DOE/OR/21548-787
CONTRACT NO. DE-AC05-86OR21548

REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN FOR THE QUARRY RESIDUALS OPERABLE UNIT

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

JANUARY 2000 **REV. 0**

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

Prepared by MK-Ferguson Company and Jacobs Engineering Group

DOE/OR/21548-787

Weldon Spring Site Remedial Action Project

Remedial Design/Remedial Action Work Plan for the Quarry Residuals Operable Unit

Revision 0

January 2000

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

011300

MORRISON KNUDSEN CORPORATION MK-FERGUSON GROUP Weldon Spring Site Remedial Action Project Contract No. DE-AC05-86OR21548	
	Rev. No. 0
PLAN TITLE: Remedial Design/Remedial Action Work Plan for the Quarry Residual Operable Unit	

APPROVALS

Quarry Residuals Operable Unit Coordinator	1/13/00 Date
Project Manager - Quarry and Vicinity Properties	14 Jan 00 Date
Data Administration Coordinator	1/17/00 Date
Environmental Safety and Health Manager	01/14/00 Date
Engineering Manager	1-17-2000 Date
Project Quality Manager	01/18/00 Date
Deputy Project Director	1/18/00 Date

m:\users\joanne\document\apr787.doc

ABSTRACT

The *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit of the Weldon Spring Site* outlines the selected action for the quarry area. This action stipulates long-term monitoring of groundwater to ensure continued protection of human health and the environment. Institutional controls will also be implemented to prevent groundwater usage in the area of impact. Field studies will be performed to collect data to verify the existing conceptual fate and transport model for the quarry area and to support ongoing evaluations regarding the benefits of groundwater remediation.

This plan is intended to provide the transition from the environmental documentation phase (RI/FS/ROD) to the final design and implementation of the selected remedial action and supporting field studies. This plan describes the criteria for:

- Developing the long-term monitoring system and the institutional controls to be implemented for this operable unit.
- Designing and implementing the interceptor trench field study.
- Addressing residually contaminated soils within the quarry proper.
- Designing the final reclamation for the quarry area.

Included in this plan is a summary of the construction activities and the specifications under which these activities will be performed. An overall project schedule and summary of costs are included for the major components of these actions.

TABLE OF CONTENTS

SECTION **PAGE**

1. INTRODUCTION 1
1.1 Purpose and Scope 1
1.2 Background 2
1.3 Components of the Quarry Project 2
1.3.1 Quarry Residuals Operable Unit 3
1.3.1.1 Soil in the Quarry Proper 3
1.3.1.2 Surface Water and Sediment in the Slough and Nearby Creeks 3
1.3.1.3 Groundwater North of the Slough 4
1.3.2 Quarry Reclamation 6
1.4 Document Organization 8
2. LONG-TERM MONITORING 10
2.1 Monitoring Strategy 10
2.2 Monitoring Locations 14
2.3 Monitoring Parameters 14
2.4 Monitoring Frequencies 15
2.5 Data Analysis and Interpretation 16
2.5.1 Groundwater Monitoring North of the Slough 16
2.5.2 Groundwater Monitoring South of the Slough 17
2.6 Contingency Actions 17
3. INSTITUTIONAL CONTROLS 19
3.1 Affected Areas 19
3.1.1 Groundwater North of the Slough 19
3.1.2 Quarry Proper 19
3.1.3 Areas Outside the Quarry Proper 20
3.2 Implementation 20
3.3 Types of Institutional Controls 21
4. FIELD STUDIES IN SUPPORT OF THE SELECTED REMEDY 22
4.1 Interceptor Trench 22
4.1.1 Design 22
4.1.2 Monitoring 25
4.1.3 Data Evaluation 25
4.2 Hydrogeological Field Studies 27
4.2.1 Geological Characterization 27
4.2.2 Hydrologic Characterization 28
4.2.3 Geochemical Characterization 29
5. QUARRY PROPER SOILS 31
5.1 Nature and Extent of Contamination 33

TABLE OF CONTENTS

SECTION **PAGE**

5.1.1 Northeast Slope Area 33
5.1.2 Ditch Area Near the Transfer Station 36
5.1.3 Snake Pit Area 39
5.2 Excavation Activities 41
5.3 Data Evaluation 41
6. QUARRY RECLAMATION 42
6.1 Work Package 513A - Quarry Restoration Contaminated Materials Removal 42
6.1.1 Removal of Contaminated Structures Associated with Bulk Waste Removal42
6.1.2 Excavation of Potentially Contaminated Soils 42
6.1.3 Excavation of Residually Contaminated Soil 43
6.1.4 Construction of Access Ramp to Northeast Slope Area 43
6.2 Work Package 513B - Quarry Restoration Backfill 44
6.2.1 Backfilling of the Quarry Proper 44
6.2.2 Removal of Uncontaminated Facilities Associated with Bulk Waste Removal 45
6.2.3 Borrow Area Development 48
6.2.3.1 Cultural Resource and Historical Site Surveys 48
6.2.3.2 Floodplain Assessments and Wetland Delineation 50
6.2.3.3 Threatened and Endangered Species Surveys 55
6.3 Work Package 529, Quarry Interceptor Trench System Reclamation 55
6.3.1 Quarry Water Treatment Plant Demolition 55
6.3.2 Removal of the Interceptor Trench System 56
6.3.3 Removal of Potentially Contaminated Soils 56
6.3.4 Restoration of the Quarry Haul Road 57
6.3.5 Final Site Grading 57
7. CONSTRUCTION ACTIVITIES 58
7.1 Quarry Reclamation 58
7.1.1 Quarry Restoration Contaminated Materials Removal 58
7.1.2 Quarry Restoration Backfill 59
7.1.3 Quarry Interceptor Trench System Reclamation 60
7.2 Quarry Interceptor Trench System 61
7.3 Monitoring Well Installation and Abandonment 63
8. PROJECT SCHEDULE 64
9. SUMMARY OF PROJECT COSTS 66
9.1 Quarry Reclamation 66
9.2 Quarry Interceptor Trench System 66
9.3 Long-Term Monitoring 67

TABLE OF CONTENTS

SECTION **PAGE**

9.4 Field Studies 67
10. QUALITY ASSURANCE PROGRAM 68
10.1 Purpose 68
10.2 Description 68
10.3 Implementation 69
11. CONTINGENCY PLAN 71
11.1 Purpose 71
11.2 Description 71
11.3 Implementation 72
12. POST-ROD DOCUMENTATION 73
12.1 Primary Documents 73
12.1.1 Final Design Submittals 73
12.1.2 Sampling Plans 73
12.1.3 Field Study Evaluations 74
12.1.4 Operation and Maintenance Plan 75
12.1.5 Contingency Plan 75
12.1.6 Remedial Action Report 75
12.2 Secondary Documents 75
12.2.1 Preliminary Design Submittals 75
12.2.2 Completion Reports 76
12.2.3 Well Field Contingency Plan 77
12.2.4 Construction Progress Reports 77
13. REFERENCES 78

APPENDIX

A Long-Term Monitoring Location Evaluation

LIST OF FIGURES

NUMBER **PAGE**

Figure 2-1 Uranium Distribution in the Shallow Aquifer....12
Figure 2-2 Long-Term Groundwater Monitoring Network....13
Figure 4-1 Location of the Interceptor Trench Field Study....24
Figure 5-1 Soil Characterization Areas in the Quarry Proper....32
Figure 5-2 Characterization Locations at the Northeast Slope Area....35
Figure 5-3 Characterization Locations at the Ditch Area....37
Figure 5-4 Characterization Locations at the Snake Pit Area....40
Figure 6-1 Primary Borrow Source for Quarry Restoration....46
Figure 6-2 Contingency Borrow Source for Quarry Restoration....47
Figure 6-3 Wetlands in the Vicinity of the Primary Borrow Source....52
Figure 6-4 Wetlands in the Vicinity of the Contingency Borrow Source....54
Figure 8-1 Quarry Residuals Operable Unit Project Schedule....65

LIST OF TABLES

NUMBER **PAGE**

Table 5-1 Cleanup Criteria for Selected Radionuclides 31
Table 5-2 Summary of Remedial Investigation Sampling Results from the Northeast Slope....33
Table 5-3 Summary of Post-Excavation Sampling Results from the Northeast Slope....34
Table 5-4 Ranges for Radiological Data from the Ditch Area 38
Table 5-5 Summary of Radiological Data from the Snake Pit Area....39
Table 6-1 Summary of Cultural Resources in the Vicinity of the Weldon Spring Quarry....49
Table 6-2 Wetland Determinations in the Vicinity of the Weldon Spring Quarry 50
Table 9-1 Summary of Costs for Quarry Reclamation 66
Table 9-2 Summary of Costs for the Quarry Interceptor Trench System....67
Table 9-3 Summary of Costs for Long-Term Monitoring 67
Table 9-4 Summary of Costs for Hydrogeological Field Studies....67
Table 12-1 RD/RA Sampling Plans for the Quarry Residuals Operable Unit....74
Table 12-2 RD/RA Completion Reports for the Quarry Residuals Operable Unit 76

1. INTRODUCTION

The Quarry Residuals Operable Unit (QROU) is the second of two operable units established for the quarry area of the Weldon Spring site. The Quarry Bulk Waste Operable Unit, which was the first operable unit, addressed the excavation and relocation of the radiologically and chemically contaminated materials within the quarry to temporary storage at the chemical plant area and ultimate placement in the on-site disposal cell. Bulk waste excavation was carried out in conjunction with a removal action to extract, treat, and discharge contaminated water from the quarry sump. The QROU addresses (1) any residual soil contamination remaining in the quarry proper after completion of bulk waste removal, (2) surface water and sediment contamination in the Femme Osage Slough and nearby creeks, and (3) groundwater contamination north of the slough.

1.1 Purpose and Scope

This plan is intended to fulfill the requirements for both the remedial design and the remedial action work plans for the implementation of the *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site* (Ref. 1). The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) signed the *Record of Decision* on September 30, 1998.

This *Work Plan* is the primary document used in defining the design and implementation of the selected remedial action for the QROU. This plan has been prepared in accordance with the *Federal Facilities Agreement* between the DOE and the EPA (Ref. 2) and the *Comprehensive Environmental Response, Compensation, and Liability Act of 1986* (CERCLA).

This *Work Plan* provides the following:

- The design strategy for the selected remedy and other activities (i.e. quarry restoration).
- The implementation approach for these activities.
- The major deliverables that will convey the design and construction activities of the selected remedy.
- The overall schedule under which the remedial design and remedial action activities will be conducted.
- General cost estimates for the activities.

1.2 Background

The *Record of Decision* presents the selected remedial action for the QROU. The action was selected following the requirements of CERCLA. The selected action stipulates long-term monitoring of groundwater to ensure continued protection of human health and the environment. Institutional controls will also be implemented to prevent groundwater usage inconsistent with recreational uses, or uses that would adversely affect contaminant migration. Field studies will be performed to collect data to verify the existing conceptual fate and transport model for the quarry area and to support ongoing evaluations regarding the benefits of groundwater remediation. Information presented in the *Remedial Investigation/Feasibility Study Work Plan* (Ref. 3), the *Remedial Investigation* (Ref. 4), the *Baseline Risk Assessment* (Ref. 5), the *Feasibility Study* (Ref. 6), and the *Proposed Plan* (Ref. 7) prepared for the operable unit was used to develop the selected action.

The objective of the *Feasibility Study* (Ref. 6) was to identify an alternative that provided a feasible option for removing or reducing the amount of uranium present in the groundwater north of the slough. Other components of the operable unit were determined to be acceptable based on the results of the risk assessment (Ref. 5). The feasibility of reducing uranium levels in groundwater north of the slough was evaluated because of the potential for impacts to the groundwater south of the slough, namely the St. Charles County well field.

During the evaluation process, the extraction of groundwater from the areas of greatest uranium contamination was identified as the most cost effective option to reduce the mass of uranium present in the groundwater north of the slough. The performance of this option was projected on the basis of available site-specific data. Calculations estimated that the extraction system may reduce the mass of uranium within the alluvial aquifer by 8% to 10% over a 2-year operating period. Uncertainties are still associated with the implementation of this option. The percentage that could be removed constitutes only a relatively small reduction in uranium in groundwater north of the slough and does not provide a measurable increase in protectiveness. The selected remedy includes a field study involving an interceptor trench to collect additional data to verify the projected performance of this option and to evaluate the benefit of groundwater extraction for uranium removal. Additional field studies to further validate the contaminant fate and transport model will also be performed.

