SET I.D. _____

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CONTRACT NO. DE-AC05-86OR21548

ENVIRONMENTAL MONITORING PLAN

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

SUPERSEDED

JANUARY 1997 **REV. 4**

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

Prepared by MK-Ferguson Company and Jacobs Engineering Group

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Weldon Spring Site Remedial Action Project

Environmental Monitoring Plan

Revision 4

January 1997

Prepared by

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

for the

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

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Weldon Spring Site Remedial Action Project Contract No. DE-AC05-86OR21548	Rev. No. 4
PLAN TITLE: Environmental Monitoring Plan	

APPROVALS

ES&H Manager — Date: 12/30/96

Data Administration Manager — Date: 12/31/96

Quality Assurance Manager — Date: 01/02/97

Deputy Project Director — Date: 1/2/97

Project Director — Date: 1/3/97

ABSTRACT

This plan is prepared to detail the environmental monitoring requirements for the Weldon Spring Site Remedial Action Project in accordance with Department of Energy Order 5400.1 and to ensure monitoring is sufficient to protect the environment and water users downstream of the Weldon Spring Site Remedial Action Project. The plan is to be reviewed annually and reissued at least every 3 years. Revision 4 of this document is the result of the re-evaluation of groundwater, National Pollutant Discharge Elimination System (NPDES) surface water, and air monitoring programs based on changes in site remediation activities and past monitoring results at the site.

The Weldon Spring Site Remedial Action Project monitoring program is designed to address pathways and constituents to human and environmental receptors in a changing waste setting and to further characterize the waste units in order to model their behavior under specific conditions. Site specific criteria considered in planning pathway analyses included physical, chemical, and biological characteristics of the radionuclides and chemical contaminants detected, spatial distribution, concentrations, depth to groundwater, geology of the area, climatic conditions, how the area is used by the public and wildlife, and the proximity of contaminated sites to potential receptors.

Site features receiving surface water will be sampled and contaminant levels will be measured. The migrating surface waters will be sampled along their courses to track their behavior until the concentrations are diluted or otherwise rendered indiscernible from background levels. Groundwater will be sampled at locations of known or potential impact to monitor the effects of remedial actions on groundwater quality and to monitor contaminant levels that may exceed water quality standards. Groundwater that surfaces at Burgermeister Spring will also be sampled to provide a complete assessment of the groundwater system.

Work-area monitoring will be conducted to provide knowledge of real-time airborne emission levels. Specific locations around the site where there is concentrated human activity are considered "critical receptor" locations and will receive focused attention. Agricultural products are monitored as part of the characterization of foodstuffs and to established natural levels of radionuclides. Radionuclides in aquatic ecosystems are monitored to assess environmental conditions. This characterization, along with the determinations made during

subsequent, routine biological and surface water sampling, will meet the environmental monitoring data needs of the project and reveal effects of the project on aquatic life.

Point discharges of storm water and treated water will be sampled in accordance with the NPDES permits issued to the Weldon Spring Site Remedial Action Project and the results will be reported to the Missouri Department of Natural Resources as required by the permits.

SUMMARY OF CHANGES

Revision 4 of the *Environmental Monitoring Plan* is the result of the re-evaluation of groundwater and air monitoring programs based on changes in site remediation activities and past monitoring results at the site. A table summarizing the changes can be found in Section 1.3.

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1 INTRODUCTION

The Weldon Spring site is located near Weldon Spring, Missouri, 48 km (30 mi) west of St. Louis, Missouri. The site formerly consisted of an inactive uranium production facility including raffinate pits, an inactive chemical plant, an abandoned limestone quarry, and associated vicinity properties. These areas contain chemically and radiologically contaminated materials originating from previous operations at the site.

Remediation of the Weldon Spring site is being conducted under the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and as part of the U.S. Department of Energy Environmental Restoration and Waste Management Program. The program is known as the Weldon Spring Site Remedial Action Project (WSSRAP). The major goals of the WSSRAP are to eliminate potential hazards to the public and the environment, and to the extent practicable, make surplus real property available for other uses. An environmental documentation approach has been developed that satisfies the requirements of both the CERCLA, as amended by the *Superfund Amendments and Reauthorization Act* (SARA), and the *National Environmental Policy Act* (NEPA). The results of this process are the *Record of Decision for the Management of the Bulk Wastes at the Weldon Spring Quarry* (Ref. 1) and the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 2) on ultimate disposal of the Weldon Spring site wastes which was issued in September 1993.

Department of Energy Order 5400.1, *General Environmental Protection Program*, requires the preparation of an Environmental Protection Program Implementation Plan at all Department of Energy sites. The Weldon Spring site *Environmental Protection Program Implementation Plan* (EPPIP) (Ref. 3) details the methods by which the WSSRAP will comply with this order. Because the WSSRAP is a remedial action project, the overall goal is different from that of the operating and/or production facilities for which Department of Energy Order 5400.1 was developed. Therefore, the WSSRAP EPPIP meets the intent of Department of Energy Order 5400.1 while being tailored to the unique aspects of a remedial action project. The WSSRAP has prepared this *Environmental Monitoring Plan* (EMP) to meet the requirements for Department of Energy environmental monitoring programs as specified in Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (Ref. 4), hereafter referred to as the *Regulatory Guide*.

This *Environmental Monitoring Plan* is to be reviewed annually and reissued at least every 3 years in accordance with Department of Energy Order 5400.1. Annual reviews will be documented and summaries of needed revisions will be transmitted to the Department of Energy along with expected dates of issuance. If during the monitoring year, significant deviations or alterations to this plan are necessary, approval by the Department of Energy will be obtained. Any deviations or alterations will also be summarized and documented in the annual site environmental report for the year of occurrence.

1.1 Purpose

Department of Energy Order 5400.1 requires the preparation of an environmental monitoring plan to define the effluent monitoring and environmental surveillance required to demonstrate compliance with applicable Federal, State, and local environmental protection laws and regulations, executive orders, and internal Department of Energy policies.

The purpose of this plan is to detail the environmental monitoring requirements at the Weldon Spring site. Environmental monitoring is performed at this site to document and quantify potential public exposure, to protect public health and safety and the environment, and to demonstrate compliance with applicable legal and regulatory requirements. The monitoring program also verifies adherence to Department of Energy environmental protection policies and supports remedial planning.

1.2 Scope

This plan describes the effluent monitoring and environmental surveillance activities that will be performed at the Weldon Spring site. These activities include monitoring of surface water, groundwater, radon, gamma exposure, air particulates, biological parameters, and meteorological conditions. The plan also describes applicable monitoring requirements, analytical methods used, and quality assurance measures. Details and rationale regarding sampling frequencies and analytical parameters are provided. Also presented are summaries of additional programs implemented to satisfy the requirements of Department of Energy Order 5400.1, Order 5400.5, and the *Regulatory Guide* (Ref. 4). An evaluation of compliance or noncompliance with each regulatory guide criteria statement is included in Appendix A of this document. Where criteria statements are applicable to the WSSRAP, recognition of satisfying

the criteria is included in the text and in Appendix A; where criteria statements are not applicable, justification for exclusion is included in Appendix A only.

1.3 Monitoring Changes From Revision 2

The EMP has been revised on a yearly basis even though, at a minimum, revision is required only every 3 years, with reviews conducted annually. The EMP was revised for 1997 because of the sufficiency of past data collected, foundation removal, and other work packages. Table 1-1 shows the major changes in monitoring and the reasons for the changes.

TABLE 1-1 Changes From Revision 3

MEDIA & PARAMETER	LOCATIONS	CHANGES	REASONS
NPDES, Site			
		None	
NPDES, Quarry			
		None	
Surface water, Site			
Uranium	NP-0107	Delete location	Water diverted to sedimentation basin
	SW-2017	Add location	Upstream monitoring
	SW-2001, 2002, 2003, 2004, 2005, 2012, 2016	All analyses on site KPA.	Proven reliability
Surface water, Quarry			
All parameters	SW-1001, SW-1002, SW-1014	Delete locations	Sufficient characterization completed
Nitroaromatics	SW-1003, SW-1004, SW-1005	Decrease monitoring frequency	Consistently at background

TABLE 1-1 Changes From Revision 3 (Continued)

MEDIA & PARAMETER	LOCATIONS	CHANGES	REASONS
Groundwater, Site			
All parameters	MW-2007, MW-2011, MW-2015, MW-2028, MW-2030	Delete locations	Plugged and abandoned
Volatile organic compounds	All chemical plant EMP locations	Add locations	Chlorinated solvents detected in groundwater.
Baseline detection monitoring parameters (Ref. 5)	Disposal cell groundwater detection monitoring network	Addition of four disposal cell monitoring wells to be sampled quarterly	Disposal cell groundwater detection monitoring
Groundwater, Quarry			
Uranium, total (off-site analysis)	MW-1002 thru MW-1005, MW-1029 thru MW-1032	Reduce frequency	Reduced activity at quarry; quarterly KPA is adequate
Uranium, KPA	MW-1002 thru MW-1023, MW-1028 thru MW-1033 MW-1038 thru MW-1039	Reduce frequency	Reduced activity at quarry
Nitroaromatics	MW-1002 thru MW-1009	Reduce frequency to quarterly	Bimonthly not required while quarry inactive
Air, Site			
Radioactive particulates	AP-2025	Add location	Replacement of deleted monitor
Radioactive particulates	AP-2013	Delete location	Retention basin construction
Alpha track radon	RD-2025	Add location	Replacement of deleted monitor
Alpha track radon	RD-2003	Delete location	Retention basin construction

TABLE 1-1 Changes From Revision 3 (Continued)

MEDIA & PARAMETER	LOCATIONS	CHANGES	REASONS
External gamma	TD-2025	Add location	Replacement of deleted monitor
External gamma	TD-2003	Delete location	Retention basin construction
Asbestos	All site locations	Delete locations	No active asbestos remediation
Air, Quarry*			
Radioactive particulates	AP-1010, AP-1015, AP-1016, AP-1017	Delete locations	Removal of bulk waste completed
Alpha track radon	RD-1003, RD-1004, RD-1006, RD-1008, RD-1009	Delete locations	Removal of bulk waste completed
Electret radon	ET-1004, ET-1009, ET-1010	Delete locations	Removal of bulk waste completed
External gamma	TD-1004, TD-1006, TD-1009	Delete locations	Removal of bulk waste completed
Asbestos	All quarry locations	Delete locations	No active asbestos remediation
Biological			
Wetland flora and fauna	Busch Conservation Area wetland complex	Begin monitoring	Monitor wetland establishment
Springs, Site			
Geochemical parameters	SP-6301	Delete parameters	Sufficient data
TCLP Metals	SP-6301	Add parameters	Monitor soil remediation impacts

* Locations were deleted after bulk waste removal was completed.

1.4 Site History

In April 1941, the Department of the Army acquired a total of 6,974 ha (17,232 acres) of land, and contracted with the Atlas Powder Company to operate 20 trinitrotoluene (TNT) and dinitrotoluene (DNT) explosives production lines. The plant was in operation from November 1941 through January 1944 as part of the facility known as the Weldon Spring Ordnance Works. Four of the production lines were located on what is now the chemical plant/raffinate pits area and the remaining 16 production lines were distributed across an adjacent property that is now referred to as the U.S. Army Reserve and National Guard Training Area. By 1949, all but approximately 809 ha (2,000 acres) of this land had been transferred to the State of Missouri (August A. Busch Memorial Conservation Area and Weldon Spring Conservation Area) and the University of Missouri (agricultural land). Except for several small parcels transferred to St. Charles County, the remaining property became the Army training area.

Through a Memorandum of Understanding between the Secretary of the Army and the General Manager for the Atomic Energy Commission (AEC), 83 ha (205 acres) of the former ordnance works were transferred in May 1955 to the AEC for the construction of the Weldon Spring Uranium Feed Material Plant. Considerable explosives decontamination was performed by Atlas Powder and the Army prior to construction of the feed materials plant. Until 1966, the feed materials plant was operated as an integrated facility for the conversion of 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 on the site.

In 1958 the AEC acquired title to the Weldon Spring Quarry from the Department of the Army. The quarry was located approximately 5.6 km (3.5 mi) south of the feed materials plant. The Army had used it earlier for disposal of wastes from the manufacture of TNT and DNT, and for disposal of TNT-contaminated rubble during operation of the ordnance works. Prior to 1942, the quarry was mined for limestone aggregate used in construction of the ordnance works. The AEC used the quarry from 1963 to 1969 as a disposal area for uranium residues and a small amount of thorium residue. But most of the material disposed of there consisted of uranium and radium-contaminated building rubble and soils from the demolition of a uranium ore processing facility in St. Louis. Other radioactive materials in the quarry include drummed wastes, uncontained wastes, and contaminated process equipment.

The Weldon Spring Uranium Feed Material Plant was shut down in 1966, and in 1967 the AEC returned the facility to the Department of the Army for use as a defoliant production plant to be known as the Weldon Spring Chemical Plant. The Army started removing equipment and decontaminating several buildings in 1968, but the defoliant project was canceled in 1969 before any process equipment was installed. The Army retained responsibility for the land and facilities at the chemical plant, but the 20.6 ha (51-acre) tract encompassing the raffinate pits was transferred back to the AEC. From 1969 to 1981, the status of the Weldon Spring site did not change. The site was placed in caretaker status from 1981 through 1985, when custody of the chemical plant and quarry were transferred from the Department of the Army to the Department of Energy. In 1985, the Department of Energy proposed designating control and decontamination of the chemical plant, raffinate pits, and quarry as a major project.

A Project Management Contractor for the WSSRAP was selected in February 1986. In July 1986, a Department of Energy project office was established on site, and the contractor, MK-Ferguson and Jacobs Engineering Group, Inc., assumed control of the site on October 1, 1986. The quarry was placed on the Environmental Protection Agency National Priorities List (NPL) in July 1987. The Department of Energy redesignated the site as a Major Acquisition System in May 1988. The chemical plant and raffinate pits were added to the NPL in March 1989.

Under the CERCLA process, a focused *Remedial Investigation/Feasibility Study - Environmental Assessment* (RI/FS-EA) was used to document the proposed management of the wastes in the quarry. Compared to the full-scope of the RI/FS, the focused RI/FS was appropriate for the bulk wastes since removal will decrease the threat of release of contaminants and is consistent with a permanent remedy for the entire site (Ref. 6). The NEPA/CERCLA environmental documentation process for the quarry bulk wastes was completed and remedial activities began in 1991. The first load of waste was removed from the quarry in the summer of 1993, and the last load was removed October 27, 1995.

Remedial investigations were conducted at the chemical plant/raffinate pits area in 1988 and 1989 under the CERCLA RI/FS process. These investigations included characterization of the groundwater; on-site soil contamination; contaminated sediments in off-site surface drainages, lakes, surface water, and springs; and chemical and radiological contaminants in the raffinate wastes. The results of each of these investigations have been published in the *Remedial*

Investigation Report for the Chemical Plant Area of the Weldon Spring Site (Ref. 7). The *Record of Decision* (Ref. 2) marks the selection of the final remediation and disposal method for the chemical plant and bulk wastes for the quarry. The *Record of Decision* was issued in September 1993.

Several interim response actions have been conducted at the WSSRAP. Interim response actions are activities that will not change the ultimate disposal method but have been conducted to mitigate or eliminate conditions that pose immediate or potential threats to worker safety, public health, or the environment (Ref. 8). Some of the interim actions taken were: removal of exposed friable asbestos, overhead piping, polychlorinated biphenyl (PCB) electrical equipment, power poles and wires; demolition of all buildings; isolation and capping of Ash Pond; capping of some other highly contaminated areas; consolidation of containerized chemicals; and removal of building foundations and contaminated soils to storage areas.

2 OBJECTIVES AND RATIONALE

The goal of the Weldon Spring Site Remedial Action Project (WSSRAP) is to protect and enhance the environment while protecting the public during remedial activities. The action consists of safely disposing of hazardous and radiological wastes that resulted from the operation of the Weldon Spring Uranium Feed Materials Plant and the Weldon Spring Ordnance Works. Within the overall project mission, the environmental protection program focuses on the operational activities of the project.

The WSSRAP objectives for the environmental protection program are as follows:

- Assess compliance with applicable environmental quality standards and public exposure limits.
- Measure background levels and site specific compound levels.
- Measure the effectiveness of effluent treatment and controls.
- Assess the validity and effectiveness of exposure models.
- Measure the long term buildup and assess environmental trends from site-released contaminants.
- Detect and quantify unplanned releases.

This *Environmental Monitoring Plan* describes the rationale and design criteria for the monitoring program; designates the extent and frequency of monitoring and measurements; outlines procedures for laboratory analyses, quality assurance requirements, program implementation procedures, and preparation and disposition of related reports.

In case of deviations from this plan, either intentionally or because of circumstances outside the control of the Project Management Contractor, concurrence will be obtained from the U.S. Department of Energy (DOE). Examples include but are not limited to long-term reductions of sampling frequency, elimination of sampling locations, elimination of analyzed

parameters, or use of less stringent analytical methods, and addition of sampling locations. On a case-by-case basis, short-term, limited, informational or emergency sampling may be conducted under this plan without prior DOE concurrence in order to investigate or followup on areas of suspected environmental concern.

The WSSRAP environmental protection program is separated into two distinct functions: (1) effluent monitoring, and (2) environmental surveillance. Effluent monitoring assesses the quantities of substances in migration pathways from the site at its perimeter or in pathways subject to compliance with applicable or relevant and appropriate regulations (e.g., National Emissions Standards for Hazardous Air Pollutants [NESHAPs]) or permit levels and requirements (e.g., the National Pollution Discharge Elimination System [NPDES]). The environmental surveillance program generally reviews environmental media within or outside the site boundary for the presence and concentration of site-related contaminants to detect and/or track the migration of those contaminants. Surveillance data are used to assess the presence and magnitude of any radiological or toxicological exposures to members of the public, or to assess the effects, if any, on the local environment.

The Weldon Spring site has maintained a relatively stable configuration of its waste materials since cessation of plant operation and decontamination of some process buildings in the early 1970s. It is believed that this stability has allowed the site to achieve a rough equilibrium regarding the migration of contaminants from the site. Since the chemical plant and quarry are presently under active remediation, the nature of the waste units and their physical positions and chemical states are subject to disturbance. The monitoring program has been designed to address pathways and constituents in a changing waste setting and to further characterize the waste units in order to model their behavior under specific conditions.

The Department of Energy has defined generic performance criteria that their operations offices must use in developing their programs. The WSSRAP environmental protection program has incorporated these criteria into its monitoring program. The objective of the WSSRAP environmental monitoring program is to generate data needed to demonstrate regulatory compliance and to assess the impact of contaminants on the public and environment. Therefore, a program must be developed to assess viable environmental pathways. The program outlined in this plan defines a scheme of minimum data points to be collected to evaluate whether environmental conditions are changing, and whether site-related contaminants or activities are

impacting public health or the environment. Where additional density or data points are required to verify trends or more closely evaluate environmental conditions, additional samples may be collected that are not defined in the plan. Those samples will be collected to serve the objectives of the environmental monitoring program at the Weldon Spring site and will be consistent with the guidelines of the DOE 5400 Orders. The following section describes the pathway analysis performed by the WSSRAP to arrive at the monitoring program.

2.1 Pathway Analysis

To evaluate the potential impact on human or ecological receptors of activities at the Weldon Spring site, it is necessary to conduct a pathway analysis. Exposure pathways are identified considering the source, mechanisms of release, type and location of contaminants at the site, the probable environmental fate (persistence, partitioning, transport, and intermedia transfer) of these contaminants, and the location and activities of potentially exposed receptors. Table 2-1 identifies the matrix of factors considered in the exposure pathway screening process. The primary objective of the pathway analysis is to identify complete pathways and give reasonable assumptions about future conditions. An exposure pathway is considered complete if a link can be shown between one or more contaminant sources, through one or more environmental transport processes, to an exposure point where human or ecological receptors are present. Identification of potentially complete pathways is a qualitative judgement. Procedures used are intended to be conservative. Identification of a complete pathway does not necessarily indicate that adverse effects will occur; it indicates that the effort to monitor releases is worthwhile from the standpoint of protecting human health and the environment.

2.2 Monitoring Program Rationale

The critical pathway analyses (radionuclide and media) conducted for the WSSRAP included both the Weldon Spring Quarry and the Weldon Spring Chemical Plant and raffinate pits, and are presented in Table 2-2. These analyses were based on data developed during various characterization and monitoring studies, from site specific criteria, site specific assumptions, and the matrix of potential exposure routes.

TABLE 2-1 Potential Exposure Route Matrix

COMPONENT OF EXPOSURE ASSESSMENT	FACTORS TO BE CONSIDERED
Affected Environmental Media	Air Groundwater Surface Water Sediment Surface Soil Subsurface Soil Aquatic Biota Terrestrial Biota
Contaminant Transport Pathway	Airborne transport Groundwater migration Surface water runoff Sediment transport Infiltration Percolation Surface soil erosion Transport of aquatic biota Terrestrial biota migration
Mechanism of Release to Affected Medium	Air - Volatilization, fugitive dust emissions, gas emissions. Groundwater - Percolation, migration, losing streams. Surface water - Surface runoff, groundwater discharge, partitioning with sediment. Sediment - Sediment transport in surface runoff, fugitive dust, partitioning with surface water. Surface soil - Fugitive dust transport/deposition, surface runoff, surface disturbance. Subsurface soil - Leaching, partitioning with groundwater. Aquatic biota - Direct contact, ingestion. Terrestrial biota - Direct contact, ingestion.

TABLE 2-1 Potential Exposure Route Matrix (Continued)

COMPONENT OF EXPOSURE ASSESSMENT	FACTORS TO BE CONSIDERED
Current and future receptors	Human - On-site workers, off-site workers, off-site residential, recreational. Ecological - On-site aquatic, off-site aquatic, on-site terrestrial, off-site terrestrial. Environmental - Physiochemical conditions of environmental media.
Routes of exposure by medium	Air - Inhalation, immersion Groundwater - Ingestion, dermal contact Surface water - Ingestion, dermal contact Sediment - Ingestion, dermal contact Surface Soil - Ingestion, dermal contact Subsurface soil - Ingestion, dermal contact Biota - Ingestion, dermal contact Cross Media Transfers

TABLE 2-2 Exposure Scenarios Evaluated for Monitoring

RECEPTOR	EXPOSURE SCENARIO	PATHWAY SELECTED FOR MONITORING	RATIONALE
Off-site Residents	Ingestion of small game animals in contact with contaminant source areas.	No	Ingestion of small game animals by residents is assumed low due to large buffer zone of wildlife area.
	Ingestion of groundwater from well downgradient from site sources.	Yes	Potential use of groundwater as a source for drinking water by residents.
	Inhalation of particulates dispersed through wind erosion and remedial actions.	Yes	Potential inhalation of airborne particulates by nearby residents.
	Dermal contact with airborne and deposited particulates	No	Dermal contact with radiologically impacted particulates is not considered a substantial exposure mechanism.
	Ingestion of surface water and/or sediment.	Yes	Potential for ingestion due to recreational activity in off-site impacted waters.
Wildlife Area Visitors	Inhalation of particulates dispersed through wind erosion and remedial action.	Yes	Potential inhalation of airborne particulates by wildlife area visitors.
	Ingestion of game and fish inhabiting wildlife area.	Yes	Potential ingestion of game and fish inhabiting wildlife area collected during hunting season.
	Ingestion of surface water and contact with sediments while swimming or wading.	Yes	Potential exposure through ingestion of, or contact with, surface water in wildlife areas.

TABLE 2-2 Exposure Scenarios Evaluated for Monitoring (Continued)

RECEPTOR	EXPOSURE SCENARIO	PATHWAY SELECTED FOR MONITORING	RATIONALE
Wildlife Area Visitors (Continued)	Dermal contact with airborne and deposited particulates.	No	Dermal contact with radiologically impacted particulates is not considered a substantial exposure mechanism.
Terrestrial Biota (on site)	Ingestion of surface water, sediments, or vegetation, or inhalation of air particulates.	No	Previous studies have indicated no substantial uptake or risk.
Terrestrial Biota (off site)	Ingestion of surface water, sediments, or vegetation, or inhalation of air particulates.	No	Previous studies have indicated no substantial uptake or risk.
Aquatic Biota (on site)	Uptake of surface water and contact with sediments.	No	Previous studies have indicated no substantial uptake or risk.
	Ingestion of invertebrates and vegetation.	No	Previous studies have indicated no substantial uptake or risk.
Aquatic Biota (off site)	Uptake of surface water and contact with sediments.	Yes	Potential human consumption of game fish in contact with surface water and sediments.
	Ingestion of invertebrates and vegetation.	Yes	Potential human consumption of game fish which ingest invertebrates and vegetation.

Site specific criteria considered in pathway analyses included physical, chemical, and biological characteristics of the radionuclides and chemical contaminants detected, spatial distribution, concentration, depth to groundwater, geology of the area, climatic conditions, how the area is used by the public and wildlife, and the proximity of contaminated sites to potential receptors.

Site specific assumptions were as follows:

- Off-site residents have limited access to the contaminant source areas.
- Access of off-site large game animals to contaminant source areas is limited by perimeter fencing.
- Prolonged or year round use of on-site water bodies by waterfowl is limited.
- Frequency and duration of wildlife area visits per individual is low (Ref. 9).
- Average annual consumption of game animals and fish per individual is low.

The monitoring programs described in the following subsections were designed with specific knowledge of the active pathways and the pathway analyses performed. Each media-specific monitoring and analysis program follows a general rationale.

2.2.1 Surface Water

Surface water is influenced by three general mechanisms:

- Storm water that flows from the site may carry site-source contaminants. Also, small quantities of water migrate from the site on a regular basis due to human influenced activities such dust control activities, discharge of water retained in excavations, etc. Treated water from the site and quarry water treatment plant is discharged directly to the Missouri River and does not contact contaminants.
- Contaminants in sediment on site and in stream channels may be resuspended.
- Discharge of contaminated groundwater from springs to surface water.

Site features receiving surface water are sampled and contaminant levels are measured. The migrating surface waters are subsequently sampled along their courses to track their behavior until the contaminant concentrations are indiscernible from background levels.

2.2.2 Groundwater

The hydrology and hydrogeology of the Weldon Spring site have been extensively studied, and separate regimes have been identified for the chemical plant and raffinate pits and the quarry based on spatial separation and differing geology. The present conceptual model of the hydrogeologic regime at the chemical plant and raffinate pits incorporates the activity of diffuse flow through the fractured limestone and the influence of discrete groundwater movement through solution enlarged fractures and conduits. Monitoring wells are used to monitor the influence of site contaminants on the groundwater. Converging conduits transport diffuse flow to discrete flow, and then to the springs previously mentioned. Appropriate monitoring of the resurging water at those springs monitors the secondary mechanism of groundwater movement from the site.

The present conceptual model of the hydrogeologic regime for the Weldon Spring Quarry incorporates the fractured flow described above and flow through the porous media of the Missouri River alluvium. Monitoring wells are used to monitor the influence of the contaminants in the wastes on the bedrock adjacent to the quarry and alluvial groundwater.

2.2.3 Air and Atmospheric Migration

Airborne releases and atmospheric migration of contaminants constitute a broad set of exposure pathways. Characterization studies indicate that the only significant sources of airborne contamination from site-related wastes lie within the boundaries of the chemical plant and raffinate pits. As remedial activities begin to disturb source areas, the potential for increased airborne emissions will increase. More intensive site-specific and work-area monitoring will provide knowledge of real-time airborne emission levels.

Radioactive airborne particulates, radon gas, and atmospheric radiation released from both the chemical plant and quarry source areas pass the facility boundaries while migrating to uncontrolled or public access areas. Site perimeter monitoring will be used to detect and monitor the migration of these constituents to off-site areas. Finally, specific off-site locations near the site where there is concentrated human activity are considered "critical receptor" locations and will receive focussed attention.

2.2.4 Soil and Sediment

For the purposes of this plan, sediments are those solid materials that are mobilized by surface water flow and which accumulate to some discernable depth in and along the stream channels and in lake bottoms. Sediments have been characterized during remedial investigations of the Weldon Spring site and Weldon Spring Quarry. That characterization, along with the determinations made during subsequent, routine biological and surface water sampling, will meet the environmental monitoring data needs of the project.

Soil and sediment on and around the Weldon Spring site have received contaminants from the site, and in some cases, continue to receive contaminants. While soils have remained in a fairly stable condition in the past, numerous remediation activities have taken place during 1995, including WP-399, WP-253, and the start up of WP-420. Portions of all three work packages included the excavation of contaminated soils. These contaminated soils were stockpiled primarily at the Ash Pond. To minimize the amount of disturbed soils and associated contamination that might be mobilized by surface water runoff, the surface water monitoring program monitored the levels of suspended and settleable solids leaving the site during these remedial actions. In addition, metals of concern (As, Cr, Pb, and Tl) and Ra-226, Ra-228, and isotopic thorium were periodically monitored at NPDES storm water outfalls. Contaminants of concern will continue to be periodically monitored. The air monitoring program combined with air modeling, when appropriate, assessed potential impacts to off-site receptors, on the chance that contaminated soil was dispersed into the air and had the potential to migrate from the site.

2.2.5 Biological Media

Biological factors, such as animals in a biouptake chain, will be sampled to assemble and provide surveillance of the environmental and potential human pathways. Biouptake sampling of fish at surrounding wildlife areas has been conducted since 1987. Game animals are sampled when specimens become available, but dose estimates are calculated on the basis of concentrations in surface water and soil. Radionuclides in aquatic ecosystems have been monitored to assess environmental conditions by using benthic invertebrates as indicators of water quality. Because results of this monitoring show that the dose to aquatic organisms is less than the protective guideline of 1 rad/day, monitoring of benthic invertebrates has been reduced to a surveillance level as described in Section 3.4.3.2.

3 ENVIRONMENTAL SURVEILLANCE

The environmental surveillance program for the Weldon Spring Site Remedial Action Project (WSSRAP) is based on a pathway analysis for possible exposure routes and receptors in accordance with Department of Energy Order 5400.1 and 5400.5 and the *Regulatory Guide* (Ref. 4). The pathway analysis is described in Section 2.1. Exposure routes requiring surveillance are air, surface water, groundwater, and biological media. Radiological concentrations obtained for each of these media are used to estimate public dose and to provide compliance data for applicable environmental regulations.

The environmental surveillance program for each medium is based on the applicable regulations, the hazard potential of radiological and chemical contaminants, the amount and concentration of contaminants, and the impacts to the environment. Sampling locations, frequency, and analyses required to determine the ambient environmental levels for each medium are summarized in the following sections.

3.1 Surface Water Surveillance Program

Surface water samples will be collected from locations that are known to be, or potentially could be impacted by elevated concentrations of contaminants from the Weldon Spring Chemical Plant and raffinate pits or the Weldon Spring Quarry. Because of the differing topography and hydrologic conditions at the chemical plant and the quarry, surface water sampling programs for each of these areas are described separately. In previous *Environmental Monitoring Plans*, the monitoring of springs was included as part of the surface water monitoring program. Since 1992, the WSSRAP has incorporated spring monitoring under the groundwater monitoring program, consistent with the draft U.S. Environmental Protection Agency guidance for groundwater monitoring in karst terrains. The data on contaminants in spring water will be more directly correlated to levels in the groundwater near the site as measured using conventional groundwater monitoring techniques.

3.1.1 Surface Water Evaluation

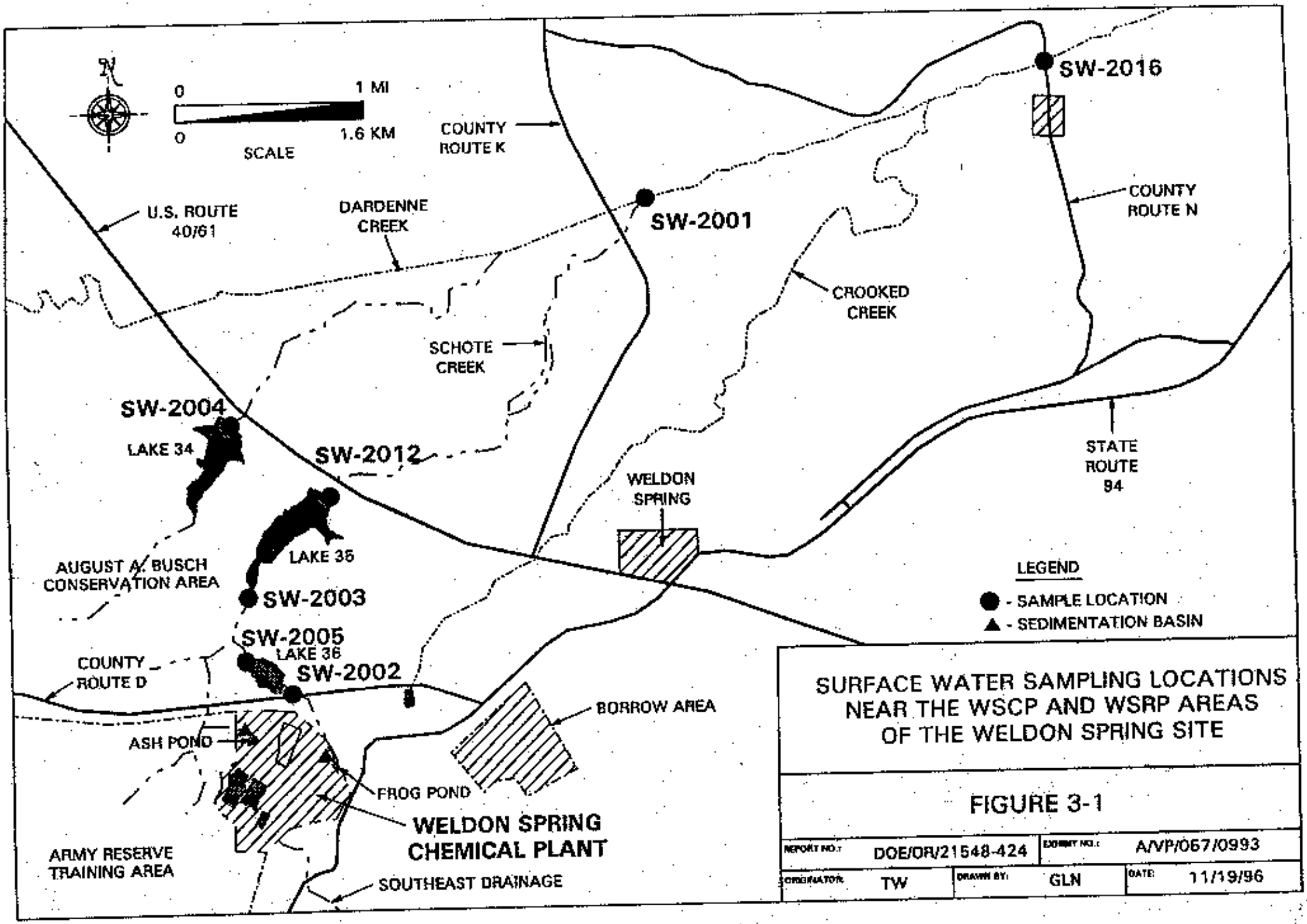
A surveillance program, which includes monitoring potentially impacted surface water, has been established to determine the distribution of radiochemical and chemical contaminants

that have migrated from the Weldon Spring site. The environmental surveillance program for surface water will be conducted in accordance with the requirements of Department of Energy Orders 5400.1, 5400.5, and the *Regulatory Guide* (Ref. 4).

3.1.2 Surface Water Monitoring Program at the Weldon Spring Chemical Plant and Raffinate Pits

Surface water draining from the chemical plant area transports both dissolved and suspended contaminants from waste materials distributed about the site. Seven monitoring locations (Figure 3-1) have been chosen to provide data necessary to monitor the impact of contaminants delivered to downgradient streams and water features. The locations of the monitoring points and the purpose for monitoring are described in the following sections.

3.1.2.1 Rationale. The U.S. Department of Energy, in cooperation with the Missouri Department of Natural Resources - Division of Geology and Land Survey and the United States Geological Survey, has established a detailed profile of the complex hydrogeologic system that influences the flow of surface water from the site. The chemical plant area is located on the Missouri-Mississippi River surface water drainage divide. The topography is gently undulating and generally slopes northward to the Mississippi River. Streams do not cross the properties, but incipient drainageways convey surface water runoff to off-site streams. Most surface drainage from the raffinate pit area discharges to an intermittent stream in the Army Reserve Training Area to the west via a sedimentation basin downstream of Ash Pond. Several much smaller stream bodies also discharge to this watershed. Discharges from these locations combine near St. Charles County Road D and flow northward into Lake 35 in the August A. Busch Conservation Area, then to Schote Creek, which in turn enters Dardenne Creek, which finally discharges into the Mississippi River. A second surface drainage system ultimately reaching the Mississippi River drains the northeastern area of the site through a sedimentation basin near Frog Pond. A storm water sewer system that previously drained land surfaces from the northern portion of the buildings area has been removed. All flows are now surface flows. Drainage from the northeastern area of the site enters Lake 36 in the August A. Busch Conservation Area. Lake 36 in turn discharges into Lake 35, which discharges into Schote Creek.



SURFACE WATER SAMPLING LOCATIONS NEAR THE WSCP AND WSRP AREAS OF THE WELDON SPRING SITE

FIGURE 3-1

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/067/0993		
ORIGINATOR:	TW	DRAWN BY:	GLN	DATE:	11/19/96

A third watershed directs storm water runoff from the southern portion of the chemical plant southeast to the Missouri River by way of the Southeast Drainage. In the past, infiltration and inflow of storm water into the abandoned process and sanitary sewers drained to the Southeast Drainage. The sewers were then terminated at pump stations and the water was pumped to the site water treatment plant. The sewer lines downstream of the lift stations were either removed or plugged. During foundation and contaminated soil removal, the abandoned sanitary and process sewers were removed and the pump stations shutdown.

Storm water flowing from the site watersheds has been in contact with contaminated soil, building debris, and miscellaneous other debris; therefore, downstream locations as noted below will be monitored to determine the effect of site discharges on downstream surface waters. Monitoring results may also be used to measure the effectiveness of site remedial activities.

3.1.2.2 Monitoring Locations. All features monitored by the surface water surveillance program are situated on the north (Mississippi River) side of the drainage divide. Waters requiring contaminant monitoring to the south of this divide are monitored by the effluent monitoring or the quarry groundwater monitoring programs. The routine monitoring locations are numbered SW-2001, SW-2002, SW-2003, SW-2004, SW-2005, SW-2012, and SW-2016 (Figure 3-1). Location SW-2015, the materials staging area basin, was added in 1992, but was transferred to the National Pollutant Discharge Elimination System (NPDES) program in 1994. Frog Pond (SW-2011) and Ash Pond (SW-2010) were transferred to the NPDES program in 1994 because the discharges from these ponds exit the chemical plant through NPDES permitted outfalls. The four raffinate pits (SW-3001, SW-3002, SW-3003, and SW-3004) were deleted from the *Environmental Monitoring Plan* (EMP) in 1994 because these waters are being treated in the site water treatment plant and, therefore, are monitored under treatment plant operations sampling.

Sampling locations SW-2001, at the confluence of Schote and Dardenne creeks, and SW-2016, downstream of SW-2001 at the intersection of Dardenne Creek and County Highway N, monitor any contribution of site derived contaminants to Schote and Dardenne creeks. Locations SW-2002, SW-2003, SW-2004, SW-2005 and SW-2012 monitor the three lakes in the August A. Busch Memorial Conservation Area that lie within the watershed immediately downstream of the chemical plant site. During late 1996, Lake 36 was drained to

prepare for remediation during 1997. Although there will be no permanent pool in Lake 36 for all or part of 1997, water flowing into and out of the lake will continue to be monitored.

3.1.2.3 Monitoring Schedule. All surface water locations retained in the monitoring program will be monitored for uranium according to the schedule in Table 3-1. Samples will be collected once a quarter and, if possible, on the same day that upstream NPDES samples are collected. Samples will be analyzed using the site kinetic phosphorescent analyzer (KPA), thus allowing a more timely receipt of results. In the event uranium levels are elevated at the NPDES outfalls (as determined by KPA results), then surface water samples will be analyzed using the site KPA on at least a monthly basis until elevated levels decrease. The uranium concentration defining an elevated level will be determined on a case-by-case basis using historical data. Other site derived contaminant parameters were removed from the monitoring schedule because they have remained below water quality standards at these locations. Data generated from this surface water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values as shown in Appendix E, Tables E-1 and E-2, to determine if the concentrations are "above normal." "Above normal" values are reported to the U.S. Department of Energy (DOE) and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

TABLE 3-1 Weldon Spring Chemical Plant Surface Water Monitoring Program

	TOTAL URANIUM
LOCATION	KPA
SW-2001	Q
SW-2002	Q
SW-2003	Q
SW-2004	Q
SW-2005	Q
SW-2012	Q
SW-2016	Q

Q Quarterly.

3.1.3 Surface Water Monitoring Program for the Weldon Spring Quarry

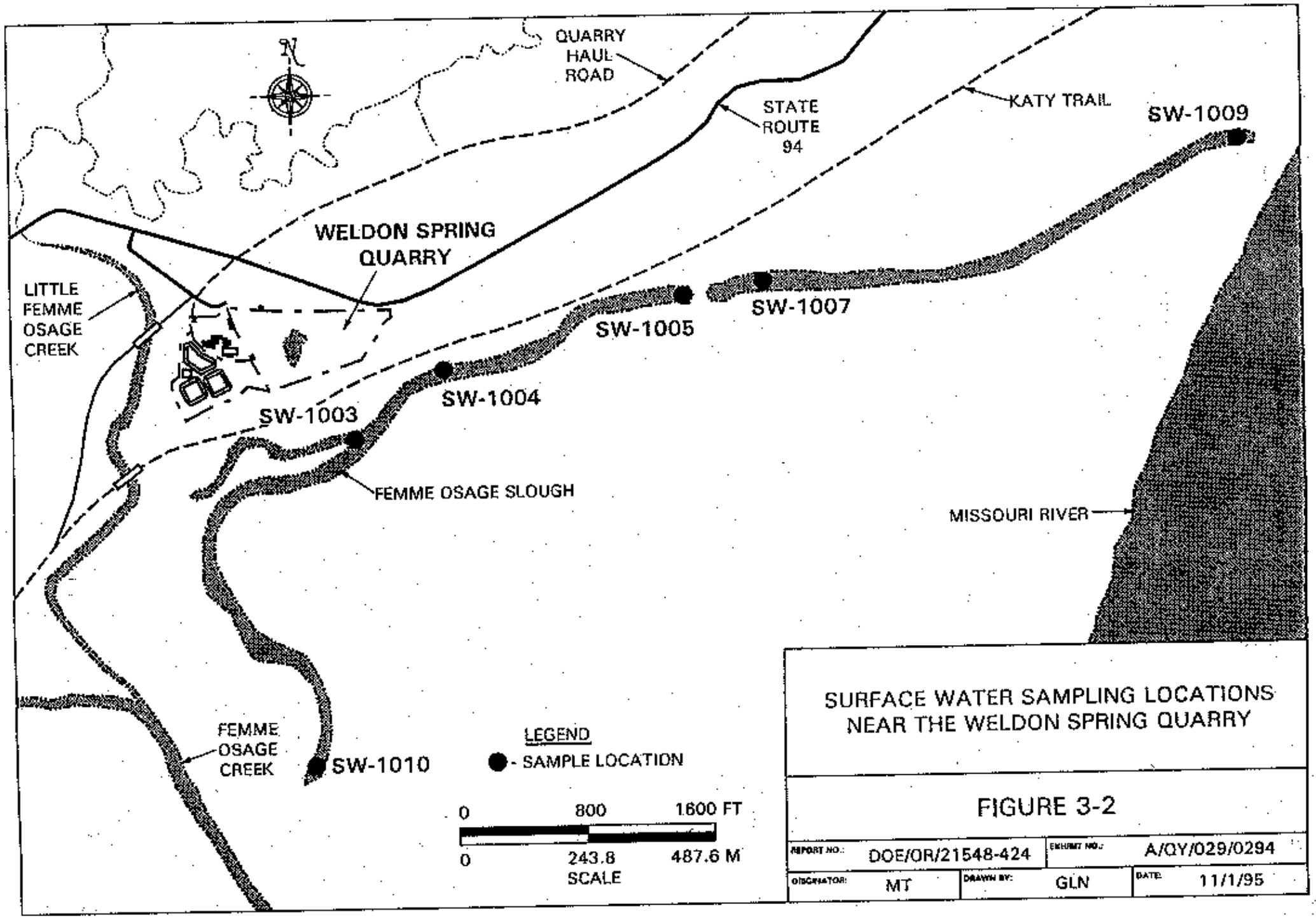
Six surface water monitoring locations near the quarry will be routinely sampled. These locations were chosen to investigate and document whether surface waters near the quarry might pose a risk to human health or the environment because of potential mobilization of residual quarry wastes and migration of contaminated groundwater into surface waters near the quarry.

3.1.3.1 Rationale. The quarry is located on the northern bluff of the Missouri River valley. Surface water within the quarry collects in the quarry pond; therefore, there is no direct surface water runoff from the quarry. When the quarry sump is not in a pumped-down condition, movement of contaminated groundwater through the fractured bedrock of the quarry into the fine-grained alluvium to the Femme Osage Slough has resulted in elevated uranium levels in the slough water. The slough is impacted by contaminated groundwater migrating from the quarry; therefore, it is routinely monitored. All bulk waste has been removed from the quarry; therefore, monitoring will also show the affect of bulk waste removal on surface water.

3.1.3.2 Monitoring Locations. Six sampling locations, SW-1003 through SW-1005, SW-1007, SW-1009, and SW-1010 (Figure 3-2), are distributed along the Femme Osage Slough west of, adjacent to, and east of the quarry. These locations within the slough were chosen to provide representative data for areas that are potentially impacted by the quarry contamination. The quarry pond is monitored during the quarry water treatment plant operations. Missouri River sampling was deleted from the surface water program because baseline water quality data sampling for water treatment plant operation activities was completed.

3.1.3.3 Monitoring Schedule. The surface water near the Weldon Spring Quarry that is potentially affected by the quarry is the Femme Osage Slough. The locations to be sampled are shown in Figure 3-2. Table 3-2 outlines the monitoring schedule.

All locations will be monitored for total uranium because of the fluxuations in concentrations as a result of changing slough levels and groundwater static water levels, and because the surface water contaminants potentially impact groundwater south of the slough. This will allow trends to be identified in addition to maintaining a surveillance of uranium in surface water bodies near the quarry. Locations SW-1003 through SW-1005 will be monitored semiannually for nitroaromatic compounds because they are downgradient from the area of



SURFACE WATER SAMPLING LOCATIONS NEAR THE WELDON SPRING QUARRY

FIGURE 3-2

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/029/0294
DESIGNATOR:	MT	DRAWN BY:	GLN
DATE:	11/1/95		

TABLE 3-2 Weldon Spring Quarry Surface Water Monitoring Analytical Program

LOCATION	PARAMETERS		
	TOTAL URANIUM		NITROAROMATIC COMPOUNDS
	KPA	OFF-SITE	
SW-1003	B	A	S
SW-1004	B	A	S
SW-1005	B	A	S
SW-1007	Q	A	NS
SW-1009	Q	A	NS
SW-1010	Q	A	NS

S Semiannually
B Bimonthly
Q Quarterly
NS Not Sampled
KPA Kinetic Phosphorescent Analyzer (On Site)

greatest nitroaromatic groundwater contamination. Historic data indicate no nitroaromatic impact at the remaining surface water sample locations.

