements.

MOU for the Army Property

Use restrictions have been identified for a portion of the neighboring Army property (Shown as G-3 in Figure 3) as part of DOE's GWOU remedy. An existing MOU (dated February 2005) committed the Army to support the remedial actions implemented by DOE. DOE decided to modify/update the MOU to specify the use restrictions identified for the GWOU. The new or revised MOU was to be specific with respect to the necessary groundwater use restrictions for property under Army control. The MOU would 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.

Special Area Designation under the Missouri Water Well Drillers Act

DOE decided to request further well drilling restrictions to be imposed in the groundwater restriction areas by petitioning for a rule change under 10 CSR 23-3.100, "Special Areas." Special Areas, which present unique or additional constraints, are designated on a case-by-case basis. The regulation requires a driller to consult with MDNR to gain "specific guidance on well drilling protocol and construction specifications on a case-by-case basis. The division must provide approval for all new wells prior to construction."

Implementation

Easements: The LTS&M Plan set out a specific schedule for DOE to begin the implementation of the additional ICs. DOE met the schedule, which included: (1) submitting proposed easements to the State agencies within 8 months of the effective date of the LTS&M Plan (July 2005), (2) submitting a draft updated MOU to the Army for review and comment within 6 months of the effective date of the LTS&M Plan, and (3) submitting a package that proposed Special Area designation to the MDNR within 4 months of the effective date of the LTS&M Plan.

DOE issued initial letters, dated October 12, 2005, to the surrounding State agency property owners in order to reinitiate discussions regarding the proposed easements. DOE negotiated and met with the property owners several times the next several years. DOE and MDNR-Parks finalized and signed the easement regarding the MDNR-Parks property in September 2009. The easement with MDC was finalized in July 2011. The easement with the Missouri Department of Transportation was finalized in June 2012. Obtaining these requisite easements was a very time-consuming process.

MOU for the Army Property: The updated MOU with the Army was completed and signed in October 2009.

Special Area Designation under the Missouri Water Well Drillers Act: Regarding the Special Area designation under the Missouri Water Well Drillers Act, DOE decided to work with the Army to collaborate on this regulation change as the Army had contaminated groundwater issues in the same general areas. The DOE and Army attended several meetings of the Missouri Well Installation Board to assist in finalization of the rule.

A draft of the rule was published in the *Missouri Register* on February 15, 2007, for a 30-day review period. The final rule was published by reference in the July 2, 2007, *Missouri Register* stating the rule would become effective 30 days after publication.

Monitoring and Maintenance of ICs

The DOE conducts an annual LTS&M site inspection that includes an inspection of the institutional control areas. Inspectors walk the IC areas to ensure that the restrictions imposed by ICs are not being violated. The DOE and contractor staff is joined by several participants during the inspection including county, state, and federal regulators, representatives of additional state entities, and members of the public. These restrictions include no drilling of wells, no soil disturbance, and no residential use or construction. All property owners with ICs on their property are contacted to ensure that they remain aware of the ICs and to keep their contact information current. As a requirement of the inspection, inspectors verify that the institutional control real estate restrictions are recorded with the County.

By making contact with the owners of surrounding properties regarding the ICs that are in effect on their property, DOE has kept the landowners' contact information up to date and, perhaps more importantly, stayed abreast of other issues that could affect DOE.

The physical inspection of the IC areas keeps DOE and the regulators familiar with the area and with changes being made to the surrounding properties. For example, the Army has changed their mission in the past few years and has constructed a new reserve center. The close contact with the Army during the annual inspection resulted in knowledge that the DOE leachate discharge pipeline (which is National Pollutant Discharge Elimination System [NPDES] permitted) would be moved by the Army during construction of a storm-water pond to support the new reserve center.

The inspection process is a successful mechanism for ensuring the effectiveness of ICs that protect human health and the environment. It is also a process that DOE has instituted to maintain regular communication with regulators, neighboring property owners, and other stakeholders.

CONCLUSIONS

The process of researching, determining, proposing, negotiating, and implementing the ICs at the Weldon Spring Site was a long and arduous process. The process required determination and active follow-up. The ICs were layered to ensure effectiveness. The visibility and durability of the ICs is ensured by several mechanisms including officially recording the ICs, inspecting the ICs annually, contacting affected parties annually, and including the ICs in the LTS&M Plan. The informational ICs in effect at the Weldon Spring Site help to maintain the visibility of the ICs. These include the Interpretive Center and historical markers. The enforceability of the ICs is established by the Federal Facility Agreement negotiated between DOE, EPA, and MDNR. The success of the ICs at the Weldon Spring Site depends on all of these aspects. It has been a long and often difficult journey but well worth the effort for all parties involved with the site.

REFERENCES

1. DOE (U.S. Department of Energy), 2008. *Long-Term Surveillance and Maintenance Plan for the U.S. Depart of Energy Weldon Spring, Missouri, Site,* LMS/WEL/S00790, U.S. Department of Energy Office of Legacy Management, December.