1.3 Components of the Quarry Project

The quarry project can be divided into two tasks: (1) implementation of the *Record of Decision* for the QROU and (2) final reclamation of the quarry area. Since the implementation of both projects is necessary to attain final closure of the quarry area and has impact on the final configuration of the quarry, the design and construction activities necessary to complete these projects have been integrated into this *Plan*.

1.3.1 Quarry Residuals Operable Unit

Components of the operable unit include soil in the quarry proper, surface water and sediments in the slough and nearby creeks, and contaminated groundwater north of the slough. Each of these components was investigated during the remedial investigation phase to determine the nature and extent of contamination resulting from quarry disposal activities or the migration of contaminants in groundwater and surface water.

1.3.1.1 Soil in the Quarry Proper

At the quarry proper, soil was sampled from the rims and slopes, and sediment was sampled from wall and floor fractures and from the ramp and floor of the quarry sump. Two areas, the northeast slope and the ditch area near the transfer station, that exhibit radiological levels significantly higher than background, were not completely characterized because of poor access during soil investigations. Radiological and chemical results from these remedial investigation samples indicate that under a recreational scenario, potential exposures including the northeast slope and ditch area are below to within the acceptable risk range of 10^{-6} to 10^{-4} based on a recreational visitor scenario (Ref. 5).

Characterization has now been completed at the northeast slope area and the ditch area at the quarry (Section 5). The *Record of Decision* (Ref. 1) outlines the performance of a risk assessment, after completion of the additional characterization, to determine if excavation of residually contaminated soils from these areas is warranted due to unacceptable risk. Review of the additional characterization data indicates no increase in the risk levels within the quarry proper. However, because removal of contaminated material will be performed during the early stages of quarry restoration, removal of some soil from these areas has been included in the restoration project. Excavation limits will be based on the cleanup criteria for radionuclides presented in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 8).

1.3.1.2 Surface Water and Sediment in the Slough and Nearby Creeks

Surface water and sediment from the upper and lower reaches of the Femme Osage Slough, the Little Femme Osage Creek, and downstream portions of the Femme Osage Creek have been characterized for radiological and chemical contamination. Fish from the slough were collected and analyzed to investigate any potential impacts from site contaminants.

Radiological and chemical results from the surface water and sediment samples indicate that under a recreational scenario the potential risk estimated for the slough and creeks is within the acceptable risk range of 10^{-6} to 10^{-4} (Ref. 5). The current levels of contamination in surface water and sediments from the slough and the Little Femme Osage Creek do not appear to have affected ecological resources at these habitats and do not pose a future risk to biota at the site. The results

from the risk assessment indicate that no action is warranted for the surface water and sediments in the slough and nearby creeks.

1.3.1.3 Groundwater North of the Slough

Groundwater from the well field (located south of the slough) is used for residential purposes and monitoring data indicate that uranium levels in this area are similar to background levels. The contaminated quarry groundwater is not accessible to either current or future recreational users. For informational purposes, risk estimates for groundwater were calculated for a hypothetical residential user. At some locations north of the slough, the potential estimated risk is greater than the acceptable risk range of 10^{-6} to 10^{-4} (Ref. 5).

Because source removal was accomplished under a previous action, no additional contaminants to the groundwater system should be introduced. However, because of the presence of significant levels of uranium in groundwater north of the slough (2,740 pCi/l), it was considered prudent to continue an evaluation of the effectiveness and benefit of reducing the levels of uranium in the groundwater in the quarry area through field studies. The available hydrological and geochemical information, as well as water quality data, supports the conclusion that site contaminants will not measurably affect the aquifer of the Missouri River alluvium south of the slough. However, given the reliance on natural systems to preclude potentially significant impacts to this aquifer, alternatives addressing groundwater remediation were evaluated in the *Feasibility Study* (Ref. 6).

Long-term groundwater monitoring with institutional controls on groundwater usage in the area of impact was presented as the selected action in the *Record of Decision* (Ref. 1). The selected action addresses groundwater contamination by monitoring to provide data for verifying that conditions in the quarry area and the well field remain protective of human health and the environment. This determination will be made based on the collection of groundwater data from strategically selected monitoring wells, both inside and outside the area of groundwater impact. This data will also document any continued effects of natural processes on contaminant concentrations within the area.

This action will be designed to provide for long-term monitoring of groundwater, including the groundwater in the Missouri River alluvium. Existing wells, with the addition of one new monitoring well, will be utilized in this network. If long-term monitoring identifies a trend or change in monitoring wells south of the slough resulting in increased levels of uranium approaching a target level of 30 pCi/l, the potential for significant impacts to the well field and the alluvial aquifer will be reevaluated.

Chemical- and action-specific applicable or relevant and appropriate requirements (ARARs) for the selected action are discussed in the *Record of Decision* (Ref. 1). Chemical-specific ARARs set concentration limits or ranges in various environmental media for specific

hazardous substances, pollutants, or contaminants of concern. Missouri water quality standards for nitrobenzene (17 μg/l), 2,4-dinitrotoluene (DNT) (0.11 μg/l), and 1,3-dinitrobenzene (DNB) (1.0 μg/l) are chemical-specific ARARs for quarry groundwater. Currently, only a few locations exceed the Missouri water quality standards for groundwater. It is projected that these ARARs are likely to be met within a reasonable period of time and that long-term monitoring of the groundwater will establish compliance with these limits.

The standard for uranium in groundwater outlined in 40 CFR 192.02 was considered as a potential ARAR for this action during development of the *Feasibility Study* (Ref. 6) and *Proposed Plan* (Ref. 7). The groundwater north of the slough is impacted; however, it is not considered to be a usable groundwater source. Conversely, the Missouri River alluvium south of the slough is currently not impacted and is presently being used as a potable water source. Because groundwater north of the slough is not a useable source, 40 CFR 192.02 is not considered an ARAR for that groundwater. However, 40 CFR 192.02 would likely be an ARAR for any remedial action considered for the useable groundwater source south of the slough in the unlikely event of contaminant migration from north of the slough. While 40 CFR 192.02 currently appears to be the only groundwater standard that would be considered as a potential ARAR for any future remediation, other standards in place at the time of any future action would also be considered in the ARAR analysis.

Institutional controls will be necessary to prevent uses inconsistent with recreational use, or uses that would adversely affect contaminant migration. Coordination with the Missouri Department of Natural Resources and the Missouri Department of Conservation (affected landowners), will be performed to establish a written agreement, such as a license agreement, memorandum of understanding, or deed attachment, outlining and agreeing to the terms of the institutional controls. Terms may include limiting access to groundwater north of the slough for the following uses: irrigation, consumption, etc. The terms of the agreement will be evaluated periodically based on the results of the long-term monitoring program. Changes or deletions to the terms would be made, as appropriate, based on the results of this program.

During bulk waste removal activities, the U.S. Department of Energy (DOE) developed the *Well Field Contingency Plan* (Ref. 9) to ensure the continued availability of a safe and reliable public water supply for St. Charles County. Specific activities, which were undertaken as part of this plan, were:

- Continued water quality monitoring to detect trends or abrupt changes in contaminant levels near the well field.

- Contaminant transport calculations and numerical modeling of the Weldon Spring Quarry and St. Charles County well field hydrogeologic system to enhance the understanding of processes controlling groundwater flow and contaminant migration.

- Definitions of action levels and response actions.
- Preparation of a plan to support development of replacement wells in the existing well field.
- Preparation of a plan to support development of a replacement well field.
- Development of criteria for design and construction of a replacement well field.

The monitoring and contingency objectives of the *Well Field Contingency Plan* (Ref. 9) will be integrated into the long-term monitoring program for this operable unit. The contingencies outlined in the *Contingency Plan* will be reevaluated based on current data and understandings. This program will be developed and presented in a long-term monitoring and surveillance plan at a later date.

Field studies are planned given the presence of significant levels of contamination in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field; and the reliance on natural systems to limit potential exposure. The following studies will be conducted to support the selected action described in the *Record of Decision* (Ref. 1):

- Studies to support the evaluation presented in the *Feasibility Study* regarding the need for and effectiveness of groundwater remediation, which includes an interceptor trench.
- Field sampling to further characterize the conditions controlling the fate and transport of uranium in the shallow aquifer.

1.3.2 Quarry Reclamation

Components of the reclamation of the quarry area include restoration of the quarry proper, demolition of the quarry water treatment plant, removal of the interceptor trench system (field study), and dismantlement of facilities utilized during bulk waste removal activities. The reclamation of the quarry area is planned as a three-phased project that includes the removal of contaminated materials, including structures and soil, restoration of the quarry proper, and dismantlement of the quarry interceptor trench system, including the quarry water treatment plant. Because the water treatment plant will need to be available to treat water from the interceptor trench, dismantlement of the treatment plant can not be implemented until after the activities related to the field studies have been completed. It is expected that restoration of the quarry proper itself will be completed before demolition of the treatment plant can be implemented. Grading of the site during

quarry proper restoration will be performed to an intermediate site plan. Final site grading will be performed after demolition of the quarry water treatment plant.

The quarry proper restoration design plan includes backfilling the quarry with soil to:

- Reduce fall hazards.
- Eliminate ponding of surface water.
- Force groundwater flow around the inner quarry.
- Reduce the infiltration of precipitation through the backfill.
- Prevent the mobilization of residual contamination in fractures to the surface through erosion and/or freeze/thaw action.
- Reduce the potential for mobilization of potential residual contamination into the groundwater.

Dismantlement of the facilities utilized during bulk waste removal activities would also be performed during this time. This includes removal of:

- Decontamination facility.
- Transfer station.
- Fuel station.
- Associated piping.
- Ancillary structures.
- Haul road structures.

Restoration design will also include removal of radiologically impacted soils from the ditch area near the transfer station, the northeast slope area, and the snake pit area.

Final reclamation of the quarry area will be performed at the completion of the interceptor trench field study. Reclamation will include:

- Demolition of the quarry water treatment plant and associated basins.
- Dismantlement of the interceptor trench.
- Grading of the treatment plant and interceptor trench areas to conditions that are as close, as possible, to natural contours.

1.4 Document Organization

The remaining sections of the document are:

Section 1 LONG TERM MONITORING – provides a summary of the major components to be evaluated in the development of the groundwater monitoring program stipulated in the selected remedy.

Section 2 INSTITUTIONAL CONTROLS – provides a summary of the evaluation and implementation of institutional control measures that will be employed for the QROU.

Section 3 FIELD TESTING – provides a summary of the interceptor trench and hydrogeological studies that will be performed to evaluate the benefits of uranium removal in the area north of the slough. Sampling methods and performance evaluations will be summarized in this section.

Section 4 QUARRY PROPER SOIL – provides a summary of the soil characterization activities that have been performed in the quarry proper. A discussion of soil removal approaches is also provided.

Section 5 QUARRY RECLAMATION – provides a summary of the restoration of the quarry area after completion of the remedial activities being performed under this operable unit. A summary of the environmental assessments performed in support of the selected remedy and quarry reclamation activities is also included.

Section 6 CONSTRUCTION ACTIVITIES - provides a summary and construction specifications of the activities which will be undertaken to implement the selected remedy and quarry reclamation.

Section 7 PROJECT SCHEDULE - provides an overall schedule for the design and implementation of the different activities discusses in this plan.

Section 8 SUMMARY OF PROJECT COSTS - provides a summary of the costs for design and construction for the selected remedy, as well as the additional activities.

Section 9 QUALITY ASSURANCE PROGRAM PLAN - provides a brief abstract of the project quality assurance program plan.

Section 10 CONTINGENCY PLAN - provides a brief abstract of the project emergency plan.

Section 11 POST-ROD DOCUMENTS - provides a summary of the primary and secondary documents that will be prepared for the remedial design and remedial action phases of the QROU.

Section 12 REFERENCES – provides a summary of the reference documents used in preparation of this plan.

2. LONG-TERM MONITORING

The selected remedy for the Quarry Residuals Operable Unit (QROU) provides for continued protectiveness to human health and the environment by addressing the contaminated groundwater north of the slough. The selected remedy provides the following key components:

- Monitoring of groundwater long-term to verify that groundwater quality at the quarry area and the St. Charles County well field remains protective of human health and the environment.