Data generated from this surface water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values as shown in Appendix E, Tables E-1 and E-2, to determine if the concentrations are "above normal." "Above normal" values are reported to the DOE and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

3.2 Groundwater Surveillance Program

Groundwater samples will be collected from locations in the chemical plant area and the quarry areas where groundwater is known to be impacted or has the potential to be impacted. Due to the differing hydrology and hydrogeology of the two areas, these groundwater monitoring programs are discussed separately.

Groundwater beneath several waste storage facilities at both the chemical plant and quarry is monitored to comply with the intent of 40 CFR 246, Subpart F and 10 CSR 25-7.264(2)(F). A separate monitoring program has been established for these facilities and is outlined in Section 3.2.4.

3.2.1 Groundwater Evaluation

Groundwater within and around the chemical plant and quarry has been radiologically and chemically characterized through sampling and analyses. A surveillance program that includes monitoring potentially impacted groundwater has been established to monitor radiological and chemical conditions. The groundwater surveillance program has been developed based upon applicable regulations, hazard potential of effluents, quantities and concentrations of effluents, public interest, and the potential or actual impacts on groundwater. The environmental surveillance program for groundwater will be conducted in accordance with the requirements of the Department of Energy Orders 5400.1, 5400.5, and the *Regulatory Guide* (Ref. 4).

3.2.1.1 Groundwater Characterization. Potential exposure pathways were determined based on the sampling of groundwater within, and near, the chemical plant and the quarry. Chemical and radiological characterization of the groundwater was provided through the implementation of work plans, sampling plans, and other characterization plans. These plans were approved by the Department of Energy and the U.S. Environmental Protection Agency, and included environmental monitoring, sampling locations, procedures, equipment, frequency and analysis required, minimum detection limits, and levels of quality assurance/quality control. Evaluation of the characterization data and potential exposure pathways provided the basis for the groundwater environmental surveillance program described in this monitoring plan.

In addition to the chemical/radiochemical characterization, changes in the static groundwater level are monitored either manually or with dedicated transducers. Manual readings are taken during sampling events and quarterly during the well inspections. Dedicated electronic pressure transducers are installed in certain wells to document the static water level fluctuations on a daily basis when considered necessary.

3.2.1.2 Parameter Categories. The following radiological and chemical parameter categories will be monitored in groundwater at selected quarry and chemical plant locations since similar contaminant constituents are present at both areas:

- Total Uranium (U): Uranium is a contaminant of concern at both the quarry and the chemical plant due to both the purification process of uranium and raffinate storage at the chemical plant and the disposal of uranium contaminated materials and process wastes at the quarry. Uranium is monitored to assess migration in the groundwater system and contamination levels in the aquifer, and the potential for exposure to the public.

- Radiochemical Parameters (R): The radiological parameters consisting of gross alpha, Th-230, Th-232, Ra-226, and Ra-228 are monitored at both the quarry and the chemical plant due to their presence in uranium residues at each site. These parameters are monitored to assess the potential for exposure to the public and the environment and to assess migration in the groundwater system and contamination levels in the aquifer.

- Nitroaromatic Compounds (N): Nitroaromatic compounds are contaminants of concern at both the quarry and the chemical plant due to the previous production of trinitrotoluene (TNT) and dinitrotoluene (DNT) at the Weldon Spring Ordnance Works and the disposal of TNT/DNT contaminated materials at the quarry. Groundwater at both sites will be monitored for 1,3,5-trinitrobenzene (TNB); 1,3-dinitrobenzene (DNB); 2,4,6-TNT; 2,4-DNT; and 2,6-DNT.

- Sulfate-Nitrate-Alkalinity (I): Both nitrate and sulfate are contaminants of concern due to their presence as residual products during the uranium purification process at the chemical plant and in the production of nitroaromatics at the ordnance works. Both nitrate and sulfate levels are elevated in the raffinate pits and at some groundwater locations at the chemical plant. Elevated sulfate levels were observed in monitoring wells adjacent to the quarry and in the alluvium north of the Femme Osage Slough. Monitoring of nitrate at the quarry was discontinued in 1993 because there was no evidence of notable groundwater contamination. Nitrate and sulfate provide potentially important constraints on

the areal extent of contaminated plumes because these parameters generally behave as conserved elements in the groundwater system (i.e., they are not strongly impacted by sorption, precipitation, or degradation reactions). Alkalinity is monitored to verify general groundwater quality and to determine whether conditions are favorable to sustain the elevated levels of contaminants.

- Volatile Organic Compounds (VOCs): VOCs have been detected in groundwater at localized areas of the chemical plant. The VOCs have been detected in the vicinity of Raffinate Pits 3 and 4, and near the northwest perimeter of the site. The identified VOCs are chlorinated hydrocarbons, which most likely originated from discarded degreasing agents/solvents used on equipment during plant operations.

3.2.1.3 Groundwater Estimated Release Quantities and Public Doses. It is the objective of the groundwater monitoring program at both the chemical plant and the quarry to collect sufficient data to estimate the approximate quantity of radionuclides released along a given migration route. This information will be used to calculate the public dose to hypothetical groundwater users. At present, no wells within a 1.6 km (1 mi) radius of the chemical plant site are actively pumped as water supplies. Wells outside that area have been sampled in the past and have shown no evidence of radionuclide contamination from the WSSRAP. Those private wells will continue to be routinely sampled and analyzed as part of an independent program by the Missouri Department of Health. The results are also made available to WSSRAP staff for review.

Presently, eight drinking water production wells are located within a 1.6 km (1 mi) radius of the quarry. The data collected from the quarry area and the St. Charles County well field allow the WSSRAP to monitor changes in concentrations of contaminants. No measurable increases in uranium or chemical contaminant levels above background have been seen at the well field to date.

3.2.2 Groundwater Monitoring Program for the Weldon Spring Quarry

3.2.2.1 Geology and Hydrogeology. The geology of the quarry area is generally separated into upland overburden, Missouri River alluvium, and bedrock. The Missouri River

alluvium and bedrock units yield useable quantities of groundwater, and it is within these units that the groundwater is monitored. General descriptions of each unit follow.

The unconsolidated upland material overlying bedrock consists of up to 9.2 m (30 ft) of silty clay soil and loess deposits. A residual soil is present in some areas between the silty clay and the bedrock; however, the upland soils near the quarry are generally not saturated and groundwater is not monitored.

The sediments comprising the alluvium along the Missouri River vary from clays, silts, and sands, to gravels, cobbles, and boulders. The maximum alluvium thickness near the quarry is approximately 31 m (100 ft). The alluvium is laterally discontinuous and is truncated at the erosional contact with Paleozoic bedrock bluffs. The alluvium thickness increases dramatically with distance from the bluffs. Silts and clays with minor amounts of sand are the primary sediments between the bluffs and the Femme Osage Slough. The thick, water-producing sands and gravels of the alluvial aquifer between the Femme Osage Slough and the Missouri River give way to fine-grained organically rich overbank deposits beneath the slough. The potentiometric surface of the alluvial aquifer fluctuates in response to pumping of the St. Charles County production wells and the stage of the Missouri River. The Missouri River is the primary recharge source for the alluvial aquifer.

Bedrock at the Weldon Spring Quarry consists of three distinct Ordovician formations. They are, in descending order, the Kimmswick Limestone, the limestone and shale of the Decorah Group, and the Plattin Limestone. The Kimmswick Limestone is a coarsely crystalline limestone with numerous near vertical solution-enlarged joints. The Decorah Group consists of interbedded limestone and green shale; it is approximately 9.2 m (30 ft) thick, and is horizontally fractured. The Plattin Limestone is a thinly bedded limestone about 31 m to 38 m (100 ft to 125 ft) thick.

3.2.2.2 Rationale. Residual chemical and radiological wastes in the quarry following completion of bulk waste removal are of concern because of their proximity to the St. Charles County well field located approximately 0.8 km (0.5 mi) to the south. Bulk waste removal was completed at the quarry during 1995; hence bulk waste no longer has a direct effect. However, residual contamination at the quarry is a potential groundwater contamination source. Well field protection is a sensitive issue for the public, the Department of Energy, and

other regulatory agencies. The Department of Energy has issued a number of orders providing direction on the assessment of exposure to the public, including directions for protection from radiation and chemicals, where applicable. The groundwater monitoring program at the quarry and well field has been designed to provide the necessary data to accomplish the following objectives:

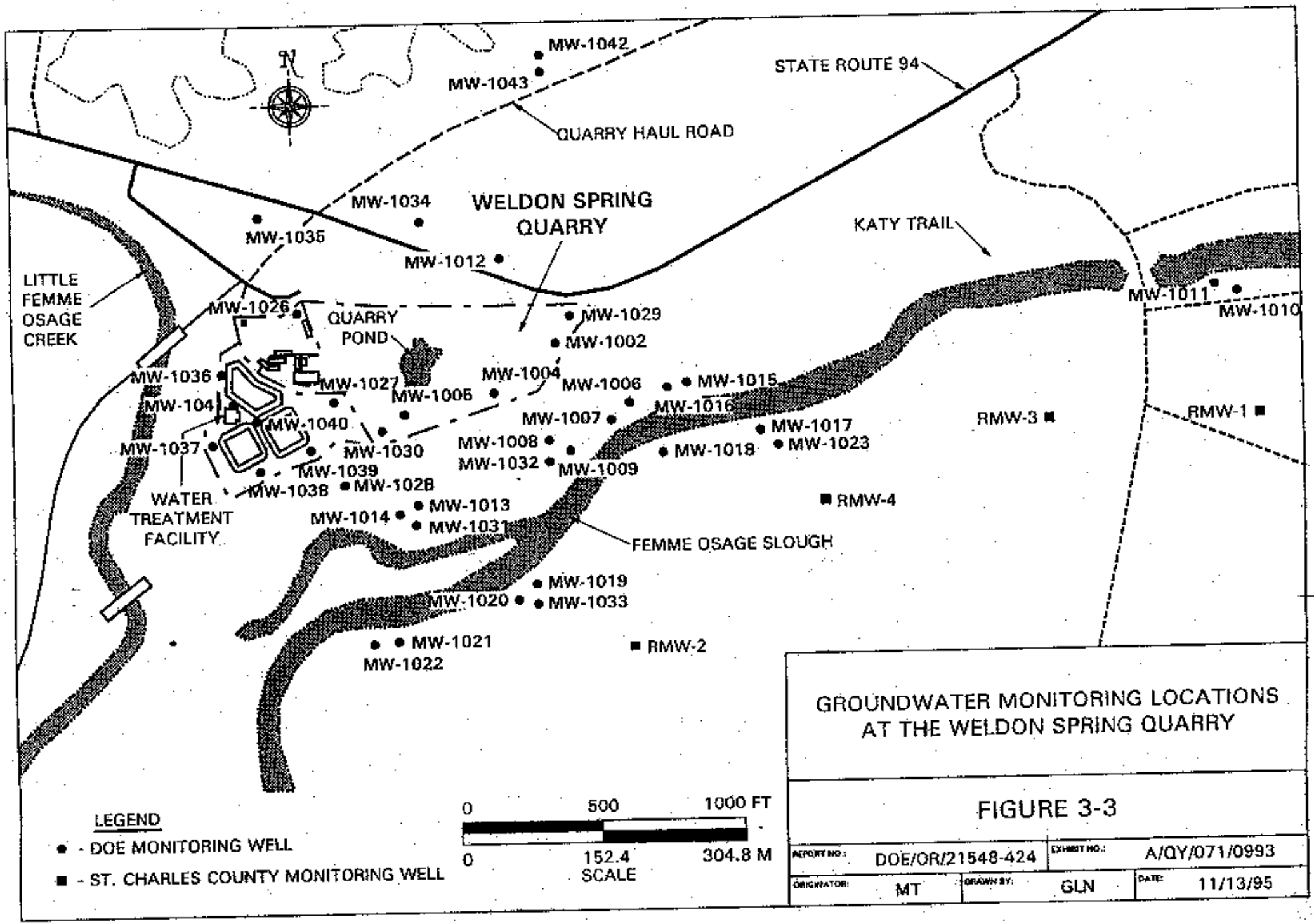
- Protect public health and the environment. This objective includes: assessing whether present contaminant levels exceed State, and Federal water quality standards, or Department of Energy derived concentration guidelines; detecting exceedence of background levels at the quarry and the St. Charles County well field; and monitoring concentration trends of contaminants.

- Provide information on the effects of quarry dewatering and bulk waste removal.

- Perform spatial and temporal trend analyses.

3.2.2.3 Monitoring Locations. Currently, 35 wells, including eight municipal production wells, four county-owned monitoring wells, and 23 Department of Energy monitoring wells are screened within the alluvial material located between the quarry and the Missouri River (see Figures 3-3 and 3-4). Five of the wells, MW-1035 through MW-1037, MW-1040, and MW-1041, are located west of the quarry to monitor the immediate area around the quarry water treatment plant equalization basin. Since 1994, these wells have been monitored under a separate program discussed in Section 3.2.4. Six wells, MW-1006 through MW-1009, MW-1014, and MW-1016, are located between the quarry and the slough to monitor contaminant migration south of the quarry within the alluvium. Monitoring wells MW-1010, MW-1011, and MW-1017 through MW-1024 are located south of the slough within the alluvium and are monitored to enable detection of contaminants south of the slough. St. Charles County monitoring wells RMW-1 through RMW-4 are monitored to provide an early warning of contaminant migration toward the county production well field, if this should occur. The eight county municipal wells, PW-2 through PW-9, are also monitored to detect the presence of any quarry contaminants affecting the quality of the municipal well field water supply.

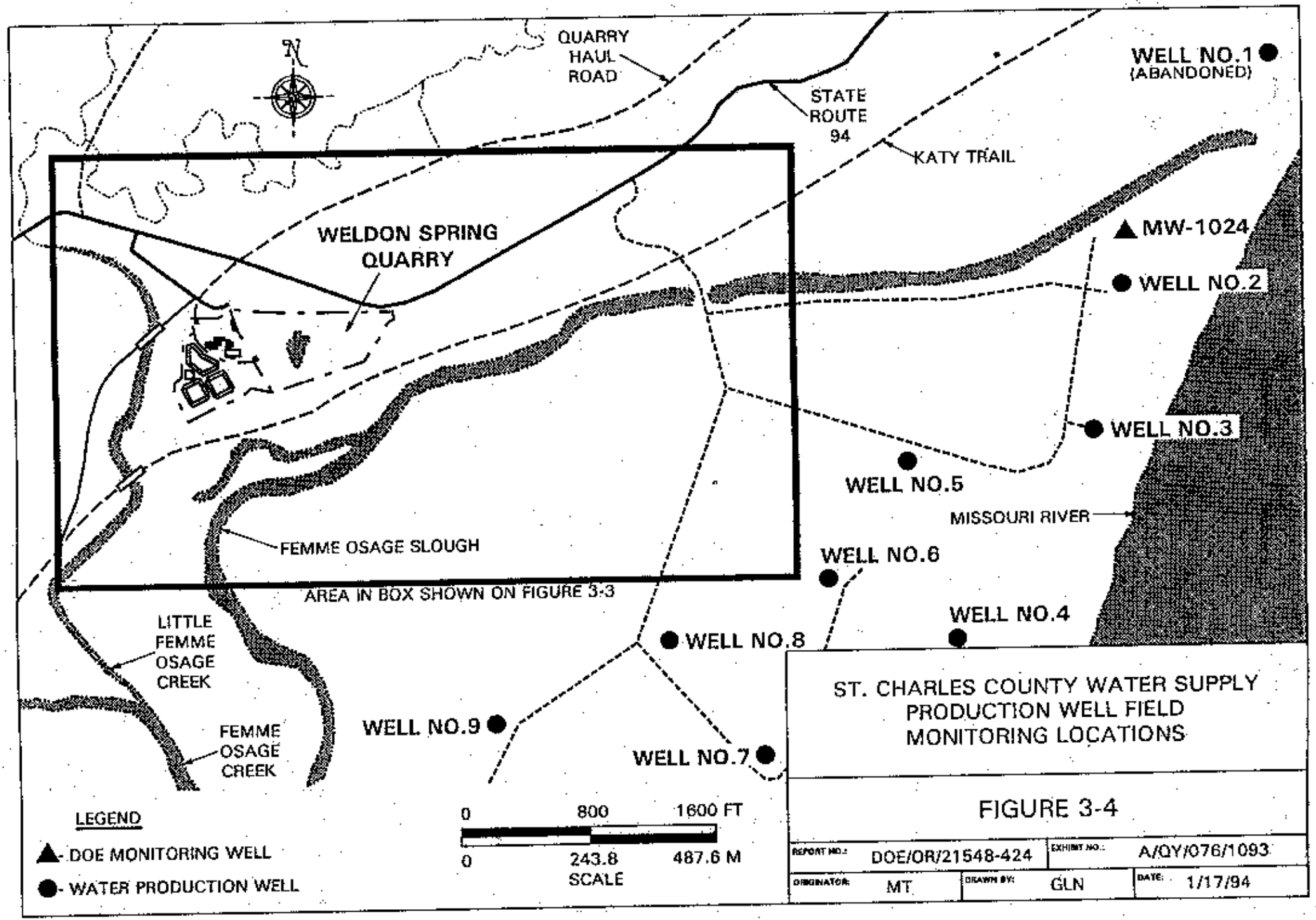
Currently, 17 Department of Energy monitoring wells are screened within either the Kimmswick-Decorah or Plattin Formations to monitor contaminants near the quarry within the



GROUNDWATER MONITORING LOCATIONS AT THE WELDON SPRING QUARRY

FIGURE 3-3

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/071/0993		
ORIGINATOR:	MT	DRAWN BY:	GLN	DATE:	11/13/95



ST. CHARLES COUNTY WATER SUPPLY
PRODUCTION WELL FIELD
MONITORING LOCATIONS

FIGURE 3-4

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/076/1093		
ORIGINATOR:	MT	DRAWN BY:	GLN	DATE:	1/17/94

bedrock. Monitoring wells MW-1002, MW-1004, MW-1005, MW-1012, MW-1013, MW-1015, MW-1026, MW-1027, MW-1029, MW-1030, MW-1032, and MW-1034 were installed to monitor contaminants within the Kimmswick-Decorah Formations surrounding the quarry. Monitoring wells MW-1028, MW-1031, and MW-1033 are located south of the quarry within the Plattin Limestone to determine if vertical contaminant migration through the fracture system has occurred. Monitoring wells MW-1042 and MW-1043 were completed into the Plattin and Decorah formations, respectively, north (hydraulically upgradient) of the quarry in order to determine background groundwater quality and to detect the presence of contaminants which may potentially originate directly upgradient from the quarry.

For the quarry bedrock south and west of the quarry, monitoring well MW-1034 (bedrock) is the upgradient location for the assessment of background groundwater quality in these materials. Eight groundwater monitoring wells are located in the Darst Bottom area approximately 1.6 km (1 mi) southwest of the St. Charles County well field. These wells were installed by the U.S. Geological Survey to study the characteristics of the Missouri River alluvium groundwater upgradient from the vicinity of the quarry. Analyses of the groundwater from those wells were used by the WSSRAP as background values for the well field area. These analyses were provided to the WSSRAP by the U.S. Geological Survey to determine background concentrations.

Dedicated transducers with electronic recording capacity are frequently used to monitor the static water levels in selected monitoring wells south and west of the quarry. These wells include MW-1004, MW-1005, MW-1027, and MW-1040. Readings are taken every 24 hours to correlate with dewatering activities and significant precipitation events. A transducer in MW-1040 measures the static water level with respect to the base of the quarry water treatment plant equalization basin leachate collection system following significant precipitation and/or flooding events. This data collection is expected to continue through the completion of groundwater studies for the quarry residuals operable unit.

3.2.2.4 Monitoring Schedule. Two separate groundwater monitoring programs have been developed for the quarry to monitor specific areas according to the levels of contaminant impact, public concern, and regulatory guidelines. The monitoring programs are as follows:

- The Weldon Spring Quarry and Department of Energy monitoring wells north and south of the Femme Osage Slough.

- The St. Charles County well field and water treatment plant.

The first program is summarized in Table 3-3. This program was developed to monitor contaminant migration and the effects of quarry dewatering and bulk waste removal, which began in mid-1993 and was completed in late 1995. This program consists of quarterly or semiannual sampling of certain monitoring wells for total uranium and chemical parameters. It is critical to continue monitoring for these parameters to assess negative or positive impacts to groundwater induced by bulk waste removal activities and the post-removal response of environmental contaminants. The frequency of sampling for each location is based on the distance of the well from the source or migration pathway and the level of understanding of contaminant levels necessary to properly characterize the contaminant condition. All monitoring wells will be sampled at least annually for radiochemical parameters. Selected monitoring wells will be qualitatively analyzed for nitroaromatic compounds quarterly or semiannually. Bimonthly sampling of certain monitoring wells will monitor the effects of dewatering activities and bulk waste removal. Total uranium samples will be collected quarterly or semiannually for off-site analyses; however, to provide verification of stable total uranium levels at critical locations, samples will be analyzed quarterly or semiannually at the same locations using an on-site KPA. If major changes in uranium concentrations are observed at any locations, based on data from the on-site KPA, then data from these locations will be confirmed by off-site analysis.

The second program monitors the St. Charles County well field and the associated potable water treatment plant. Active production wells and the St. Charles County RMW-series monitoring wells are to be sampled quarterly and semiannually for selected parameters. Table 3-4 presents the analytical parameters and sampling frequency of these wells. This portion of the monitoring program has been developed by representatives of the Department of Energy and the Missouri Department of Natural Resources. Any deviation from this program will be summarized in the WSSRAP annual site environmental report.

The well field monitoring program includes sampling both untreated and treated water from the St. Charles County water treatment plant. Gross alpha analysis will be performed on a quarterly basis. This portion of the monitoring program satisfies the portion of the *Regulatory*

TABLE 3-3 Weldon Spring Quarry Groundwater Monitoring Program Summary

	TOTAL URANIUM					
LOCATION	OFF-SITE ANALYSIS	KPA	RA-226, RA-228, TH-230, AND TH-232	NITROAROMATIC COMPOUNDS	SULFATE	ARSENIC
MW-1002	S	Q	S	Q	Q	Q
MW-1004	S	Q	S	Q	Q	NS
MW-1005	S	Q	S	Q	Q	S
MW-1006	S	Q	S	Q	Q	S
MW-1007	S	Q	S	Q	Q	S
MW-1008	S	Q	S	Q	Q	S
MW-1009	S	Q	S	Q	Q	S
MW-1010	S	S	S	NS	S	S
MW-1011	S	S	S	NS	S	S
MW-1012	S	S	S	S	S	S
MW-1013	S	Q	Q	Q	Q	S
MW-1014	S	Q	Q	Q	Q	S
MW-1015	S	Q	Q	Q	Q	S
MW-1016	S	Q	Q	Q	Q	S
MW-1017	S	S	S	S	S	S
MW-1018	S	S	S	S	S	S
MW-1019	S	S	S	S	S	S
MW-1020	S	S	S	S	S	NS
MW-1021	S	S	S	S	S	S
MW-1022	S	S	S	S	S	NS
MW-1023	S	S	S	S	S	NS
MW-1024	S	Q	S	S	S	S
MW-1026	S	Q	S	S	S	NS
MW-1027	S	Q	S	Q	Q	S
MW-1028	S	S	S	Q	Q	S
MW-1029	S	Q	Q	Q	Q	S
MW-1030	S	Q	Q	Q	Q	NS

TABLE 3-3 Weldon Spring Quarry Groundwater Monitoring Program Summary (Continued)

	TOTAL URANIUM					
LOCATION	OFF-SITE ANALYSIS	KPA	RA-226, RA-228, TH-230, AND TH-232	NITROAROMATIC COMPOUNDS	SULFATE	ARSENIC
MW-1031	S	Q	S	Q	Q	S
MW-1032	S	Q	S	Q	Q	S
MW-1033	Q	Q	S	S	S	S
MW-1034	S	Q	S	S	Q	NS
MW-1038	S	S	S	NS	Q	NS
MW-1039	S	S	S	NS	Q	NS
MW-1042	S	Q	S	S	S	S
MW-1043	S	Q	S	S	S	S

Q Quarterly
S Semi-annual
NS Not sampled

TABLE 3-4 St. Charles County Well Field Sampling Program Summary

MONITORING LOCATIONS	PARAMETERS						
	TOTAL URANIUM*	RA-226, RA-228, TH-230, AND TH-232	GROSS ALPHA	NITROAROMATIC COMPOUNDS	METALS		SULFATE
					As	Ba	
MW-1024	Q	S	Q	Q	Q	Q	Q
RMW-1	Q	S	Q	Q	Q	Q	Q
RMW-2	Q	S	Q	Q	Q	Q	Q
RMW-3	Q	S	Q	Q	Q	Q	Q
RMW-4	Q	S	Q	Q	Q	Q	Q
PW-2	Q	S	Q	Q	S	S	S
PW-3	Q	S	Q	Q	S	S	S
PW-4	Q	S	Q	Q	S	S	S
PW-5	Q	S	Q	Q	S	S	S
PW-6	Q	S	Q	Q	S	S	S
PW-7	Q	S	Q	Q	S	S	S
PW-8	Q	S	Q	Q	S	S	S
PW-9	Q	S	Q	Q	S	S	S
Raw water	Q	S	Q	Q	S	S	S
Treated water	Q	S	Q	Q	S	S	S

A Annual
Q Quarterly
S Semiannual
* KPA analysis will also be performed quarterly.

Guide (Ref. 4) and Department of Energy Order 5400.5 requiring the monitoring of affected or potentially affected public drinking water supplies as defined in 40 CFR Part 141.26. The quarterly gross alpha values will be averaged and presented in the annual environmental report. Above-normal and outlier quarterly values will be responded to by implementation of procedure ES&H 1.1.7, *Environmental Data Review and Above Normal Reporting*. Possible responses

include validation of the reported value and resampling of the monitoring location. All values not disqualified as being non-natural will be included in the annual average.

Quality control samples (including duplicate, matrix spike, field blank, equipment blank, and water blank samples) are not included in this schedule, but are collected in compliance with Procedure ES&H 4.1.4. Sampling frequency, collection methods, and sample handling protocols for quality control samples are discussed in Section 7, Quality Assurance.

3.2.3 Groundwater Monitoring Program for the Weldon Spring Chemical Plant and Raffinate Pits

Groundwater monitoring is required by DOE 5400.1 and the *Regulatory Guide* (Ref. 4) to identify and document pre-operational conditions and monitor the effects of Department of Energy operations on groundwater quality, and to demonstrate compliance with applicable Federal and State laws and regulations. Groundwater monitoring has been conducted at the chemical plant since the first quarter of 1987. The program has been adjusted yearly to accommodate changes in laws and regulations, specific project needs, and the requirements of the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and the *National Environmental Policy Act* (NEPA).

Forty-five groundwater wells have been chosen for routine monitoring to investigate and document the locations and migration of contaminants that may pose a risk to human health and the environment.

3.2.3.1 Geology and Hydrogeology. Geology at the chemical plant, raffinate pits, and vicinity properties may be divided into two major units based on gross lithologic characterization: the unconsolidated glacial and residual soils, and the underlying bedrock. The unconsolidated material consists of topsoil, loess, glacially derived sediments, and residuum. On average, the glacial soils are silty clays with minor amounts of gravel. The unconsolidated materials, which are present at depths ranging from 6 m to 15 m (20 ft to 50 ft), are usually not saturated and thus are not monitored. Saturated conditions are generally first encountered in the Burlington-Keokuk Limestone, the uppermost bedrock unit. The Burlington-Keokuk Limestone is composed of two different lithologic zones: a shallow weathered zone underlain by an unweathered zone.

The weathered zone is typically a grayish-orange to yellowish-gray, argillaceous limestone containing up to 60% chert, which occurs as discrete nodules or interbedded lenses. The weathered limestone is a low-yield, semiconfined, heterogeneous, anisotropic aquifer that is fractured and susceptible to natural solution processes. Within the confines of the chemical plant, the uppermost aquifer generally exhibits diffuse flow properties; however, discrete flow zones may be present in saturated, highly weathered bedrock and in the saturated residuum which fills paleochannels.

The unweathered or competent portion of the Burlington-Keokuk Limestone is thinly to massively bedded, gray to light gray, finely to coarsely crystalline, styolitic, and fossiliferous. Fracture densities are significantly lower in the unweathered zone as compared to the weathered zone.

In contrast to the quarry, which is located near a poorly drained area, the chemical plant site straddles a topographic high. Thus site soils are well drained with minimal accumulation of organic material. These conditions foster oxidizing conditions in the unconsolidated materials and upper bedrock units beneath the chemical plant, whereas, potentially reducing conditions are present in the quarry environs. Redox conditions are an important control on the mobility and stability of many species that are potential contaminants at these two locations.

3.2.3.2 Rationale. Groundwater flow and contaminant transport mechanisms at the chemical plant, raffinate pits, and vicinity properties differ from those at the quarry because of differences in the geologic environments of these two locations. Site geologic conditions are briefly described in the following section. At the chemical plant and environs, the aquifer generally exhibits diffuse flow properties that are overlain by zones of fracture or conduit flow. To accommodate these two flow mechanisms, the groundwater surveillance program includes analyses of water from monitoring wells, which typically sample the diffuse component of flow, and from springs, which represent the resurgence point for discrete or conduit flow paths.

The groundwater monitoring program at the chemical plant is designed to provide the necessary data to accomplish the following objectives, outlined in Department of Energy Order 5400.1, Chapter IV, Section 3 and Section 5, Part b:

- Ensure protection of public health and the environment. Included in this objective are (1) determining whether contaminants are present at levels exceeding maximum contaminant levels (MCLs) or assumed background concentrations, and (2) monitoring concentration levels of contaminants which exceed these criteria.

- Develop a baseline for studying long-term and short-term effects of source removal, as part of CERCLA-NEPA activities. Baseline data are required to provide adequate information for future comparisons.

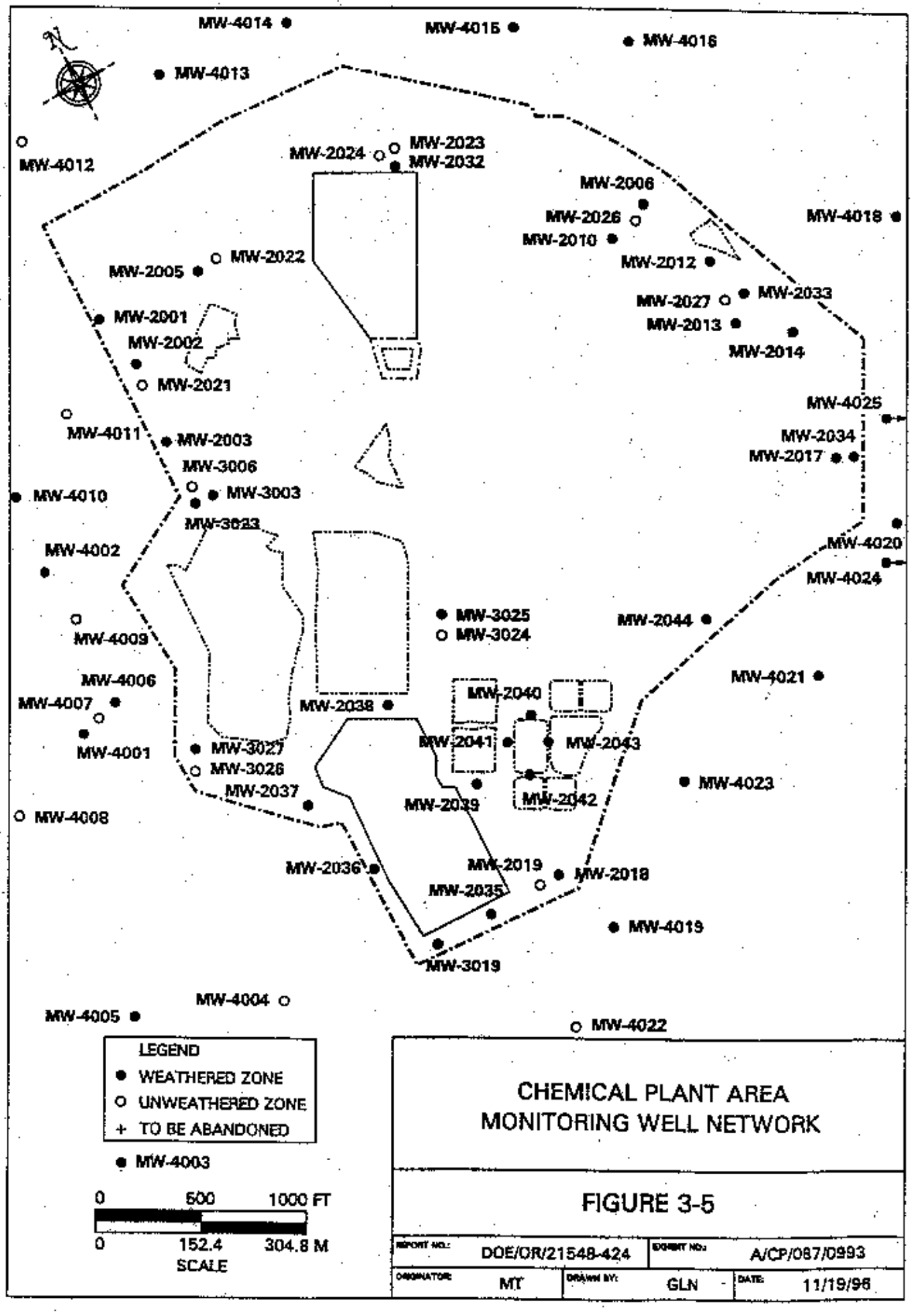
- Monitor potential effects of the equalization basin associated with the site water treatment plant and on-site construction activities associated with site remediation.

- Perform spatial and temporal trend analyses.

3.2.3.3 Monitoring Locations. Currently, 65 Department of Energy monitoring wells exist or existed at one time in the chemical plant and raffinate pit vicinities (see Figure 3-5). Nine of the Department of Energy monitoring wells were installed in late 1992 to monitor impacts of the equalization basin at the site water treatment plant and the temporary storage area on the quality of the uppermost aquifer. Background water quality characteristics for the chemical plant area have been determined by the U.S. Geological Survey (Ref. 10).

Sixty-five Department of Energy wells have been completed in the upper, weathered portion of the shallow aquifer, 45 of which will be monitored in 1997. The remaining 20 wells have been completed in the deeper, unweathered portion of the aquifer, and these wells will not be monitored in 1997. As site remedial activities progress and site development occurs, some wells will require abandonment due to conflicts with land use. In each instance, an evaluation of the data requirements from that location will be conducted and a determination of well replacement will be performed. Locations MW-2004, MW-2007, MW-2008, MW-2009, MW-2011, MW-2015, MW-2028, MW-2030, and MW-4017 were abandoned in 1995. Replacement wells are not considered necessary at this time.

3.2.3.4 Monitoring Schedule. For most locations, the 1997 groundwater monitoring program for the chemical plant reflects no significant change in sampling frequency or the number of analyses performed (see Table 3-5). The exceptions to this are locations



CHEMICAL PLANT AREA MONITORING WELL NETWORK

FIGURE 3-5

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/CP/087/0993		
ORIGINATOR:	MT	DRAWN BY:	GLN	DATE:	11/19/98

TABLE 3-5 Weldon Spring Chemical Plant Monitoring Program Summary

LOCATION	TOTAL URANIUM	RAD[a]	NITROS[b]	ANIONS		VOAs[c]
				NO_3	SO_4	
Weldon Spring Chemical Plant Monitoring Wells						
MW-2001	A	NS	A	A	NS	NS
MW-2002	A	NS	A	A	NS	NS
MW-2003	A	NS	A	A	NS	M
MW-2005	A	NS	A	A	NS	NS
MW-2006	A	NS	A	NS	NS	M
MW-2010	A	NS	A	NS	NS	NS
MW-2012	A	NS	A	NS	NS	M
MW-2013	A	NS	A	NS	NS	M
MW-2014	A	NS	A	NS	NS	NS
MW-2017	A	NS	A	NS	A	NS
MW-2018	A	NS	A	A	NS	NS
MW-2032	A	NS	A	NS	NS	M
MW-2033	A	NS	A	NS	NS	M
MW-2034	A	NS	A	NS	NS	NS
MW-2044	A	A	A	NS	NS	NS
Weldon Spring Raffinate Pits Monitoring Wells						
MW-3003	A	A	A	A	NS	M
MW-3019	A	A	A	A	NS	M
MW-3023	A	A	A	A	NS	M
MW-3024	A	A	A	A	NS	M
MW-3025	A	A	A	A	NS	M
MW-3026	A	A	A	A	NS	M
MW-3027	A	A	A	A	NS	M

TABLE 3-5 Weldon Spring Chemical Plant Monitoring Program Summary (Continued)

LOCATION	TOTAL URANIUM	RAD[a]	NITROS[b]	ANIONS		VOAs[c]
				NO_3	SO_4	
Vicinity Property Monitoring Wells						
MW-4001	A	NS	A	NS	NS	M
MW-4002	A	NS	A	NS	NS	M
MW-4003	A	NS	A	NS	NS	NS
MW-4005	A	NS	A	NS	NS	NS
MW-4006	A	NS	A	NS	NS	NS
MW-4010	A	NS	NS	NS	NS	NS
MW-4011	A	NS	A	A	A	NS
MW-4013	A	NS	NS	NS	NS	NS
MW-4014	A	NS	NS	NS	NS	NS
MW-4015	A	NS	A	NS	NS	NS
MW-4016	A	NS	NS	NS	NS	M
MW-4018	A	NS	NS	NS	NS	M
MW-4019	A	NS	NS	NS	NS	NS
MW-4020	A	NS	NS	NS	NS	NS
MW-4021	A	NS	NS	NS	NS	NS
MW-4022	A	NS	NS	NS	NS	NS
MW-4023	A	NS	NS	NS	NS	NS
MW-4024	A	NS	NS	NS	NS	NS
MW-4025	A	NS	NS	NS	NS	NS

A Annual
M Monthly
S Semiannual
NS Not sampled
(a) Rad: Ra-226, Ra-228, Th-228, Th-230, Th-232, gross alpha, and gross beta
(b) Nitros: 1,3,5-TNB; 1,3-DNB; 2,4,6-TNT; 2,4-DNT; 2,6-DNT and Nitrobenzene
(c) VOAs: Volatile organic analyses

suspected of being impacted or in close proximity to locations impacted by volatile organic compounds (VOCs). These locations are in the vicinity of Raffinate Pits 3 and 4 and Frog Pond (northeast portion of the chemical plant). These locations will be sampled monthly for VOCs to identify potential source locations and migration paths for the VOCs identified during 1996. The water treatment facility monitoring program will remain unchanged.

The monitoring schedule is justified for this period because, with the exception of VOCs, groundwater chemistry has remained relatively constant, and site conditions are not expected to change substantially over the next year. Increased monitoring is anticipated for 1998 afterdisposal cell construction and raffinate pit removal begin, because these activities will alter the site and are likely to result in changes to groundwater conditions.

Previous Characterization

The quality of groundwater in most chemical plant monitoring wells has been well studied. Routine monitoring for uranium, nitrate, sulfate, and nitroaromatic compounds has been conducted since 1987. In addition to these analyses, water quality (geochemical) parameters have been measured in at least six independent samples for most locations.

Unscheduled groundwater sampling was implemented in 1996 to detect potential impacts to groundwater during remedial action in the vicinity of Raffinate Pits 3 and 4. Over 2,000 discarded 55-gallon drums had been uncovered in Raffinate Pit 4 and sludges were being dredged in Raffinate Pit 3. The rationale for initiating the special groundwater sampling was to investigate the potential for increased contaminant mobility during disturbances as the raffinate pits are remediated. Volatile organic compounds (VOCs) were detected to the south and east of Raffinate Pit 3. VOC analysis will be included for selected wells at the chemical plant for 1997.

Evaluation of the monitoring data has shown that the distribution and concentration of most contaminants in the groundwater beneath the chemical plant area have remained relatively constant over the last 8 years. Statistical analysis of contaminant concentrations was conducted for the 1993 and 1995 annual site environmental reports to evaluate seasonal variations and trends in the groundwater. Seasonal effects were not detected in the data and only a limited number of trends were identified. Less than one-third of these trends were positive (i.e.,

indicating increasing concentrations). Of the positive trends, none were steep (i.e., indicative of significant changes in concentrations) and most occurred in wells with low levels of contamination.

Based upon the information presented above, the 1997 groundwater monitoring program for the Weldon Spring Chemical Plant is summarized as follows:

- Uranium will be measured in weathered zone wells and impacted unweathered zone wells.
- Nitrate and sulfate will be analyzed at locations that have shown increases since 1993 or that have concentrations exceeding drinking water standards.
- Nitrates will be measured at locations in the vicinity of the raffinate pits.
- Waste storage facilities wells will be sampled quarterly and analyzed for the constituents described in Section 3.2.4 and listed in Table 3-6.
- Nitroaromatics will be analyzed annually at locations that have shown historical detections of nitroaromatics.
- Burgermeister Spring, which monitors off-site migration of contaminated groundwater, will be analyzed quarterly for uranium, nitrate, and semiannually for nitroaromatic compounds and toxicity characteristic leaching procedure (TCLP) metals and disposal cell monitoring parameters.
- VOCs will be analyzed at selected chemical plant EMP groundwater monitoring locations to identify chlorinated hydrocarbon impacts and potential migration.
- Wells in the unweathered zone that have not historically shown contamination will not be sampled during 1997.

TABLE 3-6 Waste Storage Facility Monitoring Program

MONITORING LOCATIONS	PARAMETERS							
	TOTAL* URANIUM	RADIOCHEMICAL[a]	ANIONS[b]	METALS[c]	NITROS[d]	PCBs[e]	VOAs SEMI-VOAs[f]	PESTICIDES[g]
Quarry Water Treatment Plant Equalization Basin								
MW-1035	Q	A	Q	Q	Q	A	A	A
MW-1036	Q	A	Q	Q	Q	A	A	A
MW-1037	Q	A	Q	Q	Q	A	A	A
MW-1040	Q	A	Q	Q	Q	A	A	A
MW-1041	Q	A	Q	Q	Q	A	A	A
Site Water Treatment Plant Equalization Basin								
MW-2040	Q	A	Q	Q	Q	A	A	A
MW-2041	Q	A	Q	Q	Q	A	A	A
MW-2042	Q	A	Q	Q	Q	A	A	A
MW-2043	Q	A	Q	Q	Q	A	A	A
Temporary Storage Area								
MW-2035	Q	A	Q	Q	Q	A	A	A
MW-2036	Q	A	Q	Q	Q	A	A	A
MW-2037	Q	A	Q	Q	Q	A	M	A
MW-2038	Q	A	Q	Q	Q	A	M	A
MW-2039	Q	A	Q	Q	Q	A	m	A

A	Annually
M	Monthly
Q	Quarterly
S	Semiannually

(a) Radiochemical: U-234, U-238, Ra-226, Ra-228, Th-230, and Th-232
(b) Anions: Nitrate, sulfate, chloride, and fluoride
(c) Metals: As, Ba, Cd, Cr, Pb, Hg, and Se, (TCLP [RCRA] metals)
(d) Nitros:
(e) PCBs: polychlorinated biphenyls
(f) VOAs: Volatile organic analyses
Semi-VOAs: Semi-Volatile organic analyses
(g) Pesticides : Endrin, lindane, methoxychlor, toxaphene, 2,4-D and 2,4,5-TP Silvex
* KPA analysis will be performed quarterly.

Additional analytical parameters and/or increased sampling frequencies will be considered in future groundwater monitoring programs if site remedial activities, trend analyses, or field observations suggest that increased monitoring is warranted.

3.2.4 Groundwater Monitoring of the Waste Storage Facilities

3.2.4.1 Existing Waste Storage Facilities. Groundwater monitoring wells have been placed around three existing waste management units: the quarry and site water treatment plant equalization basins, and the temporary storage area (see Figures 3-3 and 3-5). These wells were installed to detect monitoring parameters in the uppermost water unit beneath these storage facilities in order to comply with the requirements of 40 CFR 264, Subpart F, and 10 CSR 25-7.264(2)(F). The monitoring parameters were derived from previous evaluations performed and documented in the *Engineering Evaluation/Cost Analysis for the Proposed Management of Contaminated Water in the Weldon Spring Quarry* (Ref. 11) and the *Baseline Risk Evaluation for Exposure to Bulk Waste at the Weldon Spring Quarry, Weldon Spring, Missouri* (Ref. 12).

The detection monitoring program will consist of quarterly, semiannual, and annual monitoring of selected parameters. A summary of the monitoring locations, the corresponding waste management unit, and the schedule of sampling is shown in Table 3-6. In conjunction with these analyses, the groundwater surface elevation at the time of each sampling event will be measured.

Concentrations at the monitoring wells will be compared with baseline concentrations for each well. If there is statistically significant evidence of contamination at the monitoring wells, a program of increased monitoring and/or evaluation of the liners of the basins or storage areas will be initiated in accordance with the *Leachate Production Action Response Plan* (Ref. 13). Statistical treatment of data is discussed in Section 6. If groundwater protection standards are exceeded, corrective action plans will be evaluated on an individual basis.