- Implementation of institutional controls to prevent the use of the groundwater in the area of uranium impact (see Section 3).

- Collection of field data related to the effectiveness of uranium recovery in quarry groundwater to validate predictive models relating to groundwater remediation that were presented in the *Feasibility Study* (Ref. 6) (see Section 4).

The *Federal Facilities Agreement* (Ref. 2) requires the preparation of an operations and maintenance plan for each operable unit with continuing action, such as monitoring or treatment. A long-term monitoring plan will be prepared to include the specifics for this program. The institutional controls that will be established and enforced for this operable unit will be presented under a separate plan.

This section provides a summary of the major components that will be evaluated and established for the long-term monitoring program for the Quarry Residuals Operable Unit. Components discussed are:

- Monitoring strategy.
- Monitoring locations.
- Monitoring parameters.
- Monitoring frequency.
- Data interpretation.
- Contingency actions.

2.1 Monitoring Strategy

Long-term monitoring for the QROU will consist of two programs that are designed to:

1. Monitor uranium levels south of the slough to ensure they remain protective of human health and the environment.

2. Monitor contaminant levels within the area of groundwater impact north of the slough until they attain a predetermined target level indicating negligible potential to impact the groundwater south of the slough.

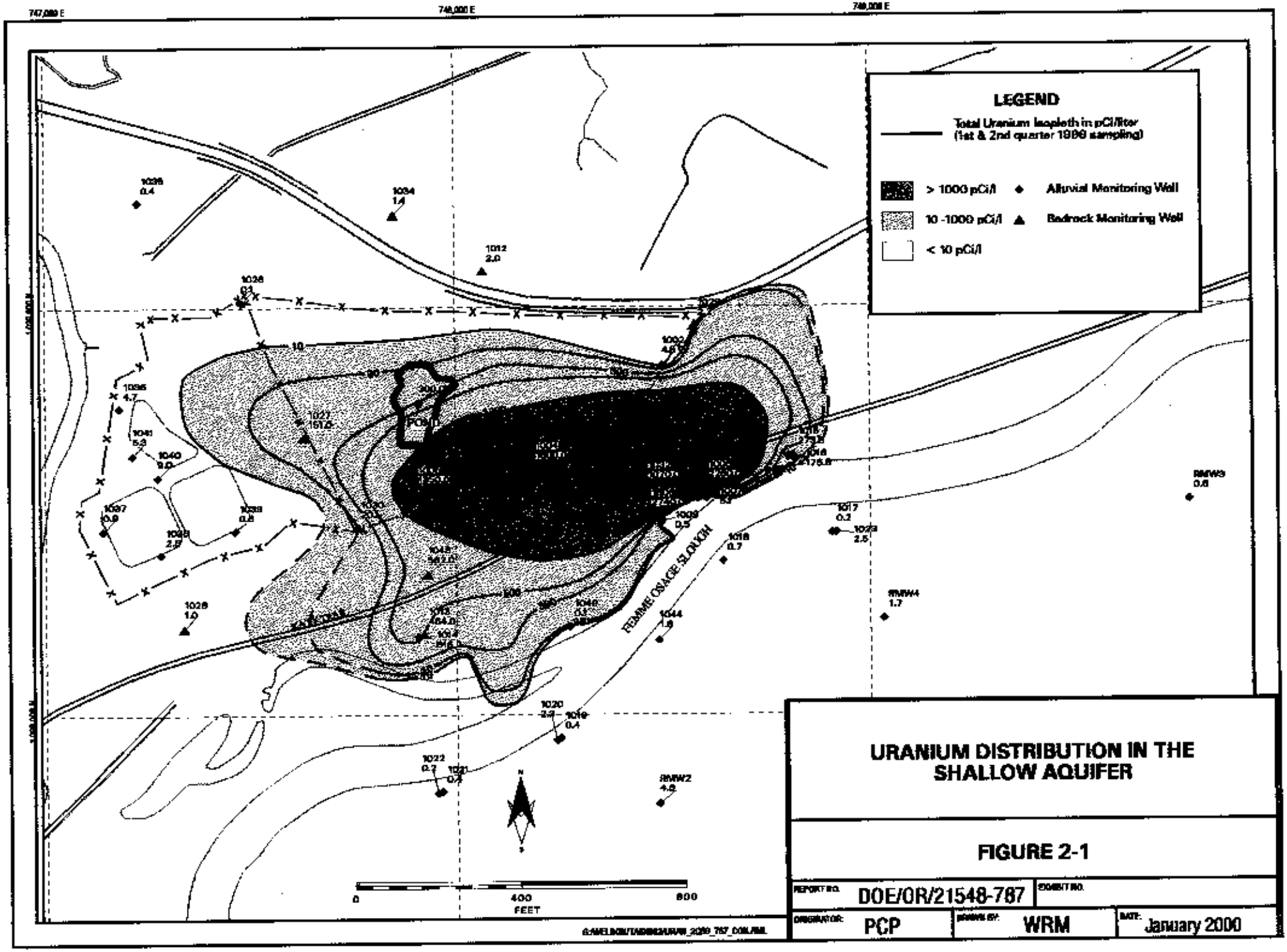
Although uranium levels in groundwater north of the slough are relatively high, levels in monitoring wells south of the slough and at the production wells in the St. Charles County well field have been, and remain, within background ranges (Figure 2-1). Monitoring is prudent to ensure uranium contaminated groundwater north of the slough has a negligible potential to impact the well field. The recent (1999) maximum uranium level in groundwater north of the slough is 2,740 pCi/l. Establishing a metric at 10% of this maximum would result in a uranium target level of approximately 300 pCi/l in the plume north of the slough. This value would represent significant reduction in the uranium levels north of the slough, thereby reducing the possibility of uranium impacting the St. Charles County well field.

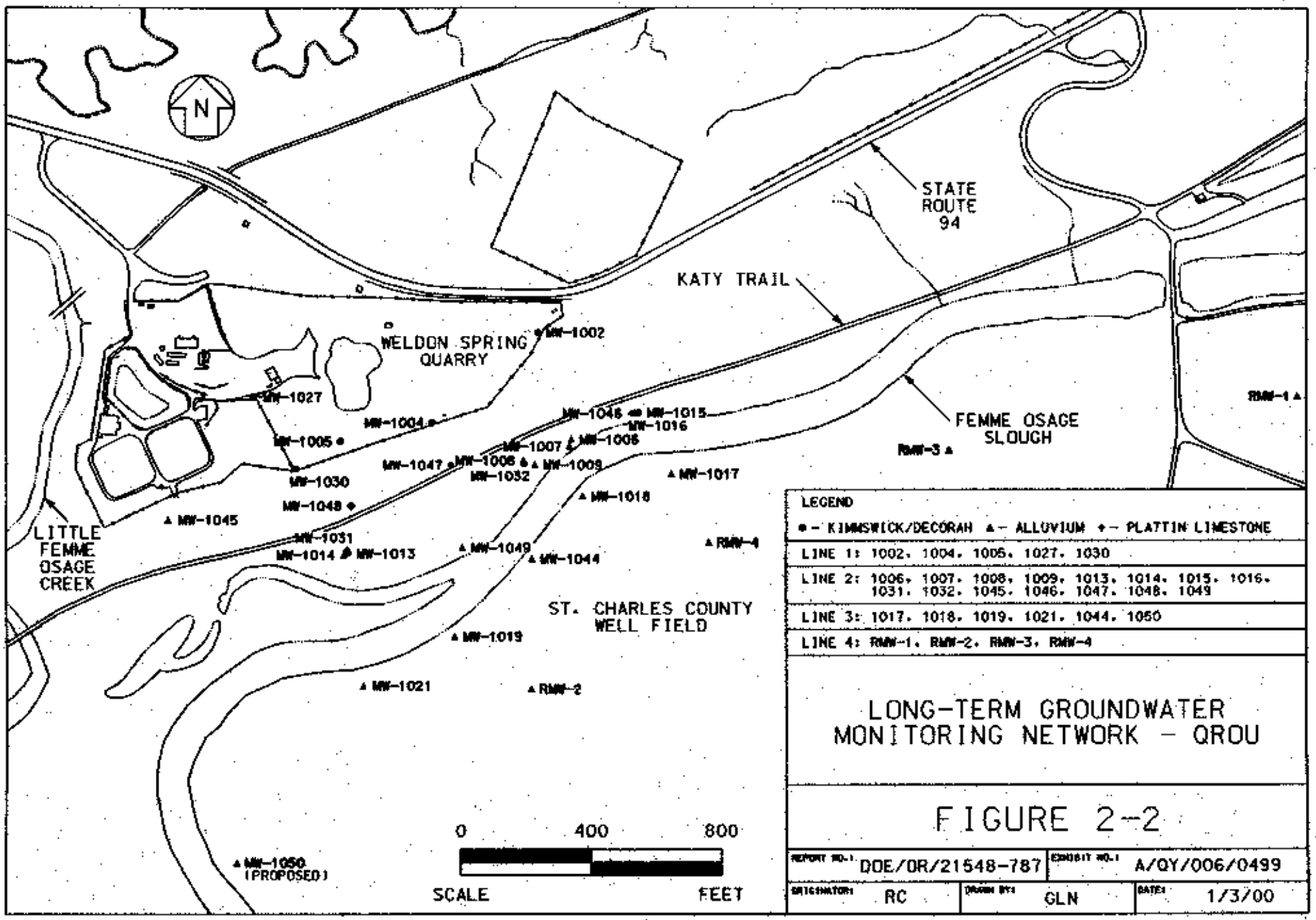
The vulnerability of the St. Charles County well field to impact from contaminated groundwater originating from the quarry has been the focus of several studies. It was determined from these studies (Ref. 4 and Ref. 33) that recharge from the area of impact accounts for less than 1% of the total flow through the St. Charles County well field. Under current conditions, the groundwater north of the slough poses no imminent risk to human health from water obtained from the well field. If after attainment of the target level of 300 pCi/l, attenuation mechanisms were to become ineffective, the increase to the well field would be 3 pCi/l. Future conditions are expected to be similar to current conditions, if not better, because the source of contamination has been removed.

The *Record of Decision* (Ref. 1) states the potential for significant impact to the well field and the alluvial aquifer will be reevaluated if long-term monitoring identifies a trend or change resulting in increased levels of uranium south of the slough approaching a target level of 30 pCi/l. The target level of 30 pCi/l is sufficiently above the established natural variation of uranium in the alluvial aquifer (0.1 pCi/l to 16 pCi/l) to be a useful indicator of currently unanticipated migration from the area north of the slough.

The target level for 2,4-DNT in groundwater both north and south of the slough has been set at 0.11 µg/l, the Missouri water quality standard. At present (1999) only three wells marginally exceed this standard and it is projected that this level will likely be met within a reasonable period of time, based on decreases in nitroaromatic compound levels since completion of bulk waste removal activities.

The groundwater monitoring strategy for the quarry has consisted of a stepped approached, which will continue to be implemented for the long-term monitoring program. The long-term wells will be monitored to provide data on contaminant distribution and concentration. The wells have been separated into four lines (Figure 2-2) that provide specific information. The lines are as follows:


LEGEND
Total Uranium Isopleth in pCi/liter (1st & 2nd quarter 1999 sampling)
> 1000 pCi/l
10 -1000 pCi/l
< 10 pCi/l
Alluvial Monitoring Well
Bedrock Monitoring Well
POND
FEMME OSAGE SLOUGH
N
0
400
800
FEET
URANIUM DISTRIBUTION IN THE SHALLOW AQUIFER
FIGURE 2-1
DOE/OR/21548-787
PCP
WRM
January 2000


N
STATE ROUTE 94
KATY TRAIL
WELDON SPRING QUARRY
MW-1002
MW-1027
MW-1004
MW-1005
MW-1030
MW-1048
MW-1045
MW-1031
MW-1014
MW-1013
MW-1047
MW-1006
MW-1032
MW-1007
MW-1008
MW-1009
MW-1046
MW-1015
MW-1016
MW-1017
MW-1018
MW-1049
MW-1044
RMW-4
RMW-3
RMW-1
FEMME OSAGE SLOUGH
LITTLE FEMME OSAGE CREEK
ST. CHARLES COUNTY WELL FIELD
MW-1019
MW-1021
RMW-2
MW-1050 (PROPOSED)
0
400
800
SCALE
FEET
LEGEND
● - KIMMSWICK/DECORAH ▲ - ALLUVIUM + - PLATTIN LIMESTONE
LINE 1: 1002, 1004, 1005, 1027, 1030
LINE 2: 1006, 1007, 1008, 1009, 1013, 1014, 1015, 1016, 1031, 1032, 1045, 1046, 1047, 1048, 1049
LINE 3: 1017, 1018, 1019, 1021, 1044, 1050
LINE 4: RMW-1, RMW-2, RMW-3, RMW-4
LONG-TERM GROUNDWATER MONITORING NETWORK - QROU
FIGURE 2-2
REPORT NO.: DOE/OR/21548-787
EXHIBIT NO.: A/QY/006/0499
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 1/3/00

- The first and second lines of monitoring wells monitor the area of impact. These wells are sampled to establish trends in contaminant concentrations.

- The third line of wells monitors the alluvial materials south of the slough. These wells have shown no impact from quarry contaminants and are monitored as the first line of warning for potential migration of uranium south of the slough.

- The fourth line of wells monitors the same portion of the alluvial aquifer that supplies the well field. These wells are sampled to monitor the groundwater quality in the productive portions of the alluvial aquifer and to determine the occurrence of uranium outside the range of natural variation.

2.2 Monitoring Locations

The network of wells to be monitored as part of this action was designed to provide for long-term monitoring of groundwater. Some existing wells, with the addition of one new monitoring well southwest of the area of impact (MW-1050), will be utilized in this network. Monitoring locations for the long-term monitoring program were selected to achieve the following criteria:

- Monitor changes and establish trends in contaminant levels in the area of known impact.

- Monitor potential migration pathways from north of the slough to south of the slough.

- Provide water quality data from the productive portions of the Missouri River alluvial aquifer.

- Monitor the geochemistry of the shallow aquifer in the area of known impact.

Each existing monitoring well has been, and any proposed monitoring wells will be evaluated against the above criteria in order to optimize the monitoring network to obtain the most representative data from the area of interest. The results of this comparison are presented in Appendix A. The wells shown on Figure 2-2 comprise the long term groundwater monitoring network.

2.3 Monitoring Parameters

The contaminants of concern identified in quarry groundwater north of the slough are uranium and nitroaromatic compounds (Ref. 1). These contaminants were derived from contaminated bulk wastes that were previously disposed of in the quarry. Although other

contaminants were present in quarry bulk wastes, uranium and nitroaromatic compounds were the most soluble and were leached from the bulk wastes into the shallow groundwater.

The geochemical characteristics of the aquifer have some affect on the extent of uranium contamination. In the groundwater north of the slough, causes for chemical variability can be attributed to changes in the oxidation potential (Eh). Changes in the oxidation state could result in mobilization of constituents that were previously precipitated under differing conditions.

Monitored parameters have been selected to meet the following criteria:

- Parameters that are primary contaminants in the quarry groundwater.
- Parameters that characterize or indicate changes in the geochemistry of the shallow aquifer.

Based on these criteria, the long-term monitoring program will sample for uranium and nitroaromatic compounds (1,3,5-trinitrobenzene (TNB), 1,3-dinitrobenzene (DNB), 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (DNT), 2,6-DNT, and nitrobenzene). Geochemical parameters that will be monitored are pH, Eh, sulfate, and iron (total, Fe^{2+}, and Fe^{3+}).

2.4 Monitoring Frequencies

Groundwater monitoring has been performed in the quarry area on a routine basis since 1986. Data over a 10-year period have been evaluated to determine the nature and extent of contamination. The horizontal and vertical extent of groundwater contamination at the QROU has remained nearly constant over the past 13 years of monitoring (1986 to present), although concentrations have exhibited downward trends since bulk waste removal. Statistical analysis of the data, performed on at least a biannual basis, indicated that contaminant levels do not exhibit seasonal variability.

The criteria for development of the monitoring frequency are:

- Locations south of the slough will be sampled at a frequency that will account for the groundwater travel times from the area of impact north of the slough to monitoring locations south of the slough.
- Sampling will be sufficiently frequent to provide data for statistical analysis, as outlined in this section.

Using conservative assumptions for hydraulic conductivity and groundwater gradients between Lines 2 and 3, a semiannual sampling frequency will account for the groundwater travel

time from north of the slough to immediately south of the slough. Calculations indicate a travel time between these two areas is approximately 1 year. Due to the lower gradients between Lines 3 and 4, an annual sampling frequency can be used for the Line 4 monitoring locations (RMW-series monitoring wells).

Monitoring north of the slough is being performed to accommodate the statistical analysis for attainment of a target level; therefore, a more frequent sampling interval has been selected for this area. Groundwater samples will be collected on a quarterly basis from monitoring wells in Lines 1 and 2.

Geochemical sampling will be performed at the same frequency as contaminant sampling both north and south of the slough.

2.5 Data Analysis and Interpretation

The monitoring strategies for north and south of the slough have been designed to accomplish different objectives (see Section 2.1.1); therefore, the interpretation of the data from each area will be discussed separately.

2.5.1 Groundwater Monitoring North of the Slough

Data from north of the slough will be evaluated to determine if the target levels have been statistically attained in the area of impact. The methodology presented in *Methods for Evaluating the Attainment of Cleanup Standards - Volume 2: Groundwater* (Ref. 10) was used as a guideline in the development of the evaluation method for data from this area. The groundwater will be judged to attain the target level if the contaminant concentrations in the area of impact are statistically less than the target level. Wells in the area north of the slough (Lines 1 and 2, Section 2.1) will be assessed as a group for the interpretation of the statistical results for determining that the groundwater has attained the target level.

The attainment objective for the long-term monitoring for the groundwater north of the slough is that the 90th percentile of the data within a monitoring year is below the target level of 300 pCi/l for uranium and 0.11 µg/l for 2,4-DNT (see Section 2.1). Also, data from each well will be trended to establish that the uranium and 2,4-DNT concentrations in the groundwater north of the slough are decreasing.

It will be recommended that long-term monitoring activities be concluded for this operable unit if it is determined that the levels north of the slough have attained the objective for the monitoring program. Recommendations may be made to delete either uranium or 2,4-DNT from the monitoring program if either of these parameters meets the necessary monitoring criteria.

2.5.2 Groundwater Monitoring South of the Slough

Data from south of the slough will be evaluated to ensure that the uranium levels at each location remain below the target level of 30 pCi/l. Data from each well will also be trended to establish that the uranium levels in the groundwater south of the slough are not increasing. If it is determined that the target value has been exceeded or that increasing trends in uranium levels are occurring, actions outlined in Section 2.6 will be assessed.

Once the criteria for monitoring north of the slough have been attained, the groundwater monitoring program will be completed. As a result, groundwater monitoring south of the slough would also be terminated.

2.6 Contingency Actions

The monitoring and contingency action portions of the *Well Field Contingency Plan* (Ref. 9) will be integrated into the long-term monitoring program for this operable unit. In the event an alternate source of drinking water is required, engineering design and construction will proceed based on the design criteria established in the *Contingency Plan*. This plan also outlines the preliminary planning and preparation that will be necessary to implement the construction of new wells in the existing well field or a partial or full replacement well field if the *Contingency Plan* requires implementation.

If a consistently upward trend in uranium or 2,4-DNT levels is determined based on three consecutive data points in the groundwater north or south of the slough, investigation of the source and transport mechanism for the increasing levels will be initiated. This may include performance of hydrogeologic and/or contaminant investigations, installation of additional monitoring wells, or increased sampling frequency of the monitoring network.

In the event it is determined that groundwater south of the slough no longer remains below the target level of 30 pCi/l for uranium, notifications will be made to the Environmental Protection Agency (Region VII), the Missouri Department of Natural Resources, and St. Charles County. If the increased value is determined to be valid, the potential for significant impacts to the well field and the alluvial aquifer will be reevaluated (Ref. 1). This evaluation may include:

- Resampling of the locations in question and other potentially affected locations, and submittal of samples to analytical laboratories for expedited analyses.
- Increased frequency of sample collection.
- Performance of hydrogeologic and/or contaminant investigations to identify migration pathways.

- Installation of additional monitoring wells, if deemed appropriate and necessary.
- Groundwater modeling to predict long-term impacts, if deemed appropriate or necessary.
- A risk evaluation consistent with methods outlined under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA).
- Identification of applicable or relevant and appropriate requirements (ARARs)
- Determination of the need for groundwater remediation.
- Implementation of contingencies.

3. INSTITUTIONAL CONTROLS

Due to the presence of residual radiological contamination remaining in the quarry area, institutional controls have been incorporated into the selected remedy for this operable unit.

3.1 Affected Areas

Institutional controls will be evaluated for the groundwater north of the slough and evaluated for the soil in the quarry proper. Based on levels of residual contamination, these areas cannot be released for unrestricted use; institutional controls will be imposed until such time as the area can be released.

3.1.1 Groundwater North of the Slough

The contaminated groundwater north of the slough is not a useable groundwater source (Ref. 1). A risk assessment was performed for a hypothetical residential user that indicated the potential estimated risk is greater than 10^{-4} in some wells. Uranium in groundwater north of the slough ranges from 2,740 pCi/l to less than 1 pCi/l, and 2,4-dinitrotoluene (2,4-DNT) ranges from 0.50 µg/l to less than 0.03 µg/l. Uranium levels south of the slough are within background ranges (0.1 pCi/l to 16 pCi/l). Since 1994 uranium levels have not exceeded 10 pCi/l, although prior to this time historical highs of 15 pCi/l were periodically observed in this area. Nitroaromatic compounds have not been detected in groundwater south of the slough.

Institutional controls will be implemented to prevent groundwater usage for consumption or uses that would adversely affect contaminant migration, such as extraction or collection of groundwater for irrigation or other purposes. The affected areas will be determined based on uranium and 2,4-DNT levels obtained prior to the implementation of the long-term monitoring portion of this remedial action. Long-term monitoring is scheduled to be implemented at the completion of the quarry reclamation project (see Section 6).

Following attainment of the long-term monitoring target levels in groundwater north of the slough, an assessment of the residual risks based on actual groundwater concentrations will be performed to determine the need for future institutional controls on the groundwater in this area. As outlined in the *Record of Decision* (Ref. 1), 5-year reviews will be conducted to evaluate the conditions at the quarry and to ensure that conditions remain protective of human health and the environment.

3.1.2 Quarry Proper

Soil sampling during the remedial investigation phase indicated the presence of elevated radiological contamination in two areas in the quarry proper. These two areas, the northeast corner area and the ditch area near the transfer station, could not be fully characterized during the

remedial investigation to determine the extent of contamination. Risk calculations were performed for the quarry proper using all available data, including the data from these two areas. The results of this assessment indicated residual levels are within the EPA's acceptable risk range of 10^{-6} to 10^{-4} under a recreational scenario.

Removal of soils from three areas within the quarry proper will be performed during quarry restoration activities based on review of the existing characterization data and the results of recent characterization activities on the northeast slope and the ditch area. Soil exceeding the subsurface cleanup criteria presented in the *Record of Decision for Remedial Action at the Chemical Plant Area* (Ref. 8) will be excavated from the ditch area and the snake pit area. The surface cleanup criteria will be applied to soil in the northeast slope. Removal of these soils has been included in the quarry restoration project because excavation to these levels would further reduce the already low risk levels in the quarry proper, could reduce potential future disposal costs, and could facilitate release of the quarry as surplus property.

After completion of the quarry reclamation project, the residual risks will be assessed. The final configuration of the quarry will be taken into account when identifying potential exposure to residual contamination when a decision is made whether to release the area or establish institutional controls on the quarry proper.

3.1.3 Areas Outside the Quarry Proper

Radiological and chemical results from the surface water and creek and slough sediment samples indicate that under a recreational scenario the potential risk is within the EPA's acceptable risk range. Characterization results from soils outside the quarry proper also indicate that under a recreational scenario, the potential risk is within the acceptable risk range. These areas will be evaluated to determine the necessity of restrictions for future use. Recent data and land configuration will be used for this determination.