3.2.4.2 Disposal Cell Facility. Construction of the Weldon Spring site disposal cell is scheduled to begin in late 1996 and early 1997. A groundwater monitoring plan for the cell has been developed to satisfy requirements set forth in 40 CFR 264, Subpart F and 10 CSR 25-7.264 (2)(F). The *Weldon Spring Site Disposal Cell Groundwater Monitoring Plan*

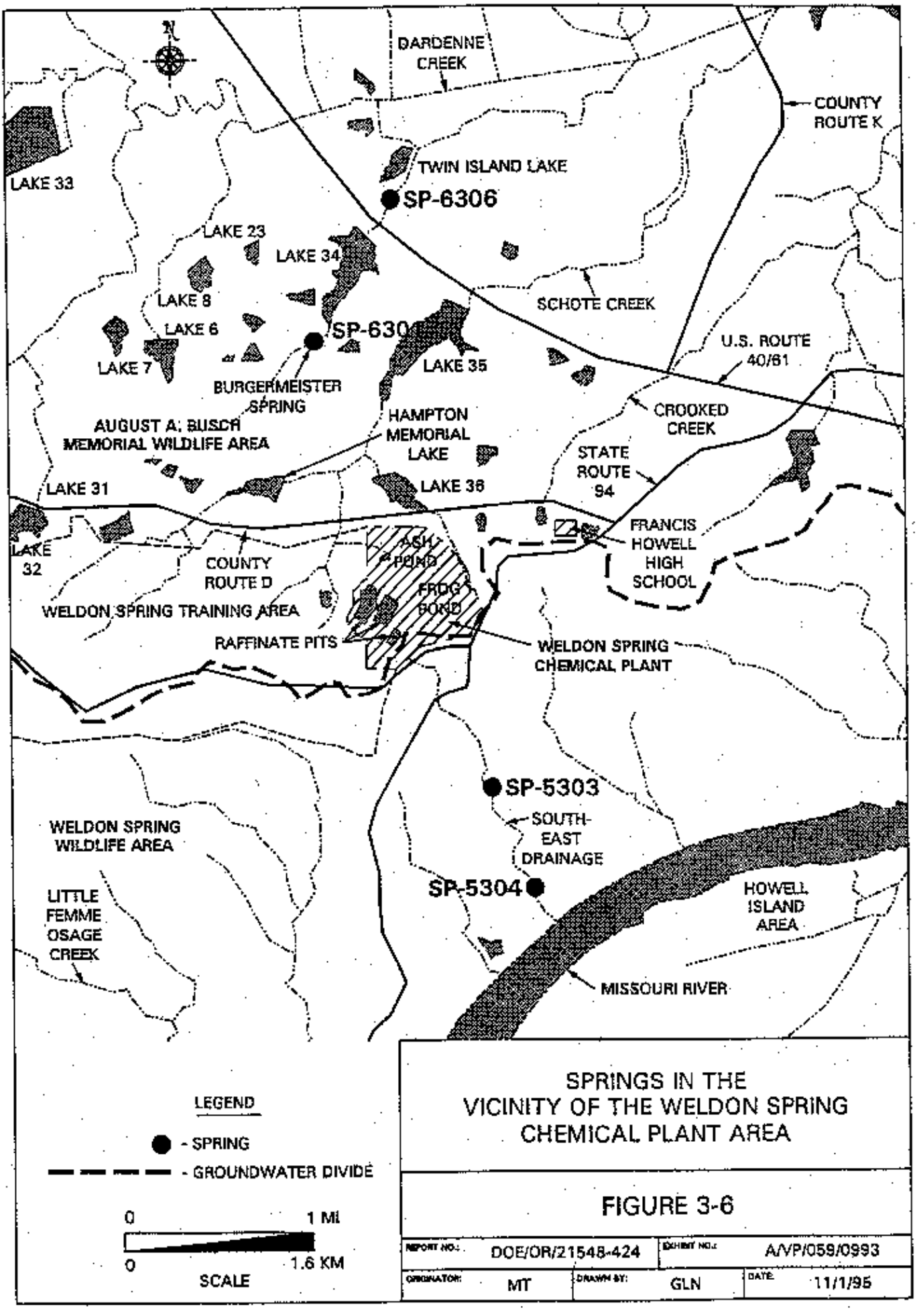
(Ref. 5) details the strategy for establishing baseline values and long-term detection monitoring. Detection monitoring wells were installed in late 1996 and baseline groundwater monitoring will continue through 1997, as described by the cell monitoring plan.

3.2.5 Groundwater Monitoring at Springs

The groundwater flow system beneath the chemical plant, raffinate pits, and vicinity properties comprises both diffuse and discrete flow components; therefore, a complete groundwater monitoring program must include sampling at conventional groundwater monitoring wells near the contaminant sources and at springs. Springs in the vicinity of the site have been monitored since 1987, beginning with the Department of Energy and Project Management Contractor broad-based Phase I spring and seep characterization, which involved 30 springs and seep features within a 3.2 km (2-mi) radius of the site. The springs and seeps were inventoried and sampled at varying flow rates. The springs impacted by the site were identified, and a program of regular monitoring was established for those springs. Through that program and additional studies conducted by the Department of Energy, the contractor, the Missouri Division of Geology and Land Survey, and the U.S. Geological Survey, the flow characteristics of the springs and their recharge basins were determined.

3.2.5.1 Monitoring Locations. As a result of the early characterization results, investigations by the Missouri Department of Natural Resources on shallow groundwater movement (Ref. 14), and the subsequent annual monitoring at select locations, sufficient data have been collected to understand the basic mechanics and contaminant levels in the springs of concern. For the 1997 monitoring year, only Spring SP-6301 (Burgermeister Spring) will be monitored regularly. SP-6301 (Figure 3-6) exhibits recognizable contribution from contaminated groundwater from the Weldon Spring site throughout the year and is believed to be a local discharge point for contaminated groundwater from beneath the site. For that reason, it is a key monitoring location for identifying changes in groundwater contamination conditions from the site and will allow the project to document improvements in groundwater contamination conditions as remedial actions at the site proceed.

The Burgermeister Spring branch receives site-contaminated ground and surface water. Although the Weldon Spring site is not located in Valley 6300, it is connected to this drainage by losing streams that travel along solution-enlarged karst conduits and emerge at springs in the



SPRINGS IN THE VICINITY OF THE WELDON SPRING CHEMICAL PLANT AREA

FIGURE 3-6

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/059/0993
ORIGINATOR:	MT	DRAWN BY:	GLN
DATE:	11/1/95		

Burgermeister Spring branch. The most prominent location is Burgermeister Spring (SP-6301), a perennial spring that discharges site-contaminated water during high and low flow periods. High flow is dominated by a surface water component, whereas low flow is dominated by a groundwater component. Spring 6306, located downstream of Busch Lake 34 and downstream of Burgermeister Spring, also contains uranium. Considerable evidence suggests that Lake 34 is a plausible source for the uranium in Spring 6306. However, there is also evidence of a possible connection with Busch Lake 35, which is located in the same drainage as the Weldon Spring site and also has elevated uranium levels.

Burgermeister Spring is the only location that will be sampled during 1997. Springs SP-5303, SP-5304, and SP-6306 will not be sampled since sufficient data have been collected to characterize the contamination conditions.

3.2.5.2 Monitoring Program. Burgermeister Spring will be monitored at low flow, which is defined hereafter as seasonal base flow, or the stage of spring discharge when it is not influenced by active surface water runoff from local land surfaces. Low flow samples are intended to monitor the undiluted groundwater component of flow. To meet this criterion, low flow samples will be collected no sooner than one week following the conclusion of a precipitation event of sufficient intensity to cause surface runoff. To provide a direct comparison with groundwater collected from monitoring wells, samples will not be filtered.

Burgermeister Spring will also be sampled at high flow. In contrast to low flow, high flow is induced by precipitation events. During high flow, discharge is dominated by surface runoff. Only contaminants of concern will be measured during high flow. These samples will not be filtered. The monitoring schedule for Burgermeister Spring is presented in Table 3-7.

3.2.6 Groundwater and Spring Data Review

Data generated from the EMP groundwater sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values shown in Appendix E to determine if the concentrations are "above normal" requiring reporting to the U.S. Department of Energy (DOE) as outlined in Procedure ES&H 1.1.7. Environmental response levels for critical groundwater receptors are shown in Table E-1. The maximum contaminant levels (MCL) referenced in Table E-1 are listed in Table E-2. Baseline values for

TABLE 3-7 Spring Monitoring Program

SPRING	Q1	Q2		Q3	Q4	
	LOW	LOW	HIGH	LOW	LOW	HIGH
SP-6301	U,I,N,DM	U,I	U,I	U,I,N,M	U,I	U,I

U Uranium, total
I Inorganic Anions (nitrate and sulfate)
N Nitroaromatic compounds
M Metals
DM Disposal Cell Detection Monitoring Parameters (Ref. 5)

the detection monitoring wells at the chemical plant and the quarry are listed in Table E-4 and Table E-5, respectively.

3.3 External Radiation Exposure Environmental Surveillance Monitoring

The external radiation exposure environmental surveillance program at the Weldon Spring site is designed to monitor potential external exposure points at the chemical plant, raffinate pits, quarry perimeter, vicinity properties, and at off-site locations where the potential for exposure of the general public to gamma radiation is greatest. Gamma radiation is emitted by nearly all the radionuclides of the U-238 and Th-232 decay series, and these radionuclides are found in above-background concentrations on the site.

In addition, the environment contains naturally occurring radioactive substances that emit gamma radiation. Terrestrial radiation sources are natural radioactive elements that originate from the earth's crust. Cosmic radiation is high-energy radiation that originates in outer space and filters through the atmosphere to reach the earth's surface. Together, these two sources account for natural background gamma radiation. Terrestrial radiation levels depend largely on the soil composition and the type of rock. Cosmic radiation levels depend strongly on elevation above sea level.

Measurements with a pressurized ion chamber as suggested in the *Regulatory Guide* (Ref. 4) will not be made at monitoring stations used in previous years. Because the environmental thermoluminescent dosimeters (TLDs) that are used at the site integrate gamma

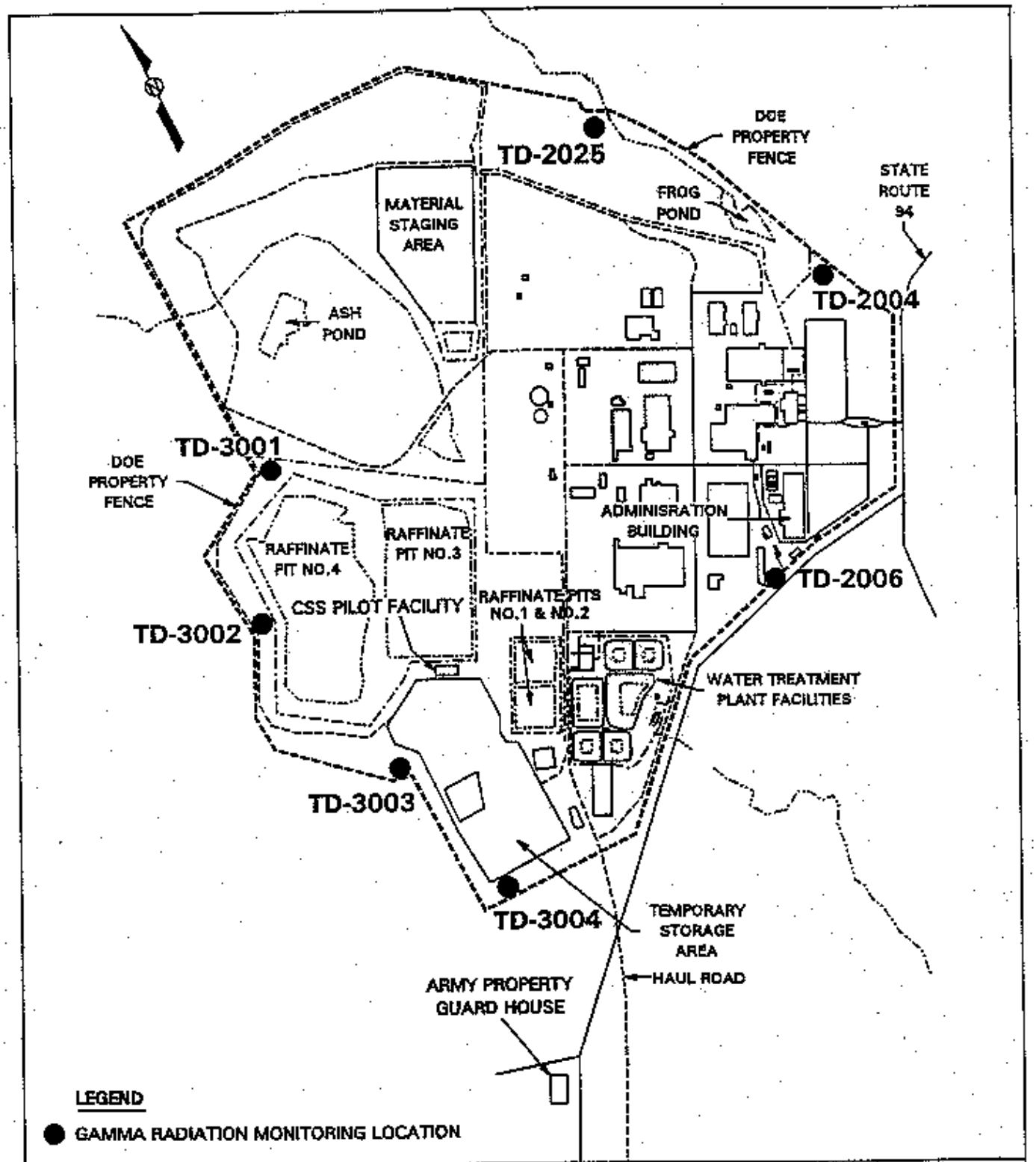
exposure for 13 weeks, the TLDs actually provide a better means of identifying natural occurring anomalies than would a short term pressurized ion chamber measurement.

Results of previous TLD measurements are consistent with yearly background gamma exposures made by the Project Management Contractor and other Department of Energy contractors around the site. The monitoring stations at the quarry are located in the controlled area near contaminated soils and material. Any above background results detected by these stations are due to the proximity of the monitoring stations to the contaminated soils. Because previous TLD measurements are consistent with background exposure rates performed by the contractor and others, and are within the expected range for the altitudes of the stations, it is concluded that no naturally occurring anomalies are present. Thus, pressurized ion chamber measurements are not necessary.

3.3.1 Weldon Spring Site Monitoring Locations

The choice of locations for external gamma radiation monitoring stations was based on the characteristics of both the chemical plant and quarry. External gamma exposure to the public as a result of fugitive dust emissions from the site is an unrealistic exposure pathway. This conclusion is based on the fact that for the primary radioactive contaminant of uranium, three air monitoring programs have been established to ensure that airborne concentrations at the perimeters are maintained at near background levels. If there is an airborne emission from the site, it will be intermittent and contain low concentrations of radionuclides. Thus, this pathway is not expected to result in measurable external exposure to the general public. In addition, there are no high energy accelerators, industrial X-ray, or large isotopic radiation sources at either the chemical plant or quarry. The only potential for external exposure to the general public results from contaminated soils and waste at the chemical plant, raffinate pits, quarry, and vicinity properties.

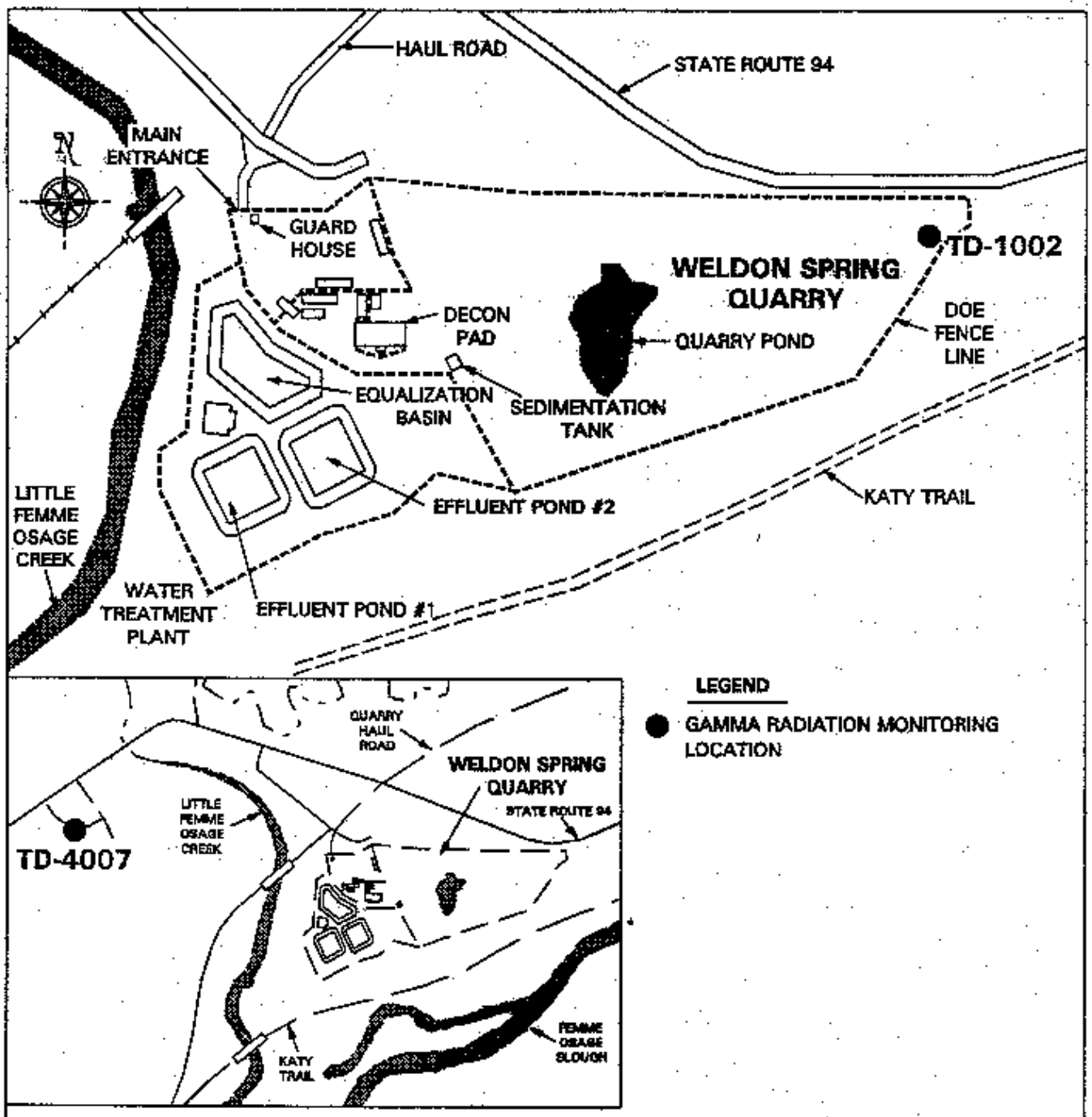
Gamma radiation at the Weldon Spring site perimeters will be monitored at eight locations using TLDs. Seven monitoring stations will be located around the perimeter fence of the chemical plant (Figure 3-7), and one station will be located along the quarry perimeter fence (Figure 3-8). These locations are summarized in Table 3-8. After the completion of bulk waste removal, monitoring stations that indicated gamma radiation levels statistically comparable to background levels for a minimum of two consecutive calendar quarters were targeted for



GAMMA RADIATION (TLD) MONITORING LOCATIONS AT THE CHEMICAL PLANT AREA

FIGURE 3-7

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/CP/027/0393		
ORIGINATOR:	MP	DRAWN BY:	GLN	DATE:	11/19/96



GAMMA RADIATION (TLD) MONITORING LOCATIONS AT THE WSQ AREA

FIGURE 3-8

REPORT NO.:	DOE/OR/21548-424	DOCUMENT NO.:	A/QY/029/0393
ORIGINATOR:	MP	DRAWN BY:	GLN
DATE:	12/10/96		

TABLE 3-8 Gamma Radiation (TLD) Monitoring Locations

STATION	LOCATION	STATION	LOCATION
Chemical Plant Area			
TD-2003	North perimeter of site	TD-3001	Northwest of Raffinate Pit 4
TD-2004	Northeast corner of site	TD-3003	South of Raffinate Pit 4 and west of TSA
TD-2006	Southeast of administration building	TD-3004	South of TSA
TD-3005	Southeast of TSA		
Quarry Area			
TD-1002	Northeast corner of quarry	TD-1006	West perimeter of quarry
TD-1004	South perimeter of quarry	TD-1009	North perimeter of quarry
Off-site and Background			
TD-4001	Busch Conservation Area	TD-4007	Residence west of quarry
TD-4002	Army site guard house	TD-4008	Katy Trail south of quarry
TD-4003	Francis Howell High School	TD-4009	Daniel Boone Elementary School, New Melle
TD-4005	West of Army site		

TD-1002) will remain in service until a decision is made on the remedial action necessary for quarry residuals.

Spacing of the monitoring stations around the perimeters of the chemical plant is based on the relative potential for external exposures. Due to the greater potential for elevated gamma radiation, the shortest distance between monitoring stations at the chemical plant is near the temporary storage area and Raffinate Pit 4. Transport of material presently at the quarry to the temporary storage area began in mid-1993 and ended during 1995. In some places, the temporary storage area perimeter is less than 31 m (100 ft) from the chemical plant perimeter. The monitoring stations are placed at wider intervals along the remainder of the chemical plant perimeter because in this area, potential for external exposure to the general public is less.

3.3.2 Off-Site Monitoring Locations

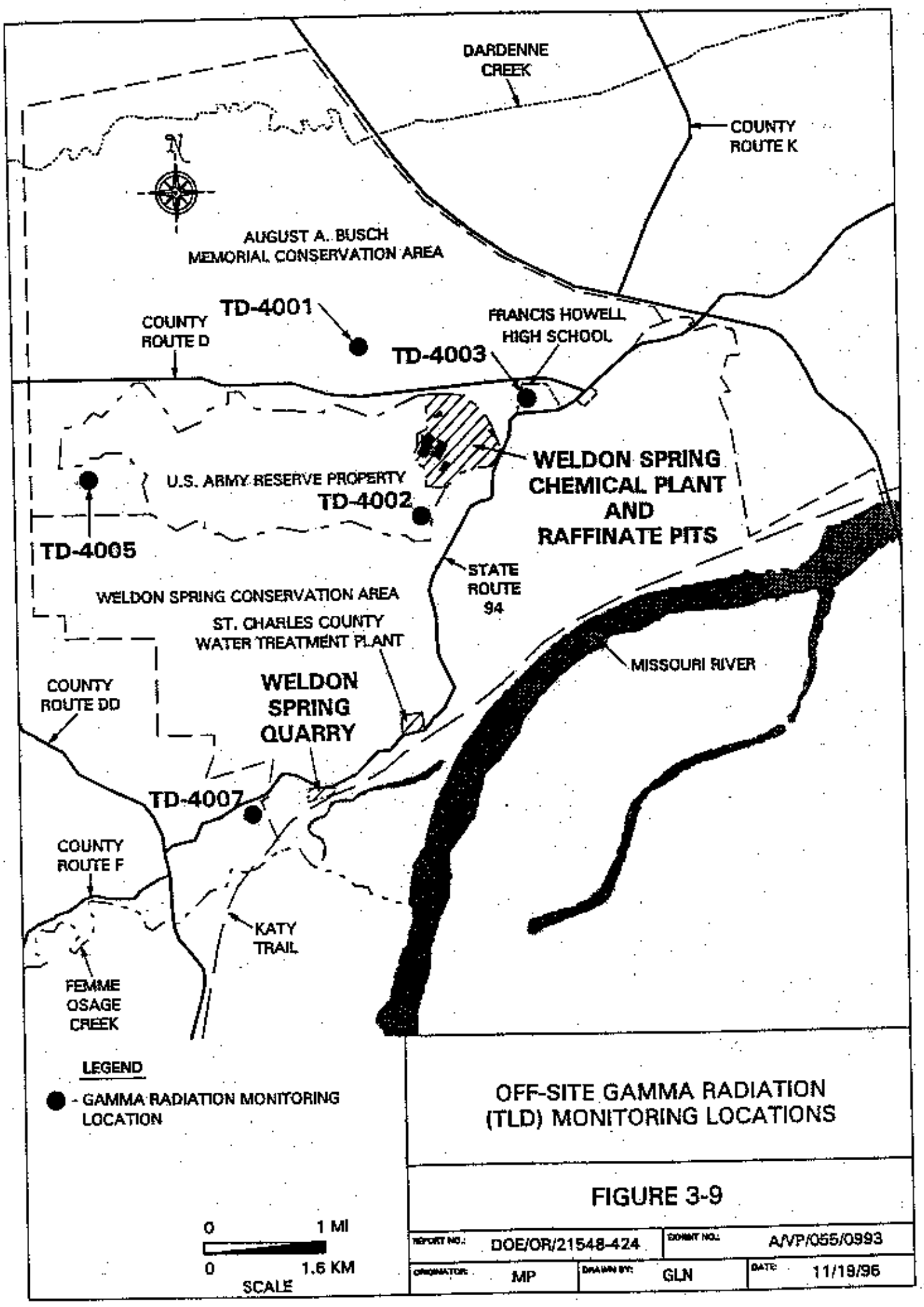
Five off-site monitoring stations (Figure 3-9), as well as two of the perimeter stations (Figure 3-7), will be used to assess gamma radiation exposure rates at locations near the chemical plant where members of the general public abide or reside. Francis Howell High School, TD-4003, and the Busch Conservation Area headquarters, TD-4001, were selected as monitoring locations because they have the largest populations near the chemical plant. The State of Missouri Highway Department, TD-2004; the Army Reserve guard house, TD-4002; and the WSSRAP administration building, TD-2006; are the closest locations to the chemical plant where members of the general public abide or reside.

Monitoring stations TD-4007, which was located by the closest quarry resident, and TD-4008, which was located adjacent to Femme Osage Slough vicinity property, were removed due to the completion of bulk waste removal and remediation of the vicinity properties.

3.3.3 Background Monitoring Locations

Two monitoring stations are used to measure background gamma radiation exposure rates (Figures 3-9 and 3-10). These locations are TD-4005 and TD-4009. In 1989, background gamma radiation exposure rates were measured in each of the three distinct geological regions in the vicinity of the Weldon Spring site. These regions are the dissected glacial till deposits, the alluvial deposition of the Missouri River, and the Salem Plateau. Statistical analysis of the data from these measurements indicated that at the 95% confidence level there was no reason to suspect a difference in the gamma exposure rates between the three geological regions. Since there was no reason to suspect a difference, an average of the results of the two background locations is used to estimate the background gamma radiation exposure rate.

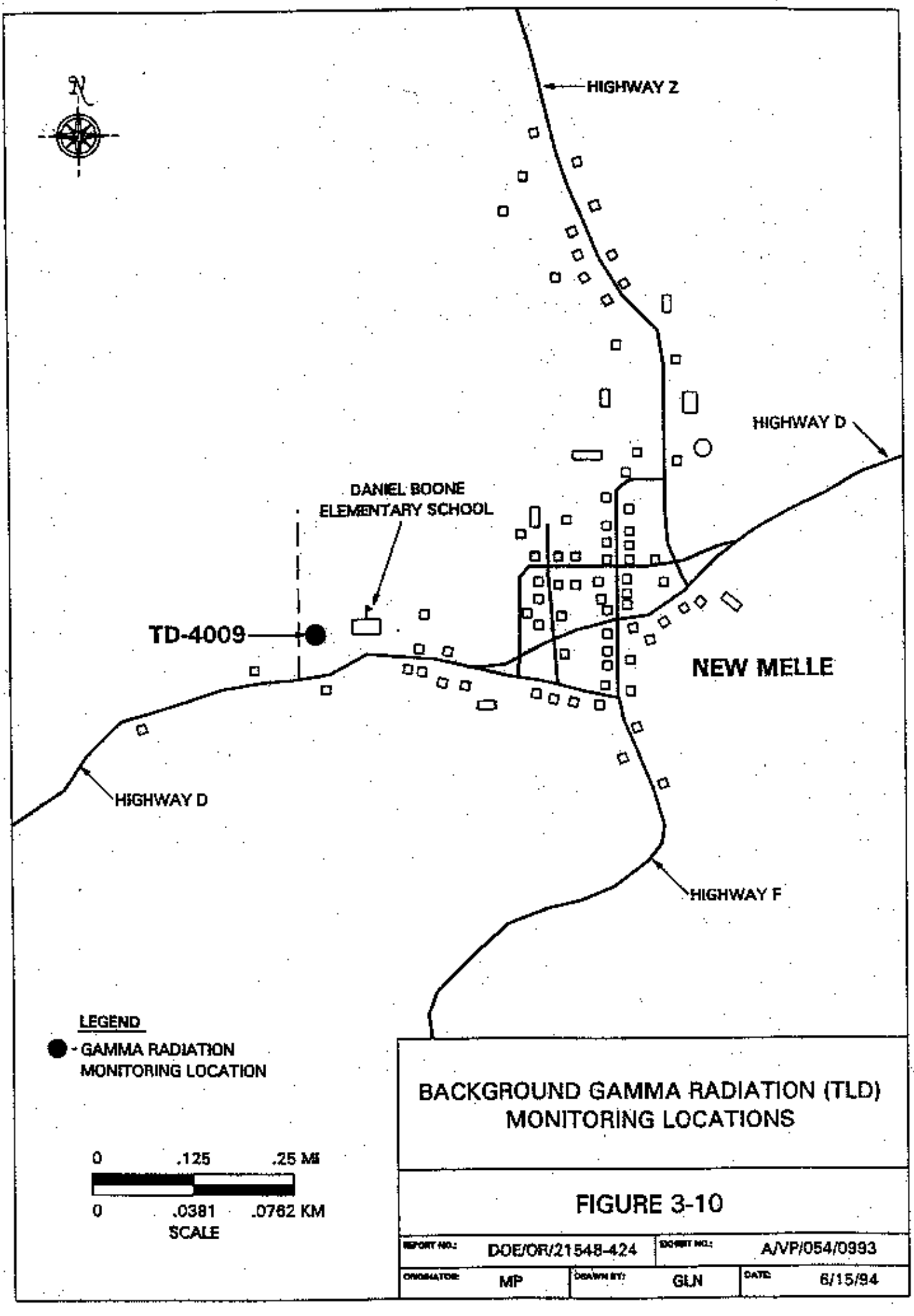
Monitoring station TD-4005 is within 6 km (4 mi) from the chemical plant and the quarry. Monitoring station, TD-4009, is approximately 13 km (8 mi) from the chemical plant and 11.3 km (7 mi) from the quarry (Figure 3-10). The *Regulatory Guide* (Ref. 4) suggests that background stations should be located at least 10 km to 15 km (6 mi to 9 mi) from a site. Although TD-4005 is at a lesser distance, it is at an appropriate distance with respect to the site. As mentioned, the site will not render external radiation exposures as a result of airborne



OFF-SITE GAMMA RADIATION (TLD) MONITORING LOCATIONS

FIGURE 3-9

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/055/0993		
ORIGINATOR:	MP	DRAWN BY:	GLN	DATE:	11/19/96



BACKGROUND GAMMA RADIATION (TLD)
MONITORING LOCATIONS

FIGURE 3-10

REPORT NO.:	DOE/OR/21548-424	DRAWING NO.:	A/VP/054/0993		
ORIGINATOR:	MP	DRAWN BY:	GLN	DATE:	6/15/94

emissions. There are no high energy accelerators, industrial X-ray, or large isotopic radiation sources at either the chemical plant or quarry; thus, the distances of the background stations from the chemical plant, raffinate pits, quarry, and vicinity properties are more than sufficient to attenuate the gamma radiation from contaminated soils and debris.

3.3.4 Quality Control

The quality control measures that will be implemented for environmental TLDs include spiked and duplicate detectors. At least two duplicate TLDs will be deployed, for each measurement period. The TLDs will be exchanged and retrieved quarterly in accordance with the appropriate standard operating procedures (SOPs), and field sheets will be used to document placement, retrieval, and unusual occurrences. Chain-of-Custody Forms will also be filled out as specified in the appropriate SOPs. The data received from vendors will be reviewed and anomalies will be identified and investigated. In addition, TLDs will be performance tested, deployed, and stored according to ANSI-N545-1975. The environmental TLD used for the long term monitoring of ambient gamma radiation is comprised of 25% calcium sulfate dysprosium ($CaSO_4$:Dy) in a Teflon matrix. With comparably high sensitivity and low fading, these dosimeters will be encased in black polyethylene bags that will be placed in plastic holders with copper shielding. The copper shielding is necessary to correct for over-response of the dosimeter at low energies. The dosimeters will be exchanged quarterly.

3.4 Biological Monitoring Program

DOE Orders 5400.1, 5400.5, and the *Regulatory Guide* (Ref. 4) have requirements for monitoring of contaminant levels in terrestrial foodstuffs as well as in aquatic biota present in the water column and sediments of affected surface waters.

Remedial activities in process at the quarry and chemical plant could potentially result in the release of contaminants to the environment. Work practices are incorporated into remedial actions to avoid releases, and programs have been established to evaluate the effectiveness of these practices. Environmental monitoring at the WSSRAP has been designed to focus on effluent monitoring to detect, characterize, and report unplanned releases; therefore, ecological studies were conducted to assess baseline conditions in the environment, such as status of lakes and streams.

3.4.1 Past Studies

Characterization studies in the past have focused on a number of areas. Prior to 1990, studies examined the level and extent of contaminants in the environment by sampling soils, surface water, and sediment. The main purpose was to examine the contaminants in relation to their potential for human exposure. Some of this information was used to satisfy Department of Energy monitoring requirements.

Beginning in 1987, other studies measured concentrations of metals, polychlorinated biphenyls (PCBs) and radionuclides in potential receptors, such as fish, small mammals, waterfowl, and white-tailed deer. Beginning in 1992, emphasis was placed upon characterizing ecological conditions on site and at vicinity properties that receive effluent from the Weldon Spring site.

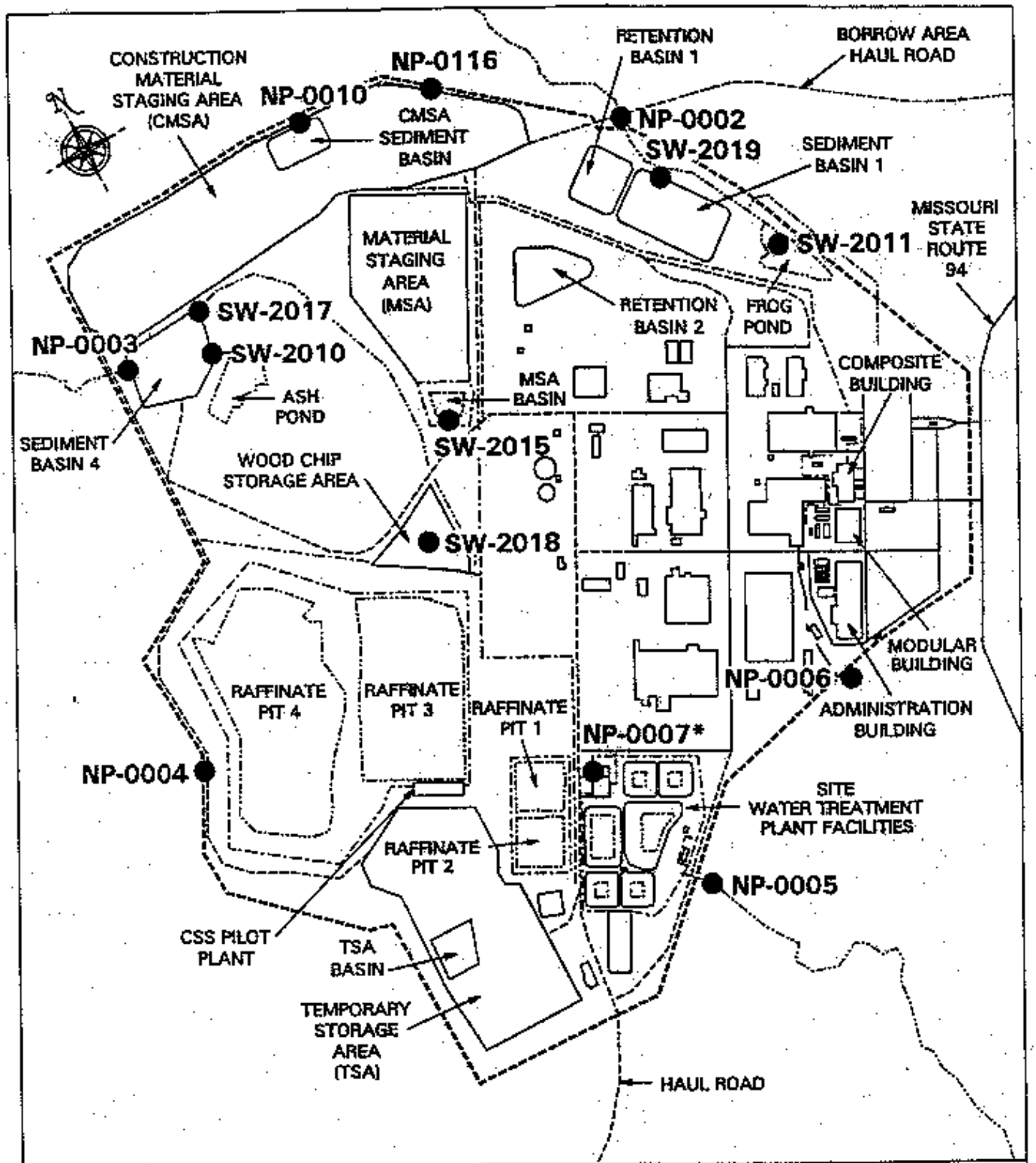
Summaries of past studies can be found in past site environmental reports and in the *Radiological and Chemical Uptake in Game Species at the Weldon Spring Site* (Ref. 15).

3.4.2 Monitoring Rationale

A biological monitoring program that may include various aquatic and terrestrial studies will be followed in 1996 to meet monitoring requirements. If studies are necessary, they will focus primarily on vicinity properties that receive effluent from the site. Criteria to be used for determining if additional studies are necessary are described in Sections 3.4.3.1 and 3.4.3.2.

3.4.3 Aquatic Habitats

Aquatic habitats monitored include a number of lakes and streams that are impacted or potentially impacted by the Weldon Spring site (Figure 3-11). To the north, chemical plant drainage impacts Busch Lakes 35 and 36, and contaminated groundwater that surfaces at Burgermeister Spring impacts Busch Lake 34. Waters from these lakes flow to Dardenne Creek and eventually to the Mississippi River. To the south, runoff flows from the chemical plant down the Southeast Drainage to the Missouri River.



* THE SITE WATER TREATMENT PLANT DISCHARGES TO THE MISSOURI RIVER, VIA THE EFFLUENT PIPLINE AT NP-0007.

● - SAMPLE LOCATION

0 500 1000 FT

0 152.4 304.8 M

SCALE

NPDES SURFACE WATER SAMPLING LOCATIONS AT THE WELDON SPRING CHEMICAL PLANT

FIGURE 4-1

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/CP/086/0993
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In the vicinity of the Weldon Spring Quarry, two bodies of water are monitored: the Femme Osage Slough and the Little Femme Osage Creek. Femme Osage Slough is south of the quarry and receives contaminated groundwater migrating from the quarry. Little Femme Osage Creek is west of the quarry and does not receive runoff from the quarry.

3.4.3.1 Fish Sampling. Fish are monitored biennially at Busch Lakes 34, 35, and 36, and at the Femme Osage Slough primarily to ensure public health and safety. Busch Lake 33 will be used as a background location. In addition, during the off year, fish samples will be collected if the previous year's annual average uranium concentrations in lake water are found to be greater than the historical average plus two standard deviations. To date, the concentrations in fish tissue are extremely low and the calculated total estimated dose is less than 1.0 mrem/year. No significant difference has been found between species of fish; therefore, fish monitoring will be limited to sampling the flesh of game species. In addition, only fish within 20% of the legal length will be sampled, or in the case of species with no designated limit, only individuals greater than 17.5 cm (7 in.) will be taken.

Fish will be sampled in conjunction with the Missouri Department of Conservation fisheries program. Adult fish will be collected using the electrofishing technique in which fish are stunned with a low electrical current, dip-netted from the water, and placed in holding tanks prior to data collection. All fish collected for tissue analysis will be identified, measured (total length), and recorded for analysis of fish populations. In addition, a gross examination of each fish will be made to determine the incidence of external disease, parasites, or physical abnormalities.

Fillets and/or fish cakes from game species (specifically bass, sunfish, crappie, and catfish) will be prepared for uranium analysis. Results of this analysis will be used to calculate the effective dose equivalent to humans via consumption of fish.

3.4.3.2 Invertebrates and Zooplankton. Department of Energy Order 5400.1 specifies monitoring of benthics and organisms in the water column. Also, Department of Energy Order 5400.5 and the *Regulatory Guide* (Ref. 4) require that the interim allowable maximum absorbed dose protective of native aquatic organisms (other than plants) be 1 rad/day. To assess compliance with these mandates, benthic invertebrates and zooplankton were sampled as part of a 3-year aquatic study (1991, 1992, and 1994) and were used as indicators of the

ecological quality of surface water bodies affected by the Weldon Spring site. The data generated by this study show that the radiation dose to native aquatic organisms in waters influenced by the Weldon Spring site is well below the protective guidelines (<1 rad/day) established in DOE Order 5400.5. Therefore, further invertebrate and zooplankton sampling will be conducted only if the average annual uranium concentration in these waters is significantly higher than the historical data average plus two standard deviations for these locations. These water bodies include the Southeast Drainage, Ash Pond Drainage, Frog Pond Drainage, Busch Lakes 34, 35, 36, Burgermeister Spring, and Femme Osage Slough.

3.4.4 Terrestrial Habitats

The terrestrial community in the area of the Weldon Spring site is diverse. Much of the land immediately surrounding the chemical plant is made up of state-owned conservation lands (Ref. 16). Habitats include old field; cultivated farmlands; and upland, slope, and bottomland forests. The terrestrial community supports a wide variety of fauna including avian and mammal species. White-tailed deer, gray squirrels, and cottontail rabbits have been sighted within the chemical plant boundaries. Opossum, fox, and coyote roam the areas. Many birds are summer residents or spring/fall migratory species. Eastern screech and barred owls have been sighted in upland forests south of the chemical plant and great horned owls have been sighted at Ash Pond.

Monitoring during past years has included extensive efforts to characterize terrestrial fauna and habitats at the chemical plant as part of the requirement for assessing exposure and impact to biota.

3.4.4.1 Foodstuffs. Agricultural lands surrounding the site comprise approximately 20% of the terrestrial habitat. The August A. Busch Memorial Conservation Area and Weldon Spring Conservation Area contain approximately 890 ha (2,200 acres) of agricultural lands that are leased to sharecroppers. There are also private farms in the immediate area. Agricultural products grown in the area include corn, soybeans, and milo, which are harvested as cattle feed or left as wildlife feed.

Surveillance of foodstuffs within a 16 km (10 mi) radius of the site is required by the *Regulatory Guide* (Ref. 4). Foodstuffs include such items as meat, eggs, milk, and grains. To

establish a representative foodstuff surveillance policy, the WSSRAP developed an agricultural monitoring program. This program was based upon a tiered approach, looking first at the most prominent agricultural activity in the Weldon Spring site area, which is crop production. Sampling of agricultural crops was performed during 1991 and 1992.

The extent of terrestrial foodstuff sampling under Department of Energy Order 5400.5 is based on the projected dose to off-site populations via an air-to-crop-to-human pathway. Based on previously collected data the Weldon Spring site has a projected dose of <0.1 mrem/year to members of the public from this pathway. Therefore, as directed by the *Regulatory Guide* (Ref. 4) a surveillance program has been established for agricultural monitoring. Sampling will be conducted only if annual average air monitoring results indicate above background concentrations of radionuclides at critical receptor sites.

If sampling is required, because annual average air radionuclide concentrations are above background at critical receptor sites, samples will be taken from within the 16 km (10 mi) radius area. Samples equal to 1% of the total number of acres planted within the study area will be selected based on the type of crops planted. A minimum of four samples from each field will be collected. Weather conditions at the time of the release and the distance from the contamination source will be taken into account when samples are collected. Grain samples may include corn, milo, or soybeans. Samples will be analyzed for total uranium. Collection will take place in accordance with the *Agricultural Sampling Plan* (Ref. 18).

3.4.5 Wetland Monitoring

As mitigation for the disturbance of approximately 2.2 acres of wetland habitat at the borrow area, the WSSRAP has funded the construction of approximately 57 acres of replacement wetlands. This wetland complex is located within the August A. Busch Conservation Area, northeast of Lake 33.

In accordance with the monitoring requirements given in the Wetland Project Plan for COE Permit Application (Ref. 17), the WSSRAP will monitor the establishment of these replacement wetlands for a period of three years following the completion of the wetland complex. Monitoring will include the collection of hydrological data (water depth, duration, extent, and saturation) and biological data (vegetation, avifauna and herpetofauna) from the

constructed wetlands. Results of this monitoring will be submitted annually to the Army Corps of Engineers and may be used to make improvements to the operation of the wetland complex.

3.4.6 Collection Permits

The taking of specific fauna for scientific study is authorized by permits from the Missouri Department of Conservation and the U.S. Fish and Wildlife Service. Applications for permits, as required by sampling plans and State and Federal regulations, will be submitted prior to sample collection. Sample collection will also be in compliance with applicable State and local laws.

3.4.7 Natural Resource Trusteeship

At the WSSRAP, the Department of Energy is the primary Federal Natural Resource Trustee for the response actions being carried out under CERCLA. Other agencies that may act as co-trustees are the U.S. Department of the Interior (U.S. Fish and Wildlife Service) and the State of Missouri. The Department of Energy has notified these agencies of their status as co-trustees and will notify them of releases of CERCLA hazardous substances. The Department of Energy will also coordinate with the co-trustees on requests for further information regarding the potential damage to natural resources.

4 EFFLUENT MONITORING

The Weldon Spring Site Remedial Action Project (WSSRAP) has established two distinct monitoring programs which it characterizes as "effluent monitoring." These include waterborne and airborne effluents that could migrate beyond the site perimeters. These programs are described in the following sections. For the purposes of the environmental monitoring program, groundwater migrating from the site is included under the surveillance program and is not considered an effluent.

4.1 National Pollutant Discharge Elimination System Program

As a Federal facility, the WSSRAP is subject to, and complies with, Executive Order 12088, which requires all Federal facilities to comply with applicable pollution control standards. Further, U.S. Department of Energy Order 5400.1 states that the Department of Energy is "to conduct the Department's operations in compliance with the letter and spirit of applicable environmental statutes, regulations and standards." In this light, and because the WSSRAP contains point sources for waterborne pollutants, the project operates under Federal *Clean Water Act* requirements and Missouri Clean Water Commission laws and regulations. The Missouri Department of Natural Resources has issued National Pollutant Discharge Elimination System (NPDES) permits to the Department of Energy for the discharge of treated water, storm water and other waters.

4.1.1 Goal

In addition to verifying compliance with NPDES permitted effluent limitations, the goal of the NPDES effluent monitoring program is to characterize the water releases from the WSSRAP. The Project Management Contractor will use this information to develop strategies to minimize the discharge of waterborne contaminants from the site in accordance with the WSSRAP policy that all surface water will be closely monitored and treated, as necessary, to meet Federal and State requirements. Existing or potential water sources at the chemical plant and quarry areas are listed in Table 4-1. Since the previous revision of the *Environmental Monitoring Plan* (EMP), several water sources have been altered or their capacity has been reduced: (1) Ash Pond is now operated as a flow-through basin, (2) no water enters Frog Pond except by direct precipitation, (3) all bulk waste has been removed from the quarry, and (4)

Raffinate Pit 4 has been dewatered and the sludge will be consolidated into the southern end with a greatly reduced capacity. Estimates of the quantity of water from the sources are described in rates or total volume, depending on the source. The current treatment is also provided for each source.

TABLE 4-1 Existing or Potential Water Sources

SOURCE	CATEGORY[a]	QUANTITY
SITE		
Raffinate Pits No. 1[b]	RAD	1.3×10^6 gal
2[b]	RAD	1.3×10^6 gal
3[b]	RAD	7.7×10^5 gal
4[b]	RAD	4.9×10^6 gal
Frog Pond	STR	100,000 gal maximum[b]
Ash Pond	STR/RAD	[b][g]
Decontamination Pad	RAD	8.3 gpm[c]
TSA (10 acres)	RAD	9,800,000 gpy[b][e]
MSA (9 acres)	STR/RAD	8,800,000 gpy[b][e]
Sanitary Sewage Treatment Plant	SAN	4,000 gpd
Laboratory	RAD	<10 gpd
Storm Water Discharges (200 acres)	STR	195,000,000 gpy[e]
Worker Toilets	SAN	---[f]
Worker Showers	RAD	1.7 gpm[c]
Decontamination Facilities	RAD	<1,000 gpd[c]
Retention Basins	STR/TBD[d]	[b]
Dust Control Water	STR	Unknown
Mud Wash Water	STR	Unknown

TABLE 4-1 Existing or Potential Water Sources (Continued)

SOURCE	CATEGORY[a]	QUANTITY
QUARRY		
Quarry Sump	RAD	3,750,000[b]
Quarry Storm Water (9 acres)	RAD	8,800,000 gpy[e]
Decontamination Pad	RAD	2.0 gpm[c]
Worker Toilets	SAN	--[f][c]
Worker Showers	TBD[d]	0.6 gpm[c]

(a) Category is based on the primary treatment method required and the existing natural uranium concentration.
(b) Part of storm water
(c) While operating
(d) Case-by-case basis
(e) Based on average annual precipitation
(f) Removed off site
(g) Ash Pond does not accumulate water. Water is accumulated only if monitoring indicates elevated levels of contaminants.
MSA Material storage area
RAD Complex treatment; Uranium - greater than 600 pCi/l
SAN Biological treatment; Uranium - background to 30 pCi/l
STR Sediment treatment; Uranium - less than 600 pCi/l
TBD To be determined
TSA Temporary storage area

The remedial action goal is to clean up the site with no increase in contaminant discharge or degradation of the off-site streams. Therefore, the remedial action program includes source identification and periodic sampling and analyses which enable the Project Management Contractor to identify treatment requirements. The program uses studies to identify, analyze, and evaluate appropriate measures for control of runoff, erosion, sediment, and contamination sources. From these studies, procedures and plans are developed for appropriate control and maintenance measures. Control measures for storm water are used to minimize erosion and remove sediment to a level commensurate with the "best practical technology."

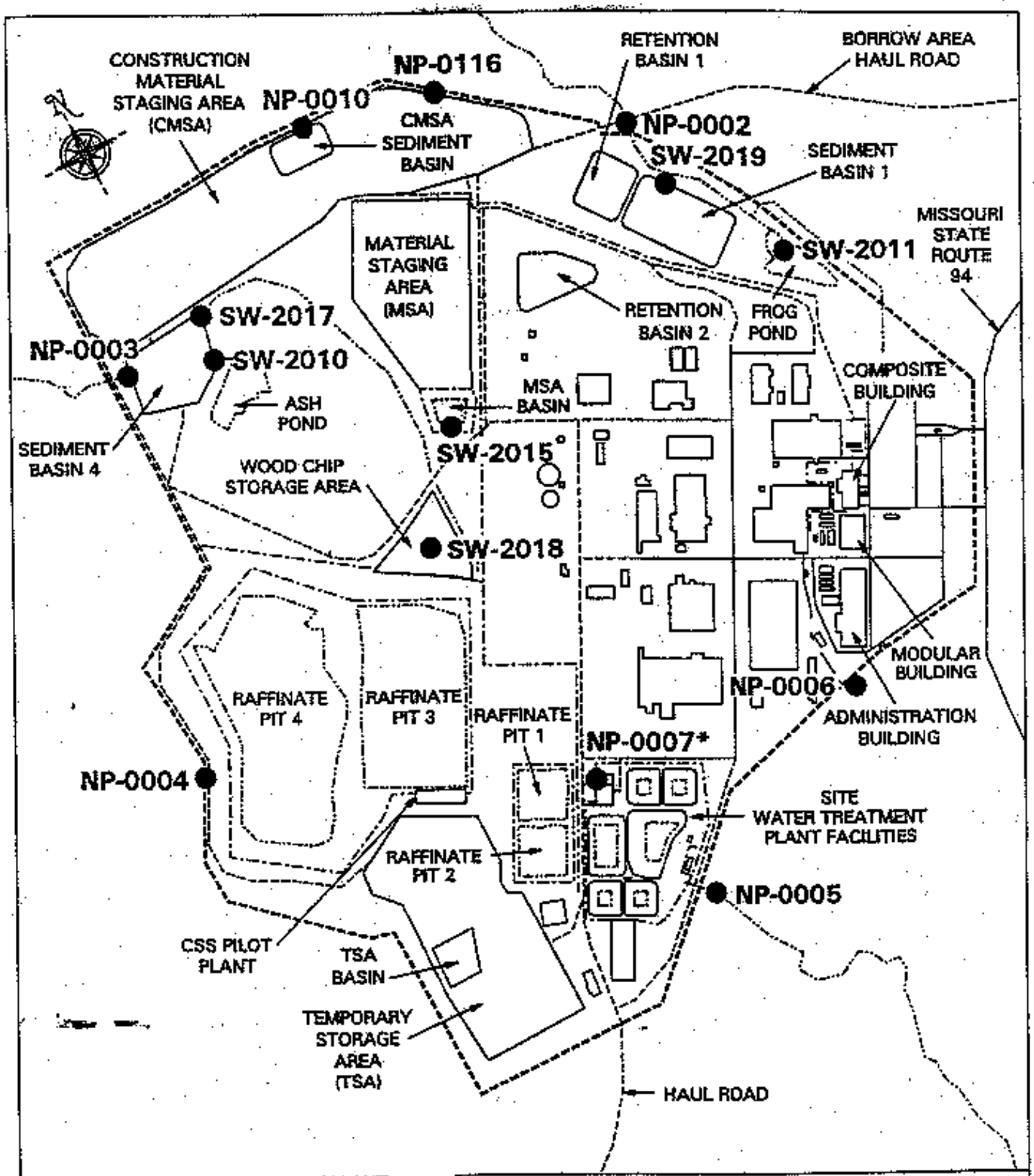
4.1.2 NPDES Permits

The Department of Energy currently holds three active NPDES permits for the discharge of various waters from the chemical plant and quarry areas. NPDES permit MO-G679035 for hydrostatic test water from the construction of site water treatment plant Train II was terminated November 27, 1995.

4.1.2.1 NPDES Permit MO-0107701. Permit MO-0107701 applies to various discharges from the chemical plant. This permit was originally issued to the Department of Energy on July 29, 1988, for discharge of surface water runoff through five outfalls (NP-0001 through NP-0005). A sixth outfall (NP-0006) was added on November 4, 1988, for discharge from the sewage treatment plant at the administration building. A seventh outfall (NP-0007) was added on October 1, 1990, for the discharge of batches (ranging from about 1 to 2 million gallons each) of treated effluent from the site water treatment plant effluent ponds. The permit was reissued on March 4, 1994, at which time storm water Outfall NP-0010 was added to monitor the construction material storage area and Outfall NP-0004 was deleted. This permit was revised on August 4, 1995, resulting in the deletion of Outfall NP-0001 and the addition of parameter limits for management of storm water which accumulates in the chipped wood storage area basin (see Table 4-3). If water in the CWSA basin meets the limits it may be discharged to Outfall NP-0003. If limits are not met then the water must be treated in the SWTP. Table 4-3 describes the required monitoring if the water is treated by the SWTP. Figure 4-1 shows the NPDES outfalls at the chemical plant and Tables 4-2 through 4-4 show monitoring requirements for each outfall. This permit requires that sampling results be submitted to the Missouri Department of Natural Resources each calendar quarter in a discharge monitoring report. The report is due by the 28th day of the month following the reporting period.

This permit was further revised during late December 1996. The revision increased the limits for selected parameters for outfall NP-0007. The revised limits are shown in Table 4-3 and will become effective the first full calendar quarter after the date of issuance of the permit.

In addition to permitted parameters the storm water Outfalls, NP-0002, NP-0003, NP-0005 may be periodically monitored for 2,4-dinitrotoluene (DNT), 2,4,6-trinitrotoluene (TNT), polycyclic (or polynuclear) aromatic hydrocarbons (PAH), Hazardous Substance List



* THE SITE WATER TREATMENT PLANT DISCHARGES TO THE MISSOURI RIVER, VIA THE EFFLUENT PIPLINE AT NP-0007.

● - SAMPLE LOCATION

0 500 1000 FT
0 152.4 304.8 M
SCALE

NPDES SURFACE WATER SAMPLING LOCATIONS AT THE WELDON SPRING CHEMICAL PLANT

FIGURE 4-1

REPORT NO.:	DOE/OR/21548-424	COMM NO.:	A/CP/086/0993		
ORIGINATOR:	TW	DRAWN BY:	GLN	DATE:	11/19/96

TABLE 4-2 NPDES Permit MO-0107701 Monitoring Requirements - Sanitary and Storm Water Outfalls

PARAMETERS	UNITS	PERMITTED LIMIT	FREQUENCY
Storm Water Outfalls NP-0002, NP-0003[a], NP-0005 and NP-0010[b]			
Flow	gpd	Monitor	once/month
Settleable Solids	ml/l/hr	1.0	once/month
Total Suspended Solids	mg/l	Monitor[c]	once/month
Nitrate + Nitrite as N	mg/l	Monitor	once/month
Uranium, total	mg/l	Monitor[d]	once/month
Gross Alpha	pCi/l	Monitor	once/month
pH	SU	6-9	once/month
Sewage Treatment Plant Outfall NP-0006			
Flow	gpd	Monitor	once/month
Biochemical Oxygen Demand	mg/l	30/45[e]	once/quarter
Total Suspended Solids	mg/l	30/45[e]	once/quarter
pH	SU	6-9	once/quarter
Fecal Coliform	Colonies/100 ml	400/1,000[f]	once/quarter

(a) The chipped wood storage area basin water may be discharged to outfall NP-0003 if concentrations for copper, zinc, and creosote constituents are below limits as listed in Table 4-3.
(b) Described in permit as outfall 008.
(c) Limit is 50 mg/l if erosion control is not designed for 1 in 10 year, 24 hour storm.
(d) Must notify MDNR if uranium levels exceed 2.0 mg/l (monthly average) or 4.0 mg/l (daily maximum).
(e) Monthly average/weekly average.
(f) Monthly average/daily maximum.

TABLE 4-3 NPDES Permit MO-0107701 and MO-0108987 Monitoring Requirements - Site Water Treatment Plant and Quarry Water Treatment Plant

PARAMETER	PERMIT LIMIT	FREQUENCY	SAMPLE TYPE
Site NP-0007 and Quarry NP-1001			
Flow	Monitor, gpd	once/week*	24-hr total
Chemical Oxygen Demand	90/60 mg/l[a]	once/week*	grab
Total Suspended Solids	50/30 mg/l[a]	once/week*	grab
pH	6-9 standard units	once/week*	grab
Arsenic, Total	0.10 (0.20)** mg/l	once/week*	grab
Chromium, Total	0.10 (0.40)** mg/l	once/week*	grab
Copper, Total: Quarry	1.0 mg/l	once/month	grab
Lead, Total	0.1 (0.20)** mg/l	once/week*	grab
Manganese, Total	0.1 (0.50)** mg/l	once/week*	grab
Mercury, Total	0.004 (0.005)** mg/l	once/week*	grab
Selenium, Total	0.02 (0.05)** mg/l	once/week*	grab
Cyanide, Amenable	0.0075 (0.05)** mg/l	once/week*	grab
2,4-DNT	0.22 (1.1)** µg/l	once/week*	grab
Fluoride, Total	4.0 (12.0)** mg/l	once/week*	grab
Nitrate + Nitrite as N: Site	20 (100)** mg/l	once/week*	grab
Nitrate + Nitrite as N: Quarry	Monitor, mg/l	once/week*	grab
Sulfate as SO_4	500 (1000)** mg/l	once/week*	grab
Chloride	Monitor, mg/l	once/week*	grab
Gross Alpha	Monitor, pCi/l	once/week*	grab
Gross Beta	Monitor, pCi/l	once/week*	grab
Uranium, Total	Monitor, pCi/l[b]	once/week*	grab

TABLE 4-3 NPDES Permit MO-0107701 and MO-0108987 Monitoring Requirements - Site Water Treatment Plant and Quarry Water Treatment Plant (Continued)

PARAMETER	PERMIT LIMIT	FREQUENCY	SAMPLE TYPE
Site NP-0007 and Quarry NP-1001 (Continued...)			
Ra-226	Monitor, pCi/l	once/month	grab
Ra-228	Monitor, pCi/l	once/month	grab
Th-230	Monitor, pCi/l	once/month	grab
Th-232	Monitor, pCi/l	once/month	grab
Priority Pollutants[c]	Monitor, mg/l	once/year	grab
Whole Effluent Toxicity[d]	[e]	once/quarter	grab
Polonium 210: Quarry	Monitor, pCi/l	once/year	grab
Actinium 227: Quarry	Monitor, pCi/l	once/year	grab
Radon: Quarry	Monitor, pCi/l	once/year	grab
Copper: Site	1.0/0.66 mg/l[a]	[h]	grab
Zinc: Site	5.0/3.33 mg/l[a]	[h]	grab
Creosote constituents: Site[f]	2.5 times Q.L[g] 1.5 times Q.L[g][a]	[h]	grab
In-Stream River Sediment SD-4090 and SD-4091 (Sampling locations shown on Figure 4-2)			
Uranium, Total	Monitor, pCi/g	once/year	grab

(a) Daily maximum/monthly average.
(b) Water will not be discharged if greater than 100 pCi/l.
(c) Complete priority pollutant list shown on Table 4-4.
(d) Requires upstream receiving water control sample to be collected from Missouri River at location SW-1011.
(e) No statistical difference observed in mortality observed in the effluent test concentration and the upstream receiving water control at a 95% confidence level.
(f) Includes: acenapthylene, acenaphthene, benzo(a)anthracene, dibenzo(a,h)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, and phenanthrene.
(g) As set by the most recent edition of Standard Methods.
(h) Once per batch or once per week for each batch sampled within a period of 30 days following introduction of CWSA water (which has failed these limits) to the SWTP.

* Equates to once/batch or once/week for continuous flow.
** Limits in parentheses to take effect at outfall NP-0007 the first full quarter after the revision to NPDES Permit MO-0107701 is issued.
Q.L. Quantification level.

TABLE 4-4 NPDES Permit MO-0107701 and MO-0108987 Monitoring Requirements - Priority Pollutant List (Site NP-0007 and Quarry NP-1001)

Acenaphthylene	1,3-dichloropropylene
Acenaphthene	4-chlorophenyl phenyl ether
Acrolein	4-bromophenyl phenyl ether
Acrylonitrile	Bis (2-chloroisopropyl) ether
Benzene	Bis (2-chloroethoxy) methane
Benzidine	Methylene chloride (dichloromethane)
Carbon Tetrachloride (tetrachloromethane)	Methyl chloride (chloromethane)
Chlorobenzene	Methyl bromide (bromomethane)
1,2,4-trichlorobenzene	Bromoform (tribromomethane)
Hexachlorobenzene	Dichlorobromomethane
1,2-dichloroethane	Chlorodibromomethane
1,1,1-trichloroethane	Hexachlorobutadiene
Hexachloroethane	Hexachlorocyclopentadiene
1,1-dichloroethane	Isophorone
1,1,2-trichloroethane	Naphthalene
1,1,2,2-tetrachloroethane	Nitrobenzene
Chloroethane	2-nitrophenol
Bis (2-chloroethyl) ether	4-nitrophenol
2-chloroethylvinyl ether	2,4-dinitrophenol
N-nitrosodi-n-propylamine	4,6-dinitro-o-cresol
Pentachlorophenol	N-nitrosodimethylamine
Phenol	N-nitrosodiphenylamine
Bis (2-ethylhexyl) phthalate	Phenanthrene

TABLE 4-4 NPDES Permit Monitoring Requirements Priority Pollutant List Quarry NP-1001 and Site NP-0007 (Continued)

Butyl benzyl phthalate	dibenzo(a,h)anthracene
Di-n-butyl phthalate	Indeno (1,2,3-cd) pyrene
Di-n-octyl phthalate	Pyrene
Diethyl phthalate	Tetrachloroethylene
Dimethyl phthalate	Toluene
benzo(a)anthracene	Trichloroethylene
Benzo(a)pyrene	Vinyl chloride (chloroethylene)
3,4-benzofluoranthene (benzo(b)fluoranthene)	Aldrin
benzo(k)fluoranthene	Dieldrin
Chrysene	Chlordane
Anthracene	4,4'-DDT
benzo(ghi)perylene	4,4'-DDE
Fluorene	4,4'-DDD
2-chloronaphthalene	Alpha-endosulfan
2,4,6-trichlorophenol	Beta-endosulfan
p-chloro-m-cresol	Endosulfan sulfate
Chloroform (trichloromethane)	Endrin
2-chlorophenol	Endrin aldehyde
1,2-dichlorobenzene	Heptachlor
1,3-dichlorobenzene	Heptachlor epoxide
1,4-dichlorobenzene	Alpha-BHC
3,3'-dichlorobenzidine	Beta-BHC
1,1-dichloroethylene	Gamma-BHC
1,2-trans-dichloroethylene	Delta-BHC
2,4-dichlorophenol	PCB-1242 (Arochlor 1242)
1,2-dichloropropane (1,3-dichloropropane)	PCB-1254 (Arochlor 1254)

TABLE 4-4 NPDES Permit Monitoring Requirements Priority Pollutant List Quarry NP-1001 and Site NP-0007 (Continued)

2,4-dimethylphenol	PCB-1221 (Arochlor 1221)
2,4-dinitrotoluene	PCB 1232 (Arochlor 1232)
2,6-dinitrotoluene	PCB-1248 (Arochlor 1248)
1,2-diphenylhydrazine	PCB-1260 (Arochlor 1260)
Ethylbenzene	PCB-1016 (Arochlor 1016)
Fluoranthene	Toxaphene
Antimony	Arsenic
Beryllium	Cadmium
Chromium	Copper
Lead	Mercury
Nickel	Selenium
Silver	Thallium
Zinc	Cyanide, Total
Phenols, Total	

(HSL) metals, polychlorinated biphenyls (PCBs), Ra-226, Ra-228, and isotopic thorium based on upstream activities.

Outfall NP-0010 will not be monitored for these contaminants because the watershed upstream of NP-0010 has been remediated and is used for storage of clean materials only. Data generated from this NPDES water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values as shown in Appendix E, Table E-3, to determine if the concentrations are "above normal." "Above normal" values are reported to DOE and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

4.1.2.2 NPDES Permit MO-0108987. Permit MO-0108987 applies to treated water discharged from the quarry water treatment plant. The location of the quarry water treatment plant outfall (NP-1001) is shown on Figure 4-2. This permit was originally issued to

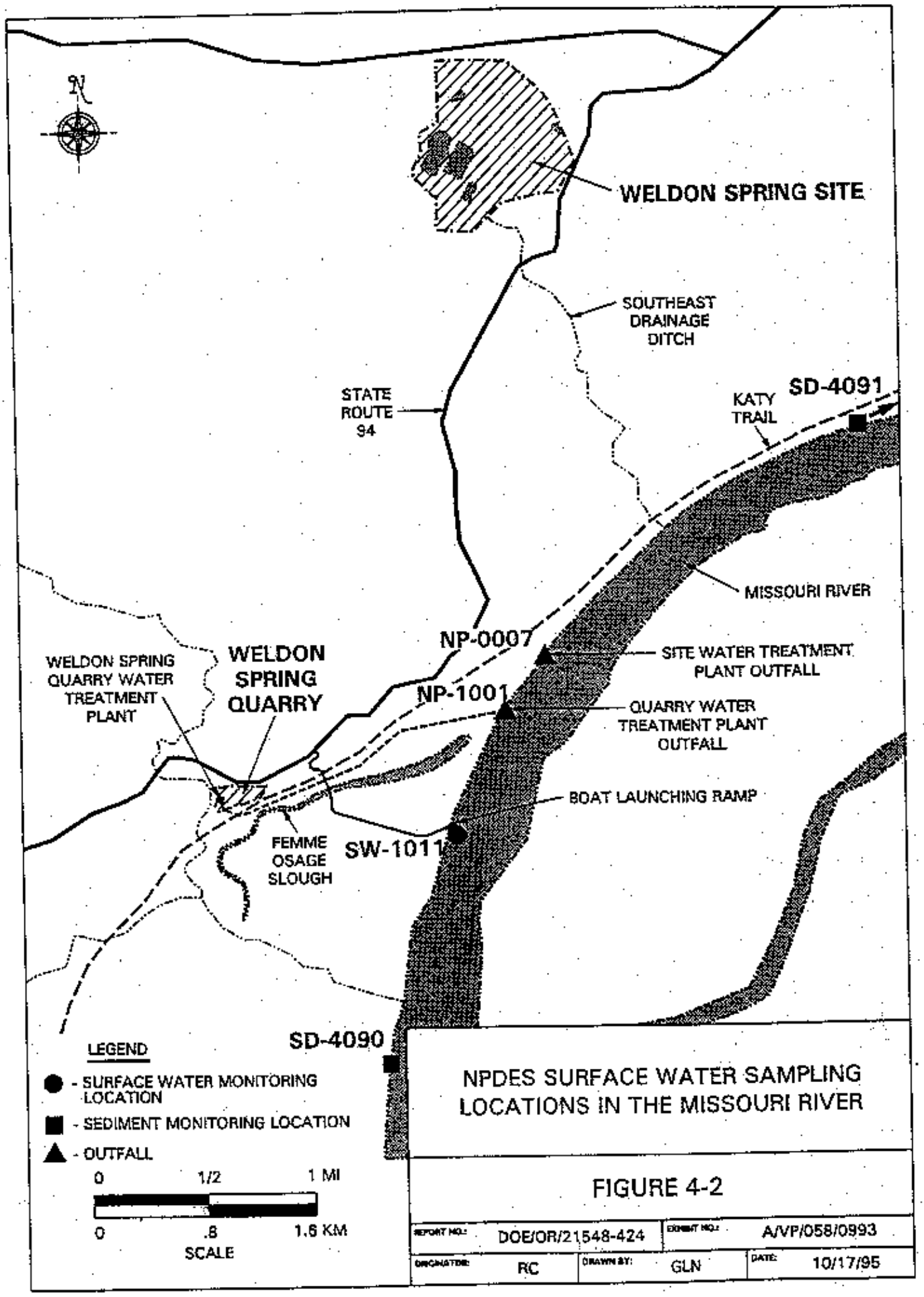
the Department of Energy on May 5, 1989. The permit expired on May 5, 1994, and was reissued on June 10, 1994. The quarry water treatment plant treats water from several sources: (1) quarry pond, (2) storm water, and (3) equipment decontamination and washdown water. Tables 4-3 and 4-4 show permit limits and monitoring requirements for release of treated water from the quarry water treatment plant. This permit requires that sampling results be submitted to the Missouri Department of Natural Resources each calendar quarter in a discharge monitoring report. The report is due by the 28th day of the month following the reporting period.

Data generated from this NPDES water sampling will be reviewed in accordance with Procedure ES&H 1.1.7. The data will be compared to historical data and reference values as shown in Appendix E, Table E-3, to determine if the concentrations are "above normal." "Above normal" values are reported to DOE and other agencies in a timely manner as outlined in Procedure ES&H 1.1.7.

4.1.2.3 NPDES Permit MO-R100869. Permit MO-R100869 was issued on September 1, 1994, and applies to storm water which flows from the borrow area as well as the borrow area haul road. This permit does not specify outfalls, parameters, or frequency of monitoring. However ES&H staff will sample runoff from these areas in accordance with the strategy presented in Table 4-5. Outfalls will be chosen to monitor disturbed areas until they are stabilized. Reporting levels will be self imposed as footnoted in the table.

4.1.3 Upstream Source Identification Needs

Sources of contamination are present upstream of the three main storm water discharges. These main discharges are located at the weir downstream of Frog Pond (NP-0002), the weir downstream of Ash Pond (NP-0003), and the Southeast Drainage weir (NP-0005). Remediation activities above these outfalls during 1996 have removed foundations, contaminated soils, sewers (process, sanitary and storm), etc., and as a result, many upstream sampling locations used in the past have either been removed or now receive runoff from confirmed clean areas.



NPDES SURFACE WATER SAMPLING LOCATIONS IN THE MISSOURI RIVER

FIGURE 4-2

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/058/0993
ORIGINATOR:	RC	DRAWN BY:	GLN
		DATE:	10/17/95

TABLE 4-5 NPDES Permit MO-R100869, Monitoring Plan for Borrow Area and Borrow Area Haul Road Land Disturbance Storm Water

PARAMETER	PERMIT LIMIT	FREQUENCY	SAMPLE TYPE
Settleable Solids	2.5 ml/l/hr[a]	once/quarter	grab
Oil and Grease[b]	10 mg/l[a]	once/quarter	grab

(a) This is not an effluent limitation but a self imposed reporting level. If settleable solids exceed 2.5 ml/l/hr or oil and grease exceeds 10 mg/l the Missouri Department of Natural Resources will be informed in the quarterly discharge monitoring report. Concentrations were derived from a previous land disturbance NPDES permit.
(b) At selected locations

Monitoring of upstream facilities is not required by the permit, but since they may be sources for contamination at the outfalls, they will be monitored. Monitoring can also be used to fully understand the effects of remediation efforts on waste characteristics at the permitted outfalls. The results of upstream sampling can then be used to determine ways to reduce contaminant levels at the outfalls to acceptable levels. Also, explanations of violations of permit limits are required by the Missouri Department of Natural Resources when the sampling results vary significantly from the norm, and upstream water analytical data are often needed for these explanations.

Four upstream locations have been identified for monthly water monitoring. This monitoring will take place at the same time the monthly NPDES sample is collected so that a direct comparison can be made. The discharges from Frog Pond (SW-2011) and sedimentation basin No. 1 (SW-2019) will be sampled in conjunction with Outfall NP-0002, and the discharge from Ash Pond (SW-2010) and the diversion channel above sedimentation basin No. 4 (SW-2017) will be sampled in conjunction with Outfall NP-0003 (Table 4-6). These locations are shown in Figure 4-1. Sample parameters will be total uranium analyzed using the site kinetic phosphorescent analyzer (KPA). If there is no flow at the upstream locations during NPDES sampling, no sample will be collected for that month. As site conditions change, additional parameters may be monitored at these locations on a case-by-case basis. Other sample locations may also be selected on a case-by-case basis and the water will be analyzed for uranium using the site KPA.

TABLE 4-6 Upstream Monitoring in Conjunction with NPDES Monitoring at NP-0002 and NP-0003

UPSTREAM SAMPLING LOCATIONS: FROG POND, (SW-2011), ASH POND, (SW-2010), AND ASH POND DIVERSION CHANNEL (SW-2017), SEDIMENTATION BASIN NO. 1 (SW-2019)		
PARAMETERS	**UNITS**	**FREQUENCY**
Flow	gpd	Once per month during collection of NPDES samples
Uranium, total	pCi/l	Once per month during collection of NPDES samples. Analysis on site KPA.

4.1.4 Additional Storm Water Requirements and Needs

4.1.4.1 Current Erosion and Sediment Control Requirements. Permits for both the site and quarry do not normally place limitations on total suspended solids; however, if runoff from material storage and construction areas is not treated in a facility that is designed, constructed, and operated to treat the volume of water associated with a 10-year, 24-hour rainfall event, limits are placed on total suspended solids. The total suspended solids must not exceed 50 mg/l, at the outfalls. This condition also requires a limit of 6.0 to 9.0 for pH but a pH limit is imposed at the outfall under all conditions. Additionally, limits for settleable solids are 1.0 ml/l/hour at the storm water outfalls. The *WSSRAP Chemical Plant Surface Water and Erosion Control Report* (Ref. 19) and Procedure ES&H 4.2.1, *Erosion Control Survey*, ensure that erosion control measures are designed and maintained to control erosion for a 1 in 10 year 24-hour storm.

Most storm water at the chemical plant site is managed in a network of retention basins and sedimentation basins before it flows from the site at the storm water outfalls. The sedimentation basins act to reduce solids levels in the storm water and the retention basins will allow for testing of waters from certain areas (if required) to determine the appropriate management strategy (i.e., treatment at the site water treatment plant or release through outfalls). In addition, periodic off-site stream inspections may be conducted to assess the effectiveness of on-site erosion controls. Total suspended solids, settleable solids, and pH measurements from the permitted outfalls are reported to the Missouri Department of Natural Resources in the regular *Discharge Monitoring Report*.

4.1.4.2 Material Staging Area Pond and Ash Pond Monitoring. Surface water location SW-2015, the material staging area basin, was added to the environmental monitoring schedule in order to determine the contaminant levels in runoff produced from precipitation falling on materials at the staging area and collected in a holding basin. This impoundment is pumped periodically into the Ash Pond diversion channel, which ultimately discharges into Busch Lake 35. This location will be monitored for total uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, PAHs, As, Cr, Tl, Pb, PCBs, 2,4-DNT, and 2,4,6-TNT on a quarterly basis. Monitoring may be modified based on site activity and/or previous sampling results.

Surface water location SW-2010, Ash Pond, was added to the environmental monitoring schedule to determine the contaminants in the pond water produced from storm water runoff from the pond watershed which contains the contaminated soil storage area. Ash Pond discharges to Outfall NP-0003 and ultimately to Busch Lake 35. This location will be monitored for total uranium, Ra-226, Ra-228, Th-228, Th-230, Th-232, 2,4,6-TNT, 2,4-DNT, PCBs, PAHs, As, Cr, Pb, and Tl on a quarterly basis. Monitoring frequency may be modified based on site activity and/or previous sampling results.

4.1.4.3 Retained Storm Water Monitoring. Storm water that is retained in excavations, trenches, tanks, barrels, secondary containment, retention basins, etc. is managed in accordance with the *Surface Water Management Plan* (Ref. 20) and the surface water management procedure. These documents require that Project Management Contractor (PMC) personnel determine, using site characterization data and process knowledge, whether or not the retained storm water is to be sampled, and if sampled, for which parameters. The procedure specifies criteria to be used to determine if the retained storm water may be released to the surface or must be treated before release.

4.1.4.4 Emergency Monitoring. In the event of accidental releases or spills, samples will be collected just downstream of the release or spill and at the affected NPDES outfall. Parameters will be selected based on the nature of the event.

4.2 Airborne Effluent and Environmental Surveillance Program

This section documents the rationale and requirements of the programs that will be implemented to monitor airborne emissions from the WSSRAP and to evaluate the impacts of

those emissions on the public and the environment. The two diffuse sources of airborne radiological emissions at the WSSRAP are the chemical plant and the quarry. The WSSRAP currently has the following point sources: the site water treatment plants (Trains 1 and 2), and the quarry water treatment plant. Emissions from these sources and the estimated exposures are predicted to be low. The emissions monitoring program is tailored to a low potential for exposure and to meet the requirements of Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide* (Ref. 4).

4.2.1 Source Assessment

As required by Department of Energy guidance, an assessment of the sources was conducted. The assessment included documenting the different radionuclides that could be released from the sources and their concentrations. In addition, the assessment addressed the factors that could contribute to the resuspension of contaminants. The assessment provided a basis for the airborne emissions monitoring program and enabled the design to provide timely, representative, and adequately sensitive monitoring results. The Department of Energy guidance also requires that these sources be assessed under normal operating conditions with loss of emission controls. The loss of emission controls for the diffuse sources at the WSSRAP would require the affected remediation activities to halt. Loss of emission controls used at the WSSRAP, such as water spray, surface cleaning, and high efficiency particulate air (HEPA) filtration would be immediately noticed; therefore, remediation activities would be immediately halted and there would be no resultant increase in air emissions.

4.2.1.1 Point Source Assessment. The point sources at the WSSRAP include site water treatment plant Train 1 and quarry water treatment plant filter press ventilation system exhaust vents, and the site water treatment plant Train 2 distillate tank vent.

The site water treatment plant Train 1 treats contaminated water from the raffinate pits, and other sources while the quarry water treatment plant treats quarry sump water. Filter press operation at both plants is a potential source of emissions. The filter presses are isolated in rooms that are ventilated through HEPA filters. Engineering calculations and *Clear Air Act* Assessment Package - 1988 (CAP-88 PC) modeling results show that the exhaust vents from either of the treatment plant filter press room ventilation systems will not produce an annual dose equivalent greater than 0.1 mrem to any member of the public.

The site water treatment plant Train 2 treats water in Raffinate Pits 1 and 3 that contains nitrates. The plant uses a vapor compression distillation system. Because the vapor compression distillation system is closed to the atmosphere, the potential for air particulate emissions is insignificant. The distillate tank is vented through a carbon radon absorber system that has the capability for in-place regeneration. Engineering calculations and Industrial Source Complex Short Term, Version 2 (ISCST2) modeling results show that uncontrolled radon emissions would not produce an annual dose greater than 0.1 mrem to any member of the public.

4.2.1.2 Weldon Spring Quarry Diffuse Source Assessment. The Weldon Spring Quarry is a 3.6 ha (9-acre) limestone quarry located approximately 6.4 km (4 miles) south-southwest of the chemical plant area. The quarry is essentially in a closed basin; surface water within the rim flows to the quarry floor and into a pond that covers approximately 0.2 ha (0.5 acre). The quarry was used as a disposal area for DNT and TNT process wastes; uranium, radium, and thorium residues; the associated daughter products from on-site and off-site processing of uranium and thorium; and building rubble and soils from the demolition of a uranium processing facility in St. Louis, Missouri.

In August 1993, a major remediation project involving the removal and controlled temporary storage of approximately 110,000 m^3 (144,000 cu yd) of contaminated bulk wastes began. The bulk wastes excavated from the quarry have significant levels of radiological contamination. Engineering controls were implemented during removal to restrict the release of airborne particulates from the quarry. The bulk waste removal was completed in 1995. Residual radioactive contamination remains at the quarry and could potentially be a source of airborne particulates.

4.2.1.3 Weldon Spring Chemical Plant and Raffinate Pits Diffuse Source Assessment. The Weldon Spring Chemical Plant and raffinate pits diffuse source encompasses 87 ha (217 acres) on which the Ash Pond storage area, four raffinate pits, the temporary storage area (TSA), and the material staging area are located. Airborne emissions from the site chemical plant result from windblown resuspension of radioactive particulates from site soils and chemical plant building material/debris, and resuspension of radioactive particulates from site operations such as raffinate sludge consolidation and soil excavation. In addition, there are

airborne emissions from the chemical plant due to the transformation of Ra-224 and Ra-226 (progeny of Th-232 and U-238), into Rn-220 (thoron gas) and Rn-222 (radon gas).

Characterization of the buildings and soils was completed in support of the site remedial investigation and feasibility study. Radiological contaminants in the buildings were uranium, thorium, and their progeny. Concentrations in bulk samples collected from the buildings range from background levels to 20,000 pCi/g U-238, 190 pCi/g Ra-226, 5,400 pCi/g Ra-228, and 540 pCi/g Th-230. Particle analysis and a lung solubility study was conducted using materials from the chemical plant. Bulk samples from process buildings and the raffinate pits were collected for the study.

This data allows for a more accurate assessment of dose equivalents resulting from an inhalation uptake. The buildings were dismantled and the materials were placed at the material staging area (MSA). The building materials placed at the MSA were either washed, wet wiped, and/or HEPA vacuumed to minimize removable contamination. This was done to minimize migration of contaminants via air and precipitation.

The site soils characterization indicated that the contaminants in the soils are uranium and thorium and their associated progeny. Most of the 87 ha (217 acres) of the chemical plant site have above background concentrations of uranium (>1 pCi/g). Radionuclide concentrations range from 0.3 to 2,259 pCi/g U-238, 0.2 to 452 pCi/g Ra-226, 0.1 to 155 pCi/g Ra-228 and 0.3 to 123 pCi/g Th-230.

Foundations and sewer removal work was initiated in 1996 and is scheduled to be completed in August 1997. Action levels have been established for airborne radioactive particulate concentrations in the immediate work zone. Dust control measures will include the use of water and possibly foam.

Raffinate Pit 4 debris removal should be completed in 1996 and raffinate sludge consolidation is scheduled for completion during the summer of 1997. These efforts consist of dewatering Raffinate Pit 4, removing the debris (i.e., equipment and drums) and placing it in interim storage, and consolidating the sludges using land based equipment in the southern portion of Raffinate Pit 4. Characterization of Raffinate Pit 4 sludges indicated an average concentration

of 570 pCi/g U-238, 2,500 pCi/g Th-230, 72 pCi/g Ra-226, 320 pCi/g Th-232, 230 pCi/g Ra-228, and 300 pCi/g Th-228 (Ref. 21).

As mentioned in Subsection 4.2.1.2, placement of the quarry bulk waste at the temporary storage area was completed in 1995. Engineering controls such as the use of water to control airborne particulate emissions were used. Radon gas emissions at the temporary storage area due to the higher radium concentrations in the bulk waste have been minimized through the use of an attenuating soil cover. In the *Feasibility Study for Management of the Bulk Waste at the Weldon Spring Quarry* (Ref. 6), a dose estimate for airborne emissions from the bulk waste at the temporary storage area was calculated. In the study, a dose estimate was calculated for a worker in an on-site office building and a student at Francis Howell High School. The calculated dose to the office worker was 0.08 mrem from radon, and 0.84 mrem from radioactive particulates for a total of 0.92 mrem. The calculated dose for the student was 0.05 mrem from radon, and 0.05 mrem from radioactive airborne particulates for a total of 0.1 mrem.

Action levels have been established for airborne radioactive particulate concentration levels, radon concentrations, and total dust concentrations. These action levels are aimed at controlling emissions to levels that are as low as reasonably achievable (ALARA), and are discussed in detail in Section 4.2.2.

4.2.2 Airborne Monitoring Programs

To effectively monitor the diffuse sources present at WSSRAP, three air monitoring programs will be utilized: site specific monitoring, perimeter monitoring, and critical receptor monitoring. These three programs are designed to meet the requirements for airborne effluent monitoring and environmental surveillance as specified in the *Regulatory Guide* (Ref. 4) and Department of Energy Orders 5400.1 and 5400.5.

Changes to the air monitoring program include the addition of several modified alpha track radon detectors at the site and at the Francis Howell High School (FHHS). The modified detectors are used to differentiate Radon-222 and Radon-220 (thoron) concentrations. In addition, continuous radon gas and daughter monitoring will be periodically performed during work activities, which could result in elevated radon releases and potential exposures. In

addition to electret and alpha track radon monitoring, continuous radon monitoring may be performed at the FHHS. With the completion of quarry bulk waste removal, the radioactive airborne particulate, radon, and asbestos monitoring will be reduced at the quarry.

Locations, equipment, sampling time, minimum detection levels, accuracy, and investigation levels are discussed in the site specific, site perimeter, and critical receptor monitoring program sections of this plan. Sample location heights, proximity to obstructions, and linear flow rates are also discussed in the individual monitoring program sections.

4.2.2.1 Site Specific Monitoring Program. As mentioned in the chemical plant site source assessment, the large diffuse source is made up of a number of smaller diffuse sources that include wind blown resuspension of radioactive particulates from contaminated soils and resuspension of radioactive particulates due to site remediation activities such as raffinate sludge consolidation, dredging, dewatering, consolidation of sludge and storage of bulk waste at the TSA, and excavation of soils and radon emissions from raffinate pits. Although there is potential for resuspension of radioactive particulates due to natural meteorological occurrences, it is much less than the potential for resuspension due to site remediation activities. In order to assess the contribution of site remediation activities to the total airborne emissions from the chemical plant, site specific monitoring will be utilized. Site specific monitoring will use mobile air particulate samplers and total dust monitors to measure the airborne radioactive particulate and dust concentrations. Radon/thoron gas and progeny monitors will be used to measure radon gas and progeny concentrations.

Site specific monitoring, in addition to providing data concerning the contribution of specific activities to the total airborne inventory, will provide faster feedback concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific air particulate monitors will be collected on a daily basis as compared to weekly for the perimeter samplers. The total dust monitors will provide instantaneous airborne dust concentrations. The continuous radon gas and progeny monitors are capable of hourly measurements. Electret radon gas monitors may be used for short term measurements of 2 days to 14 days and are dependent, depending on the radon concentration.

Air particulate samplers may be placed at the work zone perimeters. The number of samplers used will be commensurate with the potential for above background emissions. In

addition, a group of site specific samplers may be used to monitor separate work activities that are in relatively close proximity to one another. This will facilitate more efficient use of site specific samplers and maintain air monitoring coverage for all the activities. Total dust measurements will be taken within the work zones as needed to measure total dust concentrations. Radon/thoron gas and progeny measurements will also be collected within the work zones when there is a significant potential for elevated concentrations.

When possible, the air particulate samplers will be placed in areas that are free from obstructions or conditions that could effect the air sampling results. The air particulate samplers are usually placed twice the distance from an obstruction or structure as the obstruction or structure is high (i.e., an air sampler would be placed 3 m [10 ft] from a 1.5 m [5 ft] tall tree). In addition, the samplers will not be placed, if possible, in areas that have turbulent air conditions, such as nearby busy roads or active equipment. Total dust monitors will be used as needed to perform instantaneous checks of total airborne dust concentrations during work activities to confirm that engineering controls and good work practices are effective.

Equipment that will be used for site specific air particulate sampling includes a portable air particulate sampler with a filter holder and a vacuum pump, a rotameter, a filter, a portable power supply, and an air sampler stand. Equipment used for site specific total dust measurements includes a total dust monitor and data logger. Equipment used for the radon gas and progeny measurements includes continuous radon gas and progeny monitors, electret chambers, alpha track monitors, associated weather housings, dessicant gas drier, data printer, and an electret voltage reader.

The portable air samplers that will be used for site specific air particulate sampling are low volume, carbon vane, oilless vacuum pumps. The low volume pumps generally operate at approximately 40 l/minute (1.4 cu ft/minute). The linear flow rate for the low volume air samplers (volume sampled per unit time divided by the filter area) is approximately 23 m/minute (7 ft/minute). The total dust monitors that will be used are self-contained aerosol monitors whose sensing principle is based on the detection of scattered electromagnetic radiation in the near infrared range.

The continuous radon progeny monitors (Figures 4-3 and 4-4) will be portable, fully automated instruments capable of continuously monitoring for radon and thoron daughters. The

radon progeny monitors use a silicon barrier diode detector to detect radon and thoron daughters that are deposited on a membrane filter with a 0.45 μm pore size. The continuous radon progeny monitors will have internal data storage capabilities. The data can be retrieved through a portable printer or obtained from computer's data storage. The sensitivities of the continuous radon progeny monitors are 1.0 mWL. The accuracy for the continuous radon progeny monitors is within $\pm$10% of the measured concentration. The continuous progeny monitors will be calibrated annually and operated in accordance with the applicable standard operating procedures.

The continuous radon gas monitor is a portable, fully automated instrument capable of continuously monitoring for radon and thoron. It has an internal cell of 0.7 liter hemisphere, coated on the inside with an electrical conductor. A solid-state alpha detector is placed at the center of the hemisphere. The high voltage, therefore, creates an electrical field in order to detect the radon/thoron gas. The continuous radon monitor has internal data storage capabilities. The data will be retrieved through a portable printer automatically or obtained from the computers' data storage. The sensitivities of the continuous radon gas monitors will be 0.1 pCi/l and 1.0 mWL. The accuracy for the continuous radon monitors is within $\pm$10% of the measured concentration. The continuous radon gas monitors will be calibrated annually and operated in accordance with applicable standard operating procedures.

A rotameter, calibrated to National Institute of Standards and Testing (NIST) specifications, is used to set beginning flow rates for the portable air particulate samples and to measure ending flow rates for each sampling period. Monitor flow rates can change due to filter dust loading or ambient temperature changes. If the ending flow rate change is greater than $\pm$20% of the beginning flow rate, the flow meter will be evaluated to determine if service is required. The data will be flagged and flow rate change noted when the data is reported.

The portable air particulate sampler pumps will not be leak-tested because the flow rate is determined by placing a rotameter in the line between the filter assembly and the pump. Pump leakage will not affect the flow reading, which is made on the air passing through the filter to the pump. In addition, the *Regulatory Guide* (Ref. 4) and Environmental Protection Agency Methods 5 and 17, for measurement of airborne particulates, specify that the filter head assemblies need only to be designed and inspected to minimize leakage around the filter.

The filters that will be used for low-volume samplers are a membrane of mixed cellulose esters which has a high collective efficiency and minimum alpha burial loss. These filters have a pore size of 0.8 μm and are 47 mm (1.85 in.) in diameter and the filter media retains 99.98% of dioctylphthalate particles with an aerodynamic mean diameter of 0.3 μm at 32 l/minute (1.1 cu ft/minute) across a surface area of 100 cm^2 (15.2 $in.^2$). The samplers will be placed on portable stands at a height of approximately 0.8 m (2.5 ft) off the ground. The air samplers will be placed at 0.8 m (2.5 ft) rather than 1.5 m (5 ft), as specified by the Environmental Protection Agency, due to the weight of the pumps and the safety problems that would be brought about by placing the pumps 1.5 m (5 ft) off the ground. The 1.5 m (5 ft) height would require personnel to lift the pumps, which are relatively heavy and will be moved frequently, above their heads. In addition, the stands would have a high center of gravity, making them susceptible to tipping in strong winds. Due to the proximity of the portable monitors to the work area, placement of the monitors at a lower height would provide conservative measurement of fugitive dust and any subsequent dose assessments.

There is limited electrical service in the controlled area of the chemical plant where the portable air samplers will generally be used; therefore, portable generators will primarily be used to power the air samplers.

The minimum detectable concentration that will typically be achieved during site-specific monitoring is approximately 5.0E-14 μCi/ml. Because work activities may not always have a duration long enough to collect a large sample volume, a sample minimum detectable concentration may be higher than the typical minimum detectable concentration of 5.0E-14 μCi/ml. Whenever possible, a large sample volume will be collected in order to reduce the minimum detectable concentration.

At one standard deviation, the total typical uncertainty associated with a site specific air particulate sample at a concentration of 2.4E-14 μCi/ml is approximately 8E-15 μCi/ml. The total sample uncertainty is dependent on the uncertainty associated with a number of sources, which include the volume sampled, detector calibration, efficiency, background count rate, and sample count rate.

After samples are collected, the filters will typically be stored for a minimum of five working days before they are counted to allow for decay of the short-lived radon and thoron

decay products. The activity of the samples will then be counted on an alpha-scintillation detector or a gas-flow proportional counter. The counting times will generally be 60 minutes. Since detection sensitivity increases as counting times increase, counting times may be longer to achieve a lower minimum detectable concentration.