3.2 Implementation

Institutional controls will be employed and enforced through agreements between the U.S. Department of Energy and the affected landowners. The objective for institutional controls is to limit access to property contaminated by residual radioactive material. For groundwater north of the slough this will consist of limiting access to groundwater, preventing uses that will impact contaminant distribution, and preventing the alteration of the geochemistry of the aquifer. For soils in the quarry proper, if it is determined that institutional controls are necessary, access to residually contaminated areas should be prevented. The procedures for establishing institutional controls for the Quarry Residuals Operable Unit and the enforcement of these controls will be integrated into an institutional controls plan.

3.3 Types of Institutional Controls

Many types of institutional controls are available. The most commonly used controls include, but are not limited to, maintaining ownership, easements, deed notifications or restrictions, permits, zoning restrictions, or signage. Selection of the most reasonable control or combination of controls will be performed during the development of an institutional controls plan for this operable unit. Evaluation of the institutional controls will take into account implementability, effectiveness, and cost. These evaluations will be made with input from the EPA, MDNR, and other stakeholders.

4. FIELD STUDIES IN SUPPORT OF THE SELECTED REMEDY

The selected remedy in the *Record of Decision* (Ref. 1) outlines the performance of two field studies to support the decision for long-term monitoring of groundwater. These field studies will consist of the installation and operation of an interceptor trench and hydrologic and geochemical sampling within the area of uranium impact to verify the effectiveness of uranium removal by groundwater extraction methods, as presented in the *Feasibility Study* (Ref. 6) and to further define the conditions controlling the fate and transport of uranium. These studies are planned for the following reasons: (1) the presence of significant levels of contamination in quarry groundwater north of the slough, which is in close proximity to the St. Charles County well field, and (2) the reliance on natural systems to limit potential exposures. The results from these studies will be used to evaluate the effectiveness and benefits of removing the uranium from the groundwater north of the slough.

4.1 Interceptor Trench

Several configurations of an interceptor trench were evaluated in the *Feasibility Study*. The most effective configuration was determined to be a trench located near the center of the uranium plume. This configuration could result in expedited removal of the highest uranium concentrations. Groundwater modeling using analytical methods indicated that this extraction system had the potential to reduce the mass of uranium in groundwater north of the slough by 8% to 10% over a 2-year operating period (Ref. 6). This removal would constitute a small reduction of the total uranium contamination present and would not provide a measurable increase in protectiveness over the foreseeable future.

The objective of this field study is to confirm the predictive model on uranium removal from the shallow aquifer using actual field data. If the performance of the trench is less effective or within the specified performance goals (≤ 10% of the mass of uranium removed within the area of influence of the trench within a 2-year testing period), further evaluation regarding treatment of groundwater in this area will not be necessary and no further treatment and/or testing will occur. If the performance of the trench exceeds the specified goals (> 10% of the mass of uranium removed within the area of influence of the trench within a 2-year testing period), the effectiveness or benefit of continued groundwater extraction will be reevaluated.

4.1.1 Design

The design criteria are summarized in the *Design Criteria for Work Package 508, Architect/Engineer Service VI, Task 6, Revision 1* (Ref. 11) and supporting documents. Design and construction documents are summarized in Work Package 515, Quarry Interceptor Trench System.

The interceptor trench will be constructed to intersect a representative cross section of alluvial material and will be optimally located to extract groundwater in areas with high uranium contamination. Specific criteria used for siting the interceptor trench are:

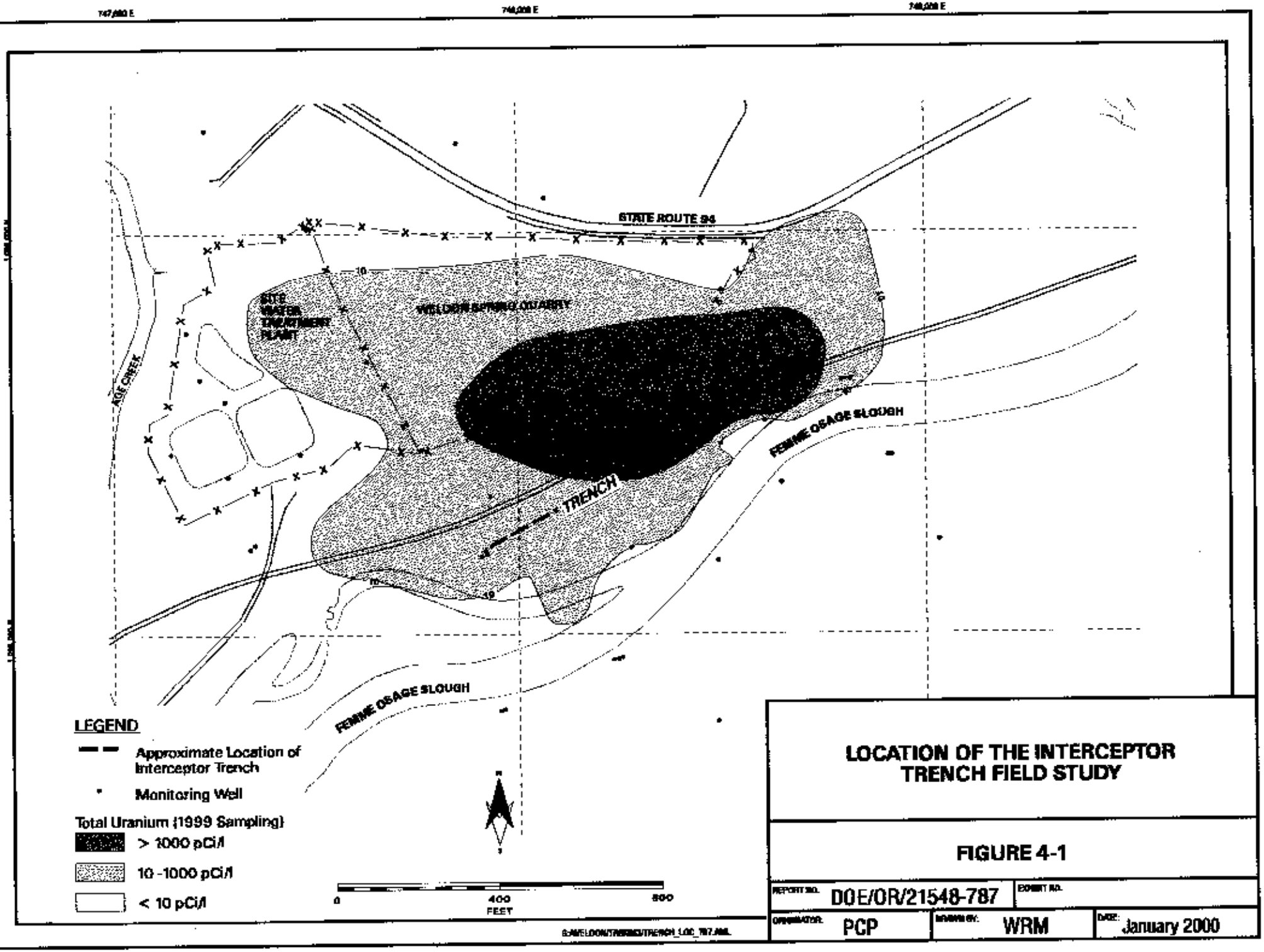
- Bound the hydraulic variations present north of the slough.
- Bound the contaminant variation present north of the slough.
- Extract groundwater over the full thickness of the alluvial materials.
- Prevent dewatering of the slough and extraction of unnecessarily large volumes of water.

The interceptor trench will be located in the alluvial aquifer south of the Katy Trail and north of the slough and will be approximately 550 ft long (Figure 4-1). The trench will be constructed through the entire thickness of the alluvial materials. The trench will be sufficiently wide to accommodate filter media and collection piping and pumps, with a minimum width of 12 in. The orientation of the trench will be perpendicular to the general groundwater flow direction.

The trench will extend to the top of the bedrock with sumps located at depressions in the bedrock topography. The trench will be backfilled with a permeable filter media, which will be covered with a lower permeability material to prevent direct communication between the alluvial aquifer and the atmosphere and to prevent surface water from entering the trench. Pumps and piping will be enclosed below grade to prevent vandalism and to be unobtrusive.

The trench will provide hydraulic capture of uranium-contaminated groundwater in the alluvial aquifer along its length. The pumping rate will be optimized to provide continuous pumping without dewatering of the alluvial materials. It is estimated that the pumping rate from the trench will be approximately 10 gpm, based on calculations presented in the *Feasibility Study* (Ref. 6). The actual pumping rate will be determined from the performance of this field study; therefore, pumps capable of variable rates will be utilized.

Water produced from the interceptor trench will be routed below grade to the quarry water treatment plant. Conveyance piping to the plant will be double-walled and have a leak detection system. The water treated at the plant will be discharged to the Missouri River using the existing effluent pipeline. A means of discharging the water from the trench without being processed through the treatment plant will be designed in the event water produced from the trench is below the applicable discharge limits for the treatment plant.


STATE ROUTE 94
WELDON SPRING QUARRY
SITE WATER TREATMENT PLANT
ACE CREEK
FEMME OSAGE SLOUGH
TRENCH
FEMME OSAGE SLOUGH
LEGEND
Approximate Location of Interceptor Trench
Monitoring Well
Total Uranium (1999 Sampling)
> 1000 pCi/l
10 -1000 pCi/l
< 10 pCi/l
0
400
800
FEET
LOCATION OF THE INTERCEPTOR TRENCH FIELD STUDY
FIGURE 4-1
REPORT NO. DOE/OR/21548-787
EXHIBIT NO.
ORIGINATOR: PCP
DRAWN BY: WRM
DATE: January 2000

The trench and conveyance system will be capable of year-round operation, including during flood conditions (if possible). The design life of the trench and conveyance systems will be 5 years.

4.1.2 Monitoring

The performance of the trench will be monitored to determine: (1) the efficiency of uranium removal from the aquifer and (2) the area of influence of the trench. Levels of nitroaromatic compounds will also be monitored. Effluent from the trench, groundwater samples, and measurement of the static water levels in the vicinity of the trench will be used to assess the performance of the trench system. The scope and methodology for sampling during the field study will be presented in the *Sampling Plan for the Quarry Residuals Operable Unit Interceptor Trench Field Study*.

The trench will be designed to allow sampling of the effluent from the trench and from each sump within the trench to evaluate the mass of uranium removed from the aquifer. Operational samples will be collected from the trench on at least a weekly basis. The water level within each sump will be measured on at least a weekly basis to evaluate the drawdown in the aquifer.

Observation wells will be installed in close proximity to the trench to monitor the effects of the trench operation on the water quality of the alluvial aquifer and groundwater flow directions. Groundwater samples will be collected on a monthly basis from these wells. Groundwater will also be sampled from the nearby monitoring wells. Static water level measurements will be taken on at least a monthly basis to monitor the effects of groundwater withdrawal on the aquifer.

The observation wells will be screened through the entire thickness of the alluvial aquifer in order to sample the aquifer thickness extracted by the trench and to obtain the water level of the unconfined shallow aquifer. The wells will be constructed using polyvinyl chloride (PVC) materials. These wells will be constructed in accordance with 10 CSR 23, the *Missouri Well Driller's Law*.

4.1.3 Data Evaluation

The system will be evaluated and monitored for up to two years. Data will be collected from the trench (i.e., volume of water extracted and uranium and nitroaromatic compound levels) and from nearby monitoring wells. This data will be combined with other data collected as part of the hydrogeologic field data to evaluate the effectiveness of the trench versus predetermined performance goals.

The interceptor trench is expected to remove only a percentage of the uranium in the groundwater after a specified operational period. The efficiency of the system depends on three factors:

- The initial mass of uranium present in the area of influence of the trench.
- The volume of groundwater extracted.
- The concentration of uranium in the effluent.

The initial mass of uranium present in the area north of the slough will be determined prior to initiation of the field study. The interceptor trench will not have an influence over the entire area of the plume; therefore, only a percentage of the total mass of uranium will be considered to determine the effectiveness of its operation. The percentage of the plume under the influence of the interceptor trench will be determine from the static water level measurements obtained during the study.

The rate of uranium removal from the trench will be derived from measurements of the uranium concentration and the volumetric discharge rate from the trench over time. The ratio of the cumulative mass of uranium removed to the initial total mass present will provide an indication of the trench efficiency. A curve of the cumulative mass of uranium removed versus time can be constructed. This curve may be used to extrapolate the amount of uranium that will be removed during the two-year operational period of the trench. It is anticipated that the removal rate of uranium will be largest at the beginning of trench operations, and then is expected to decrease and approach a constant value with time.