Quality control procedures that will be implemented as part of the site-specific monitoring program include the calibration of instruments, source and background counts, recounts of samples, review of documentation, and use of standard operating procedures (SOPs). The quality control procedures are intended to check the accuracy and validity of the data.

Calibration will be required for the alpha-scintillation and gas-flow proportional detectors and the rotameters. The alpha-scintillation detector will be calibrated a minimum of every 6 months using NIST traceable radioactive sources in accordance with applicable SOPs. The gas-flow proportional counter will be calibrated when repairs are made to the detector or if daily checking of the detector indicates that the instrument requires calibration. Calibration will be in accordance with applicable SOPs. The rotameter will be calibrated on an annual basis to NIST specifications using the BIOS International Dry Calibration technique. The total dust monitors will be reference checked with a NIST traceable reference scattering standard prior to each use.

Daily source and background counts will be made on the alpha-scintillation and gas-flow proportional detectors in accordance with the applicable SOPs, and these count results will be compared to the calibration results. If daily checks are within three standard deviations when compared to results obtained during calibration, or within control limits as generated by the gas flow proportional software package, the instruments will be put into service. Instruments failing the daily background and/or source check will be taken out of service as described in the applicable WSSRAP standard operating procedure.

At least one in 20 air particulate samples will be recounted and the results compared to the initial count results. The precision between the two sample counts will be calculated and the results kept on file.

A review by an individual other than the sampler of the sample documentation and calculations will be required as part of the quality control procedure. The reviewer will be responsible for ensuring that the documentation is complete and the calculations correct.

4.2.2.2 Site Perimeter Monitoring. A perimeter monitoring program will be in place to monitor airborne emissions from the chemical plant area and the quarry, which encompass soils with above background radionuclide concentrations. The Weldon Spring Chemical Plant perimeter monitoring includes the use of seven radioactive airborne particulate sampler locations, 11 alpha track radon detectors locations, and five electret radon detector locations. The Weldon Spring Quarry perimeter monitoring includes two radioactive airborne particulate sampling locations and two alpha track radon detectors. The 1997 quarry perimeter monitoring represents a decrease of two radioactive airborne particulate monitors and five alpha track radon detectors. The decrease in quarry perimeter monitoring was prompted by the completion of bulk waste removal in 1995 and subsequent monitoring results. The high volume radioactive airborne particulate monitors are discussed in Section 4.2.2.3. The background monitoring station, which includes low and high volume air particulate samplers, a pair of alpha track detectors, and a pair of electrets, is located at Daniel Boone Elementary School in New Melle, Missouri. These locations are summarized in Tables 4-7 and 4-8 and shown on Figures 4-3 through 4-7. In addition, portable air particulate samplers may be deployed depending on the current work activities.

The monitors will be used in conjunction with site specific monitoring to estimate the total airborne emissions. The use of air monitors at the chemical plant and quarry perimeter, in conjunction with site specific monitoring, is the most effective way to monitor airborne emissions from the project.

The sources described in the source assessment are primarily ground sources. Sources such as stacks or vents that release radioactive material at a significant distance above the ground have the highest measured concentrations at ground level some distance from the source. This occurs because it takes time for the material to reach the ground, and as the material falls, it is driven from the source by the wind. Ground sources have the highest concentration measured at the ground level at points closest to the source; therefore, the highest concentrations that leave the chemical plant and quarry are at ground level.

There will be seven permanent radioactive air particulate monitoring stations at the chemical plant site (Figure 4-3). These monitors will generally be equally spaced along the perimeter fence with distances ranging from approximately 76 m to 610 m (250 ft to 2,000 ft). As the site perimeter fence is moved to accommodate remedial activities, any affected perimeter monitoring stations will be repositioned to remain adjacent to the fence line. Because the potential for airborne emissions is low, any airborne emissions that do occur will be intermittent and have low concentrations of radioactive air particulates. Hence, the use of seven perimeter monitoring locations is consistent with the low potential for exposure to the general public.

There will be two permanent perimeter radioactive particulate monitoring stations at the quarry (Figure 4-4). Monitoring station AP-1009 is located on the northeast upper rim. This location historically has indicated the greatest radioactive particulate concentrations. Monitoring station AP-1017 is located south of the quarry water treatment plant and is closest to the Katy Trail hiking and biking trail. This monitoring location will be used to assess potential radiation exposures to users of the trail. Monitoring station AP-1015 may be used if quarry residual remediation activities have the potential for off-site releases of above background radioactive particulates.

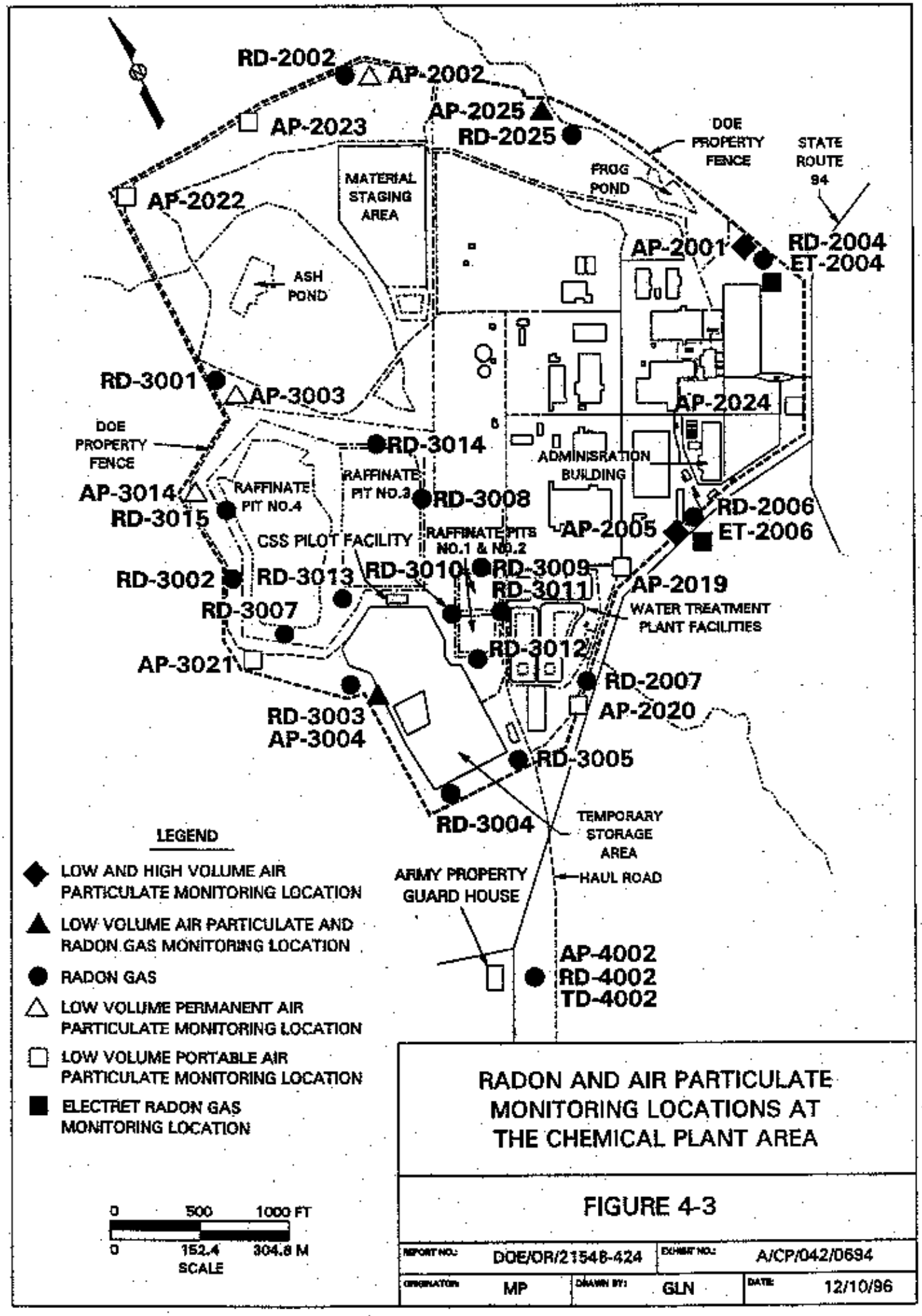
There will be 10 alpha track and five electret radon monitoring stations at the chemical plant site perimeter (Figure 4-3) placed approximately 122 m to 610 m (400 ft to 2,000 ft) apart. Due to the characteristics of the chemical plant diffuse radon source, the density of radon monitoring stations around the perimeter will be commensurate with the potential for causing an exposure from radon to the general public. Remediation of the chemical plant soils is not expected to increase radon concentrations at the site perimeter. The storage of quarry bulk waste at the TSA and the Raffinate Pit 4 debris removal and subsequent sludge consolidation could potentially increase radon and thoron concentrations at the site perimeter. As a result, the perimeter monitoring stations near the temporary storage area and raffinate pits will be closer together. An effective dose equivalent of 0.08 mrem was calculated at the nearest chemical plant critical receptor with the highest potential for an exposure to the general public as a result of radon emission from temporary storage area operation (Ref. 6). Therefore, the 10 alpha track and five electret radon monitoring stations at the chemical plant perimeter will be sufficient to monitor potential radon emissions.

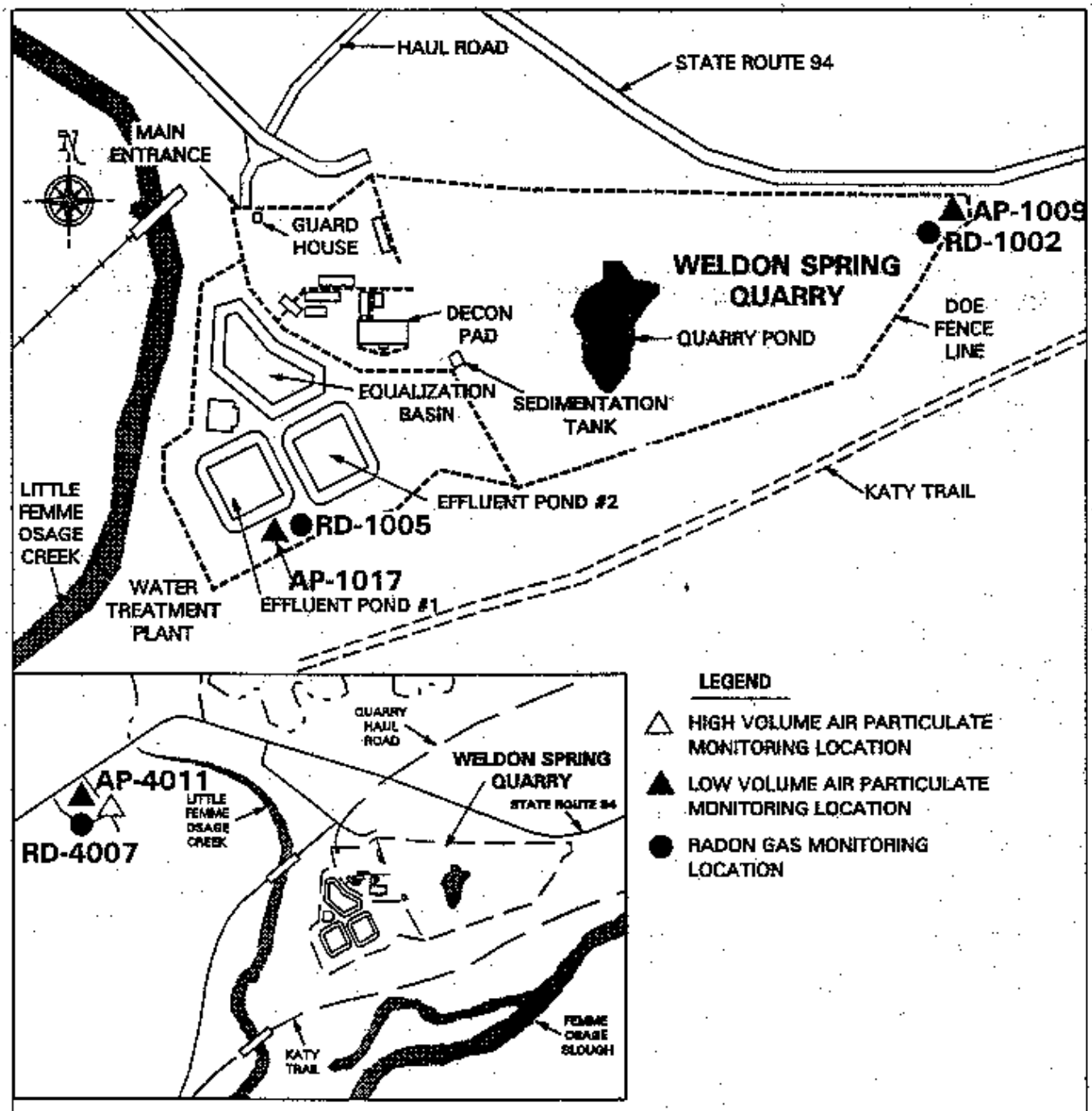
TABLE 4-7 Air Particulate Monitoring Locations

STATION	LOCATION	AIR VOLUME	
		LOW	HIGH
Chemical Plant Area			
AP-2001	Northeast corner of site	Yes	Yes
AP-2002	North perimeter of site	Yes	No
AP-2005	Southeast of Administration Building	Yes	Yes
AP-2025	Gate "C" N.E. perimeter of site	Yes	No
AP-3003	Northwest of Raffinate Pit 4	Yes	No
AP-3004	South of Raffinate Pit 3 and west of TSA	Yes	No
AP-3014	West of Raffinate Pit 4	Yes	No
Quarry Area			
AP-1009	Northeast corner of quarry	Yes	Yes
AP-1017	South of Quarry Water Treatment Plant	Yes	No
Off-Site Critical Receptors			
AP-4006	Francis Howell High School	Yes	Yes
AP-4007	Busch Conservation Area	Yes	Yes
AP-4008	Army Site Guard House	Yes	Yes
AP-4011	Residence West of Quarry	Yes	Yes
Background			
AP-4012	Daniel Boone Elementary School, New Melle	Yes	Yes

TABLE 4-8 Radon Track Etch Monitoring Locations

STATION	LOCATION	STATION	LOCATION
Chemical Plant Area			
RD-2002	North perimeter of site	RD-3005	Southeast of TSA
RD-2004	Northeast perimeter of site, adjacent to Highway Department facility	RD-3008	East side of Raffinate Pit 3
RD-2006	Southeast perimeter adjacent to Administration Building	RD-3009	North side of Raffinate Pit 1
RD-2007	East of Site Water Treatment Plant	RD-3010	West side of Raffinate Pits 1 and 2
RD-2025	North perimeter of site	RD-3007	South side of Raffinate Pit 4
RD-3001	Northwest of Raffinate Pit 4	RD-3011	East side of Raffinate Pits 1 and 2
RD-3002	West of Raffinate Pit 4	RD-3012	South side of Raffinate Pit 2
RD-3003	South of Raffinate Pit 4 and west of TSA	RD-3013	Southeast side of Raffinate Pit 4
RD-3004	South of TSA	RD-3014	North side of Raffinate Pit 3
		RD-3015	North side of Raffinate Pit 4
Quarry Area			
RD-1002	Northeast corner of quarry	RD-1006	West perimeter of quarry proper
RD-1003	South perimeter of quarry	RD-1008	North of Quarry Water Treatment Plant
RD-1004	South perimeter of quarry	RD-1009	North perimeter of quarry
RD-1005	South of Quarry Water Treatment Plant		
Off-Site and Background			
RD-4001	Busch Conservation Area	RD-4005	West of Army site
RD-4002	Army Site Guard House	RD-4007	Residence west of quarry
RD-4003	Francis Howell High School	RD-4009	Daniel Boone Elementary School, New Melle

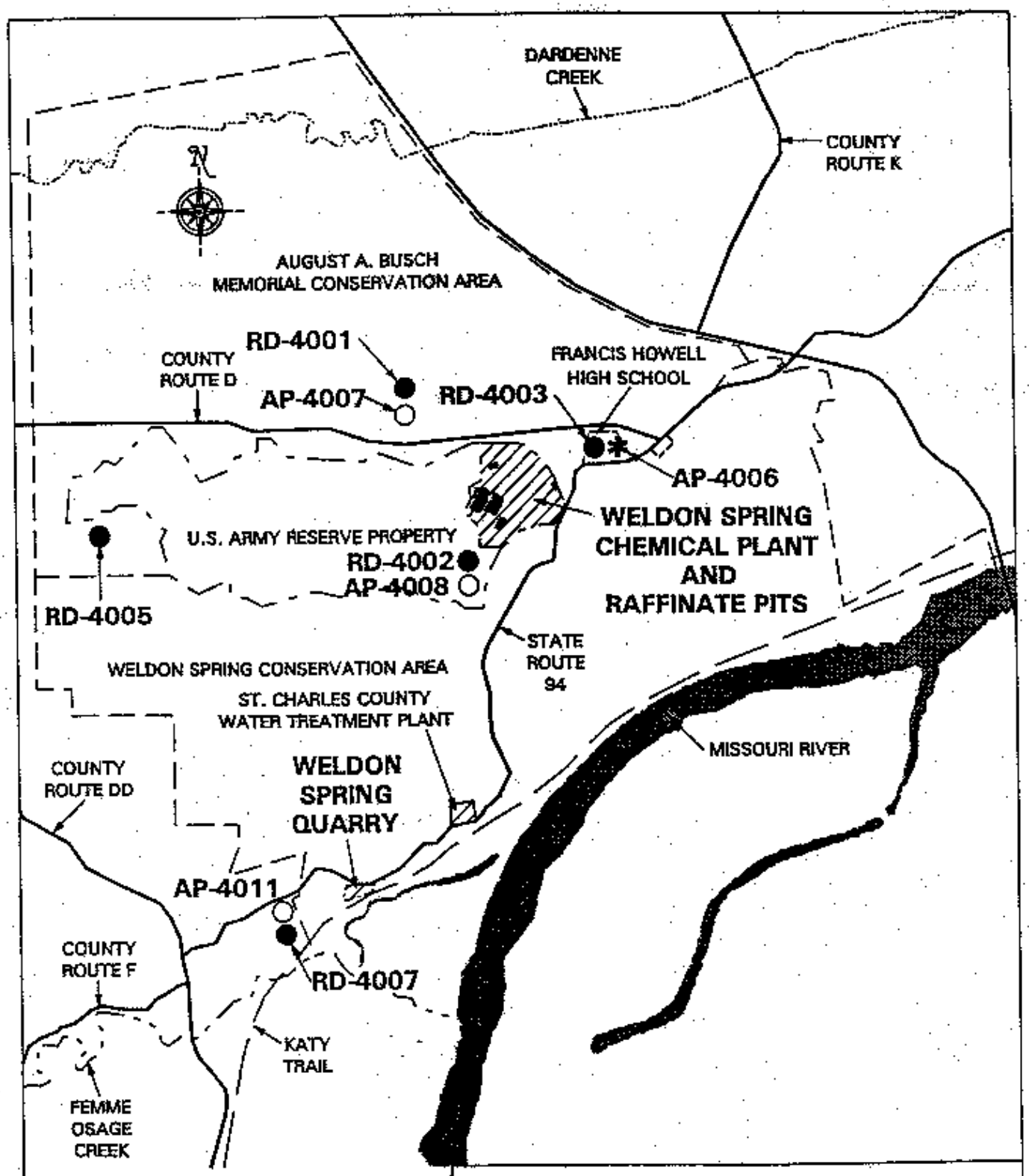

RD-2002
AP-2002
AP-2025
RD-2025
AP-2023
AP-2022
MATERIAL STAGING AREA
DOE PROPERTY FENCE
STATE ROUTE 94
FROG POND
AP-2001
RD-2004
ET-2004
ASH POND
RD-3001
AP-3003
AP-2024
DOE PROPERTY FENCE
RD-3014
ADMINISRATION BUILDING
AP-3014
RAFFINATE PIT NO.4
RAFFINATE PIT NO.3
RD-3008
RD-3015
RD-2006
ET-2006
CSS PILOT FACILITY
RAFFINATE PITS NO.1 & NO.2
AP-2005
RD-3002
RD-3013
RD-3010
RD-3009
RD-3011
AP-2019
RD-3007
WATER TREATMENT PLANT FACILITIES
RD-3012
AP-3021
RD-2007
AP-2020
RD-3003
AP-3004
RD-3005
RD-3004
TEMPORARY STORAGE AREA
ARMY PROPERTY GUARD HOUSE
HAUL ROAD
AP-4002
RD-4002
TD-4002
LEGEND
LOW AND HIGH VOLUME AIR PARTICULATE MONITORING LOCATION
LOW VOLUME AIR PARTICULATE AND RADON GAS MONITORING LOCATION
RADON GAS
LOW VOLUME PERMANENT AIR PARTICULATE MONITORING LOCATION
LOW VOLUME PORTABLE AIR PARTICULATE MONITORING LOCATION
ELECTRET RADON GAS MONITORING LOCATION
0 500 1000 FT
0 152.4 304.8 M
SCALE
RADON AND AIR PARTICULATE MONITORING LOCATIONS AT THE CHEMICAL PLANT AREA
FIGURE 4-3
REPORT NO: DOE/OR/21548-424
EXHIBIT NO: A/CP/042/0694
ORIGINATOR: MP
DRAWN BY: GLN
DATE: 12/10/96



RADON AND AIR PARTICULATE MONITORING LOCATIONS AT THE QUARRY AREA

FIGURE 4-4

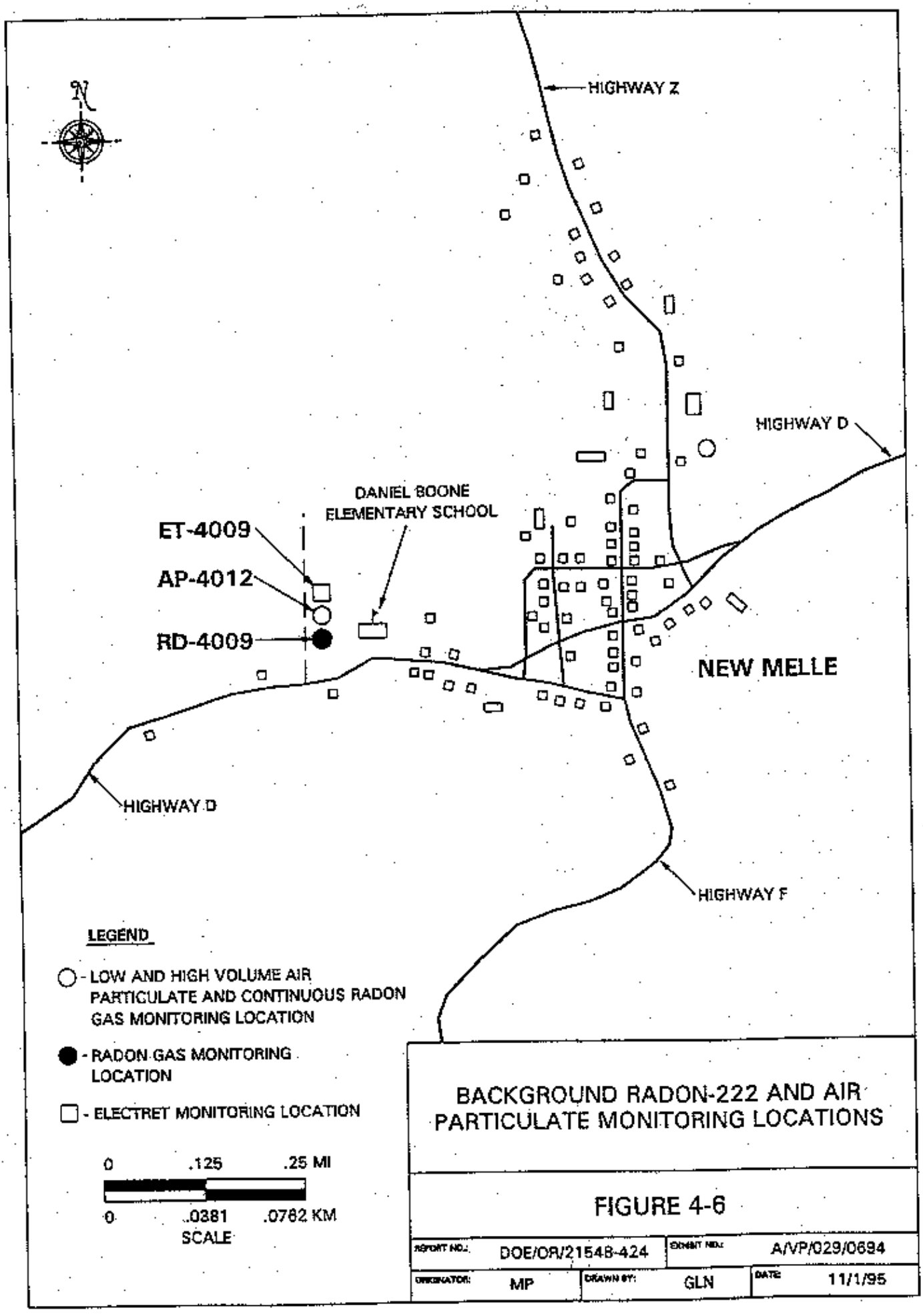
REPORT NO.:	DOE/OR/21548-424	DWNG NO.:	A/QY/046/0694
ORIGINATOR:	MP	DRAWN BY:	GLN
DATE:	12/10/96		



OFF-SITE RADON AND AIR PARTICULATE MONITORING LOCATIONS

FIGURE 4-5

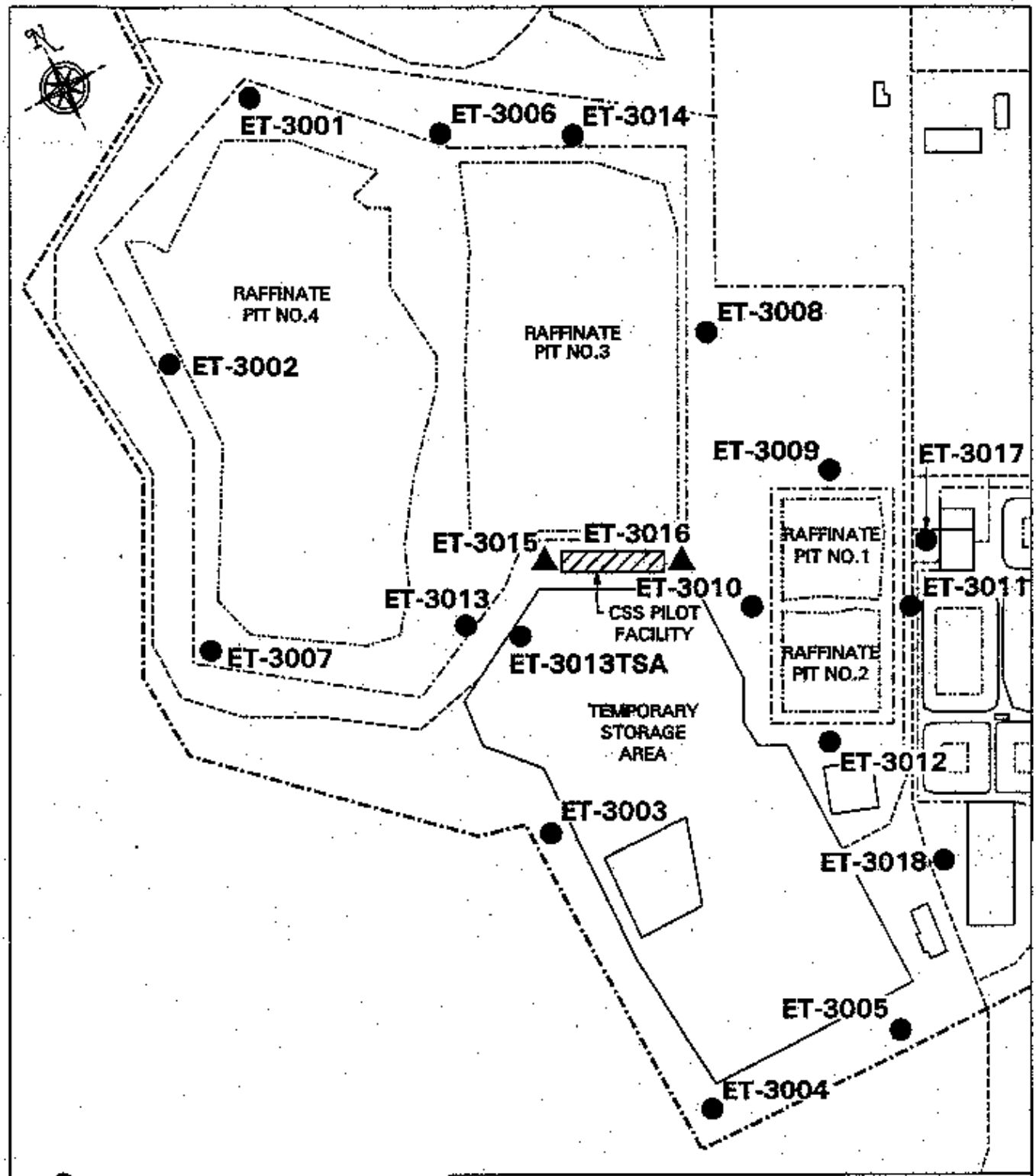
REPORT NO.: DOE/OR/21548-424	EXHIBIT NO.: A/VP/028/0694	
ORIGINATOR: MP	DRAWN BY: GLN	DATE: 11/19/96



BACKGROUND RADON-222 AND AIR PARTICULATE MONITORING LOCATIONS

FIGURE 4-6

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/VP/029/0694		
ORIGINATOR:	MP	DRAWN BY:	GLN	DATE:	11/1/95



● ELECTRET MONITORING LOCATION

▲ ELECTRET, TRACK ETCH RADON DETECTOR, AND/OR GAMMA MONITORING LOCATION

NOT TO SCALE

ELECTRET MONITORING LOCATIONS AT THE WELDON SPRING RAFFINATE PIT AREA

FIGURE 4-7

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/RP/010/0694
ORIGINATOR:	MP	DRAWN BY:	GLN
DATE:	12/10/96		

Nine alpha track and 13 electret radon monitoring stations will be placed around the perimeters of the raffinate pits to measure radon and/or thoron levels during future remediation activities and dredging activities. Four alpha track and four electret monitors will be placed around Raffinate Pits 1 and 2, and five alpha track and nine electret monitors will be placed around Raffinate Pits 3 and 4 (Figure 4-3 and 4-7). These monitors will be placed approximately 60 m to 367 m (200 ft to 1,200 ft) apart.

There will be two alpha track radon monitoring stations RD-1002 and RD-1005, on the quarry perimeter (Figures 4-4 and 4-8). Monitoring location RD-1002 is located on the northeast perimeter of the quarry and historically has indicated the greatest radon concentrations at the quarry perimeter. Monitoring location RD-1005 is located south of the quarry water treatment plant and will be used to assess exposures to users of the Katy Trail. Due to the completion of quarry bulk waste removal, the radon source material has been virtually eliminated. Therefore, the two alpha track radon monitoring stations at the quarry perimeter will be sufficient to monitor potential radon emissions.

The number of radioactive air particulate and radon monitoring stations at the chemical plant and quarry is in proportion to the potential for emissions from the sources. In addition, the use of site specific monitoring will allow monitors to be placed such that the density of monitors will be increased during activities with higher potential for airborne emissions.

Equipment for the site and quarry perimeter monitoring program includes low-volume air-particulate samplers, a rotameter, scintillation detectors, a gas-flow proportional detector, filters, and alpha-track and electret radon detectors.

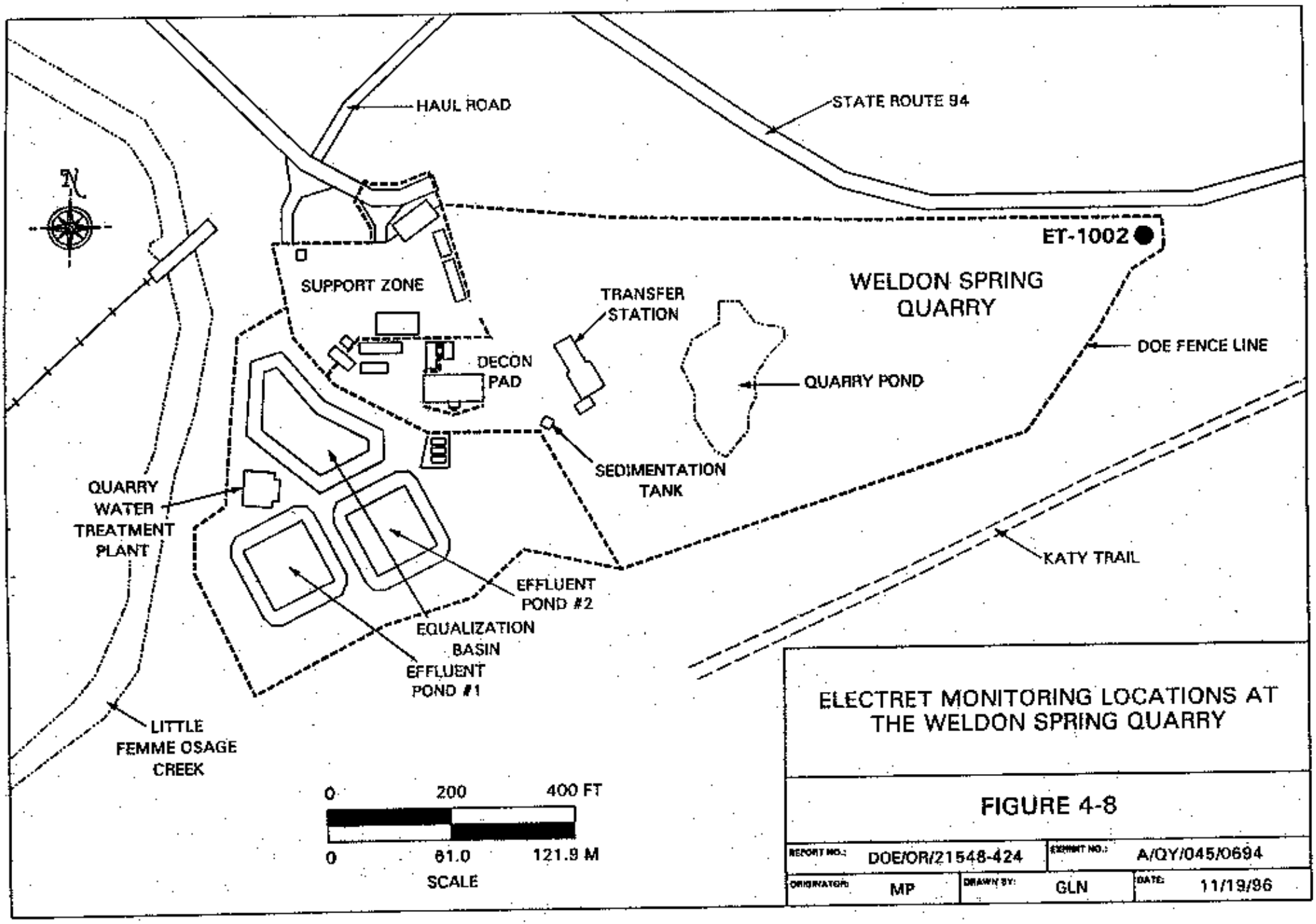
The low-volume, air-particulate samplers at the chemical plant and quarry site perimeter locations are self-adjusting, carbon-vane, oilless air pumps. Each permanent sampler will be mounted in a weather-protective housing with a 110 volt outlet. Each temporary sampler will be mounted on a wheeled platform inside a protective housing. The samplers will have hour meters to document the operational period, and regulators to maintain a constant flow.

The alpha track monitors are made of a plastic material and monitor both radon and thoron gas. The principle of radon/thoron detection is based on the production of damage tracks in the plastic from passage of alpha particles from radon/thoron decays. The track density is

determined by manual or automated scanning and is proportional to the integrated exposure. Processing and exposure determination are provided by the vendor. The radon alpha track detectors have a minimum sensitivity of 0.2 pCi/l. The uncertainty of one standard deviation from the mean for the radon alpha track detectors is ±25% of the measured concentration. The detectors will be placed in pairs of each of the locations, and will be exchanged on a quarterly basis. Modified alpha track detectors may also be used. These detectors, which filter out Rn-220 (thoron), will be placed adjacent to the alpha track radon detectors to distinguish radon and thoron.

The electret radon and thoron detectors operate by a filtered diffusion of ambient air into an electrically conducting plastic chamber where decay generates ions that are collected by the charged electret. The change in electret charge is measured after the monitoring period with a voltage reader. The surface charge of the electret is reduced proportionately during the monitoring period with the integrated radon/thoron concentration. Typically the electrets are deployed in pairs for a minimum of 14 days at an uncertainty of ±25%. The minimum sensitivity for a 14 day exposure is approximately 0.4 pCi/l.

A rotameter is used to set and measure low-volume, air particulate samples. The low-volume air particulate samplers will be run continuously at a flow rate of approximately 40 l/minute (1.4 cu ft/minute) with weekly filter replacement. Prior to changing the filter each week, the flow rate will be measured. After the filter is changed, the flow rate will be adjusted as needed to 40 l/minute (1.4 cu ft/minute). The starting flow rate of 40 l/minute (1.4 cu ft/minute) will then be averaged with the ending flow rate, and the average flow rate used to calculate the total volume of air sampled. If the flow rate changes by ±20% during the sampling period, the monitor will be evaluated to determine if service is required. The data will be flagged and the change in flow rate noted when the data is reported. The linear flow rate for the perimeter low volume air particulate samplers will be approximately 23 m/minute (75.4 ft/minute) at 40 l/minute (1.4 cu ft/minute). The site perimeter airborne particulate samplers will not be leak tested because the flow rate will be determined by placing a mass flow meter in line between the filter assembly and the pump, and the flow reading is made only on the air passing through the filter to the pump. Therefore, it will not be effected by pump leakage.



ELECTRET MONITORING LOCATIONS AT THE WELDON SPRING QUARRY

FIGURE 4-8

REPORT NO.:	DOE/OR/21548-424	EXHIBIT NO.:	A/QY/045/0694
ORIGINATOR:	MP	DRAWN BY:	GLN
DATE:	11/19/96		

The filters used to monitor the site perimeter will be the same mixed-cellulose ester filters used for site-specific monitoring. These filters are 47 mm (1.85 in.) in diameter, have a pore size of 0.8 μm and retain 99.98% of dioctylphthalate particles with an aerodynamic mean diameter of 0.3 μm.

The perimeter air particulate samplers and the electret radon detectors will be placed at approximately 1.5 m (5 ft) above the ground. The alpha track radon detectors and the continuous radon progeny monitors will be placed above the ground approximately 2 m (6.25 ft) and 1 m (3.2 ft), respectively. With the exception of the monitors at the quarry perimeter, samplers, detectors, and monitors will be placed away from unusual localized effects or other conditions (e.g., large buildings, vehicular traffic, and trees) that could result in artificially high or low concentrations. Several of the quarry perimeter monitoring stations are near trees. Because the trees serve as a natural barrier to airborne emissions, the trees will not be removed from the area near the monitoring locations. In addition, due to the limited space available along the ridge at the southeastern perimeter of the quarry, the stations cannot be moved away from the trees.

The air particulate filters will be counted to determine gross alpha concentrations using an alpha scintillation detector or a gas flow proportional detector in accordance with applicable SOPs. The counting times for samples will generally be 60 minutes.

Each sample will be collected for a period long enough to ensure that a gross alpha minimum detectable concentration of 1E-15 μCi/ml can be obtained. Because naturally occurring Po-210 and Pb-210 (daughters of Rn-222) exist in the atmosphere at concentrations on the order of 2.5E-15 μCi/ml, obtaining a minimum detectable concentration less than 1E-15 μCi/ml is of little value due to the interference from Po-210 and Pb-210. In addition, the derived concentration guideline for Th-232, Class W (most restrictive derived concentration guideline for contaminants at the Weldon Spring site) is 7.0E-15 μCi/ml. With a background of 2.0E-15 μCi/ml and a gross alpha activity of 1.0E-15 μCi/ml, the composite activity of 3.0E-15 μCi/ml is still less than the Th-232 derived concentration guideline. The minimum detectable concentration is dependent on sample volume (sample time multiplied by the flow rate), the efficiency and background count rate of the instrument used to measure the activity on the filter, and the sample and background count times.

At one standard deviation, the total typical uncertainty associated with a site perimeter air particulate sample at a gross alpha concentration of 8.7E-16 μCi/ml is 3.0E-16 μCi/ml. The total sample uncertainty is dependent on the uncertainty associated with the volume sampled, detector calibration uncertainties with the determination of detector efficiency, and detector background count rate, as well as the uncertainty associated with the sample count rate. Uncertainty may vary because different detectors are used, and because of variations in the other sources of uncertainty. It is assumed that 1E-16 μCi/ml represents a typical uncertainty achieved with a sample having a gross alpha concentration of 1E-15 μCi/ml.

The investigation level that will be established for the perimeter air monitoring program is based on a one-tail hypothesis test which compares the data collected at the background station with the data from a particular monitoring station. The test uses data collected from the previous 104 weeks to determine if a particular monitoring station's data is different than background at the 95% confidence level.

Because the alpha track radon detectors will be collected on a quarterly basis, there will be only four data points per year per location; therefore, the alpha track radon detectors will be compared to the background stations results only on an annual basis. Each monitoring period the electret radon detector will be compared to the background station results. If the results from a monitoring location are found to be statistically greater than the results from the background stations, an investigation will be conducted to determine the source of the above background concentrations, with the exception of the quarry, TSA, and raffinate pit monitoring stations, which are historically greater than background because of the radiologically contaminated material in these locations.

The quality assurance/quality control procedures for the low volume air particulate samplers will be the same as those described for site specific monitoring. The quality assurance/ quality control procedures that will be implemented for the continuous radon progeny monitors include calibration standard operating procedures.

The quality assurance/quality control procedures that will be employed for the perimeter alpha track radon detectors include duplicates, spikes, chain-of-custody and laboratory authorization forms, field sheets, and review of vendor data. The pair of alpha track radon detectors placed at each location will serve as duplicates. At least three spikes (alpha track

detectors exposed to a known source) will be returned to the vendor for analysis on a quarterly basis. In addition, field sheets will be used during deployment and recovery of the radon track etch detectors to document detector locations and any unusual occurrences. Chain-of-custody and laboratory authorization forms will be filled out in accordance with the applicable standard operating procedure in order to track the radon alpha track detectors. Finally, the data received from the vendor will be reviewed for anomalies.

The quality assurance/quality control procedures used for the electret radon detectors include duplicates, reference electrets, gamma exposure rate measurements, field sheets, and data review. A pair of electrets used at each monitoring location will serve as duplicates. Field sheets are used during deployment and recovery of the electrets to document detector locations and any unusual occurrences. High accuracy reference electrets are used to check the accuracy of the voltage reader. Gamma exposure rates are measured in each electrets measurement period with a pressurized ion chamber or an exposure rate meter in locations with expected elevated gamma radiation. Finally, the data is reviewed by a second party for anomalies.

4.2.2.3 Critical Receptor Monitoring. The most accurate method of dose calculation at nearby receptor points is through the use of actual concentration measurements at these locations. Measurements from nearby receptor points or critical receptors will be an important element in determining the emissions from the chemical plant and the quarry when used in connection with site specific monitoring data and the perimeter air monitoring data. Critical receptors are defined as those locations at which individuals abide or reside were the highest potential off-site concentrations of radionuclides are likely to occur during remediation of the site. The sites that were selected as critical receptors are located within 1 km (0.6 mi) of the site where members of the public may spend at least 8 hours per day for a significant fraction of the year. The critical receptors will be monitored in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) plan which has been approved by the U.S. Environmental Protection Agency, Region VII.

Critical receptor locations AP-2001, AP-4006, AP-4007, AP-4008, and AP-2005 (Figures 4-3 and 4-5) are strategically located to measure radioactive airborne emissions from the chemical plant at points where maximally exposed individuals reside or abide. Station AP-2001 is at the common boundary of the chemical plant and Missouri Highway Department Maintenance Facility. Station AP-4006 is located at the Francis Howell High School. Station

AP-4007 is located at the August A. Busch Memorial Conservation Area. Station AP-4008 is located at the U.S. Army Reserve and National Guard Training Area. Station AP-2005 is located adjacent to the WSSRAP administration building.

Critical receptor location AP-4011 (Figure 4-4) is strategically located to measure radioactive airborne emissions from the quarry. Station AP-4011 is located 50 m (165 ft) from the nearest residence 0.2 km (0.12 mi) west of the quarry. Station AP-4012 (Figure 4-6) is located approximately 12.9 km (8 mi) from the chemical plant and 11.3 km (7 mi) from the Weldon Spring Quarry to monitor the Daniel Boone Elementary School and establish background levels.

Other facilities (i.e., the St. Charles County water treatment plant, the residence west of the August A. Busch Memorial Conservation Area, and the Weldon Spring Heights subdivision) are located near the site; however, because of the greater distance, and because previous monitoring data from closer critical receptor locations indicate with 95% confidence that there has been no above-background radioactive airborne concentrations, these areas are not considered critical receptors.

Monitoring at the critical receptor locations includes high volume air samplers, low volume air samplers, and alpha track radon detectors at all locations. Electret radon monitoring will also be used at critical receptor location AP-4006 (Francis Howell High School). An electret monitor will also be deployed at background station AP-4012 (Daniel Boone Elementary School). The high volume samplers have heavy duty, turbine-type blowers and feature an electronic controller that automatically adjusts the speed of the sampler to correct for variations in line voltage, temperature, pressure, and filter loading. The low volume air monitoring program at the critical receptors will be just as those used for the site perimeter monitoring program. The alpha track and electret radon detectors are described in the site perimeter monitoring program.

A mass flow meter will be used to measure and set the flow rates of the high-volume air samplers. The high-volume air particulate samplers will run continuously at 950 l/minute (33.6 cu ft/minute). The linear flow rate for the high-volume air particulate samplers is 48 m/minute (157.4 ft/minute). Flow rates for the high-volume air samplers will be checked at the end of each week and then readjusted to the desired flow rate after the new filter is

installed. The start and finish flow rates will be averaged, and the average will be used to calculate the total volume sampled. If the flow rate changes by ±20% during the sampling period, the monitor will be evaluated to determine if service is required. The data will be flagged and used for qualitative purposes only.

The high-volume air samplers use 203 mm by 254 mm (8 in. by 10 in.) glass fiber filters that have a mean dioctylphthalate efficiency of 99.99% for particulate diameters of 0.3 μm to 0.4 μm.

The low-volume air particulate samplers and continuous radon monitors will be placed at the same height specified in the site perimeter monitoring section. The high-volume air particulate samplers have a sample height of approximately 1.2 m (4 ft). In addition, the monitoring receptor stations will not be located in proximity to unusual localized effects or other conditions (e.g., large buildings, vehicular traffic, or trees) that could result in artificially high or low concentrations.

On a quarterly basis, each of the 13 weekly filters from the high-volume air particulate samplers at critical receptors and at the background station will be composited by location. The composite sample will then be dissolved and divided into three aliquots. The 21 composite samples (three aliquots from seven sampler locations) will be analyzed for Th-228, Th-230, Th-232, Ra-228, Ra-226, and total uranium.

The investigation level for the critical receptor monitoring locations will be high-volume sample concentrations greater than background concentrations. The monitoring results from each location will be compared to the background station results using a statistical test. If a station is found to be statistically different than background, an investigation will be conducted to determine the validity and/or source of this difference.

The quality control program for the high-volume air samplers will include spikes, duplicates, and blanks. With each group of high-volume sampler filters sent for radiochemical analysis, two filters will be spiked with known activities of Th-230, and two filters will be spiked with known activities of natural uranium (U-238, U-235, and U-234 in natural activity ratios). Since each filter composite collected at critical receptor locations is split into thirds, these thirds will serve as duplicates.

Field blanks will be collected each week when filters are exchanged. A field blank is an unused filter that the technician takes to the field. In addition, an unused filter will be collected directly from the filter package. The two sets of blanks will also be composited and analyzed radiochemically. Results from the blank composite will be used to identify field or laboratory contamination of filters.

In addition to the system of spikes, duplicates, and blanks, the radioanalytical analyses will be evaluated for internal consistency. At the site, U-238 and U-234 are in secular equilibrium. Uranium concentrations on air filters should also be in equilibrium. When radioanalytical results are provided, the degree of equilibrium will be evaluated. In most cases, Th-228 and Ra-228 are also in equilibrium. Equality between these radionuclides will also be evaluated.

The high-volume air particulate samplers will be operated in accordance with the applicable standard operating procedure. The standard operating procedure also specifies how filters are to be handled before, during, and after collection.

4.3 Asbestos Monitoring

Site perimeter air monitoring for asbestos will be routinely performed only when activities involving disturbance of asbestos are taking place. Perimeter asbestos monitoring locations at the chemical plant and at the quarry are the same as those used for radioactive air particulate monitoring (Figures 4-3 and 4-4). At least two perimeter asbestos monitoring stations will be used, one upwind and the other downwind from activities involving handling of asbestos. A determination of which monitoring stations to use will be based on current meteorological conditions during activities involving asbestos. During activities involving handling of asbestos at the chemical plant, an asbestos monitor will be placed at the Francis Howell High School in the same location as the radioactive air particulate monitoring station.

When activities involving handling of asbestos are being performed at the site, daily asbestos monitoring will be performed in the immediate work area. Samples from the perimeter asbestos monitoring stations and from the Francis Howell High School monitoring station will be collected on a weekly basis. If elevated levels are detected at any of these monitoring locations, the results from the adjacent and immediate work areas will be reviewed in relation

to the elevated levels and pertinent data will be included in the annual site environmental report. At this time no asbestos related work activities are scheduled for 1997. Environmental asbestos monitoring will be discontinued until work activities pose an off site airborne asbestos hazard. This monitoring approach was communicated to and considered appropriate by the Francis Howell High School consultant.

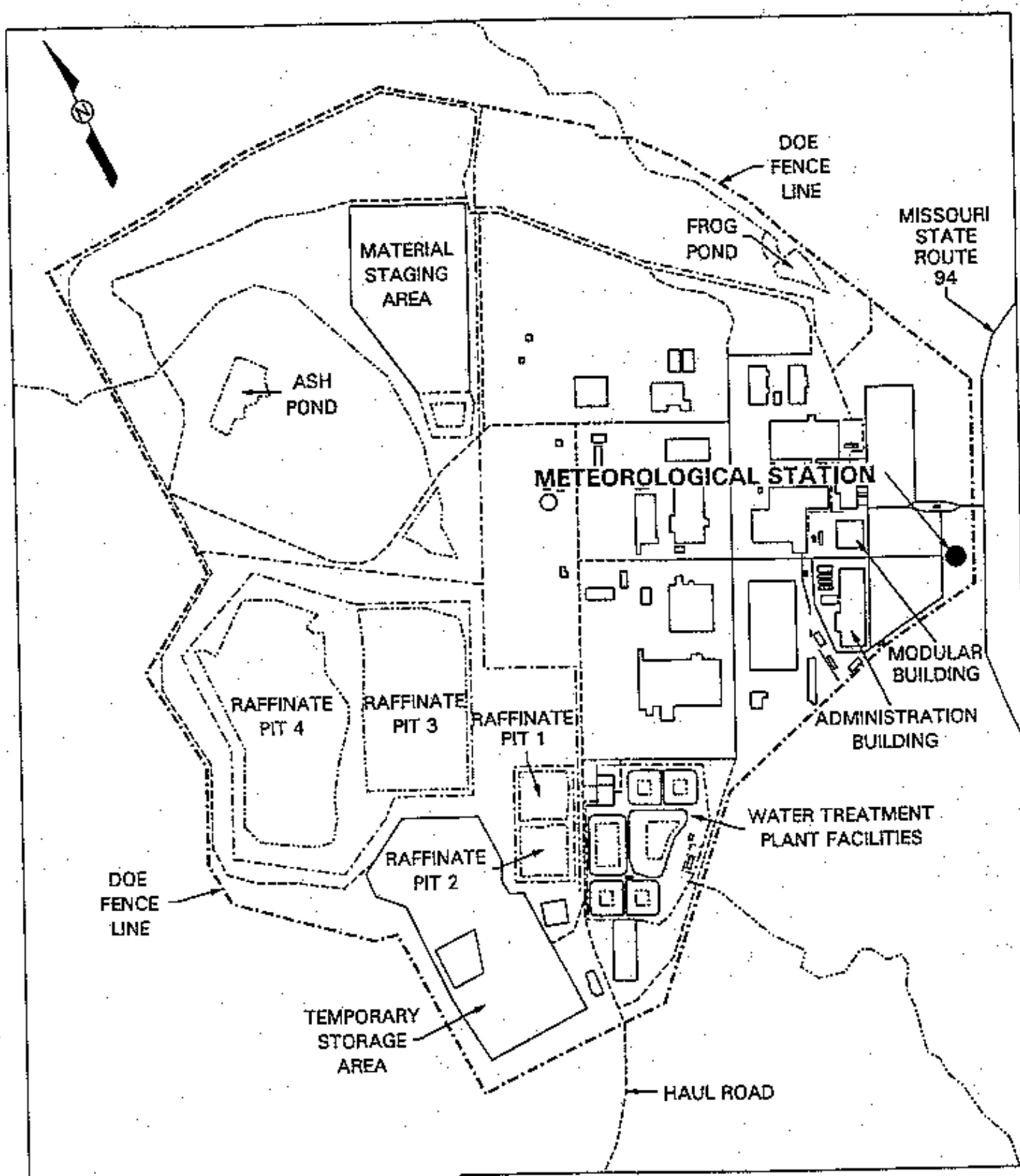
5 METEOROLOGICAL MONITORING PROGRAM

This section describes the meteorological parameters measured, meteorological instrumentation, and computer programs and models that support the environmental surveillance and emergency response activities at the Weldon Spring Site Remedial Action Project (WSSRAP). Estimation of radiological dose to the general public due to routine activities at the WSSRAP is generally based upon measurements from critical receptor locations (Section 4), rather than modeling of downwind dispersion. This method allows for more accurate estimates of dose. The sources for off-site airborne releases at the site are primarily diffuse sources from waste areas and site remedial activities. No stack-type point sources exist at the site.

The WSSRAP has two sources of potential airborne radiological emissions: the Weldon Spring Chemical Plant and raffinate pits, and the Weldon Spring Quarry. The meteorological station is located on the eastern edge of the chemical plant area and is more than 122 m (400 ft) from the nearest building (Figure 5-1). An assessment of the sources was conducted as required by the *Regulatory Guide* (Ref. 4) and is summarized in Section 4.2.1. The assessment included documentation of concentrations of radionuclides that could be released from the sources.

The WSSRAP meteorological station records wind speed and direction, horizontal wind fluctuation, ambient air temperature, barometric pressure, relative humidity, solar radiation, (used to determine on site stability class) and precipitation intensity and accumulation. The station microprocessor performs signal computations and stores data electronically.

The meteorological station consists of a tower, an instrumentation enclosure, and a precipitation gauge. The wind speed and direction sensors are mounted 10 m (33 ft) above ground level on a retractable, tilt down tower. Sensors at greater heights are unnecessary since potential sources of accidental airborne releases are at or near ground level. The wind aspirated temperature and relative humidity sensor and barometric pressure transducer are mounted 2 m (6.6 ft) above ground level at the enclosure. The solar radiation shield is mounted 2 m (6.6 ft) above ground level on the tower. Horizontal wind fluctuation is computed by the station microprocessor.



LOCATION OF THE
WELDON SPRING SITE
METEOROLOGICAL STATION

FIGURE 5-1

REPORT NO.:	DOE/OR/21548-424	COMBAT NO.:	A/CP/104/1093
ORIGINATOR:	EA	DRAWN BY:	GLN
DATE:	11/1/95		

These parameters are collected and stored every 60 seconds. The 1 minute recordings are averaged once per hour and the hourly data are downloaded in ASCII format several times a week to the meteorological station computer. Data are then reviewed and archived digitally.

To facilitate access to real-time meteorological information by site field personnel, the on-site station has been assigned a cellular telephone number and is equipped with a voice synthesizer modem. The voice synthesizer provides audible, current meteorological information (i.e., windspeed, wind direction, temperature, relative humidity, barometric pressure, and precipitation since midnight) when the cellular number is dialed.

Meteorological data are used to support many WSSRAP environmental monitoring program functions, including the following:

- Station data enable dispersion and diffusion modeling to supplement critical receptor monitoring in the event of an accidental airborne release.
- Ecological studies require rainfall, temperature, and wind speed data to determine water level fluctuation in lakes and wetland areas, foliar vegetation absorption analysis, and in agricultural data reviews.
- The Environmental Protection Group utilizes precipitation data to correlate aquifer level fluctuations in the Femme Osage Slough and the quarry. This aids in identifying the cause of fluctuating uranium concentrations in the area.
- Hydrological analyses utilize precipitation measurements to correlate surface and groundwater level fluctuations and to assess seasonal influences on contaminant concentration trends.
- Meteorological data are used to help prepare the annual site environmental report, study off-site effluent discharges, and to determine site watershed runoff coefficients for the *Effluent Information System/On-Site Discharge Information System Report*.

- Station data have been used in the application for the National Pollutant Discharge Elimination System (NPDES) storm water permit application.

- The Construction, Management and Operations Group utilizes wind speed data to comply with Occupational Safety and Health Administration requirements (e.g., crane operation).

Furthermore, the real-time data readout of meteorological variables aid site personnel in observing and analyzing the dispersion of potentially released airborne materials during and after potentially reportable incidents.

If it is determined that air pathway modeling is necessary, the WSSRAP will use either the computer program CAP-88 (a modified version of AIRDOS-EPA) or ISCST3 (Industrial Source Complex Short Term, Version 3). Both models employ steady-state Gaussian equations to model the dispersion plume generated as the result of an airborne release.

On-site inspection and maintenance of the meteorological station, data collection and archival, monthly data reviews, and semi-annual maintenance and performance checks are performed and documented in accordance with Procedure ES&H 4.8.3.

6 ENVIRONMENTAL MONITORING PROGRAM ADMINISTRATION

6.1 Introduction

The preceding chapters gave the rationale for collecting environmental samples at the Weldon Spring Site Remedial Action Project (WSSRAP) and discussed the groundwater, surface water, National Pollutant Discharge Elimination System (NPDES), air, biological and meteorological sampling programs. This section describes the requirements for off-site laboratories, data review (accuracy and precision), comparison of data to past data (statistical analyses), use of data in calculating human radiation doses, reporting and records requirements and several peripheral requirements.

6.2 Laboratory Programs

Laboratories performing analyses for the environmental monitoring plan primarily use Environmental Protection Agency Contract Laboratory Program (CLP) analytical methods. For certain analyses (such as radiochemical and wet chemistry) the laboratories use EPA 600 (drinking water), EPA 900 (radiochemical analysis of drinking water), or a method that is reviewed and approved by the Project Management Contractor prior to analysis of a sample. Contracted laboratories have each submitted a site-specific quality assurance project plan to the WSSRAP and have submitted controlled copies of their standard operating procedures. The quality assurance project plan and standard operating procedures are reviewed and approved by the contractor prior to sample shipment to a laboratory. Any changes to the standard analytical protocols or methodologies are documented in their controlled standard operating procedures. All laboratories currently being used by the WSSRAP have had preliminary assessments of their facilities to make sure they have the capability and facilities to perform work according to the specifications in their contracts. Quality assurance assessments are also performed to inspect the laboratory facilities and operations, to verify that the laboratories are performing analyses as specified in their contracts, and to check that WSSRAP data documentation and records are being properly maintained.

Site-specific quality assurance project plans from laboratories define standard practices aimed at ensuring that the laboratories are performing high quality work. Each plan is prepared in accordance with the appropriate requirements of EPA QA/R-5 (Draft Interim Final), *EPA*

Requirements for Quality Assurance Project Plans for Environmental Data Operations (Ref. 22). The laboratories demonstrate compliance with additional quality assurance/quality control requirements as specified in their contracts which include sample preparation and analytical methods; calibration of instrumentation; periodic inspections, maintenance, and servicing; statistical procedures to optimize precision and accuracy; corrective action programs; participation in the external Environmental Protection Agency Performance Audit Program; maintenance and storage of WSSRAP records; hardcopy and electronic formatting; and notification of nonconforming issues.

The laboratories' standard operating procedures provide detailed information about internal policy on standard analytical protocol on methods. These standard operating procedures provide step-by-step instructions for performing analytical work and for calculating, reducing, and recording pertinent information about analyses.

The accuracy of chemical and radiological analyses of samples are monitored by the routine use of control samples. This is a requirement of many published protocols (i.e., those of the Environmental Protection Agency) and is good laboratory practice. The accuracy and precision of sample analyses and the frequency of collection of quality control samples is summarized in the annual site environmental report.

Detailed information on the Project Management Contractor laboratory evaluations program can be found in the *WSSRAP Sample Management Guide* (Ref. 23), the *Environmental Quality Assurance Project Plan* (Ref. 24) and various ES&H Department procedures. These programs give information about sample collection, data administration,and management programs necessary to make the overall WSSRAP laboratory program accurate and reliable to the data users.

6.3 Data Analysis and Statistical Treatment

Proper data analysis and statistical treatment practices are essential to obtain quality results from the effluent monitoring and environmental surveillance programs required by U.S. Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide* (Ref. 4). Therefore, it is necessary to develop a plan for the following action items to:

- Determine contaminant concentrations at each sampling location for each sampling period, and evaluate the accuracy and precision of those concentrations.

- Compare the contaminant concentrations at each sampling location to previous concentration estimates and evaluate changes or inconsistencies in contaminant levels.

- Compare contaminant concentrations at sampling locations to the established regulatory or administrative limits or standards for those contaminants and/or background concentrations.

The WSSRAP has taken steps to establish appropriate investigation levels for groundwater, surface water, and site effluents to achieve consistent review of environmental data and initiation of appropriate and timely action when necessary. The criteria applied by the WSSRAP to define the investigation levels for all environmental monitoring data are described in several Environmental Safety and Health Department procedures. The procedures listed below direct the WSSRAP staff in the evaluation of environmental monitoring data. These evaluations include assessing data quality and determining whether a given datum exceeds specific action levels. Administrative procedures that must be followed when action levels are exceeded are also defined. The procedures governing data review are:

ES&H 1.1.7 - *Environmental Data Review and Above Normal Reporting*

ES&H 4.6.1 - *Environmental TLD Deployment and Handling*

ES&H 4.6.4 - *Constant Flow Low Volume Air Sampler Operation and Air Sample Filter Handling*

ES&H 4.6.6 - *Constant Flow High Volume Air Sampler Operation and Air Sample Filter Handling*

ES&H 4.6.7 - *RGA-40 Radon Gas Monitor: Operation and Data Handling*

ES&H 4.6.8 - *WLM-30 Radon Daughter Monitor: Operation and Data Handling*

ES&H 4.6.9 - *Electret Radon and Thoron Gas Monitor: Operation and Data Handling*

ES&H 4.9.1 - *Environmental Monitoring Data Verification*

These procedures are intended to effectively address Department of Energy guidance criteria for determining investigation levels for environmental monitoring programs.

The statistical techniques used to evaluate and analyze the data are designed to accommodate environmental data sets. Such data sets typically include skewed distributions of time series data, variable analytical results, missing data, and data that are below analytical detection limits.

6.3.1 Summary of Data Analysis and Statistical Treatment Requirements

The following subsections summarize the procedures for data analysis and statistical treatment of the environmental and effluent data. Immediately upon receipt from the verification/validation group all new groundwater, surface water, and NPDES data are evaluated against the corresponding historical data by the data user according to standard operating Procedure ES&H 1.1.7. After these data have been reviewed and verified by the Verification/Validation Group in accordance with standard operating Procedure ES&H 4.9.1, they are entered into the WSSRAP environmental database. Air monitoring data obtained from off-site laboratories, as required by the NESHAP, will be verified in accordance with Procedure ES&H 4.9.1. Air monitoring data obtained from the WSSRAP on-site laboratory will be handled in accordance with Procedure ES&H 2.6.7.

6.3.2 Variability of Environmental and Effluent Data

Data precision and accuracy is a measure of the variability of analytical results. Careful design and execution of the monitoring and laboratory programs can substantially improve the quality of environmental and effluent monitoring data.

6.3.2.1 Sources of Variability. Variability of data may arise from six sources: sample collection errors, analytical errors, statistical counting variations, data recording errors, and temporal and spatial variability between environmental samples. Efforts will be taken to

minimize variability due to sampling, analytical, and recording errors; however, variability due to statistical counting variations and environmental factors (temporal and spatial) cannot be controlled.

6.3.2.2 Estimating Accuracy and Precision. The validation process will assess the accuracy and precision of groundwater, surface water, and NPDES data sets according to the WSSRAP data validation procedure (ES&H 4.9.2). National Emission Standards for Hazardous Air Pollutants (NESHAPs) air monitoring will be performed in accordance with 40 CFR 61, which outlines specific requirements for the accuracy and precision of each data set. Data will also be validated in accordance with Procedure ES&H 4.9.2, if required. The accuracy and precision of data obtained from the WSSRAP on-site laboratory will be determined in accordance with Procedure ES&H 2.6.7. The annual site environmental report will summarize the completeness, accuracy, and precision of the data.

6.3.3 Review of New Environmental Data and Testing for Outliers

Review of new environmental data encompasses comparison with historical trends and/or with action-level criteria. Data review is accomplished using a set of elementary statistical parameters that are easy for the reviewer to calculate and are included in the data management system software. The statistical procedures, which are described in ES&H 1.1.7, are intended to provide a consistent, simple method to screen analytical data for outliers that require further investigation and/or qualification and to detect data that exceed the action-level criteria (as defined in Procedure ES&H 1.1.7). These procedures are not recommended for other applications, such as evaluating a datum for compliance with a regulatory level or setting a confidence level about the mean. For these needs, data users are referred to the *Environmental Protection Agency Guidance* (Ref. 25).

6.3.3.1 Data Below the Limit of Detection. Data below the limit of detection are included in all statistical calculations conducted for the purposes of data review except in special cases of high detection limits. A high detection limit is a limit that exceeds the mean of the detected values or exceeds two times the mean of previous detection limits for data sets that only include nondetects. One half the detection limit (DL/2) is normally substituted for nondetects in statistical calculations supporting data review. Uncensored data, when available, may be used directly in these statistical calculations provided the uncensored value is greater than or equal

to zero (Appendix D). Because negative concentrations are not possible in nature, all negative values will be identified as non-detect and may be included in the statistical calculation after this conversion.

6.3.3.2 Elements of Good Practice. The review of data is documented in accordance with Procedure ES&H 4.9.1, which constitutes a formal record that becomes part of the data verification package.

The new electronic data management system facilitates tracking and documenting data quality. Outliers that have been identified during the data review may be identified and tracked in the Data Reviewer Qualifier field. Verification and validation qualifiers are displayed in their own field as well as rankings for quality control samples. An extended comments field is available to add additional comments on the quality of a datum. Field sheets, field data, and shipping information are also stored in the system and may be retrieved by the reviewer to assist in evaluating data.

6.3.4 Treatment of Significant Figures

Calculations performed using the analytical data received from the laboratory will follow the accepted rules for significant figures. Results of calculations will not contain more significant figures than the least precise value used in the calculation.

6.3.5 Parent-Decay Product Relationships

The delays associated with the time between sample collection and sample analysis are insignificant compared to the half-lives of the radionuclides routinely monitored at the Weldon Spring site. Therefore, it is not necessary to take into account decay times when calculating parent-decay product relationships.

6.4 Documentation Requirements

The WSSRAP recognizes numerous Department of Energy orders, notices, and directives in addition to Federal, State, and local regulations. Since the Weldon Spring site is a remedial action project, rather than an operating facility, the distinction between applicable and

nonapplicable guidelines must be determined when interpreting these regulations. The project must comply with appropriate regulations, write and distribute reports in a timely manner, and maintain records properly. The following Department of Energy Orders describe required activities at the site: 0232.1, 5400.1, 5400.5, 5284.1B, and 5484.1. These orders are discussed in the following paragraphs.

Department of Energy Order 0232.1, *Occurrence Reporting and Processing of Operations Information*, defines a system of reporting occurrences listed in Orders 5400.5, 5484.1, 5480.19, 5480.23, 5480.30, 5632.7A, 0360.1, 5500 series and 5400.13. Occurrences are categorized into 10 groups: facility condition, environmental, personnel safety, personnel radiation protection, safeguards and security, transportation, value basis reporting, facility status, nuclear explosive safety, and cross category items and are divided into three categories in order of decreasing severity: emergencies, unusual occurrences, and off-normal occurrences. The *Manual for Categorization of Reportable Occurrences* (Ref. 26) and Procedure RC-5, *Occurrence Reporting* are also used to classify occurrences.

Department of Energy Order 5400.1, *General Environmental Protection Program*, requires that all Department of Energy facilities comply with all applicable Federal, State, and local environmental protection laws and regulations. Both environmental occurrences and routine monitoring reporting are covered. The WSSRAP has prepared an *Environmental Protection Program Implementation Plan* (EPPIP) (Ref. 3) to meet the specific requirements of Department of Energy Order 5400.1. Environmental occurrences will be reported as stated in DOE 5484.1 and DOE 0232.1 in accordance with WSSRAP procedures.

Department of Energy Order 5400.5, *Radiation Protection of the Public and the Environment*, states that Department of Energy facilities will adopt specific standards and requirements that will not allow undue risk from radiation to affect the public or the environment. The WSSRAP has formulated its environmental protection program to meet the requirements of this order and the *Regulatory Guide* (Ref. 4).

Department of Energy Order 5482.1B, *Environment, Safety, and Health Appraisal Program*, establishes a review and appraisal program for the environmental safety and health programs at the WSSRAP. There are six levels of appraisals and audits: management appraisals, technical safety appraisals, functional appraisals, internal appraisals, environmental

surveys, and environmental audits. Each appraisal and audit requires a quarterly status report, or a report as otherwise directed on corrective actions. Internal appraisals are performed, at the operating level, by the Project Management Contractor Project Quality Department.

Department of Energy Order 225.1, *Accident Investigations*, outlines requirements and procedures for investigating occurrences which may impact environmental protection, safety, and health. Occurrences are categorized into three levels. In addition, DOE Order 231.1, *Environmental Safety and Health Reporting*, requires an annual report of any exposures of Department of Energy or Project Management Contractor employees, nonemployee radiation workers, and visitors be sent to the Radiation Exposure Information Reporting System (REIRS).

6.5 Plans

The following are summaries of WSSRAP plans generated in accordance with Federal, State, and/or local environmental protection laws and regulations, Executive Orders, internal Department of Energy policies, or agreements with other agencies.

6.5.1 Environmental Monitoring Plan

The *Environmental Monitoring Plan* (this document) is produced in accordance with Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide* (Ref. 4) and details environmental and effluent monitoring, sampling, and analysis. This plan is required to be reviewed annually and reissued at least every three years.

During the monitoring year, it may be necessary to alter the scope of the monitoring program. In such a case, the changes in monitoring parameters, schedule, frequency, and/or locations will be authorized by the Environmental Protection Group Manager with notification given to the Environmental Safety and Health Department Manager. All variances from the program scope will be documented with a memorandum to project management and will be reported in the annual site environmental report.

6.5.2 Groundwater Protection Program Management Plan

The *Groundwater Protection Program Management Plan* (Ref. 27) structures the groundwater program into a consistent program which facilitates periodic review. This plan is reviewed annually and updated at least every three years. The *Groundwater Protection Program Management Plan* (Ref. 27) is taken, in part, from the environmental monitoring plan (this document), with the focus on the groundwater monitoring program.

6.5.3 Environmental Protection Program Implementation Plan

The *Environmental Protection Program Implementation Plan* (Ref. 3) outlines Department of Energy Order 5400.1 as it applies to the WSSRAP. This plan is updated annually to outline how environmental occurrence reporting and routine monitoring are administered at the WSSRAP.

6.6 Reports

The following are summaries of reports generated at the WSSRAP to satisfy Federal, State, and/or local environmental protection laws and regulations, Executive Orders, internal Department of Energy policies, or agreements with other agencies.

6.6.1 On-Site Discharge Data Report

The *Radioactive Effluent Information System and Onsite Discharge Data Report* is an annual report which documents any radioactive discharges or releases from the WSSRAP. This report is accompanied by Department of Energy Form F 5821.1 and is sent to Lockheed Idaho Technologies Company. The report is drafted in accordance with the *Effluent Information System (EIS) and On-Site Discharge Information System (ODIS) User's Manual* (Ref. 32).

6.6.2 Annual Site Environmental Report

The annual site environmental report presents the findings of the environmental monitoring program conducted at the site for each monitoring year. The report presents summaries of environmental data both routine and nonroutine, discusses compliance with

environmental standards, and highlights significant programs and studies undertaken to better understand the impacts of the project on the environment and public. Annual environmental monitoring reports have been prepared for the Weldon Spring site (or portions thereof) since 1981. The results of special studies and nonannual sampling are summarized if the information is of public or environmental concern and reference is made to the next sampling event if applicable. These include Oak Ridge National Laboratories research on site, Federal Facility Agreement driven activities, and activities not scoped in this *Environmental Monitoring Plan*.

The annual site environmental report is the vehicle for documenting the results of the extensive monitoring program at the WSSRAP. The report provides the public and concerned regulatory agencies with summary level discussions regarding the routine environmental monitoring program. It explains how the WSSRAP effluent monitoring program meets the requirements of the NPDES program and radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations, and compares the measured contaminant levels in several environmental media to applicable Federal and State standards and Department of Energy requirements. When additional characterization and monitoring activities are conducted that are not defined within the scope of the *Environmental Monitoring Plan*, a judgement will be made by the Environmental Protection Group Manager as to the relevance of each of those activities to the overall environmental reporting requirements. An example of an activity that might be reported in the annual site environmental report is a soil or water characterization effort that exceeds the scope of those previously performed in the area. Conversely, an example of activities that may not warrant reporting are "engineering characterization" efforts performed in support of various construction activities at the site. An exception to this is the ecological characterization required by the *National Environmental Policy Act* (NEPA) that would provide information to assess impact to the ecosystem.

Human doses due to site activities are calculated for the report on the basis of annual data and several scenarios. The report also indicates whether changes are occurring in contaminant distribution or contaminant source conditions that might lead to variations in exposure scenarios for human or environmental receptors. Methods for calculation of radiation doses to humans are described in the next subsection.

6.6.2.1 Surface Water, Groundwater and Airborne Radiological Dose Calculations. This section describes models, computer programs, input data, and data sources

that will be used to assess accurate and realistic radiation doses, to the population and to a hypothetical maximally exposed individual, that could result from remediation activities at the Weldon Spring site. Environmental monitoring data will be used either as direct input data in dose calculations or, where appropriate, will serve as data input in exposure and dose models.

The results of the dose calculations will be reported in the annual site environmental report. The methodology used to calculate the exposure point concentration and to estimate dose will also be documented in that report.

The radiological data from the surface water and groundwater effluent monitoring and environmental surveillance programs will be evaluated in the site environmental report for its potential to contribute to a radiological dose to a member of the general public. Exposure and dose will be estimated for both the general off-site population and a maximally exposed receptor. If measured concentrations in surface water and groundwater effluent from a specific site exceeds the natural background concentration with 95% confidence, an exposure scenario will be developed to assess the dose. Intake variables for a given pathway will be selected to reflect a reasonable, realistic exposure mode. Realistic ingestion rates and times will also be assigned for a maximally exposed individual. A standard dose conversion factor will be assumed and referenced for the dose assessment calculations. Doses to humans will be reported in the site environmental report.

Radiological dose from airborne emissions will be assessed using environmental data as well as computer models. Exposures for critical receptors and hypothetical maximally exposed individuals will be calculated from monitoring data. For sources where perimeter monitors indicate with 95% confidence that background levels have been exceeded, population dose estimates will be made by computer modeling. The site specific monitoring program, in conjunction with perimeter monitoring data, will be used to obtain a more reliable source term. This will allow computer modeling to be used if necessary.

The computer models that will be considered for use in dose assessments include CAP88-PC and ISCST3, both of which are Environmental Protection Agency approved computer models. CAP88-PC evaluates the annual dose equivalent due to low level chronic exposures to radionuclides. ISCST3 is the current version of ISCST. Both models can be used to model emissions from stacks, vents or diffuse sources.

Those pathways that are complete and could realistically contribute to a dose to a member of the general public will be assessed and documented in the annual site environmental report. Justification for elimination of any pathways will also be provided in the annual site environmental report. Scenarios that reflect realistic but conservative assumptions will be developed for those pathways that could contribute to a dose to a member of the general public. Realistic occupancy times will be assumed for potentially exposed individuals. Standard breathing rates and dose conversion factors from the *Federal Guidance Report No. 11* (Ref. 28) will be used in the calculations.

6.6.3 Quarterly Environmental Data Summary

Though not required by a Department of Energy Order, the Federal Facility Agreement requires that *Quarterly Environmental Data Summaries* be produced to aid in communicating site environmental data to the public and participating regulatory agencies. The *Quarterly Environmental Data Summaries* summarize environmental data and highlight findings that are "above normal" as determined by Procedure ES&H 1.1.7. This allows preliminary data to be reviewed by interested individuals and organizations on a more frequent basis.

6.6.4 NPDES Discharge Monitoring Reports

Permits issued under the National Pollutant Discharge Elimination System and provisions of the *Clean Water Act* also require record keeping and reporting. Record keeping requirements are stated in the NPDES permits issued by Missouri Department of Natural Resources (MDNR). Discharge monitoring reports are submitted as required in the permits and include information on sample collection, flow, and laboratory results. Also included in the reports are noncompliance events. If there is a noncompliance with a daily maximum limitation, the Department of Natural Resources must receive a written report within 5 days. Any noncompliance that may endanger health or the environment requires that oral notification be made to the MDNR within 24 hours followed by a written report within 5 days.

6.6.5 Performance Indicator Quarterly Reports

The Department of Energy Performance Indicator Program is a requirement of DOE Order 210 that calls for the production of a quarterly report. This program allows trending and

analysis of operational data to aid in improvement of Department of Energy and contractor line management operational control. The report includes a management summary, an Indicator Program summary, trends and analysis, and quantitative data.

6.6.6 Compliance Reports

Under the *Federal Facility Agreement*, the Department of Energy must submit status reports on activities and technical documents to the Environmental Protection Agency for their review and approval. These include, but are not limited to, the *Quarterly Environmental Data Summary*, sampling plans, and unplanned sampling activity notifications. Each of these reports has its own reporting requirements and time constraints and will be detailed in the *Federal Facility Agreement Implementation Plan* (Ref. 29).

The *Annual Report on Environmental Permits* is issued annually to the Department of Energy. This report is required by Department of Energy Order 5400.1 and covers all environmental permits issued to the site.

6.7 Records

Department of Energy Order 5400.1 requires that all environmental surveillance and effluent monitoring records, computer programs, raw data, and procedures be retained. These records must be protected against damage or loss. The WSSRAP *Sample Management Guide* (Ref. 23) governs sampling plan preparation, data verification and validation, database administration, and data archiving.

The *Sample Management Guide* specifies a tracking system for sampling activities. Field log books and field sampling forms are filled out at sample collection. A Chain-of-Custody Form is completed and accompanies the sample until it is properly disposed of or returned to the WSSRAP. The Chain-of-Custody Form is sent along with the sample to authorize testing by an off-site laboratory. The sample information, such as identification number, date, and parameters are then entered into the Environmental Sample Tracking System. This system tracks the samples and calculates costs, invoice payments, and budget reports. Upon receipt of data from a laboratory, the data are reviewed through a verification process. The review includes data delivery, sample preservation and identification, chain of custody, holding times,

and data to confirm compliance with the laboratory's quality assurance project plan and standard operating procedures.

Several databases are used to track samples and data at the WSSRAP. Sample information such as sample number, date, parameters, etc., are entered into the Field Sample Tracking (FST) system. Sample shipping and accounting are processed through the Environmental Sample Tracking (EST) system. Analytical results are stored using a computerized data management program developed on site, called the WSSRAP Information System for Archiving and Retrieving Data (WIZARD). WIZARD allows data to be selected and sorted by identification number and parameter. Records are protected so that data cannot be altered by the user.

Other computer programs used to track exposure information and waste management data are the Safety, Health, and Radiation Protection (SHARP) program, and the Waste Inventory Tracking System (WITS).

All environmental data and documentation from sampling, analysis, and quality review programs are maintained in hard copy records; i.e., in written, typed, or printed forms; and electronic records, i.e., computerized records of environmental data. Original documents are transferred to the Project Quality Department and stored as quality assurance records in a fireproof vault. Copies are kept in the Environmental Safety and Health Department files. Work data files and electronic data records are archived annually.

6.8 Emergency Preparedness

The WSSRAP maintains the management and staffing structure on site necessary to respond to environmental and medical emergencies. Plans and procedures are in place that detail the response and reporting program, implementation criteria, and routine environmental response and safety drills. The *Emergency Plan* (Ref. 30) addresses these measures. This plan encompasses environmental emergencies, spills, fire, and medical and natural disasters.

7 QUALITY ASSURANCE

Quality assurance for environmental monitoring activities at the Weldon Spring site is divided into two separate categories. The first, programmatic or overall project quality assurance, relates to the incorporation and documentation of the quality of all site activities. This approach is discussed in Section 7.1. The second category is specific to the environmental monitoring activities presented in this plan and is discussed in Section 7.2.

7.1 Programmatic Quality Assurance

The Weldon Spring Site Remedial Action Project (WSSRAP) is obligated to comply with Department of Energy Order 5700.6C. This requirement was developed to ensure that work performed at facilities handling, processing, or utilizing radioactive materials is of documented quality. To satisfy this obligation, the Project Management Contractor has prepared a project specific *Project Management Contractor Quality Assurance Program* (Ref. 31) which details DOE Order 5700.6C requirements which support, control, or guide the environmental monitoring program. This plan has been reviewed and approved by project management, the Project Quality Manager, and the U.S. Department of Energy Project Manager. 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.

The WSSRAP also has prepared an *Environmental Quality Assurance Project Plan* (Ref. 24) to meet the intent of EPA QA/R-5, (Draft Interim Final) EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (Ref. 22). This document supports the *Project Management Contractor Quality Assurance Plan* (Ref. 31) and is specific to environmental monitoring and characterization. The *Environmental Quality Assurance Project Plan* (Ref. 24) also meets the requirements of Department of Energy Order 5700.6C.

7.2 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 (data verification) and data quality evaluations (data validation); maintaining quality assurance records; performing independent assessments; and evaluating analytical laboratories, sample collection activities, and programmatic procedures. Each of these items will be discussed in the following subsections.

7.2.1 Standard Operating Procedures

Standard operating procedures have been developed for routine activities associated with environmental monitoring at the Weldon Spring site. These procedures have been developed from U.S. Environmental Protection Agency and Department of Energy guidance and from standard industry practices and are specific to the site. Procedures at the site are prepared, reviewed, and approved by cognizant department managers, the Project Quality Manager, and project management. Controlled copies of procedures are maintained in accordance with the document control requirements of Department of Energy Order 5700.6C. Procedures are reviewed at least annually and revised as appropriate.

Personnel undergo training specific to their responsibilities, varying from procedure review, through classroom training, and "hands on" training under the supervision of a qualified individual. This training is tracked through the use of a training matrix. Each manager prepares a unique subset of procedures for each individual from a list of all site procedures. Training records are maintained by the Project Training and Improvement Group. As procedures are revised, the matrices are updated and personnel are retrained.

Standard operating procedures applicable to environmental monitoring activities at the WSSRAP are listed in Table 7-1. These procedures cover all activities from sampling through sample chain-of-custody and provide detailed instructions to monitoring personnel.

TABLE 7-1 Procedures Applicable to Environmental Monitoring Activities

PROCEDURE NUMBER	PROCEDURE TITLE
ES&H 1.1.7	Environmental Data Review and Above Normal Reporting
ES&H 2.6.5	Calibration and Operation of the KPA-11 Kinetic Phosphorescence Analyzer
ES&H 4.1.1	Numbering System for Environmental Samples and Sampling Locations
ES&H 4.1.2	Initiation, Generation, and Transfer of Environmental Chain-of-Custody
ES&H 4.1.3	Sampling Equipment Decontamination
ES&H 4.1.4	Quality Control Samples for Aqueous and Solid Matrices: Definitions, Identification Codes and Collection Procedures
ES&H 4.3.1	Surface Water Sampling
ES&H 4.4.1	Groundwater Sampling
ES&H 4.4.2	Groundwater Level Monitoring and Well Integrity Inspections
ES&H 4.4.5	Soil/Sediment Sampling
ES&H 4.5.1	pH and Temperature Measurement in Water
ES&H 4.5.2	Specific Conductance Measurement in Water
ES&H 4.5.7	Measurement of Settleable Solids
ES&H 4.5.8	Water Sampling Filtering
ES&H 4.6.1	Environmental TLD Deployment and Handling
ES&H 4.6.2	Radon Concentration Measurement in Ambient Air
ES&H 4.6.4	Constant Flow Low Volume Air Sampler Operation and Air Sample Filter Handling
ES&H 4.6.6	Constant Flow High Volume Air Sampler Operation and Air Sample Filter Handling
ES&H 4.6.10	Operation of the NITON RAD7 Radon Detector
ES&H 4.6.11	Operation of the Pylon WLX Working Level Monitor
ES&H 4.6.12	Calibration of the Pylon WLX Working Level Monitor Using the Rn-190 and Th-190 Daughter Standards
ES&H 4.9.1	Environmental Monitoring Data Verification

TABLE 7-1 Procedures Applicable to Environmental Monitoring Activities (Continued)

PROCEDURE NUMBER	PROCEDURE TITLE
ES&H 4.9.2	Environmental Monitoring Data Validation
CM&O-15	Task-specific Safety Assessments
RC-30	Monitoring Well Waste Management

7.2.2 Quality Control Samples

Numerous quality control samples are collected in support of environmental monitoring activities. Quality control samples are collected in accordance with Procedure ES&H 4.1.4. These include: duplicate samples, replicate samples, blank samples, and rinsate samples. Samples are also provided to the laboratory for internal laboratory quality control evaluations specific to sample media (matrix spikes, matrix spike duplicate and matrix duplicate samples). Table 7-2 presents a summary of the various quality control samples that will be collected to support environmental monitoring activities.

Quality control samples will be collected for each defined matrix. The matrices associated with the environmental monitoring samples are the Weldon Spring quarry groundwater, the St. Charles well field groundwater, the quarry surface water, the Weldon Spring Chemical Plant groundwater, and the chemical plant surface water. Quality control samples are also collected for National Pollutant Discharge Elimination System (NPDES) samples and airborne radiological monitoring programs.

Quality control data will be summarized in the annual site environmental report, which will also contain an evaluation of the performance of the WSSRAP data collection and analysis program. The report will also specify the precision and accuracy by matrix to determine the variability of the analyses.

TABLE 7-2 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
Blind Duplicate/Secondary Duplicate	As needed/1 per 20	Assess matrix, intralaboratory, and interlaboratory variability.
Field Replicate	1 per month	Assess matrix, intralaboratory, and field operations variability
Equipment Blank (non-dedicated equipment only)	1 per 20	Assess effectiveness of decontamination
Distilled Water Blank **	1 per month	Assess quality of distilled water
Trip Blank	1 pair per cooler containing VOA samples	Assess potential VOA cross-contamination during shipping
Field Blank**	1 per month	Assess impact of ambient conditions on samples

* 1 per 10 single batches for quarry and site water treatment plants.
** Collected together on the same day.

Contracted laboratories will be required to submit for review all applicable performance evaluation samples from external programs, such as the Environmental Protection Agency environmental monitoring systems laboratory and Department of Energy environmental measurements laboratory programs. Evaluation of performance evaluation samples will be made by the Project Management Contractor during laboratory assessments to determine if quality control is being met by the contracted laboratories.

7.2.3 Analytical Methods

Standardized analytical methods, procedures, and protocols that are used to analyze samples collected for the environmental monitoring plan are contained in Appendix B. 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 WSSRAP standard operating procedures. Variations of contracted laboratories' standard operating procedures are approved and controlled by the Data Validation Group and Project Quality Department. Appendix B also has a summary of the accuracy and precision requirements and is taken from the *Sample Management Guide* (Ref. 23).

7.2.4 Data Management Activities and Data Quality Evaluations

Overall environmental data management activities for the Weldon Spring site are detailed in the *Sample Management Guide* (Ref. 23). The *Sample Management Guide* provides guidance for the development of sampling plans, describes data management activities, and details general data quality requirements. These general data quality goals have been adopted for this monitoring program. The primary activities associated with this environmental monitoring program include data verification, database management, and data validation. These programs document the quality of data generated by on-site and off-site analyses of samples.

Data verification is the WSSRAP's process of reviewing the sampling documentation and analytical data to ensure that adequate documentation is maintained and that all results are reported in compliance with established reporting requirements. All data generated by analytical laboratories for the *Environmental Monitoring Plan* are verified. The verification process consists of reviewing for transcription errors, reviewing sampling documentation and chain-of-custody documentation, comparing actual holding times to method specified holding times, and a review of the data for comparability with historical results. All of these activities are documented according to Procedure ES&H 4.9.1.

Following completion of data verification, data are merged into the site database and are available for general use. All databases are backed up regularly. To maintain the integrity of the computer files, access to edit the data base is restricted.

Data validation is an independent formal review of laboratory records performed by WSSRAP personnel to assess the quality of the reported data. Actual laboratory records are reviewed by data validation personnel to determine whether the analytical instruments were within calibration, to ensure the analytical procedures were followed, to ensure quality control samples were within their respective acceptance limits, and to ensure that adequate

documentation is available to support the validity of the data. Data validation is performed on approximately 10% of all the data generated which are randomly selected by the validation group. Validation activities provide the WSSRAP with qualified data and evaluate completeness of analytical data from the individual laboratories. All validated data receive a database qualifier that provides information for data users to evaluate the useability of the data. These activities are performed and documented in accordance with Procedure ES&H 4.9.2.

7.2.5 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 verification and validation documentation records are all considered quality assurance records and are maintained by the Project Quality Department in accordance with the requirements of Procedure SQP-7. This provides both security and protection for these records.

7.2.6 Assessments

Three aspects of the WSSRAP are assessed to evaluate the quality-related activities of the environmental monitoring program. These include analytical laboratories, sample collection activities, and programmatic procedures.

Analytical laboratories performing analyses for the site are assessed on scheduled intervals (i.e., annually or biennially). These assessments are directed by a lead assessor from the Project Quality Department, with support provided by a team of site personnel who have knowledge of analytical methods and procedures. These assessments focus on compliance with the specifications of the contract, the project-specific *Quality Assurance Project Plan* (QAPjP) prepared by the laboratories prior to performing sample analysis, and with laboratory-specific procedures and policies. An assessment report is generated and corrective actions tracked by the Project Quality Department.

The Project Quality Department routinely assess site operations, including environmental monitoring activities. These assessments evaluate compliance with project-specific procedures. As with all other assessments, an assessment report is generated and corrective actions are tracked by the Project Quality Department. The department also reviews and approves all new

and revised standard operating procedures to verify that they comply with quality related activities.

The Weldon Spring site is also routinely assessed by numerous external entities including Department of Energy - Headquarters and Department of Energy - Oak Ridge. These assessments address compliance with applicable regulations, and Department of Energy orders guidance, site plans, and procedures. Formal reports and corrective actions are tracked using the Site Wide Assessments Tracking System (SWATS).

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5500.6B	*Shutdown of Departmental Operations Upon Failure by Congress to Enact Appropriations*
5500.7B	*Emergency Operating Records Protection Program*
5500.8A	*Emergency Planning and Management*

5500.9A	*Emergency Planning, Preparedness, and Response to Continuity of Government Emergencies*
5500.10	*Emergency Readiness Assurance Program*
5500.11	*Power Marketing Administration Emergency Management Program*
5632.7A	*Protective Force Program*
5700.6C	*Quality Assurance*

FEDERAL AND STATE REGULATIONS

40 CFR 141, *National Primary Drinking Water Regulations*
40 CFR 246, *Source Separation for Materials Recovery Guidelines*
40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*
10 CSR 20-6.010, *NPDES Construction and Operating Permits*
10 CSR 20-7.015, *Effluent Regulations*
10 CSR 20-7.031, *Water Quality Standards*

PROCEDURES

ES&H 1.1.7	*Environmental Data Review and Above Normal Reporting*
ES&H 2.6.4	*Ludlum Model 2000 Scaler and Model 43-10 Detector: Gross Alpha Measurement Operation and Calibration*
ES&H 2.6.5	*Calibration and Operation of the KPA-11 Kinetic Phosphorescence Analyzer*
ES&H 2.6.7	*Calibration and Operation of the HT-1000 Low Background Gas Flow Proportional Counter*
ES&H 4.1.1	*Environmental Numbering System*
ES&H 4.1.2	*Chain of Custody*
ES&H 4.1.3	*Sampling Equipment Decontamination*
ES&H 4.1.4	*Packaging and Shipping Requirements for Non-regulated Samples*
ES&H 4.2.1	*Erosion Control Survey*
ES&H 4.3.1	*Surface Water Sampling*
ES&H 4.4.1	*Groundwater Sampling*
ES&H 4.4.2	*Groundwater Level Monitoring and Well Integrity Inspections*

ES&H 4.4.5	*Soil/Sediment Sampling*
ES&H 4.5.1	*pH and Temperature Measurements in Water*
ES&H 4.5.2	*Specific Conductance Measurement in Water*
ES&H 4.5.7	*Measurement of Settleable Solids*
ES&H 4.5.8	*Water Sampling Filtering*
ES&H 4.6.1	*Environmental TLD Deployment and Handling*
ES&H 4.6.2	*Radon Concentration Measurement in Ambient Air*
ES&H 4.6.4	*Constant Flow Low Volume Air Sampler Operation and Air Sample Filter Handling*
ES&H 4.6.6	*Constant Flow High Volume Air Sampler Operation and Air Sample Filter Handling*
ES&H 4.6.7	*RGA-40 Radon Gas Monitor: Operation and Data Handling*
ES&H 4.6.8	*WLM-30 Radon Daughter Monitor: Operation and Data Handling*
ES&H 4.6.9	*Electret Radon and Thoron Gas Monitor: Operation and Data Handling*
ES&H 4.6.10	*Operation of the Niton RAD7 Radon Detector*
ES&H 4.6.11	*Operation of the Pylon WLX Working Level Monitor*
ES&H 4.6.12	*Calibration of the Pylon WLX Working Level Monitor Using the RN-190 and TH-190 Daughter Standards*
ES&H 4.8.3	*The WSSRAP Meteorological Monitoring Station*
ES&H 4.9.1	*Environmental Monitoring Data Verification*
ES&H 4.9.2	*Environmental Monitoring Data Validation*
ES&H 4.9.3	*Data Review Procedure for Surface Water, Groundwater, and Soils*
CM&O 15	*Task-specific Safety Assessments*
RC-5	*Occurance Reporting*
RC 30	*Monitoring Well Waste Management*
SQP 2	*Quality Assurance Surveillance*
SQP 7	*Quality Assurance Records*
SQP 14	*Nonconformance and Corrective Action*
SQP 18	*Independent Assessments*
SQP 26	*Site Wide Audit Tracking*

APPENDIX A
Environmental Monitoring Plan Guidance Requirements

PREFACE

The *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (Ref. 4) establishes elements of a radiological effluent monitoring and environmental surveillance program in support of DOE Orders 5400.5 and 5400.1.