If the results for the uranium removal indicate that 10% or less of the total uranium present in the area of influence will be removed over the 2-year operational period, it may be possible to terminate operation of the trench prior to the full testing period. A steep decline in groundwater extraction rates, uranium levels, or both would trigger an evaluation of the effectiveness of the trench prior to completion of the 2-year period. The results of the study to that point would be compiled and conclusions regarding the continued performance of the field study would be presented in a project completion report.

At the completion of the operational period, the data from the trench will be compiled to determine the effectiveness of an interceptor trench for the removal of uranium from the shallow aquifer. Data to be presented will include:

- Curve of the cumulative mass of uranium removed.
- Curve of the cumulative volume of groundwater extracted.
- Static water level data from observation wells and nearby monitoring wells.

- Summary of analytical data for uranium and nitroaromatic compounds from the study area (both from the trench and nearby monitoring wells).
- Summary of the total mass of uranium removed from the aquifer.
- Summary of the total volume of groundwater extracted from the aquifer.
- Conclusions regarding the performance of the interceptor trench system.

A completion report presenting the above information will be used to document the decision to consider the field study complete. The public will be made aware of the findings of this study through a published notification summarizing the results of the evaluation of the system.

4.2 Hydrogeological Field Studies

The determination to perform additional geologic, hydrologic, and geochemical field studies in the area north of the slough was made given the reliance on natural systems to limit potential exposure to groundwater. The site-specific data collected during these studies will be used to supplement and verify the current model of hydrogeologic and geochemical site characteristics which dictate the fate and transport and potential remediation of uranium in this area.

4.2.1 Geological Characterization

Geologic sampling activities were performed in accordance with the *Hydrogeological Characterization Sampling Plan in Support of the QROU Field Studies* (Ref. 12). Field work associated with this characterization was completed in February 1999. The objectives of the characterization were to:

- Further define the lateral and vertical distribution of various fine-grained materials north of the slough.
- Determine the grain-size distribution of the material types comprising the fine-grained alluvium north of the slough.
- Provide a detailed description of the Decorah Group beneath the fine-grained materials north of the slough.

Results and conclusions from this characterization are presented in the *Completion Report for the Hydrogeological Field Studies in Support of the Quarry Residuals Operable Unit* (Ref. 13). General conclusions are:

- The occurrence of coarser-grained materials increases with distance from the quarry bluff. Nearer the bluff, sands are noncontinuous and have significant fines (silt and clay) content.

- The thickness of the Decorah Group ranges from 3.9 ft to 18.3 ft in the area north of the slough.

- Weathering and fracturing is more prevalent in the upper portion (approximately 7 ft) of the Decorah Group. The base of the Decorah Group and the underlying Plattin Limestone is typically more competent.

- Soil testing performed on samples collected to represent both discrete zones and composited intervals indicated the materials north of the slough are primarily clays with silt and fine sand.

4.2.2 Hydrologic Characterization

Hydrologic sampling activities were performed in accordance with the *Hydrogeological Characterization Sampling Plan in Support of the QROU Field Studies* (Ref. 12). Field work associated with this characterization was completed in February 1999. The objectives of the characterization were to:

- Determine the variation in aquifer parameters due to the heterogeneity of the fine-grained alluvium.

- Identify zones within the bedrock that facilitate the movement of groundwater.

Results and conclusions from this characterization are presented in the *Completion Report for the Hydrogeological Field Studies in Support of the Quarry Residuals Operable Unit* (Ref. 13). General conclusions are:

- Differing grain sizes of the alluvial sediments do not appear to have a significant effect on the hydraulic conductivity test results. The variation of hydraulic conductivity of the aquifer materials ranges from 7×10^{-5} cm/s for predominantly clay materials to 9×10^{-4} cm/s for predominantly sand materials. This range of values is consistent with previous testing in this area.

- The relatively low difference in values may be due to (1) the noncontinuous distribution of the coarser grained materials in the alluvium north of the slough or (2) the presence of fine-grained materials (silt and clay) within the sand matrix.

- Results from the packer testing generally agreed with results from previous testing in the Decorah Group. The upper portion (approximately 7 ft.) of this unit was the only section of bedrock that took water during testing due to the larger degree of weathering and fracturing that occurred in the area north of the slough.

4.2.3 Geochemical Characterization

The objectives of the geochemical characterization are to:

- Assess the natural conditions of the aquifer system, which attenuates uranium in groundwater north of the slough.

- Estimate distribution coefficients for differing locations and material types north of the slough.

- Characterize the oxidation potential within the aquifer.

- Provide additional supporting evidence to identify the mechanisms, reduction and/or adsorption, attenuating uranium north of the slough.

Soil and groundwater samples will be collected throughout the shallow aquifer north of the slough to assess the natural conditions of the aquifer that attenuate or retard dissolved uranium in groundwater. The notable decrease of uranium over a short distance north of the slough indicates that processes to be investigated are sorption and reduction (precipitation) of uranium.

Sorption is a generic term describing contaminant removal from solution, and includes ion exchange, specific adsorption to mineral surfaces and/or organic matter, or other processes. Contaminant sorption to soil or the aquifer matrix from groundwater is commonly quantified in terms of a distribution coefficient (Kd). Limited site-specific Kd data is available for locations both north and south of the slough (Ref. 6). Additional sampling of soil and groundwater will be performed in the fine-grained materials north of the slough to establish the variability of Kds in this area.

The geochemical characteristics of uranium and the aquifer affect the extent of uranium contamination in groundwater. Removal of contaminants from groundwater via precipitation to solid phases typically results from changes in geochemical conditions, which cause one or more

contaminants to exceed their solubility limit in water. Uranium is soluble under oxidizing conditions and precipitates into solid phases under reducing conditions (Ref. 4). Sampling of groundwater in the area north of the slough will be performed to identify the variation of the oxidation potential (Eh) of the aquifer in this area. Direct measurements of the Eh will be performed to establish the horizontal and vertical variations. Analysis of groundwater for oxidation/reduction and Eh will be used in establishing the geochemical constraints of uranium migration in this area.

5. QUARRY PROPER SOILS

The *Record of Decision* (Ref. 1) identified a need to define the extent of radiological soil contamination at the northeast slope and the ditch area near the transfer station (Figure 5-1). Removal of soils from these two areas, as well as one additional area within the quarry proper, will be performed during quarry restoration activities based on a review of the existing characterization data and the results of recent characterization activities. Removal of these soils has been included in the quarry restoration project because of the further reduction in the already low risk levels in the quarry proper, availability of the on-site cell for disposal, and the potential to release the property as surplus.

The *Record of Decision* (Ref. 1) outlines performance of a risk assessment to determine whether to excavate residually contaminated soils from the ditch area and the northeast slope area. Additional data obtained from the characterization of these two areas would be used in the calculations. If, based on the additional data, the risk from soil in the quarry proper exceeds the acceptable levels (1×10^{-6} to 1×10^{-4}); soil from these two areas would be removed. Cleanup criteria for radionuclides presented in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 8) would be applied (Table 5-1).

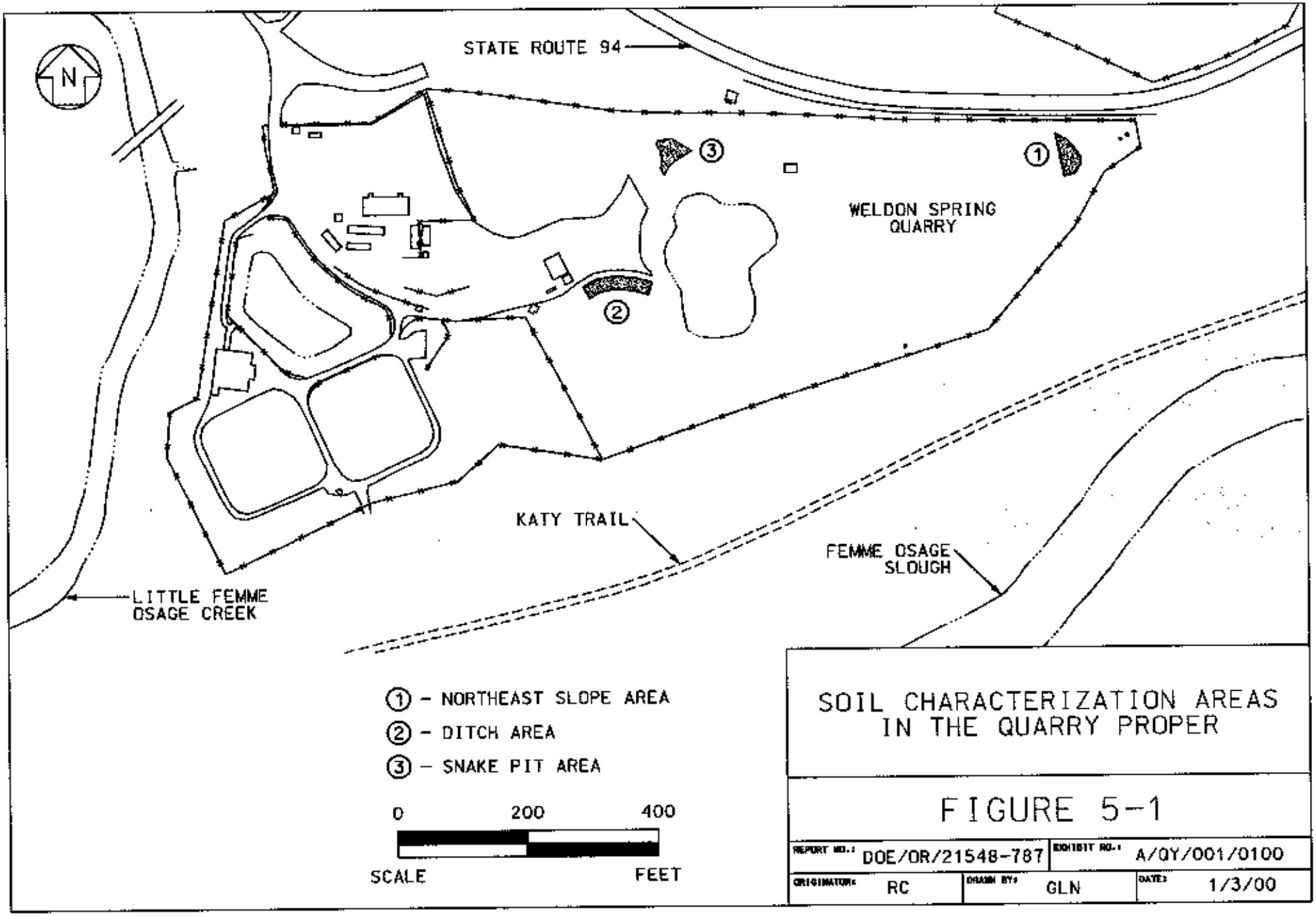
Table 5-1 Cleanup Criteria for Selected Radionuclides

Radionuclide	Surface Criteria [1]	Subsurface Criteria [2]
Ra-226 [3]	6.2 pCi/g	16.2 pCi/g
Ra-228 [3]	6.2 pCi/g	16.2 pCi/g
Th-230	6.2 pCi/g	16.2 pCi/g
U-238	30 pCi/g	120 pCi/g

Source: Ref. 8

NOTE: 1 Values apply to contamination within the upper 6 in.
2 Values apply to contamination below 6 in.
3 At locations where both Ra-226 and Ra-228 area present, the criterion applies to the sum of the concentrations.

Remediation of the northeast slope area and the ditch area is not required based on the requirements outlined in the *Record of Decision* (Ref. 1). Review of the data does not indicate an increase in the risk levels within the quarry proper due to the inclusion of the additional data into the risk calculations. However, since removal of contaminated material will be performed during the early stages of quarry restoration, removal of these soils has been included in the restoration project because:


N
STATE ROUTE 94
WELDON SPRING QUARRY
KATY TRAIL
FEMME OSAGE SLOUGH
LITTLE FEMME OSAGE CREEK
① - NORTHEAST SLOPE AREA
② - DITCH AREA
③ - SNAKE PIT AREA
0
200
400
SCALE
FEET
SOIL CHARACTERIZATION AREAS IN THE QUARRY PROPER
FIGURE 5-1
REPORT NO.: DOE/OR/21548-787
EXHIBIT NO.: A/QY/001/0100
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 1/3/00

- Removal could provide a reduction in the already low risk levels in the quarry proper.
- Removal could reduce potential future disposal costs, if the soil in the northeast slope area would require removal at a later date.
- Removal could facilitate the release of the quarry proper as surplus property.