The *Regulatory Guide* states that "should*" statements are those activities that are high priority elements of a monitoring program. The WSSRAP has implemented this statement by addressing "should*" statements as "shall" statements which must be incorporated, unless otherwise justified. Appendix A contains these "should*" statements and cites the EMP section that satisfies them or, if statements are not applicable, provides justification for not satisfying the statements.

1.0 INTRODUCTION

1.1 As required in the Environmental Monitoring Requirements section of DOE 5400.1, all DOE sites should* develop and maintain documentation concerning their environmental protection programs in the form of environmental monitoring plans.

The WSSRAP has prepared this environmental monitoring plan to meet the requirements for U.S. Department of Energy environmental monitoring programs as specified in Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*.

1.2 These required plans should* clearly describe how the minimum requirements in this document are to be met and how compliance will be ensured.

This *Environmental Monitoring Plan* defines the effluent monitoring and environmental surveillance required to comply with applicable Federal, State, and local environmental protection laws and regulations, Executive Orders, and internal Department of Energy policies. The environmental monitoring plan is made available to the State and Federal regulatory agencies.

1.3 In meeting the minimum requirements, each site should* also consider the guidance provided in this document as "should" statements and document the specific procedural criteria that are adopted.

An evaluation of the applicability or nonapplicability of should* guidance provided in the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* has been included in the *Environmental Monitoring Plan* in accordance with the above-referenced guide. Other recommendations have been evaluated and included in this document where applicable.

2.0 LIQUID EFFLUENT MONITORING

2.1 All liquid effluent streams from DOE facilities should* be evaluated and their potential for release of radionuclides assessed.

Sections 2.2 and 2.2.1. All liquid effluent streams have been and/or will be assessed. The effluent streams are monitored under the provisions of the Weldon Spring Site Remedial Action Project (WSSRAP) National Pollutant Discharge Elimination System (NPDES) permits. The effluent streams include four storm water outfalls, two water treatment plant discharges, one sanitary wastewater treatment plant discharge, and an undetermined number of storm water outfalls from the borrow area and borrow area haul road.

2.2 The results of this assessment provide the basis for the facility's Effluent Monitoring Program (DOE 5400.5), which should* be documented in the site Environmental Monitoring Plan (as described in DOE 5400.1)

Section 4. The results of the assessments provide the basis for the environmental monitoring plan as noted in Section 4 of the environmental monitoring plan. The NPDES permits provide the basic monitoring program which has been expanded to form the complete effluent monitoring program.

2.3 Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination should* be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.

Section 2.0 and 4.1. The WSSRAP is not an operating facility. Storm water discharges are monitored and average below the derived concentration guideline (DCG) for uranium. Discharges that have a potential for radioactive contamination (site and quarry water treatment plants) will be sampled, analyzed and shown in compliance before discharge is allowed.

2.4 Facility operators should* provide monitoring of liquid waste streams adequate to 1) demonstrate compliance with the applicable requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a, and 3, 2) quantify radionuclides released from each discharge point, and 3) alert affected process supervisors of upsets in processes and emission controls.

Section 4. No process water is discharged from the WSSRAP; however, storm water, construction water, treated water, etc., is monitored to satisfactorily demonstrate compliance with Department of Energy Order 5400.5 Chapter II, paragraphs 1a, 1d, 2a, and 3, and quantify radionuclides. Discharge from the water treatment plants to holding ponds which will be batch tested and released only if compliance is met.

2.5 When continuous monitoring or continuous sampling is provided, the overall accuracy of the results should* be determined (± % accuracy and the % confidence level) and documented in the Environmental Monitoring Plan.

Section 4.1.2. The only continuous monitoring that occurs is for flow monitoring at NPDES outfalls NP-0002, NP-0003, NP-0005, NP-0007, and NP-1001.

2.6 In addition, provisions for monitoring of liquid effluents during an emergency should* be considered when determining routine liquid effluent monitoring program needs.

Section 4.1.4.4. Emergency monitoring of liquid effluents is performed in the event that contaminated water is accidentally released before treatment or in the event of spills.

2.7 In addition, the selection or modification of a liquid effluent monitoring system should* be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.

Section 2.2. The rationale for the liquid effluent monitoring program includes a characterization of the sources, pollutants, sample collection systems, treatment systems,

and final release points. The NPDES permits also partially prescribe the parameters to be monitored.

2.8 For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a pre-operational assessment should* be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.

Section 4. The WSSRAP is not an operating facility; therefore, there are no process effluents. However, there have been assessments made to determine storm water and treated water flows and characteristics.

2.9 The performance of the effluent monitoring systems should* be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guides (DCGs) specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.

Section 4 and 7. The effluent monitoring systems are sufficient to determine if the effluent releases are within the DCGs described in Department of Energy Order 5400.5.

2.10 The required detection levels of the analysis and monitoring systems should* be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.

Section 7.2.3 and Appendix B. Required detection levels are adequate for NPDES monitoring and to demonstrate compliance with all regulatory requirements.

2.11 Sampling systems should* be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.

Section 4. Sampling of liquid effluents are performed in accordance with WSSRAP standard operating procedures in order to provide representative samples, to predict trends, record releases, and to quantify releases.

2.12 Continuous monitoring and sampling systems should* be calibrated before use and recalibrated any time they are subject to maintenance, modification or system changes that may affect equipment calibration.

Section 4. The only continuous monitoring systems for effluents are the flow meters at NP-0002, NP-0003, and NP-0005 and the flow meters at the site and quarry water treatment plants.

2.13 In addition, they should* be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.

Section 4. The flow meters will be recalibrated at least annually and will be routinely checked in accordance with WSSRAP standard operating procedures.

2.14 Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) should* be considered when locating sampling and monitoring systems to avoid conditions that will influence the operation of the system.

Flow meters and automatic water samplers are the only sampling and monitoring systems and are designed for use under the existing conditions at the WSSRAP.

2.15 Off-line liquid transporting lines should* be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.

This statement does not apply. The only off-site liquid transporting lines will be from the site and quarry water treatment plants. These lines will transport treated water that is sampled before entering the lines to ensure its composition.

2.16 If continuous monitoring/sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances should* be documented in the Environmental Monitoring Plan.

This statement does not apply. One storm water outfall does not have continuous flow monitoring. Outfall NP-0010 is normally dry and is a very shallow swale. The flows are very low and normally non-existent making it impractical to use continuous monitoring.

2.17 Sampling/monitoring lines and components should* be designed to be compatible with the chemical and biological nature of the liquid effluent.

Section 4. The liquid effluent is water, which is compatible with sampling/monitoring lines and components.

2.18 The output signal instrumentation, monitoring system recorders, and alarms should* be in a location that is continuously occupied by operations or security personnel.

This statement does not apply. There are no industrial processes. When the site and quarry water treatment plants begin operation, they will be manned 24 hours a day; however, there will not be a continuous release of treated water. Water will only be released in batches after it is tested and found to be under permitted limits.

2.19 To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems are required, they should* have alarms set to provide timely warnings.

This statement does not apply. There is no continuous monitoring of effluent related to public exposure since the WSSRAP is not an operating facility.

2.20 As they apply to the monitoring/sampling of liquid effluents, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. All sampling and monitoring activities are performed in accordance with the general quality assurance program provisions.

3.0 AIRBORNE EFFLUENT MONITORING

3.1 All airborne emissions from DOE-controlled facilities [a] should* be evaluated and their potential for release of radionuclides assessed.

Section 4.2.1. The WSSRAP has one diffuse source of airborne radiological emissions: the Weldon Spring Chemical Plant/raffinate pits area. An assessment of the diffuse source was conducted and included documenting the different radionuclides that could potentially be released and their concentrations. The assessment also addressed the factors that could potentially contribute to the suspension of contaminants.

3.2 The potential for emissions should* include consideration of the loss of emission controls while otherwise operating normally.

Section 4.2.1. Normal operations, consisting of remediation activities, will result in limited emissions due to the disturbance of soils and materials. Engineering controls including water spraying, cleaning of surfaces prior to movement, radon capturing systems, and high efficiency particulate air (HEPA) filtration have been incorporated into the remediation activities in order to prevent uncontrolled emissions. An assessment of

airborne emissions which included loss of emissions controls, was performed for the chemical stabilization/solidification pilot plant.

3.3 **The results of this evaluation also provide the basis for the site's effluent monitoring program (as discussed in DOE 5400.5), which should* be documented in the site Environmental Monitoring Plan (as discussed in DOE 5400.1).**

Section 4.2.1. The airborne emissions assessment provides a basis for the airborne emissions monitoring program and ensures that the design of the plan would provide timely, representative, and adequately sensitive monitoring results in accordance with Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.4 **Airborne emissions from DOE-controlled facilities that have the potential for causing doses exceeding 0.1 mrem (effective dose equivalent) to a member of the public under realistic exposure conditions from emissions in a year should* be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.**

Section 4.2. Although the estimated exposures from the chemical plant and raffinate pits and the quarry, including the water treatment plants are predicted to be low, the emissions monitoring program is tailored for the low potential for exposure and in accordance with Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.5 **The criteria listed in Table 3-1 (of the Regulatory Guide) should* be used to establish the airborne emission monitoring program for DOE-controlled sites.**

Section 4.2. The WSSRAP airborne emissions monitoring plan has taken into account the criteria for monitoring the emissions with respect to the calculated maximum annual effective dose equivalent to members of the public.

3.6 For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a pre-operational assessment should* be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.

Section 4.2.1. Engineering controls will be employed to minimize levels to those which are as low as reasonably achievable (ALARA). Engineering process documentation is used to determine the types and quantities of expected emissions and associated airborne monitoring requirements.

3.7 The performance of the airborne emissions monitoring system should* be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.

Section 4.2.2. The airborne emissions monitoring system is divided into three sections: site specific monitoring, site perimeter monitoring, and critical receptor monitoring at, and in the vicinity of, both the chemical plant and the quarry. This three-staged approach is designed to monitor the smaller sources in order to discern each source's contribution to the total amount of airborne emissions from either the chemical plant or the quarry. This approach will allow for quicker remedial action in the event elevated emissions are indicated at a specific work area, and in order to remain in compliance with the limits or requirements specified in Department of Energy Order 5400.5.

3.8 Sampling and monitoring systems should* be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.

Sections 4.2.2.1, 4.2.2.2, and 4.2.2.3. Sampling systems are calibrated in accordance with WSSRAP standard operating procedures and manufacturers' specifications.

3.9 Sampling and monitoring systems should* be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.

Section 4.2.2.1, 4.2.2.2, and 4.2.2.3. Monitoring systems are calibrated as stated in item 3.8, above.

3.10 Provisions for monitoring of airborne emissions during accident situations should* be considered when determining routine airborne emission monitoring program needs.

Section 4.2.2.1. Three air monitoring programs are utilized at the WSSRAP to monitor site specific areas, perimeter areas, and critical receptors. Site specific monitoring, in addition to providing data concerning the contributions of specific activities to the total airborne inventory, will provide faster feed back concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific monitors will be collected on a daily basis as compared to weekly for the perimeter samplers in order to assess the possibility of accidental release of airborne contaminants. Monitors will be placed immediately outside the work areas based on current meteorological conditions to assess airborne emissions from specific activities and areas within the quarry.

3.11 Diffuse sources should* be identified and assessed for their potential to contribute to public dose and should* be considered in designing the site effluent monitoring and environmental surveillance program.

Section 4.2.1. The chemical plant and raffinate pit area are the diffuse sources at the WSSRAP. To effectively monitor these sources, three air monitoring programs will be utilized to monitor the site-specific areas, the perimeter areas, and the critical receptors. The characteristics of these areas were used to determine the locations, equipment, sampling time, minimum detection levels, accuracy, and investigation levels for each program. These programs are designed to meet the requirements of Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide*.

3.12 Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations should* be identified, assessed, documented, and verified annually.

Section 4.2.1. Two diffuse sources, the chemical plant and the quarry, are monitored under the airborne effluent and environmental surveillance program due to their potential to contribute a significant fraction of the dose to members of the public. These sources are evaluated annually in the *Environmental Monitoring Plan* which is revised annually for the WSSRAP.

3.13 Airborne emission sampling and monitoring systems should* demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.

Section 4.2.2. The employment of site specific monitoring will ensure that response to elevated airborne emissions will be timely, representative, and adequately sensitive.

3.14 However, where a significant potential (greater than once per year) exists for approaching or exceeding a large fraction of the emission standard (e.g., 20%), continuous monitoring should* be required.

Section 4.2.2. Although it is not expected that airborne emissions will exceed the emission standard, continuous monitoring is performed at the site perimeter and at the critical receptor locations. Continuous monitoring is performed during work hours at site specific locations.

3.15 Design of systems such that replacement of sorbent and filter should* not disturb the geometry between the collector and detectors.

Radioiodine monitors which require the replacement of sorbent and filter are not employed at the WSSRAP. The WSSRAP utilizes portable air samplers, mass flow meters, gas-flow proportional detectors, and alpha-scintillation detectors.

3.16 To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in 3-1) are required, they should* have alarms set to provide timely warnings.

Real-time, continuous air monitoring is not performed at the WSSRAP due to the nature of operations and activities. Rather, critical receptor monitoring is performed to assess the effects of airborne effluents from the site.

3.17 As they apply to the monitoring of airborne emissions, the general quality assurance program provisions discussed in Chapter 10 should* be followed.

Quality control procedures which are implemented as part of the airborne effluent and environmental monitoring program include calibration of instruments, source and background counts, recounts of samples, review of documentation, and use of documented standard operating procedures. Additional quality assurance/quality control procedures which are employed in this program include duplicates, spikes, chain-of-custody and laboratory authorization forms, field sheets, and review of vendor data all in accordance with WSSRAP standard operating procedures.

4.0 METEOROLOGICAL MONITORING

4.1 Each DOE site (facility)[a] should* establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.

Section 5. The Weldon Spring Quarry is located approximately 4 km (2.4 mi) south-southwest of the Weldon Spring Chemical Plant and raffinate pits area. The quarry is located 200 m (650 ft) above Mean Sea Level (MSL) and the chemical plant and raffinate pits are located 153 m (500 ft) above MSL. It has been determined that the quarry and the chemical plant meteorological conditions do not differ significantly and do not require separate meteorological monitoring stations. The meteorological monitoring station is located at eastern edge of the chemical plant and is more than 122 m (400 ft) from the nearest building.

4.2 The scope of the program should* be based on an evaluation of the regulatory requirements, meteorological data needed for impact assessments, environmental surveillance activities, and emergency response.

Section 5. The meteorological information is used to support many WSSRAP environmental surveillance programs functions such as dispersion and diffusion modeling, ecological studies, hydrological analyses, and emergency response actions.

4.3 The site's meteorological program should* be documented in a meteorological monitoring section of the Environmental Monitoring Plan (DOE 5400.1).

Section 5. The meteorological program, consisting of parameters measured, instrumentation, and computer programs and models, is reviewed annually and documented in the environmental monitoring plan.

4.4 For data from an off-site source to be acceptable, the data should* be representative of conditions at the DOE facility and provide statistically valid data consistent with on site monitoring requirements.

The meteorological data utilized at the WSSRAP is obtained from an on-site meteorological monitoring station. During down time data from Lambert International Airport will be utilized. On-site meteorological data is reviewed monthly and has been determined to be comparable to Lambert International Airport data.

4.5 Specific meteorological information requirements for each facility should* be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of other DOE facilities.

Section 2. The exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered and then using site specific factors, determining those routes which will be evaluated in the environmental surveillance program. The meteorological measurements and frequencies were determined based on these criteria.

4.6 Meteorological information requirements for facilities should* be sufficient to support environmental monitoring and surveillance programs.

Section 5. Meteorological information requirements take into account the information required to support the environmental monitoring and surveillance programs as outlined in Item 4.3.

4.7 The meteorological monitoring program for each DOE site should* provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.

Section 5. Meteorological monitoring station data provides information pertinent to dispersion and diffusion modeling to supplement critical receptor monitoring in the event of an airborne release. The computer programs CAP-88 and ISCST3, employing information from the monitoring station, are EPA-approved atmospheric dispersion models designed to provide a schematic view of dispersion at the WSSRAP.

4.8 Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based should* be evaluated and the evaluation results documented.

Section 5. The WSSRAP will use the programs CAP-88 or ISCST3 if necessary. These models are based on the assumptions of steady-state Gaussian principles.

4.9 Meteorological programs for sites where on site meteorological measurements are not required should* include a description of climatology in the vicinity of the site and should* provide ready access to representative meteorological data.

Meteorological measurements are required for activities performed at the WSSRAP.

4.10 Potential release modes, distances from release points to receptors, and meteorological conditions should* be considered in assessments for DOE facilities required to take on-site measurements.

Section 2 and 5. An exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered and then using site-specific factors to determine those routes which will be evaluated in the environmental surveillance program. Meteorological conditions, such as prevailing wind direction and speed, are taken into account in the determination of required on-site measurements.

4.11 Meteorological measurements should* be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.

Section 5. The meteorological monitoring station is located at the Weldon Spring site and, therefore, provides adequate information regarding the media into which material may be released and transported at both the chemical plant and the quarry.

4.12 The instruments used in the monitoring program should* be capable of continuous operation in the expected range of atmospheric conditions at the facility.

Section 5. Measurements for wind speed and direction, horizontal wind fluctuation, ambient air temperature, relative humidity, solar radiation, barometric pressure, and precipitation intensity and accumulation are collected and stored every 60 sec. The 1-min recordings are averaged once per hour and the data downloaded daily to a remote computer. Real-time data can also be obtained to aid site personnel observing and analyzing the dispersion of potentially released airborne material during and after an incident.

4.13 Wind measurements should* be made at a sufficient number of heights to adequately characterize the wind at potential release heights.

The wind speed and direction sensors are mounted 10 m (33 ft) above ground level. Sensors at greater heights are unnecessary since potential releases of airborne emissions are at, or near, ground level.

4.14 The meteorological monitoring program should* provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers.

Section 5. Inspection and maintenance of the meteorological monitoring station, review of meteorological data, and semi-annual maintenance, calibration, and performance checks are documented and performed in accordance with ES&H Procedure 4.8.3.

4.15 Inspections, maintenance, and calibrations should* be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations should* be kept and maintained as permanent records.

Section 5. Inspection and maintenance of the meteorological monitoring station, review of meteorological data, and semi-annual maintenance, calibration, and performance checks, are documented and performed in accordance with Procedure ES&H 4.8.3.

4.16 The instrument system should* provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.

Section 5. The meteorological monitoring system is expected to provide greater than 90% data recovery on an annual basis based on inspection and maintenance of equipment in accordance with Procedure ES&H 4.8.3.

4.17 The topographic setting of a facility and the distances from the facility to points of public access should* be considered when evaluating the need for supplementary instrumentation.

Supplementary instrumentation is not necessary due to the determination by a certified meteorologist that the chemical plant and the quarry do not have differing meteorological conditions.

4.18 If meteorological measurements at a single location cannot adequately represent atmospheric conditions for transport and diffusion computations, supplementary measurements should* be made.

Supplementary instrumentation is not necessary due to the determination by a certified meteorologist that the chemical plant and the quarry do not have differing meteorological conditions.

4.19 A site-wide meteorological monitoring program should* be established at each multifacility site to provide a comprehensive database that can be used for all facilities located within the site.

The WSSRAP is not a multifacility site and the meteorological condition for the chemical plant and the quarry have been determined to be similar.

4.20 As they apply to meteorological monitoring, the general quality assurance program provisions described in Chapter 10 should* be followed.

Section 5. Inspection and maintenance of the meteorological monitoring station, review of meteorological data, and semi-annual maintenance, calibration, and performance checks are documented and performed in accordance with ES&H Procedure 4.8.3.

5.0 ENVIRONMENTAL SURVEILLANCE

5.1 An evaluation should* be conducted and used as the basis for establishing an environmental surveillance program for all DOE-controlled sites.

Section 2. The WSSRAP Environmental Monitoring Program has been established and modified yearly as a result of the evaluation of environmental conditions, pathway analyses, and Federal, State, and local laws and environmental protection regulations, Executive Orders, and internal Department of Energy policies.

5.2 The results of this evaluation should* be documented in the site Environmental Monitoring Plan (as required by DOE 5400.1).

Sections 3 and 7. This *Environmental Monitoring Plan* summarizes the environmental surveillance sampling or measurement locations for both the Weldon Spring Chemical Plant and raffinate pits area and the Weldon Spring Quarry sites and the minimum required analyses or measurement frequencies for these locations in order to adequately ensure the protection of the public and the environment. These locations are sampled or measured in accordance with documented standard operating procedures which incorporate U.S. Environmental Protection Agency and Department of Energy guidance and standard industry practices. The minimum detection level and accuracy of the analyses or measurements are in accordance with Federal, State, and local laws and environmental protection regulations, Executive Orders, and internal Department of Energy policies. The quality of the Environmental Monitoring Program is maintained and documented by standard operating procedures, quality control samples, performance audit samples, standardized analytical methods, data management, data quality evaluations, quality assurance records, self assessments, laboratory audits, and quality audits. If above normal or anomalous data values are suspected after review of data, written standard operating procedures regarding actions and reporting are employed.

5.3 The environmental surveillance program for DOE-controlled sites should* be conducted in accordance with the requirements of DOE 5400.1 and DOE 5400.5.

Section 3. The environmental surveillance program has been prepared to meet the requirements for Department of Energy environment monitoring programs as specified in Department of Energy Orders 5400.1 and 5400.5 and the *Regulatory Guide for*

Radiological Effluent Monitoring and Environmental Surveillance, as well as applicable Federal, State, and local laws and environmental protection regulations.

5.4 The criteria for environmental surveillance programs (listed in 5-1) should* be used for establishing the environmental surveillance program for DOE-controlled sites.

Section 3. Criteria listed in 5-1 of the *Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* were used in the establishment of the environmental surveillance program and are further discussed in items 5.6 through 5.10.

5.5 Any additional site-specific criteria should* be documented in the site Environmental Monitoring Plan.

Additional site specific criteria which effect or alter the criteria listed in 5-1 are documented in the *Environmental Monitoring Plan* and discussed in items 5.6 through 5.10.

5.6 When feasible, all environmental media that, as determined by site-specific radiation exposure pathway analysis, might lead to a measurable annual dose of site origin at the site boundary should* be routinely sampled and analyzed (for the critical radionuclides to dose) and routine measurements of penetrating radiation should* be performed at those sites that, as determined by site-specific exposure pathway analysis, might result in an annual dose of site origin at the site boundary, if the total exceeds a) 5 mrem effective dose equivalent; or b) 100 person-rem collective effective dose equivalent within a radius of 80 km of a central point in the site.

Sections 3 and 4.2. Measurements are made as determined by the site specific pathway analysis within the site boundaries, at the site boundaries, and at points outside the site boundaries as outlined in the previously mentioned Sections.

5.7 Environmental surveillance measurements may be performed periodically, but should* be performed at least every five years, to confirm the low dose levels, if the projected annual effective dose equivalent of site origin is $\leq$0.1 mrem.

Sections 3 and 4.2. Environmental surveillance is performed on a regular basis as specified in the previously mentioned sections.

5.8 Actual measurements on two media for each critical radionuclide/pathway combination, one of which might be the effluent stream, should* be performed as part of the site routine effluent monitoring and environmental surveillance program.

Measurements on two media for each critical radionuclide/pathway combination are not necessary due to extensive characterization of the media and historic monitoring. The *Environmental Monitoring Plan* has been designed to take into account the radionuclide/pathway combinations requiring environmental surveillance.

5.9 Use of data should* be based on statistically significant differences between the point of measurement and background (or control) data.

Background sampling or measurement locations have been established for all pathway media at both the chemical plant and the quarry. In an agreement with the U.S. Geological Survey, the Department of Energy has established background for the Missouri River Alluvium by the sampling of seven temporary wells installed by the U.S. Geological Survey. Background locations for both the Little Femme Osage Creek and the Missouri River are monitored routinely. Background for groundwater at the Weldon Spring Chemical Plant and raffinate pits area is based on the results of an ongoing sampling program by the Missouri Department of Health. Private drinking water wells in the vicinity of the chemical plant are routinely monitored by that department and the results provided to the WSSRAP, therefore, these locations are not routinely monitored as background locations. Several lakes in the Busch Wildlife Area and Dardenne Creek are sampled routinely as background locations for surface waters near the chemical plant. The Remedial Investigation for the Weldon Spring site has established statistical background levels for chemical constituents at the Weldon Spring site. A background

air monitoring station is monitored routinely to establish background levels for the chemical plant and the quarry. The background monitoring station is located approximately 12.9 km (8 mi) from the chemical plant and 11.3 km (7 mi) from the quarry.

5.10 Provisions should* be made, as appropriate, for the detection and quantification of unplanned releases of radionuclides to the environment.

Source measurement and control of all contained surface water is performed at the Weldon Spring site to prevent the release of radionuclide to the groundwater and surface waters. Monthly storm water sampling is performed to monitor the transport and release of radionuclides at the Weldon Spring site. Perimeter air monitoring is performed routinely, as well as work place monitoring, to determine releases of radionuclides at the Weldon Spring site.

Section 4.2.2.1. Three air monitoring programs are utilized at the WSSRAP to monitor site specific areas, perimeter areas, and critical receptors. Site specific monitoring, in addition to providing data concerning the contributions of specific activities to the total airborne inventory, will provide faster feedback concerning the effectiveness of engineering controls and data concerning dispersion patterns. Filters from site-specific monitors will be collected on a daily basis as compared to weekly for the perimeter samplers, in order to assess the possibility of accidental release of airborne contaminants. Site-specific monitoring will be utilized during remediation activities at the Weldon Spring Quarry. Monitors will be placed immediately outside the work areas based on current meteorological conditions to assess airborne emissions from specific activities and areas within the quarry.

5.11 The need for environmental sampling and analysis should* be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne).

Section 2. The exposure pathway analysis for the WSSRAP was performed to evaluate the impact on human or ecological receptors due to radiological effluent or emissions from the WSSRAP. Sampling or measurement locations were determined based on this

exposure pathway analysis in order to ensure the protection of the public and the environment.

5.12 This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations should* be documented in the site Environmental Monitoring Plan.

Section 2. The exposure pathway analysis was performed by initially determining the potential exposure routes and the factors to be considered, and then using site specific factors, determining those routes which should be evaluated in the environmental surveillance program. The selection samples, measurements, and locations were determined based on the selected exposure routes.

5.13 A critical pathway analysis (radionuclide/ media) should* be performed, documented, and referenced in the annual Site Environmental Report.

The critical pathway analysis is revised annually for inclusion in both the environmental monitoring plan and the annual site environmental report.

5.14 If the projected dose equivalent from inhalation of particulates exceeds the criteria of 5-1, particle-size analysis of the emission should* be conducted at least annually.

Sections 4.2.1.1 and 4.1.1.2. Particle size analysis will be performed on an annual basis on specific sources which have higher potential for airborne emissions.

5.15 For all new or modified facilities coming on-line, a pre-operational assessment should* be made and documented in the site Environmental Monitoring plan to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.

Section 3. Two water treatment plants were operational in 1993 and the chemical stabilization/solidification pilot facility is expected to be operational in 1995. Additional

monitoring of these facilities prior to operation was performed based on a pre-operational assessment as to the types and quantities of effluents from the facility and establish pre-operational characteristics of the groundwater, surface water, and ambient air at the Weldon Spring site.

Preoperational monitoring is also being performed prior to the construction of the disposal cell and supporting facilities, which will disrupt large areas of the chemical plant area.

Section 4.2.1. Engineering controls will be employed to minimize levels to those which are ALARA. Engineering process documentation is used to determine the types and quantities of expected emission and associated airborne monitoring requirements.

5.16 Calibration of dosimeters and exposure-rate instruments should* be based on traceability to National Institute for Standards and Testing (NIST) standards.

Sections 4.2 and 3.3.4. Calibration of monitoring systems requiring known value sources is performed using NIST traceable radioactive sources.

5.17 Gross radioactivity analyses should* be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.

Section 4.2.3.3. The WSSRAP has done extensive characterization of the Weldon Spring Chemical Plant and raffinate pits area and the Weldon Spring Quarry to provide reliable relationships between radionuclides. In addition, the WSSRAP continues to perform radionuclide specific analysis such as the critical receptor monitoring program.

5.18 The overall accuracy (±% accuracy) should* be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements for beta-gammas, alphas, and neutrons should* be determined and the two levels documented in the site Environmental Monitoring Plan.

Sections 4.2.2.1 and 4.2.2.2. The overall accuracy and the approximate Environmental Detection Limit for the environmental measurements are documented in the previously mentioned Sections.

5.19 Sample preservation methods should* be consistent with the analytical procedures used.

Section 6. Preservation of environmental samples is performed in accordance with Environmental Protection Agency methodology for the analyses of specific parameters.

5.20 All environmental surveillance techniques should* be designed to take a representative sample or measurement of the important radiation exposure pathway media.

Sections 3, 4, and 7. The environmental sampling techniques employed at the Weldon Spring site are performed in accordance with documented standard operating procedures in order to obtain representative samples of the media.

5.21 Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those that contribute 10% or more to off site dose greater than 0.1 mrem EDE from emissions in a year) should* take into account the half-life of the radionuclides to be measured and should* be documented in the site Environmental Monitoring Plan.

The radionuclides that exist at the WSSRAP which contribute 10% or more to off-site dose all have lengthy half-lives and would have no significance on the sampling frequency.

5.22 "Background" or "control" location measurements should* be made for every significant radionuclide and pathway combination (e.g., those that contribute 10% or more to off site dose greater than 0.1 mrem EDE from emissions in a year) for which environmental measurements are used in the dose calculations.

Section 3. Background sampling and measurement locations have been designated for both the Weldon Spring Chemical Plant and raffinate pits area and the Weldon Spring Quarry sites for all exposure media routes.

5.23 An annual review of the radionuclide composition of effluents or emissions should* be made and compared with those used to establish the site Environmental Monitoring Plan.

Section 3 and 4. The radionuclide composition of exposure media at the chemical plant and the quarry sites are determined annually for evaluation of additional environmental surveillance.

5.24 Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, should* be documented in an approved revised site Environmental Monitoring Plan.

Sections 1 and 6.4. The WSSRAP *Environmental Monitoring Plan* is reviewed annually due to the complexity and evolution of the remedial work being performed. A revised *Environmental Monitoring Plan* will be issued if it is determined that the monitoring program does not satisfy the requirements of the Department of Energy orders and applicable requirements or if there is a significant change in requirements. All variances from the program scope are documented in a memorandum to project management and reported in the annual Site Environmental Report.

5.25 The air sampling rate should* not vary by more than ±20% and total air flow or total running time should* be indicated; air sampling systems should* be leak-tested, flow-calibrated, and tested and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.

Section 4.2.2.1, 4.2.2.2, and 4.2.2.3. Sampling systems are calibrated in accordance with WSSRAP standard operating procedures and manufacturers' specifications. Alpha-scintillation detectors are calibrated a minimum of every six months using NIST traceable radioactive sources. The gas-flow proportional counter is calibrated when repairs are made to the detector or there has been a potential for drift in the readings in the equipment. The rotameter is calibrated to NIST specifications on an annual basis. If the flow rate in the field changes more than 20% during the sampling period, the air monitor will be evaluated to determine if service is required.

5.26 State and local game officials should* be consulted when selecting appropriate protected species to sample.

The ecological monitoring program is designed in close consultation with local conservation and protection agencies. Preliminary activities for annual monitoring relate to sampling of game species within the surrounding wildlife areas. State and Federal collection permits are obtained as necessary for sampling and all sampling programs are reviewed with appropriate agencies prior to work. No sampling of protected species; i.e. Federally or State listed endangered or threatened species is planned. Monitoring activities for protected species are limited to visual observations and identification for purposes of documenting occurrence of species within the Weldon Spring site area.

5.27 DOE Operations Offices and contractor staff should* ensure that groundwater monitoring plans are consistent with State and regional EPA groundwater monitoring requirements under RCRA and CERCLA, to avoid unnecessary duplication.

Section 1. The WSSRAP has prepared the *Environmental Monitoring Plan* to meet the requirements for Department of Energy environmental monitoring programs as specified in Department of Energy Orders 5400.1 and 5400.5, the *Environmental Regulatory Guide*

for Radiological Effluent Monitoring and Environmental Surveillance, and applicable Federal, State, and local laws and environmental protection regulations. Copies of the environmental monitoring plan are made available to the State and Federal regulatory agencies.

5.28 DOE Operations Offices and contractor staff should* consult with State and regional EPA personnel as needed to ensure that the requirements are incorporated into the Radiological Monitoring Plan.

Section 1. All applicable Federal, State, and local laws and environmental protection regulations regarding radiological parameters are incorporated into the environmental surveillance programs for the Weldon Spring site. Copies of the environmental monitoring plan are provided to the State and Federal regulatory agencies.

5.29 Any changes in the site-specific or generic factors should* be noted in the plan and the retired or replaced values preserved for historical purposes.

Section 2. The site-specific factors effecting the environmental surveillance program are evaluated, revised, and documented annually in the *Environmental Monitoring Plan*.

5.30 When neutron monitoring is required, the method of measurement should* be based on the anticipated flux and energy spectrum.

No significant neutron sources are present at the WSSRAP.

5.31 The sample exchange frequency for non-particulate sampling should be determined on a site-specific basis and should* be documented in the environmental surveillance files.

Sections 4.2.2.1, 4.2.2.2, and 4.2.2.3. The sampling frequency for non-particulate sampling is documented in the applicable standard operating procedures and in the previously mentioned Sections.

5.32 Liquid milk samples should be refrigerated or otherwise preserved prior to analysis; however, the analytical procedure to be used should* be considered when choosing a sample preservation method.

The 1997 environmental monitoring program does not include sampling of milk products; therefore, no sample preservation methods have been selected. Agricultural products such as corn and milo are primary foodstuffs grains within the 16 km (10 mi) monitoring area and have been sampled. The foodstuffs monitoring program is designed as a tiered sampling program.

Dairy farms are few in the area and currently three have been identified in the 16 km (10 mi) border. Air monitoring data indicate no particulate emissions that would require dairy product monitoring.

5.33 As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. All environmental surveillance activities are performed in accordance with the Department of Energy and site quality assurance program provisions.

6.0 LABORATORY PROCEDURES

6.1 Laboratory procedures and practices should* be documented in the site Environmental Monitoring Plan (in compliance with DOE 5400.1).

Section 6. All laboratories performing analysis for the environmental monitoring program have procedures and practices documented in their specific quality assurance project plans. At this time, the WSSRAP has several laboratories analyzing samples collected as part of the environmental monitoring program. In addition, the WSSRAP has a new laboratory specification that has replaced some currently used laboratories and has added new ones. Due to the large amount of information required from these laboratories, it would be impractical to document all of the procedures and practices in the *Environmental Monitoring Plan*.

6.2 Each monitoring and surveillance organization should* have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process.

Sections 3.0, 6.3, and 7.2. The WSSRAP has a sample identification system that uniquely identifies samples for collection to data submittal to database usage (Procedure-ES&H 4.1.1). Laboratories under contract to the WSSRAP generally have internal sample tracking and identification systems (unique laboratory I.D. numbers), but sample identification is reported back to the WSSRAP using WSSRAP identification numbers.

6.3 The system should* incorporate a method for tracking all pertinent information obtained in the sampling process.

Sections 6.3 and 7.2. The WSSRAP has the Field Sample Tracking (FST) and Environmental Sample Tracking (EST) systems that are used to track environmental samples from collection to receipt to invoice approval for each laboratory under contract. The WSSRAP also has the WSSRAP Information System for Archiving and Retrieving Data (WIZARD) system that is used to maintain the environmental data received from the laboratories. WIZARD is utilized to comply with Department of Energy requirements, compare data, and perform statistical analyses on routine samples that are part of the environmental monitoring program.

6.4 To prevent incorrect analysis results caused by the spread of contamination among samples, each laboratory should* establish and adhere to written procedures to minimize the possibility of cross-contamination between samples.

This requirement is not summarized in this plan. However, laboratories under contract to WSSRAP have standard operating procedures that specify identification and prevention of cross-contamination among samples. The laboratories are audited to these procedures by the site PQD on a scheduled basis. In addition, the WSSRAP Verification Group and the data reviewers request validation for data that is suspected to be in error or cross-contaminated.

6.5 High-activity samples should* be kept separate from low-activity samples.

This requirement is not summarized in this plan. However, laboratories under contract to the WSSRAP have Nuclear Regulatory Commission licenses or similar State licenses. These laboratories screen samples received from the WSSRAP to determine if they can accept the samples. According to requirements in their licenses, they can only accept samples whose activities are below specific levels. Most laboratories have controlled areas that process samples with activities above a certain level. Generally, environmental samples collected from the WSSRAP have low activity.

6.6 In addition, the integrity of samples should* be maintained; that is, the degradation of samples should* be minimized by using proper preservation and handling practices that are compatible with the analytical methods used.

Section 7. WSSRAP standard operating procedures (ES&H 4.3.1 and 4.4.1) outline the proper preservation and sample handling practices. These procedures explain what parameters are compatible with similar parameters.

6.7 To provide that the analyses performed are consistent and of the highest quality, specific analytical methods should* be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contribute 10% or more to the public dose or environmental contamination associated with the site.

Section 7.2 and Appendix B. A variety of WSSRAP and subcontractor procedures, plans, and programs are utilized to ensure that analytical methods are of the highest quality. The analytical methods are identified and documented in Sections 6.1 through 6.6 of this appendix.

6.8 Standard analytical methods should* be used for radionuclide analyses (when available), and any modification of a standard method(s) should* be documented.

Sections 6.3 and 7.2. Some radionuclide analyses have modifications to the standard method. All changes to standard methods are reviewed and approved by the Project Management Contractor prior to analyses.

6.9 In addition, methods, requirements, and necessary documentation should* be specified in any analytical contracts established with outside laboratories.

Sections 6.3 and 7.2. The specifications of the contracts with the laboratories include the requirements for documentation, methods, and other requirements regarding quality assurance. Laboratories are audited on a scheduled basis to confirm their compliance with these issues.

6.10 All sites that release or could release gamma-emitting radionuclides should* have the capability (either in-house or outside) of having samples analyzed by gamma-ray spectroscopy systems.

This requirement is not summarized in this plan. However, the WSSRAP has the capability of analyzing gamma emitting radionuclides using gamma-ray spectroscopy and also has the capability of analyzing for alpha/beta emitting radionuclides using a gas-flow proportional counter and an alpha spectroscopy system.

6.11 Counting equipment should* be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers so that accurate results are obtained.

Section 4.2. All counting equipment is calibrated using the calibration frequency recommended by the manufacturer and in accordance with Procedure ES&H 2.6.4, *Ludlum Model Scaler and Model 43-10 Detector: Gross Alpha Measurement Operation and Calibration.*

6.12 In addition, check sources should* be counted periodically on all counters to verify that the counters are giving correct results.

This requirement is not summarized in this plan. However, check sources are periodically counted to verify that the counters are giving correct results in accordance with Procedure ES&H 2.6.7, *Calibration and Operation of the WT-1000 Low Background Gas Flow Proportional Counter.*

6.13 Samples that are sent off site for analysis or for laboratory intercomparison should* be monitored for contamination and radiation levels and packaged in a manner that meets applicable transportation regulations and requirements.

This requirement is not summarized in this plan. However, samples that are sent off site for analysis are monitored for contamination and radiation levels in a manner that meets applicable transportation regulations and requirements. This is accomplished by the Site Shipping Officer, who is also responsible for properly packaging the shipments in accordance with Procedure RC-17s, *Off-site Transportation of Hazardous Materials.*

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT

7.1 The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between stations and times should* be designed with consideration of the characteristics of effluent and environmental data.

Section 6.1. Environmental data are statistically summarized using known and proven methods to determine the distribution, central tendency, dispersion, and outliers of the data. The statistical techniques take into account the characteristics of skewed distribution of time series data, high variability analytical results, missing data, and results below the analytical detection limits. All new data are evaluated against the corresponding historical statistics. Apparent outliers are only excluded from use after investigation confirms that an error has been made during sample collection, preparation, measurement, or analysis process.

7.2 Documented and approved sampling, sample-handling, analysis, and data management techniques should* be used to reduce variability of the results as much as possible.

Section 6.1. Standard operating procedures have been developed for environmental monitoring activities specific to the Weldon Spring site. These procedures have been developed from Environmental Protection Agency and Department of Energy guidance and standard industry practices. Personnel undergo training specific to their responsibilities varying from procedure review through classroom training and "hands on" training under the supervision of a qualified individual.

7.3 The level of confidence in the data due to the radiological analyses should* be estimated by analyzing blanks and spiked pseudosamples and by comparing the resulting concentration estimates to the known concentrations in those samples.

Section 6.1. Numerous quality control samples are collected in support of environmental monitoring activities including blank samples, matrix spikes, and matrix duplicates. The confidence level of the data is estimated by comparing the results of the quality control samples with known concentrations.

7.4 The precision of radionuclide analytical results should* be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.

Section 6.1. The environmental monitoring data is statistically summarized by the determination of the range, variance, and standard deviation of the data values at each sampling location.

7.5 Data should* be examined and entered into the appropriate databases promptly after analysis.

Section 6.1. Immediately upon receipt from the laboratory, all new data are verified and entered into the WSSRAP database (Section 7.2).

7.6 When selecting the data to be considered, outliers should* be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process.

Section 6.1. Apparent outliers are qualified and excluded from use only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. Procedures are employed to aid in the interpretation of the data and to improve the quality of the results from the program by helping to detect erroneous measurements.

7.7 As each data point is collected, it should* be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.

Section 6.1. All new data are evaluated against corresponding historical statistics to aid in the identification of unusual data values which may require further investigation or evaluation in accordance with WSSRAP standard operating procedures.

7.8 As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. Overall data management activities for the WSSRAP are detailed in the *Environmental Data Administration Plan*. This plan provides guidance for the development of sampling plans, describes data management activities, and details general data quality requirements. These general data quality goals have been adopted for this environmental monitoring plan. The primary activities associated with this environmental monitoring plan include data verification, database management, and data validation. These programs document the quality of data generated by on-site and off-site analyses of samples.

8.0 DOSE CALCULATIONS

8.1 Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments should*

appropriate characterize the physical and environmental situation encountered.

Section 6.2. Assessment models selected for environmental dose estimates at the WSSRAP are intended to assess accurate and realistic radiation doses to the population and to a hypothetical maximally exposed individual that could result from remediation activities. Environmental monitoring data are used either as direct input data in dose calculations or where appropriate, serves as data input in exposure and dose models.

8.2 The information used in dose assessments should* be as accurate and realistic as possible.

Section 6.2. Radiological dose assessments for selected environmental media employ data from the effluent monitoring and environmental surveillance programs in order to ensure that the data are accurate and realistic.

8.3 Complete documentation of assessments of the radiation dose resulting from the operation of DOE-controlled facilities should* be provided in a manner that supports the annual site Environmental Monitoring Report, Environmental Monitoring Plan, or other application, and show the 1) models used, 2) computer programs used, and 3) input data and data source assumptions made.

Section 6.2. The annual site environmental report includes documentation of the models, computer programs, input data, and data sources used in the assessment of radiation doses.

8.4 Default values used in model applications should* be documented and evaluated to determine appropriateness to the specific modeling situation.

Section 6.2. Model default values are evaluated to determine the appropriateness of the values as they apply to the modelling situation. The use of default values is documented with the results of dose modeling.

8.5 When performing human food chain assessments, a complete set of human exposure pathways should* be considered, consistent with current methods (IAEA 1982; Moore et.al. 1979; NCRP Report No. 76; NUREG/CR-3332).

Section 3.4.4.2 and 6.2. The foodstuffs sampling program provides data to determine the projected dose to off-site persons from an air to crop to human exposure route. A projected dose of <0.1 mrem/yr dose to a member of the public has been estimated.

8.6 Surface water and groundwater modeling should* be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.

Section 3. The WSSRAP has received no specific requirements to perform groundwater or surface water modeling from the State or regional regulators. Pursuant to CERCLA and RCRA guidance, the WSSRAP has and continues to conduct a variety of groundwater contaminant transport modeling efforts.

8.7 The general quality assurance program provisions of Chapter 10 should* be followed as they apply to performing calculations that assess dose impacts.

Section 6.2. All general quality assurance program provisions are followed as they apply to performing calculations that assess dose impacts.

9.0 RECORDS AND REPORTS

9.1 Accordingly, DOE officials and DOE management and operating contractors should* identify and comply with the relevant requirements.

Section 6. Activities at the Weldon Spring site are performed in accordance with Department of Energy Orders 5000.3A, 5400.1, 5400.5, 5284.1b. and 5484.1; National Pollution Discharge Elimination System permits issued by the Missouri Department of Natural Resources; and the *Federal Facilities Agreement*, as well as other applicable Federal, State, and local laws and environmental protection regulations.

9.2 Timely notification of occurrences and information involving DOE and its contractors should* be made to the appropriate DOE officials and to other responsible authorities.

Section 6. Reporting of all occurrences listed in Department of Energy Orders 5400.1, 5400.5, and 5484.1 is performed in accordance with Department of Energy Order 5000.3B.