5.1 Nature and Extent of Contamination

5.1.1 Northeast Slope Area

The northeast slope area was partially remediated during the last phases of bulk waste removal, but due to limitations of the equipment, some areas were not accessible for contaminated soil removal. Prior to remediation, characterization indicated the northeast slope contained small isolated pockets of concentration radium- and thorium-rich material interspersed within the disturbed native soil. The remains of a buried drum containing radium wastes were discovered near this area and were removed. Elevated exposure readings using direct reading survey instruments and thoron monitoring indicate that additional contamination is likely present.

Characterization activities for the remedial investigation indicated the presence of soil exhibiting elevated Ra-226, Ra-228, and Th-230 levels in the northeast corner (Table 5-2). Approximately 2,131 cu yd of soil was excavated from this area based on these results. Subsequent sampling in the area of excavation indicated that elevated levels of radium and thorium are still present in some parts of the northeast slope (Table 5-3).

Table 5-2 Summary of Remedial Investigation Sampling Results from the Northeast Slope

Sample ID	Elevation	Northing	Easting	Radiological Parameters (pCi/g)		
				Ra-226	Ra-228	Th-230
195101	—	1028948.23	748454.98	16.29	1.65	34.90
195102	—	1028931.22	748476.59	2.95	4.62	26.30
195103	533.81	1028908.50	748476.38	8.12	20.93	336.0
195105-01	—	1028886.20	748485.03	0.87	0.94	16.20
195105-02				0.78	0.94	16.40
195105-03				0.82	0.83	13.60
195105-04				0.77	0.88	15.70
195106	539.88	1028909.80	748487.36	1.22	1.27	18.50
195107	540.74	1028933.82	748486.49	3.28	5.19	42.40

Table 5-2 Summary of Remedial Investigation Sampling Results from the Northeast Slope (Continued)

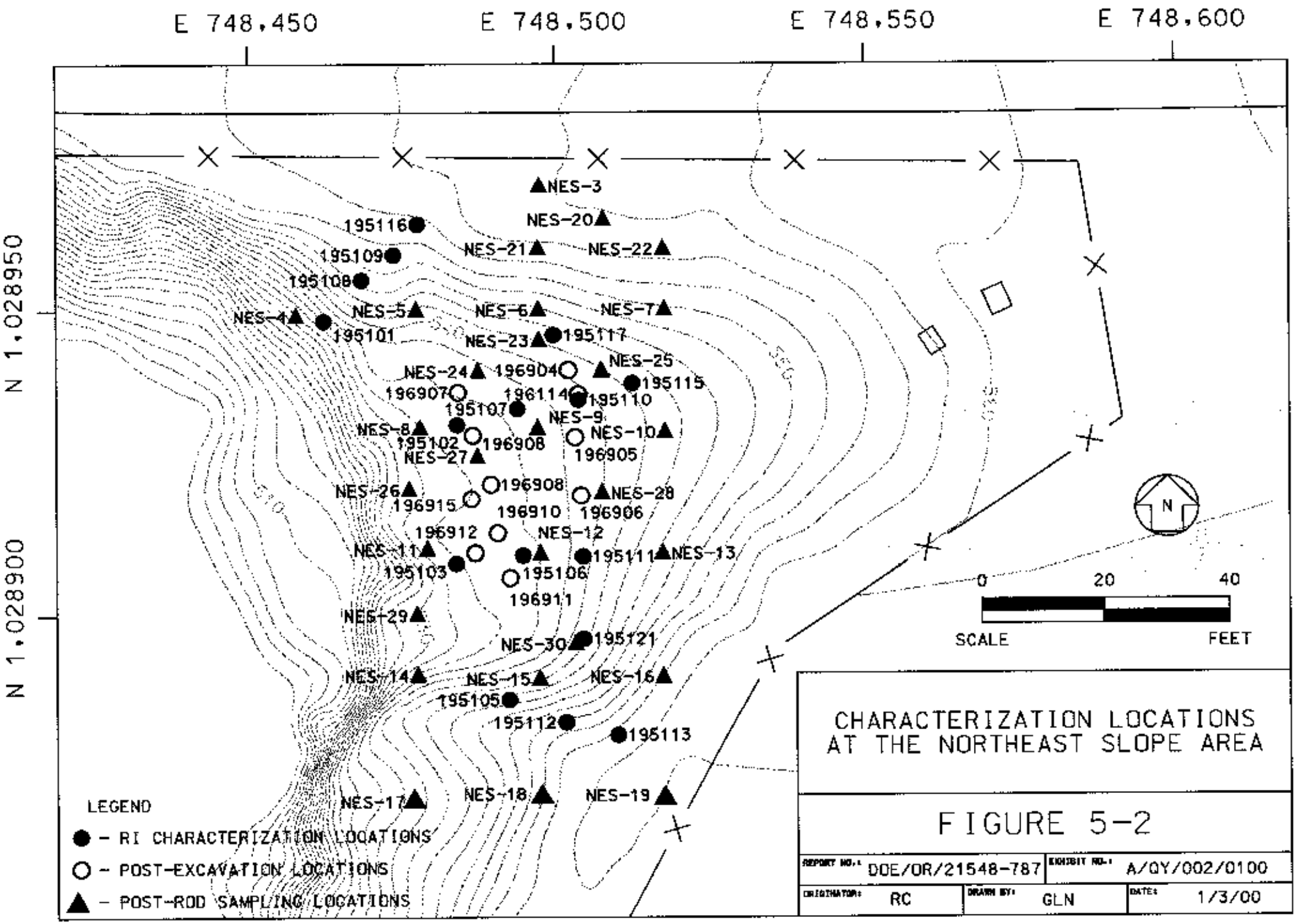
Sample ID	Elevation	Northing	Easting	Radiological Parameters (pCi/g)		
				Ra-226	Ra-228	Th-230
195108-01	543.91	1028955.01	748461.12	3.89	1.38	21.00
195108-02				1.12	0.98	15.20
195108-03				0.93	1.20	16.10
195109	547.49	1028959.11	748466.32	1.21	1.11	15.60
195110	546.71	1028935.29	748496.24	1.56	2.18	17.00
195111	—	1028909.62	748496.84	1.13	1.29	17.80
195112	—	1028882.42	748494.11	1.10	1.08	16.50
195113	—	1028880.33	748502.45	1.0	1.50	18.70
195114	—	1028911.32	748407.36	0.99	1.17	17.50
195115	552.36	1028938.02	748504.93	1.16	1.26	NA
195116	550.54	1028964.13	748470.25	4.87	1.71	25.00
195117-01	546.58	1028945.93	748492.33	1.65	3.42	23.00
195117-02				34.70	121.0	2190
195117-03				98.30	327.8	6250
195117-04				163.40	521.1	6850
195121-01	556.51	1028896.12	748496.96	58.2	244.0	4570
195121-02				27.2	103.1	2090
195121-03				30.46	95.17	2170
195121-04				2.29	1.58	18.30

Table 5-3 Summary of Post-Excavation Sampling Results from the Northeast Slope

Sample ID	Elevation	Northing	Easting	Radiological Parameters (pCi/g)		
				Ra-226	Ra-228	Th-230
196904	532.94	1028940.18	748494.66	1.29	< 1.45	2.84
196905	532.45	1028929.16	748495.69	12.7	17.0	125
196906	532.81	1028919.62	748496.58	1.96	1.25	NA
196907	534.33	1028936.53	748476.75	2.37	1.51	NA
196908	533.42	1028929.47	748479.18	3.64	3.59	NA
196909	532.70	1028921.47	748482.14	3.03	1.92	NA
196910	532.23	1028913.49	748483.23	2.17	2.26	NA
196911	531.87	1028906.13	748485.25	3.47	1.55	NA
196912	531.84	1028910.23	748479.53	21.2	24.7	48.7
196914	532.98	1028936.24	748496.22	93.3	141	1950
196915	532.35	1028919.08	748478.91	5.68	6.89	NA

NA Not analyzed

The northeast slope area was sampled to support quarry restoration design, (Figure 5-2). Sampling was develop and implemented to fulfill the following objectives:


E 748,450
E 748,500
E 748,550
E 748,600
N 1,028950
N 1,028900
NES-3
NES-20
NES-21
NES-22
195116
195109
195108
NES-4
NES-5
NES-6
NES-7
195101
NES-23
195117
NES-25
NES-24
196904
195115
196907
196114
195110
195107
NES-9
NES-8
NES-10
195102
196908
196905
NES-27
NES-26
196908
NES-28
196915
196910
196906
196912
NES-12
NES-11
195111
NES-13
195103
195106
196911
NES-29
NES-30
195121
NES-14
NES-15
NES-16
195105
195112
195113
NES-17
NES-18
NES-19
N
0
20
40
SCALE
FEET
LEGEND
● - RI CHARACTERIZATION LOCATIONS
○ - POST-EXCAVATION LOCATIONS
▲ - POST-ROD SAMPLING LOCATIONS
CHARACTERIZATION LOCATIONS
AT THE NORTHEAST SLOPE AREA
FIGURE 5-2
REPORT NO.: DOE/OR/21548-787
EXHIBIT NO.: A/QY/002/0100
ORIGINATOR: RC
DRAWN BY: GLN
DATE: 1/3/00

- Delineate the vertical and horizontal extent of Ra-226, Ra-228, Th-230 contamination in the northeast slope area.

- Provide sufficient data to design excavation limits for contaminated soil removal as discussed in the *Record of Decision* (Ref. 1).

The sampling requirements and analysis necessary to delineate the lateral and vertical extent of radiological soils contamination are provided in the *Sampling Plan for Radiological Characterization of the Northeast Corner of the Quarry Proper* (Ref. 14). A closure report, the *Completion Report for Radiological Characterization of the Northeast Corner at the Weldon Spring Quarry*, will be prepared and will discuss the field efforts and results of this sampling.

Results of this sampling were:

- None of the locations exceeded the surface criteria of 6.2 pCi/g for Ra-226.

- Five of the locations exceeded the surface criteria of 6.2 pCi/g for Ra-228.

- Seven locations exceeded the surface criteria of 6.2 pCi/g for combined Ra-226 and Ra-228.

- Nine of the locations exceeded the surface criteria of 6.2 pCi/g for Th-230.