9.3 Auditable records relating to environmental surveillance and effluent monitoring should* be maintained.

Section 6. The WSSRAP maintains a *Sample Management Guide* (DOE/OR/21548-499) which governs sampling plan preparation, data verification and validation, database administration, and data archiving. All environmental data from sampling, analysis, and quality review programs are maintained in hard copy and electronic copy. All original documentation is transferred to the Project Quality Department and stored in a controlled area in a fireproof safe.

9.4 Calculations, computer programs, or other data handling should* be recorded or referenced.

Section 6. Computer programs and data management systems utilized at the Weldon Spring site are the Environmental Sample Tracking (EST) system, the Field Sample Tracking (FST) System, the Generic Universal Report Utility (GURU) program, the Safety, Health, and Radiation Protection (SHARP) program, the Site Wide Audit Tracking System (SWATS), and the Waste Inventory Tracking System (WITS).

9.5 As they apply to reporting and record keeping activities, the general quality assurance program provisions of Chapter 10 should* be followed.

Section 7. Standard operating procedures are maintained and documented to ensure the quality of the environmental monitoring program and those activities which influence the program.

10.0 QUALITY ASSURANCE

10.1 In addition to these plans, the Environmental Monitoring Plan should* contain a section on quality assurance and should* cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ANSI/ASME NQA-1.

Section 7. The quality assurance section of the environmental monitoring plan outlines the requirements for the activities at the WSSRAP, which is obligated to comply with the requirements of ANSI/ASME NQA-1 as outlined in Department of Energy Order 5700.6C. A Quality Assurance Program is maintained for the Weldon Spring site, which addresses the requirements of Department of Energy Order 5700.6C. Also, a project specific Quality Assurance Project Plan describing how various aspects of Department of Energy Order 5700.6C and the Quality Assurance Program will be implemented at the Weldon Spring site.

10.2 Periodic audits should* be performed to verify compliance with operational and quality control procedures.

Section 7. Audits are performed periodically to evaluate quality related activities in the environmental monitoring program. Analytical laboratories performing analyses for the Weldon Spring site are audited annually by Weldon Spring site personnel from the Project Quality Department and other related departments. The Project Quality Department routinely audits site operations associated with environmental monitoring activities. The Weldon Spring site is also routinely audited by external entities, including Department of Energy-Headquarters and Department of Energy-Oak Ridge.

10.3 The following requirements from ANSI/ASME NQA-1 should* be followed: Planned and scheduled audits should* be performed to verify compliance with all aspects of the quality assurance program and to determine its effectiveness. These audits should* be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities). Audit results should* be documented and reported to and reviewed by responsible management. Follow-up action should* be taken where indicated.

Section 7. The Project Quality Department routinely audits environmental monitoring activities to evaluate compliance with project-specific procedure. Audit reports are generated and corrective actions are monitored by the Project Quality Department.

10.4 The elements of a quality assurance program plan should* be derived from the 18 criteria in ANSI/ASME NQA-1 and those stipulated in 10 CFR Part 50.

The WSSRAP complies with the requirements of ANSI/ASME NQA-1 in accordance with Department of Energy Order 5700.6c. The WSSRAP is not a nuclear production or utilization facility and, therefore, the Quality Assurance program is not derived from the criteria stipulated in 10 CFR Part 50 which pertains to these types of facilities.

10.5 Radiation measurement, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, should* be calibrated with standards traceable to NIST calibration standards (NCRP 1978; National Bureau of Standards Special Publication 609).

Section 7. Calibration of all radiation measurements is performed in accordance with documented procedures, industrial practices, and Department of Energy Orders which have standards traceable to NIST calibration standards.

APPENDIX B
Data Quality Requirements

B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
Radiation Screening	Gross Alpha	2.6.4 *	NA	NA	NA	NA	NA	NA	ES&H SOP
	Gross Beta/Gamma	2.6.3 *	NA	NA	NA	NA	NA	NA	ES&H SOP
Field Measurements	pH	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Temperature	4.5.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Conductivity	4.5.2 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Specific Ions	4.5.5 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Organic Vapors	3.1.1 *	NA	NA	NA	NA	20	NA	ES&H SOP
	Settleable Solids	4.5.7 *	NA	NA	NA	0.1 ml/l	20	NA	ES&H SOP
On-site Radioligical Measurements	U-238, U-235,	901.1	1 pCi/g	50	30	NA	NA	NA	
	Ra-226, Ra-228	901.1	1 pCi/g	50	20	NA	NA	NA	
	Th-230, Th-232	UNC	2 pCi/g	50	20	NA	NA	NA	

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
Off-site Radiological Measurements	Natural Uranium	EPA 908.0	1 pCi/g	50	30	1 pCi/l	20	20	
	Ra-226, -228	EPA 903.1	1 pCi/g	50	30	1 pCi/l	20	20	
	Th-230, -232	EERF 00/07	1 pCi/g	50	30	1 pCi/l	20	20	
Off-site Radiological Measurements (Continued)	Gross Alpha	EPA 900.0	3 pCi/g	50	30	3 pCi/l	40	40	
	Gross Beta	EPA 900.0	3 pCi/g	50	30	8 pCi/l	40	40	
Nitroaromatic Compounds	TNT	USATHAMA	e	e	e	0.03 d	f	f	
	2,4-DNT	USATHAMA	e	e	e	0.03 d	f	f	
	2,6-DNT	USATHAMA	e	e	e	0.01 d	f	f	
	1,3,5-TNB	USATHAMA	e	e	e	0.03 d	f	f	
	1,3-DNB	USATHAMA	e	e	e	0.09 d	f	f	
	Nitrobenzene	USATHAMA	e	e	e	0.03 d	f	f	

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
Miscellaneous	TSS	EPA 160.2	NA	NA	NA	2 mg/l	20	20	
	TDS	EPA 160.2	NA	NA	NA		20	20	
	TOC	EPA 415.1				0.1	20	20	
	Li	EPA 200.7	5	50	50	50	20	20	
	Mo	EPA 200.7	4	50	50	4	20	20	
	Sr	EPA 200.7	20	50	50	20	20	20	
	Cr^{+3}	EPA 200.7		50	50	10	20	20	
	Cr^{+6}	Colorimetric		50	50	5	20	20	
	TOX	EPA 450.0	5	50	50		20	20	
	NO_3	300.0/353.1	0.5	50	50	0.25/0.1c*	20	20	mg/l
	SO_4	300.0/375.1,.2	5	50	50	1.0/1.0 c*	20	20	mg/l
	Cl	300.0/325.1,.3	1.5	50	50	0.25/0.2c*	20	20	mg/l
	F	300.0/340.1,.2, .3	1.25	50	50	0.25/0.6c*	20	20	mg/l

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
Miscellaneous (Continued)	NO_2	354.1,.2	0.5	50	50		20	20	mg/l
	% Moisture	ASTM	NA	50	NA	NA	NA	NA	
	pH (soil)	EPA 160.2	NA	50	NA	NA	NA	NA	
	Asbestos-PCM/TEM	3.1.4	NA	NA	NA	NA	NA	NA	ES&H SOP
CLP	VOA	CLP	CRDL	As required by CLP		CRDL	As required by CLP		
	BNA	CLP	CRDL	As required by CLP		CRDL	As required by CLP		
	Pest/PCB	CLP	CRDL	As required by CLP		CRDL	As required by CLP		
CLP-Metals	Al	CLP-ICP	20	As required by CLP		200	As required by CLP		
	As	CLP-ICP	1	As required by CLP		10	As required by CLP		
	Be	CLP-ICP	0.5	As required by CLP		5	As required by CLP		
	Cd	CLP-ICP	0.5	As required by CLP		5	As required by CLP		
	Cr	CLP-ICP	1	As required by CLP		10	As required by CLP		
	Cu	CLP-ICP	2.5	As required by CLP		25	As required by CLP		

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
CLP-Metals (Continued)	Pb	CLP-AA	0.5	As required by CLP		5	As required by CLP		
	Hg	CLP-CV	0.1	As required by CLP		0.2	As required by CLP		
	Ni	CLP-ICP	4	As required by CLP		40	As required by CLP		
	Na	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	Zn	CLP-ICP	2	As required by CLP		20	As required by CLP		
	Ba	CLP-ICP	20	As required by CLP		200	As required by CLP		
	Ag	CLP-ICP	1	As required by CLP		10	As required by CLP		
	Fe	CLP-ICP	10	As required by CLP		10	As required by CLP		
	K	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	Mn	CLP-ICP	1.5	As required by CLP		15	As required by CLP		
	Mg	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	Se	CLP-AA	0.5	As required by CLP		5	As required by CLP		
	Va	CLP-ICP	5	As required by CLP		50	As required by CLP		
CLP-Metals	Tl	CLP-AA	1	As required by CLP		10	As required by CLP		

TABLE B-1 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Routine Water and Soil Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	ANALYTICAL METHOD (B)	MDL SOIL µg/g (b)	PRECISION (a) (SOIL)	ACCURACY (a) (SOIL)	MDL (b) µg/l	PRECISION (a) (WATER)	ACCURACY (a) (WATER)	COMMENTS
(Continued)	Sb	CLP-ICP	6	As required by CLP		60	As required by CLP		
	Ca	CLP-ICP	500	As required by CLP		5000	As required by CLP		
	Co	CLP-ICP	5	As required by CLP		50	As required by CLP		
Other parameters not listed		TBD	TBD	50	50	TBD	20	20	See Note

* See comment section
TBD To Be Determined
NA Not Applicable
Accuracy = Percent Bias = Percent Recovery - 100
(a) Accuracy and precision data are listed as percent and presented from EPA DQR guidance document - specific precision and accuracy to be negotiated with the laboratory
(b) Detection limits and methods from existing contract - new detection limits and/or methods to be established with new laboratory
(c) JTC methods and detection limits
(d) Army Environmental Hygiene Agency (AEHA) detection limits
(e) To be negotiated with the laboratory
(f) To be provided by AEHA
NOTE: Generic DQRs apply to media and/or analytical methods not listed in this table. Specific DQRs may be developed as a part of future sampling and analysis plans

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring and Characterization

CATEGORY	ANALYTICAL PARAMETER	PRECISION[a] (SOIL)	ACCURACY[a] (SOIL)	PRECISION[a] (WATER)	ACCURACY[a] (WATER)	COMMENTS
Radiation Screening	Gross Alpha	NA	NA	NA	NA	ES&H SOP
	Gross Beta/Gamma	NA	NA	NA	NA	ES&H SOP
Field Measurements	pH	NA	NA	20	NA	ES&H SOP
	Temperature	NA	NA	20	NA	ES&H SOP
	Conductivity	NA	NA	20	NA	ES&H SOP
	Specific Ions	NA	NA	20	NA	ES&H SOP
	Dissolved Oxygen	NA	NA	20	NA	ES&H SOP
	Organic Vapors	NA	NA	20	NA	ES&H SOP
	Settleable Solids	NA	NA	20	NA	ES&H SOP
On-site Radiological Measurements	U-238	50	50	NA	NA	ES&H SOP
	Ra-226, Ra-228	50	50	NA	NA	ES&H SOP
	TH-230	50	50	NA	NA	ES&H SOP
	Gross Alpha	NA	NA	20 (air)	NA	ES&H SOP
	Uranium, total	NA	NA	30	30	ES&H SOP

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	PRECISION[a] (SOIL)	ACCURACY[a] (SOIL)	PRECISION[a] (WATER)	ACCURACY[a] (WATER)	COMMENTS
Off-site Radiological Measurements	Nat. Uranium	50	30	20	20	
	Ra-226, -228	50	30	20	20	
	Th-228, 230, 232	50	30	20	20	
	Gross Alpha	50	30	40	40	
	Gross Beta	50	30	40	40	
Nitroaromatic Compounds	TNT	50	50	20	20	
	2,4-DNT	50	50	20	20	
	2,6-DNT	50	50	20	20	
	1,3,5-TNB	50	50	20	20	
	1,3-DNB	50	50	20	20	
	Nitrobenzene	50	50	20	20	
Miscellaneous	TSS	NA	NA	20	20	
	TDS	NA	NA	20	20	
	TOC			20	20	
Miscellaneous (cont.)	LI	50	50	20	20	

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	PRECISION[a] (SOIL)	ACCURACY[a] (SOIL)	PRECISION[a] (WATER)	ACCURACY[a] (WATER)	COMMENTS
	MO	50	50	20	20	
	ZR	50	50	20	20	
	CR+6	50	50	20	20	
	TOX	50	50	20	20	
	NO3	50	50	20	20	
	SO4	50	50	20	20	
	CL	50	50	20	20	
	F	50	50	20	20	
	NO2	50	50	20	20	
	% Moisture	50	NA	NA	NA	
	pH (soil)	50	NA	NA	NA	
CLP-VOA	TCL	As required by CLP		As required by CLP		
CLP-Semi VOA	TCL	As required by CLP		As required by CLP		
CLP-Pest/PCB	TCL	As required by CLP		As required by CLP		
CLP-Metals	AL	As required by CLP		As required by CLP		

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring and Characterization (Continued)

CATEGORY	ANALYTICAL PARAMETER	PRECISION[a] (SOIL)	ACCURACY[a] (SOIL)	PRECISION[a] (WATER)	ACCURACY[a] (WATER)	COMMENTS
	AS	As required by CLP		As required by CLP		
	BE	As required by CLP		As required by CLP		
	CD	As required by CLP		As required by CLP		
	CR (Total)	As required by CLP		As required by CLP		
	CU	As required by CLP		As required by CLP		
	PB	As required by CLP		As required by CLP		
	HG	As required by CLP		As required by CLP		
	NI	As required by CLP		As required by CLP		
	NA	As required by CLP		As required by CLP		
	ZN	As required by CLP		As required by CLP		
	BA	As required by CLP		As required by CLP		
	AG	As required by CLP		As required by CLP		
CLP-Metals (Continued)	FE	As required by CLP		As required by CLP		
	K	As required by CLP		As required by CLP		
	MN	As required by CLP		As required by CLP		

TABLE B-2 Data Quality Requirements for the WSSRAP Precision and Accuracy Guidelines for Airborne Monitoring and Characterization (Continued)

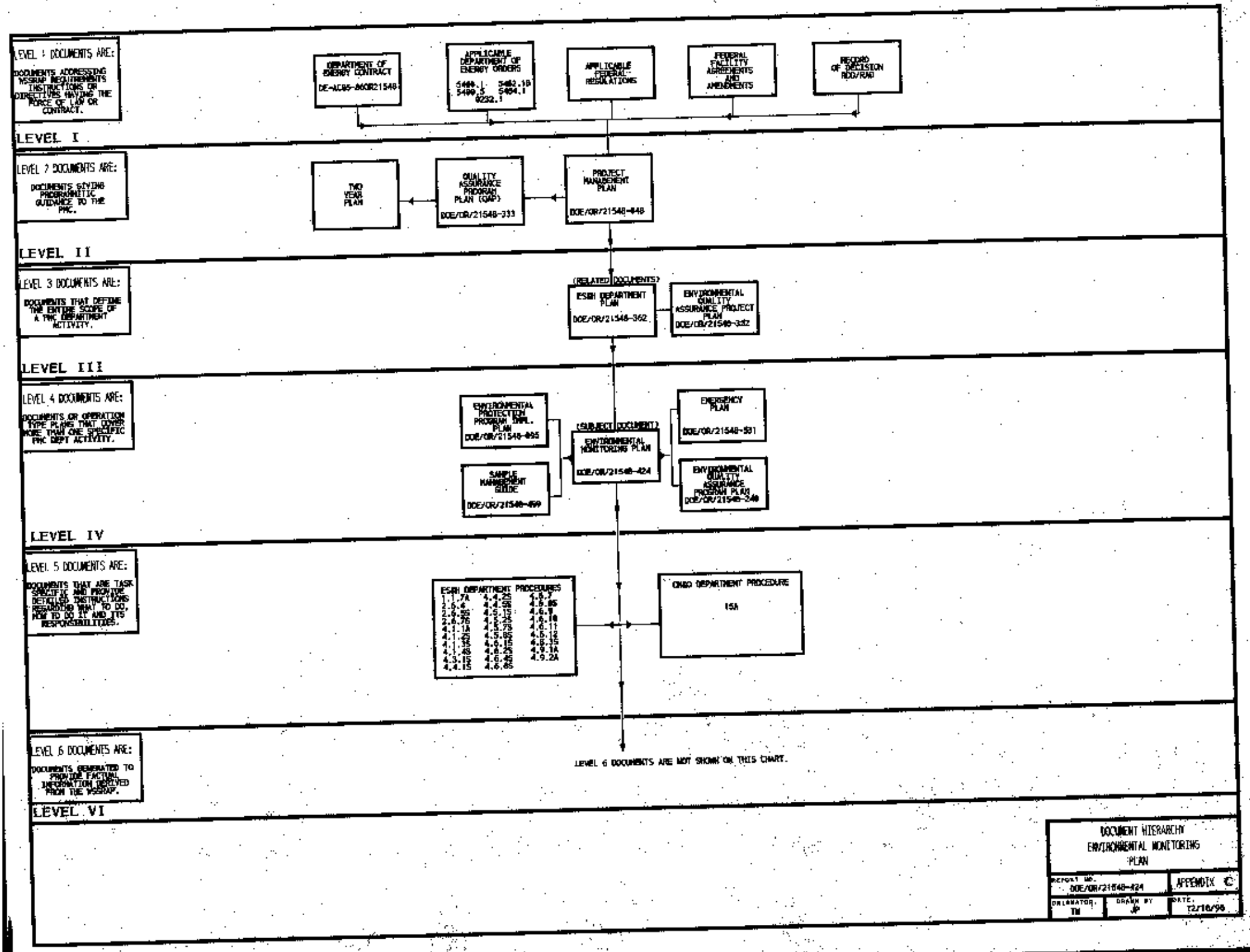
CATEGORY	ANALYTICAL PARAMETER	PRECISION[a] (SOIL)	ACCURACY[a] (SOIL)	PRECISION[a] (WATER)	ACCURACY[a] (WATER)	COMMENTS
	MG	As required by CLP		As required by CLP		
	SE	As required by CLP		As required by CLP		
	V	As required by CLP		As required by CLP		
	TL	As required by CLP		As required by CLP		
	SB	As required by CLP		As required by CLP		
	CA	As required by CLP		As required by CLP		
	CO	As required by CLP		As required by CLP		
Other parameters not listed		50	50	20	20	See Note

* See comment section
TBD To be determined
NA Not Applicable
MDC Minimum detected concentration
MDL Minimum detection limit
(a) Accuracy criteria reflects the maximum ± deviation from 100% recovery. Precision criteria reflects the maximum relative percent difference between duplicate values.
(b) Detection limits and/or methods may vary with each laboratory and may assume a dilution factor of 1.0. The soil detection limits assume 100% solids content.

NOTE: Generic DQRs apply to media and/or analytical methods not listed in this table. Specific DQRs may be developed as a part of future sampling and analysis plans.

APPENDIX C

Document Hierarchy for the Environmental Monitoring Plan


LEVEL 1 DOCUMENTS ARE:
DOCUMENTS ADDRESSING WSSRAP REQUIREMENTS INSTRUCTIONS OR DIRECTIVES HAVING THE FORCE OF LAW OR CONTRACT.
DEPARTMENT OF ENERGY CONTRACT
DE-AC05-86OR21548
APPLICABLE DEPARTMENT OF ENERGY ORDERS
5400.1 5402.1B
5400.5 5484.1
0232.1
APPLICABLE FEDERAL REGULATIONS
FEDERAL FACILITY AGREEMENTS AND AMENDMENTS
RECORD OF DECISION ROD/RAD
LEVEL I
LEVEL 2 DOCUMENTS ARE:
DOCUMENTS GIVING PROGRAMMATIC GUIDANCE TO THE PMC.
TWO YEAR PLAN
QUALITY ASSURANCE PROGRAM PLAN (QAP)
DOE/OR/21548-333
PROJECT MANAGEMENT PLAN
DOE/OR/21548-048
LEVEL II
LEVEL 3 DOCUMENTS ARE:
DOCUMENTS THAT DEFINE THE ENTIRE SCOPE OF A PMC DEPARTMENT ACTIVITY.
(RELATED DOCUMENTS)
ES&H DEPARTMENT PLAN
DOE/OR/21548-362
ENVIRONMENTAL QUALITY ASSURANCE PROJECT PLAN
DOE/OR/21548-332
LEVEL III
LEVEL 4 DOCUMENTS ARE:
DOCUMENTS OR OPERATION TYPE PLANS THAT COVER MORE THAN ONE SPECIFIC PMC DEPT ACTIVITY.
ENVIRONMENTAL PROTECTION PROGRAM IMPL. PLAN
DOE/OR/21548-095
SAMPLE MANAGEMENT GUIDE
DOE/OR/21548-499
(SUBJECT DOCUMENT)
ENVIRONMENTAL MONITORING PLAN
DOE/OR/21548-424
EMERGENCY PLAN
DOE/OR/21548-531
ENVIRONMENTAL QUALITY ASSURANCE PROGRAM PLAN
DOE/OR/21548-240
LEVEL IV
LEVEL 5 DOCUMENTS ARE:
DOCUMENTS THAT ARE TASK SPECIFIC AND PROVIDE DETAILED INSTRUCTIONS REGARDING WHAT TO DO, HOW TO DO IT AND ITS RESPONSIBILITIES.
ES&H DEPARTMENT PROCEDURES
1.1.7A 4.4.2S 4.6.7
2.6.4 4.4.5S 4.6.8S
2.6.5S 4.5.1S 4.6.9
2.6.7S 4.5.2S 4.6.10
4.1.1A 4.5.7S 4.6.11
4.1.2S 4.5.8S 4.6.12
4.1.3S 4.6.1S 4.8.3S
4.1.4S 4.6.2S 4.9.1A
4.3.1S 4.6.4S 4.9.2A
4.4.1S 4.6.6S
OH&O DEPARTMENT PROCEDURE
15A
LEVEL 6 DOCUMENTS ARE:
DOCUMENTS GENERATED TO PROVIDE FACTUAL INFORMATION DERIVED FROM THE WSSRAP.
LEVEL 6 DOCUMENTS ARE NOT SHOWN ON THIS CHART.
LEVEL VI
DOCUMENT HIERARCHY
ENVIRONMENTAL MONITORING PLAN
REPORT NO. DOE/OR/21548-424
APPENDIX C
ORIGINATOR: TM
DRAWN BY JP
DATE: 12/10/96

APPENDIX D

Telecon From L. Hopkins to File Regarding the Use of Uncensored Data Sets, Dated June 1, 1992

MK-FERGUSON
A DIVISION OF MORRISON KNUDSEN CORPORATION

INTER-OFFICE CORRESPONDENCE

DATE: June 1, 1992

TO: File

FROM: Loren Hopkins

SUBJECT: TELECON ON UNCENSORED DATA

Date of Telecon: May 27, 1992

Caller: Loren Hopkins

Call to: Bob O'Brien, Statistical Policy Branch of US EPA, Washington, DC

Telephone: (202) 260-2683

SUBJECT: UTILIZING UNCENSORED DATA IN STATISTICAL CALCULATIONS

Mr. O'Brien returned my call regarding this subject. I explained to Mr. O'Brien that the 1991 DOE Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance specified the following:

7.3.4 Less-Than-Detectable Values

Monitoring programs often include measurement of extremely low concentrations of radionuclides, below the detection limit of the counting instruments. Data sets with large numbers of less-than-detectable values need special consideration in the statistical analyses (Gilbert 1987).

Less-than-detectable data will produce numerical measurements with values below the detection limit and sometimes negative values. All of the actual values, including those that are negative, should be included in the statistical analyses. Practices such as assigning a zero, the detection limit value, or some in-between value to the below detectable data point, or discarding those data points can severely bias the resulting parameter estimates and should be avoided.

When analytical instruments or laboratories do not supply the actual values for readings less than the detection limit, but make some designation such as "ND", the actual values for those data points should be obtained. When obtaining these data points is not possible, at least the number of less-than-detectable values should be obtained.

m:\users\bickmyer\env\uncens.lh

Data from censored distributions (for which the number of less-than-detectable values is known) are more amenable to standard statistical analyses than are those from truncated distributions (for which the number of values below the detection limit are not known), which require special statistical techniques (Gilbert and Kinnison, 1981).

I explained that in incorporating uncensored data (including negative numbers) in our statistical calculations, in one case we obtained a negative dose. We question the use of applying the policy of incorporating uncensored data across the board because the results of using means derived from uncensored data may lead to physically impossible results. In addition, we were wondering if some sort of weighting approach should be applied to data below the detection limit because there is less confidence associated with these values. I asked if he had any feel for when the use of uncensored data should or should not be applied and if there was a study that validated this request for incorporation of uncensored data. Mr. O'Brien did not have an answer for me and referred me to Richard Gilbert at Batelle (509) 375-2979).

I called Richard Gilbert and explained the situation and concerns I had explained to Mr. O'Brien. He was not aware of the DOE guidance and was not aware that he was referenced in the guidance. He felt that any across-the-board application of his recommendations of the use of uncensored data was ill-founded. He recommended that we use scientific, professional judgement in including uncensored data. In general, he felt we should obtain and use uncensored data since he felt it still contained some meaning. However, if the results were not possible, we should include a caveat and explain our reasoning.

Mr. Gilbert suggested I look up a paper by Diane Lambert entitled Non-detects, Detection Limits and the Limit of Probability", from the Journal of the American Statistical Association regarding my question with weighting data below the detection limit with less confidence.

LK/ccb

APPENDIX E
Above Normal Reporting Levels

TABLE E-1 Environmental Response Levels in Groundwater and Surface Water for Critical Receptors

LOCATION	PARAMETER	RESPONSE LEVEL I	RESPONSE LEVEL II
SURFACE WATER			
SW-2002, 2003, 2004, 2005, 2012	U[a]	Reviewer discretion	$x \geq 100$ pCi/l
SW-2001, 2016	U[a]	5 pCi/l $\leq x < 10$	$x \geq 10$ pCi/l
SW-1003, 1004, 1005, 1007, 1009	U[a] Nitro[a]	100 pCi/l $\leq x \leq$ max D.L. $\geq x < 1$ µg/l	$x \geq$ max. or $x \geq 300$ $x \geq 1$ µg/l
SPRINGS			
SP-6301	U[a] Nitros[b]	100 pCi/l $\leq x <$ max D.L. $\leq x < 0.22$ µg/l	$x \geq$ max $x \geq 0.22$ µg/l
GROUNDWATER			
MW-1002 thru 1016 and MW-1027 thru 1032	U[c] Nitro[c]	$x \geq$ previous high and $x \geq \mu + 2\sigma$ $x \geq$ previous high and $x \geq \mu + 2\sigma$	2 highs[e] 2 highs[e]
Site and Quarry WTP Detection monitoring	All parameters[d]	$x \geq$ previous high and $x \geq \mu + 2\sigma$	$x \geq$ baseline
MW-1017 to MW-1023, MW-1033 and RMWs and PWs	U[a] Nitro[a] SO_4[b] Metals[f]	new high $\leq x < 10$ pCi/l 100 mg/l $\leq x < 250$ $\mu + 2\sigma < x \leq$ MCL (PWs and RMWs only)	$x \geq 10$ pCi/l $x \geq$ D.L. $x \geq 250$ mg/l $x \geq$ MCL

(a) Based on historic ranges
(b) Based on water quality standards
(c) Based on past three years historical data
(d) Based on baseline monitoring see Exhibit 8 or 9
(e) Consecutive new highs with $x \geq \mu + 2\sigma$
(f) Based on drinking water standards

TABLE E-2 Water Quality Standards

A. EPA Drinking Water Standards

PARAMETER	CONCENTRATION (mg/l)	PARAMETER	CONCENTRATION (mg/l)
Antimony[a]	0.006	Selenium[a]	0.05
Arsenic[a]	0.05	Silver[d]	0.05
Barium[a]	2.0	Thallium[a]	0.002
Beryllium[a]	0.004	Zinc[b]	5.0
Cadmium[a]	0.005	Fluoride[b]	2.0
Chromium[a]	0.1	TDS[b]	500
Cobalt[d]	1.0	Cyanide[c]	0.2
Copper[b]	1.0	PCBs[d]	4.5E-8
Iron[b]	0.3	2,4-DNT[d]	0.00011
Nitrate(N)[a]	10	Gross α[a]	15 pCi/l
Sulfate[b]	250	Ra-226 + 228[a]	5 pCi/l
Chloride[b]	250	Rn-222[f]	300 pCi/l
Lead[d]	.015	Uranium[f]	20 μg/l = 13.6 pCi/l
Manganese[b]	0.05	Mercury[a]	0.002
Nickel[c]	0.1		

(a) EPA primary maximum contaminant level.
(b) EPA secondary maximum contaminant level.
(c) MDNR primary maximum contaminant level.
(d) MDNR water quality standard for groundwater.
(f) Proposed EPA primary maximum contaminant level.

TABLE E-2 Water Quality Standards (Continued)

B. Derived Concentration Guide (DCGs)

DOE Order 5400.5, Radiation Protection of the Public and the Environment, designates the DCGs for ingestion of drinking water as:

Uranium 600 pCi/l
Radium-226 100 pCi/l
Radium-228 100 pCi/l
Thorium-228 400 pCi/l
Thorium-230 300 pCi/l
Thorium-232 50 pCi/l

TABLE E-3 NPDES Permit Limits and Notification Levels

LOCATION	PARAMETER	RESPONSE LEVEL I	RESPONSE LEVEL II
All permitted outfalls	All parameters	= permit limit	> permitted limit or = to or > than notification level

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
Chemical Oxygen Demand (COD)	mg/l	60	>60/NA
Total Suspended Solids	mg/l	30	>30/NA,NA,NA,NA,>30
Biochemical Oxygen Demand (5 day)	mg/l	30	>30/NA,NA,NA,NA,>30
Fecal Coliform	col/100 ml	400	NA/NA,NA,NA,NA,>400
Settleable Solids****	ml/l	1.0	NA/1.0,1.0,1.0,1.0,NA (>2.5 for borrow area)
pH	SU	6-9	<6 or >9
Whole Effluent Toxicity		see permits	see permits MO-0107701 and MO-0108987
Oil and grease	mg/l	*	NA/NA(>10 borrow area)
Arsenic**	mg/l	0.10	>0.1/0.1
Chromium**	mg/l	0.10	>0.1/0.1,0.1,0.13,0.1,0.1
Copper**	mg/l	1.0	>1.0/0.1,0.1,0.19,0.1,0.1
Lead**	mg/l	0.10	>0.1/0.1,0.1,0.198,0.1,0.1
Manganese	mg/l	0.10	>0.1/0.49,0.20,5.6,0.1,0.1
Mercury**	mg/l	0.004	>0.004/0.1
Selenium**	mg/l	0.02	>0.02/0.1
Cyanide-Amenable**	mg/l	0.0075	>0.0075/0.1
2,4-dinitrotoluene**	µg/l	0.22	>0.22/100
Floride	mg/l	4.0	>4.0/4.0
Nitrate	mg/l	20	>20/10
Sulfate	mg/l	500	>500/250
Chloride	mg/l	*	>250/230

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
Gross Alpha	pCi/l	*	NA
Gross Beta	pCi/l	*	NA
Uranium	pCi/l	*	>30/>600(1360 MDNR)
Radium 226	pCi/l	*	>100
Radium 228	pCi/l	*	>100
Thorium 228	pCi/l	*	>400
Thorium 230	pCi/l	*	>300
Thorium 232	pCi/l	*	>50
Actinium 227	pCi/l	*	>10
Polonium 210	pCi/l	*	>80
Radon 222	pCi/l	*	
PRIORITY POLL**			
1V acrolein	µg/l	*	200
2V acrylonitrile	µg/l	*	200
3V benzene	µg/l	*	100
5V bomoform	µg/l	*	100
6V carbon tetrachloride	µg/l	*	100
7V chlorobenzene	µg/l	*	100
8V chlorodibromomethane	µg/l	*	100
9V chloroethane	µg/l	*	100
10V 2-chlorothylvinyl ether	µg/l	*	100,125/100
11V chloroform	µg/l	*	100
12V dichlorobromomethane	µg/l	*	100
14V 1,1-dichloroethane	µg/l	*	100
15V 1,2-dichloroethane	µg/l	*	100

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
16V 1,1-dichloroethylene	µg/l	*	100
17V 1,2-dichloropropane	µg/l	*	100
18V 1,3-dichloropropylene	µg/l	*	100
19V ethylbenzene	µg/l	*	100
20V methyl bromide	µg/l	*	100
21V methyl chloride	µg/l	*	100
22V methylene chloride	µg/l	*	100
23V 1,1,2,2-tetrachloroethane	µg/l	*	100
24V tetrachloroethylene	µg/l	*	100
25V toluene	µg/l	*	100
26V 1,2-trans-dichloroethylene	µg/l	*	100
27V 1,1,1-trichloroethane	µg/l	*	100
28V 1,1,2-trichloroethane	µg/l	*	100
29V trichloroethylene	µg/l	*	100
31V vinyl chloride	µg/l	*	100
1A 2-chlorophenol	µg/l	*	100
2A 2,4-dichlorophenol	µg/l	*	100
3A 2,4-dimethylphenol	µg/l	*	100
4A 4,6-dinitro-o-cresol	µg/l	*	100/500
5A 2,4-dinitrophenol	µg/l	*	500
6A 2-nitrophenol	µg/l	*	100
7A 4-nitrophenol	µg/l	*	100,500/250
8A p-chloro-m-cresol	µg/l	*	100
9A pentachlorophenol	µg/l	*	100,500/100
10A phenol	µg/l	*	100

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
11A 2,4,6-trichlorophenol	µg/l	*	100
1B acenaphthene	µg/l	*****	*****,100/100
2B acenaphthylene	µg/l	*****	*****,100/100
3B anthracene	µg/l	*	100
4B benzidine	µg/l	*	100,250/250
5B benzo(a)anthracene	µg/l	*****	*****,100/100
6B benzo(a)pyrene	µg/l	*****	*****,100/100
7B 3,4-benzofluoranthene	µg/l	*	100
8B benzo(ghi)perylene	µg/l	*	100
9B benzo(k)fluoranthene	µg/l	*****	*****,100/100
10B bis(2-chloroethoxy)ether	µg/l	*	100
11B bis(2-chloroethyl)ether	µg/l	*	100
12B bis(2-chloroisopropyl)ether	µg/l	*	100
13B bis(2-ethylhexyl)phthalate	µg/l	*	580,100/100
14B 4-bromophenyl phenyl ether	µg/l	*	100
15B butylbenzyl phthalate	µg/l	*	100
16B 2-chloronaphthalene	µg/l	*	100
17B 4-chlorophenyl phenyl ether	µg/l	*	100
18B chrysene	µg/l	*****	*****,100/100
19B dibenzo(a,h)anthracene	µg/l	*****	*****,100/100
20B 1,2 dichlorobenzene	µg/l	*	100
21B 1,3-dichlorobenzene	µg/l	*	100
22B 1,4 dichlorobenzene	µg/l	*	100
23B 3,3'-dichlorobenzidine	µg/l	*	100,200/100
24B diethyl phthalate	µg/l	*	100

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
26B dimethyl phthalate	µg/l	*	100
26B di-n-butyl phthalate	µg/l	*	100
28B 2,6-dinitrotoluene	µg/l	*	100
29B di-n-octyl phthalate	µg/l	*	407,100/100
30B 1,2diphenylhydrazine(asazobenzene)	µg/l	*	100
31B fluoranthene	µg/l	*****	*****,100/100
32B fluorene	µg/l	*****	*****,100/100
33B hexachlorobenzene	µg/l	*	100
34B hexachlorobutadiene	µg/l	*	100
35B hexachlorocyclopentadiene	µg/l	*	100
36B hexachloroethane	µg/l	*	100
37B indeno(1,2,3-cd)pyrene	µg/l	*****	*****,100/100
38B isophorone	µg/l	*	100
39B napthalene	µg/l	*****	*****,100/100
40B nitrobenzene	µg/l	*	100
41B N-nitrosodimethylamine	µg/l	*	100
42B N-nitrosodi-n-propylamine	µg/l	*	100
43B N-nitrosodiphenylamine	µg/l	*	100
44B phenanthrene	µg/l	*****	*****,100/100
45B pyrene	µg/l	*	100
46B 1,2,4-trichlorobenzene	µg/l	*	100
1P aldrin	µg/l	*	100
2P alpha-BHC	µg/l	*	100
3P beta-BHC	µg/l	*	100
4P gamma-BHC	µg/l	*	100

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
5P delta-BHC	µg/l	*	100
6P chlordane	µg/l	*	100
7P 4,4'-DDT	µg/l	*	100
8P 4,4'-DDE	µg/l	*	100
9P 4,4'-DDD	µg/l	*	100
10P dieldrin	µg/l	*	100
11P alpha-endosulfan	µg/l	*	100
12P beta-endosulfan	µg/l	*	100
13P endosulfan sulfate	µg/l	*	100
14P endrin	µg/l	*	100
15P endrin aldehyde	µg/l	*	100
16P heptachlor	µg/l	*	100
17P heptachlor epoxide	µg/l	*	100
18P PCB-1242	µg/l	*	1
19P PCB-1254	µg/l	*	1
20P PCB-1221	µg/l	*	1
21P PCB-1232	µg/l	*	1
22P PCB-1248	µg/l	*	1
23P PCB-1260	µg/l	*	1
24P PCB-1016	µg/l	*	1
25P toxaphene	µg/l	*	100
Antimony**	mg/l	*	1.0
Beryllium**	µg/l	*	100
Cadmium**	µg/l	*	185,100/100
Nickel**	µg/l	*	870,100/100

TABLE E-3 NPDES Permit Limits and Notification Levels (Continued)

NPDES OUTFALL NOTIFICATION LEVELS (storm water, site and quarry water and sewage treatment plant outfalls)			
PARAMETER	UNITS	PERMIT LIMIT	NOTIFICATION LEVELS- SWTP, QWTP/NP-0002, NP-0003, NP-0005, NP-0010, NP-0006
Silver**	µg/l	*	200,100/100
Thallium**	µg/l	*	100
Zinc**	µg/l	*	330,112/100,220,1140,100,100
Cyanide, Total**	µg/l	*	250,100/100
Phenols, Total**	µg/l	*	100

* Monitoring only.
** Toxic pollutant 40 CFR 401.15 see permit condition for notification requirements.
*** Where one number is given it applies to all outfalls in the category unless otherwise noted.
**** Storm water outfalls only.
***** NPDES permit MO-0107701 designates permit limits for these parameters for the site water treatment plant under specified circumstances, all other outfalls are monitoring only.
Blanks: Indicate notification level not applicable.

TABLE E-4 Baseline for the Detection Monitoring System at the Weldon Spring Site Water Treatment Plant and Temporary Storage Area Location

PARAMETER	MW-2035	MW-2036	MW-2037	MW-2038	MW-2039	MW-2040	MW-2041	MW-2042	MW-2043
Arsenic (µg/l)	2.25	2.09	1.82	5.77	2.43	4.12	4.35	3.41	2.10
Barium (µg/l)	107	222	250	563	240	962	347	590	344
Cadmium (µg/l)	3.91	2.89	3.67	3.67	6.98	4.04	4.20	3.80	3.79
Chromium (µg/l)	4.21	4.33	3.83	3.83	14.1	14.1	18.4	6.62	4.52
Lead (µg/l)	4.08	2.17	1.65	1.65	1.50	3.30	8.53	2.40	2.81
Mercury (µg/l)	0.14	0.14	3.40	4.37	0.15	0.12	0.59	0.13	0.15
Selenium (µg/l)	4.71	1.86	20.0	24.9	24.5	9.42	96.6	4.11	7.11
Silver (µg/l)	5.78	6.07	6.08	6.08	13.8	5.40	10.3	6.18	4.96
Uranium (pCi/l)	1.93	1.64	2.17	2.32	4.12	4.64	8.35	3.33	2.34
Nitrate (mg/l)	2.05	5.03	668	2271	117	455	2256	13.8	8.03
Sulfate (mg/l)	6.89	5.64	177	132	54.6	27.9	196	39.5	20.8
1,3,5-TNB (µg/l)	0.02	0.02	0.29	0.37	0.02	0.02	0.02	0.02	0.02
2,4,6-TNT (µg/l)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
2,4-DNT (µg/l)	0.02	0.02	0.79	2.14	0.02	0.02	0.02	0.02	0.09
2,6-DNT (µg/l)	0.01	0.01	0.19	0.14	0.01	0.01	0.01	0.01	0.01

TABLE E-5 Baseline for the Detection Monitoring System at the Weldon Spring Quarry Water Treatment Plant Location

PARAMETERS	MW-1035	MW-1036	MW-1037	MW-1040	MW-1041
Uranium, total (pCi/l)	2.66	9.70	3.08	12.0	7.56
U-234 (pCi/l)	12.1	(a)	4.95	10.8	5.79
U-238 (pCi/l)	13.2	(a)	3.25	6.72	3.45
Ra-226 (pCi/l)	1.32	0.25	0.72	2.17	1.47
Ra-228 (pCi/l)	0.81	1.00	1.58	1.79	1.25
Th-230 (pCi/l)	1.23	2.94	0.48	0.88	1.41
Th-232 (pCi/l)	0.35	0.34	0.40	0.39	0.35
Chloride (mg/l)	6.82	102	11.8	16.0	8.34
Fluoride (mg/l)	0.28	0.18	0.71	0.12	0.26
Nitrate (mg/l)	0.37	0.32	0.82	0.28	0.32
Sulfate (mg/l)	70.0	82.0	55.5	186	52.8
Arsenic (µg/l)	6.09	4.71	5.50	9.83	6.64
Barium (µg/l)	315	351	752	330	553
Cadmium (µg/l)	3.18	3.61	3.44	3.96	3.67
Chromium (µg/l)	4.81	7.57	7.57	19.6	15.5
Lead (µg/l)	1.59	2.06	2.06	2.72	5.84
Mercury (µg/l)	0.18	0.20	0.17	0.42	0.58

TABLE E-5 Baseline for the Detection Monitoring System at the Weldon Spring Quarry Water Treatment Plant Location (Continued)

PARAMETERS	MW-1035	MW-1036	MW-1037	MW-1040	MW-1041
Selenium (µg/l)	7.81	3.63	5.09	5.63	5.28
Silver (µg/l)	4.99	4.78	4.78	5.69	8.45

(a) No data available for determination of baseline.

TABLE E-6 Storm Water Baseline Comparison Values (μ + 2σ) μg/l*

	LOCATION		
PARAMETER	**NP-0002**	**NP-0003**	**NP-0005**
Uranium pCi/l**	600 (615.51)	600(647.39)	600(1444)
Ra-226 pCi/l	1.41	1.16	1.06
Ra-228 pCi/l	1.82	1.65	2.62
Th-228 pCi/l	1.24	0.84	0.65
Th-230 pCi/l	0.56	1.01	0.62
Th-232 pCi/l	0.94	0.77	0.65
2,4-DNT	0.15	0.14	0.14
2,4,6-TNT	0.19	0.17	0.19
PCBs	1.0	1.0	1.0
PAHs	20 μg/l	20 μg/l	20 μg/l
Al mg/l	5.432	6.291	17.330
Sb	33.53	33.53	33.53
As	6.20	6.52	6.48
Ba	128.45	130.30	147.88
Be	0.91	0.78	0.78
Cd	2.74	2.74	2.74
Ca mg/l	94.5	101.4	111.9
Cr	12.24	11.65	19.64
Co	9.58	9.58	10.49
Cu	16.95	14.59	18.62
Fe mg/l	4.7	5.6	13.5
Pb	23.80	12.62	15.23
Li	27.9	8.45	9.22
Mg mg/l	18.8	19.9	18.2
Mn	705	171	169

TABLE E-6 Storm Water Baseline Comparison Values (μ + 2σ) μg/l* (Continued)

	LOCATION		
PARAMETER	**NP-0002**	**NP-0003**	**NP-0005**
Hg	0.76	0.14	0.13
Mo	12.83	12.48	12.47
Ni	32.36	35.01	37.63
K mg/l	6.7	8.1	6.1
Se	7.82	11.40	5.28
Ag	3.14	3.14	2.88
Tl	8.53	5.43	4.66
V	13.66	14.57	29.32
Zn	117.70	71.86	102.67

* Unless otherwise noted

** Value in parentheses is the baseline value but the DCG of 600 pCi/l overrides the baseline value.

TABLE E-7 Radioactive Airborne Particulates and Gases

IF...	THEN...	AND NOTIFY...
Any perimeter or critical receptor air particulate monitoring location has results that are statistically greater than background and has a measured concentration that exceeds the annual average background concentration plus three standard deviations for 2 consecutive weeks or with a measured concentration that exceeds the annual average background concentration plus 2 standard deviations for 3 consecutive weeks; or any perimeter receptor radon monitoring location quarterly results that are 1.0 pCi/l above the background concentration or any critical receptor monitoring location results that are 0.5 pCi/l above the background concentration.	Find the airborne contamination source and increase emissions controls if feasible. Increase area monitoring if current results do not identify potential contamination source(s).	DOE Project Manager, PMC Deputy Project Manager, ES&H Manager, Enviornmental Protection Group Manager, Project Manager, and Engineering Manager
The estimated committed effective dose equivalent (CEDE) at a critical receptor location or to any member of the public exceeds 1 mrem (includes quarry perimeter).	Same as above	Same as above plus persons residing or abiding in the affected critical receptor location.

TABLE E-7 Radioactive Airborne Particulates and Gases (Continued)

IF...	THEN...	AND NOTIFY...
The estimated committed effective dose equivalent (CEDE) at a critical receptor location or to any member of the public exceeds 10 mrem (includes quarry perimeter).	Same as above; stop all work that is generating airborne radioactivity in the affected area until source is identified and additional emission controls are instituted, if feasible.	Same as above, and relevant program office, Deputy assistant secretary for environment (EH-20) (DOE Order 5400.5 Chapter II, section 7). Comply with DOE Order 232.1 reporting and notification requirements for an unusual event. Comply with National Emission Standards for Hazardous Air Pollutants (NESHAP) reporting requirements (40 CFR 61.104(c).
The estimated dose equivalent at a critical receptor location exceeds 500 mrem CEDE, or any monitoring location where airborne concentrations, if averaged over 24 hours, would exceed 5000 times the appropriate inhaled air Derived Concentration Guides established in DOE 5400.5.	Stop all work that is generating airborne radioactivity in the affected area.	Same as above, plus comply with DOE 232.1 reporting and notification requirements for an emergency event.

TABLE E-8 Asbestos Monitoring

IF...	THEN...	AND NOTIFY...
The site perimeter or work place environmental samples (outside containment) exceed 0.01 f/cc using PCM.	Investigate possible sources of fiber release. Shut down or modify operations where appropriate. Conduct confirmatory Transmission Electron Microscopy (TEM) analysis if non-asbesots fibers are suspected.	DOE Project Manager, PMC Deputy Project Director, ES&H Manager, Engineering Manager, and Project Manager.
A critical receptor sample exceeds 0.01 f/cc using PCM or any TEM sample that exceeds 0.01 f/cc (except inside containment).	Same as above plus evaluate concurrent work place and list perimeter results for comparison.	Same as above and the Project Director.