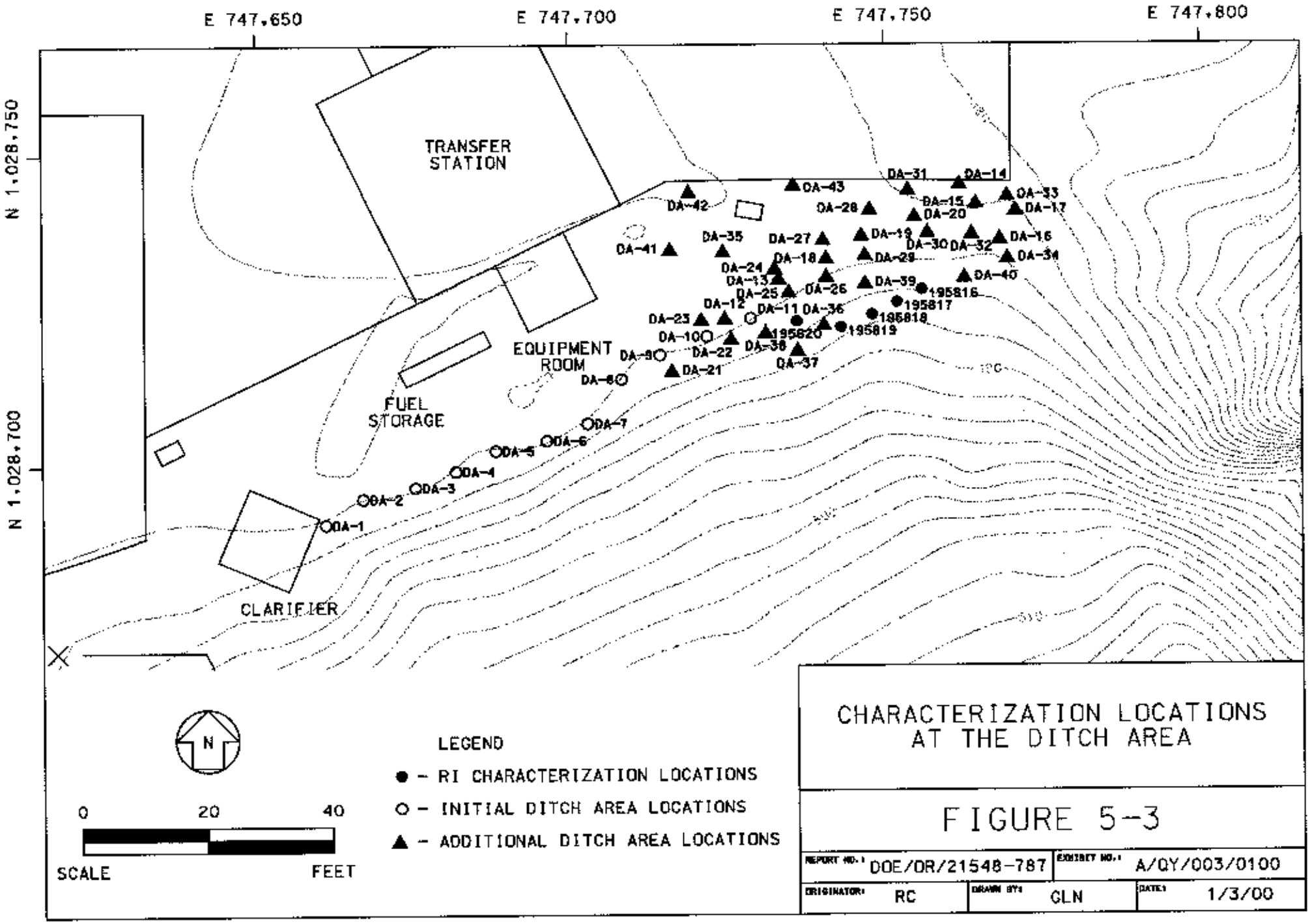
- None of the locations exceeded the surface criteria of 30 pCi/g for U-238.

- Locations that exceed the subsurface criteria for Ra-226 or combined Ra-226 and Ra-228 also exceed the criteria for Th-230.

5.1.2 Ditch Area Near the Transfer Station

A small area of residual contamination is present in a ditch near the entrance of the quarry proper (Figure 5-1). Results from previous characterization, and a more focused sampling effort, indicate elevated levels of Ra-226 and Th-230. These soils will be removed during quarry restoration.

Four samples (Figure 5-3) collected from this area during the remedial investigation indicated surface contamination for Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, and U-238. Location 816 was sampled to a depth of 3 ft. The remaining three locations were surface samples (0 in. to 6 in.). The range of values for this area is summarized in Table 5-4.



CHARACTERIZATION LOCATIONS AT THE DITCH AREA

FIGURE 5-3

REPORT NO.: DOE/OR/21548-787		EXHIBIT NO.: A/QY/003/0100	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 1/3/00	

Table 5-4 Ranges for Radiological Data from the Ditch Area

PARAMETER	MINIMUM (pCi/g)	MAXIMUM (pCi/g)
Ra-226	0.30	26.7
Ra-228	0.16	14.2
Th-228	0.46	24.1
Th-230	1.88	586
Th-232	0.45	25.2
U-234	3.28	34.2
U-235	0.07	1.4
U-238	3.12	36.5

In support of quarry restoration design, the area from the clarifier to Location 820 was sampled (Figure 5-3). Sampling was developed and implemented to fulfill the following objectives:

- Delineate the horizontal and vertical extent of radiological contamination in the ditch area soil.
- Provide sufficient data to design excavation limits for contaminated soil removal based on subsurface criteria levels presented in the *Record of Decision for Remedial Action at the Chemical Plant Area of the Weldon Spring Site* (Ref. 8).

The sampling requirements and analysis necessary to delineate the lateral and vertical extent of radiological soils contamination are provided in the *Sampling Plan for Radiological Characterization of the Ditch Area at the Weldon Spring Quarry* (Ref. 15). A closure report, *Completion Report for Radiological Characterization of the Ditch Area at the Weldon Spring Quarry* (Ref. 16) has been prepared and discusses the field efforts and results of this sampling.

The results of the sampling were:

- One location exceeded the subsurface criteria of 16.2 pCi/g for Ra-226.
- Three locations exceeded the subsurface criteria of 16.2 pCi/g for combined Ra-226 and Ra-228.
- Twenty-six locations exceeded the subsurface criteria of 16.2 pCi/g for Th-230.
- Locations that exceeded the subsurface criteria for Ra-226 and combined Ra-226 and Ra-228 also exceeded the criteria for Th-230.
- None of the locations exceeded the subsurface criteria of 120 pCi/g for U-238.

5.1.3 Snake Pit Area

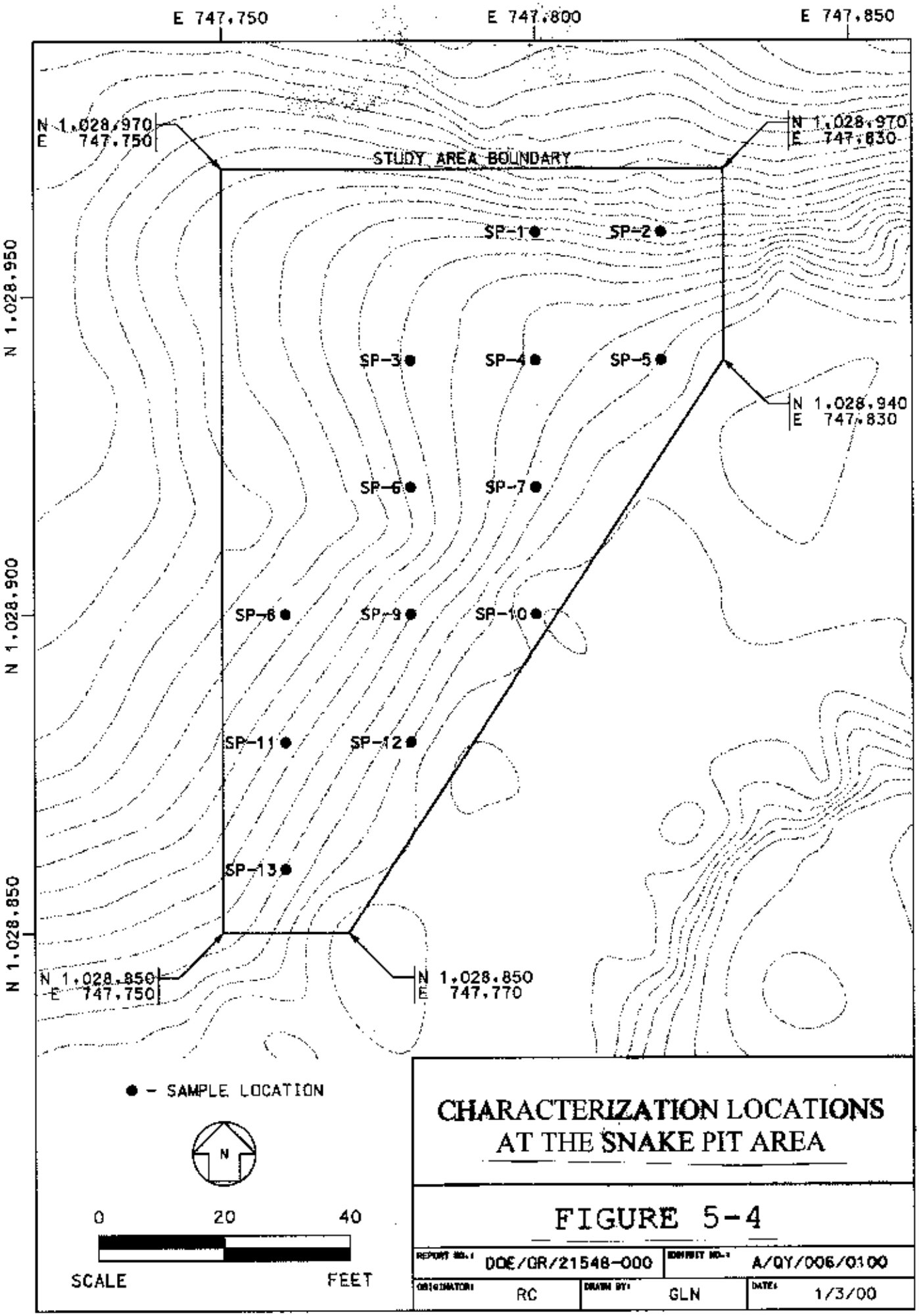
A small area of residual contamination is also present in the northwestern portion of the quarry proper (snake pit area) (Figure 5-1). Results from the remedial investigation sampling effort indicated elevated levels of Th-230. Sixteen locations (Figure 5-4) that were sampled from this area during the remedial investigation indicated surface contamination for Ra-226 and Th-230 (Table 5-5).

Table 5-5 Summary of Radiological Data from the Snake Pit Area

Sample ID	Elevation	Northing	Easting	Radiological Parameters (pCi/g)			
				Ra-226	Ra-228	Th-230	U-238
195360-COMP[1]	495.08	1028954.7	747752.6	2.55	0.95	1.5	0.89
195364-COMP[2]	492.72	1028962.5	747771.7	2.11	0.30	3.89	0.55
195365-COMP[3]	493.46	1028958.7	747762.4	1.81	4.8	3.92	0.55
195370-COMP[4]	486.14	1028955.5	747787.4	1.98	0.75	0.56	0.56
195371-COMP[5]	485.39	1028953.4	747797.4	2.55	1.6	1.58	2.05
195374-COMP[6]	485.34	1028945.4	747794.2	2.29	0.7	31.4	3.52
195811	—[7]	1028877.0	747767.0	4.91	1.41	47.4	2.82
195812	—	1028889.1	747782.5	1.12	1.34	11.1	2.51
195813	—	1028913.0	747792.4	0.53	1.45	21.7	3.72
195814	—	1028924.8	747802.5	1.05	0.45	57.5	5.58
195815	—	1028937.3	747821.9	0.44	0.41	12.2	1.78

Note:
1 Composite of 195360, 195361, 195362, and 195363
2 Composite of 195364-01 through 195360-04
3 Composite of 195365, 195366, and 195367
4 Composite of 195370-01 through 195370-04
5 Composite of 195368, 195369, and 195371
6 Composite of 195372, 195373, and 195374
7 Elevation not surveyed at time of sampling

In support of quarry restoration design, a section of the snake pit area will be sampled (Figure 5-4). The sampling requirements and necessary analyses will be provided in the *Sampling Plan for Radiological Characterization of the Snake Pit Area at the Weldon Spring Quarry*. A closure report, the *Completion Report for Radiological Characterization of the Snake Pit Area at the Weldon Spring Quarry* will be prepared and will discuss the field efforts and results of this sampling. Sampling will be performed to fulfill the following objectives:



CHARACTERIZATION LOCATIONS AT THE SNAKE PIT AREA

FIGURE 5-4

REPORT NO.: DOE/GR/21548-000		DRAWING NO.: A/QY/006/0100	
ORIGINATOR: RC	DRAWN BY: GLN	DATE: 1/3/00	

- Delineate the horizontal and vertical extent of radiological contamination in soil

- Provide sufficient data to design excavation limits for contaminated soil removal based on subsurface criteria levels presented in the *Record of Decision for Remedial Action at the Chemical Plant Area* (Ref. 8).

5.2 Excavation Activities

Excavation limits for the three areas will be developed and documented in Work Package 513A, *Quarry Restoration Contaminated Materials Removal.* Excavation limits for the ditch area and the snake pit area will be based on subsurface criteria and limits for the northeast slope area will be based on surface criteria. Subsurface criteria have been selected for the ditch area and the snake pit area because these areas will be backfilled with more than 2 ft of fill material at the completion of restoration activities. Surface criteria have been selected for the northeast slope area because of the greater potential for erosion in this area after the completion of restoration activities which could potentially cause these soils to be exposed.

5.3 Data Evaluation

Post-excavation evaluations will be performed after removal of the soil to the engineered excavation limits to verify attainment of design goals. This evaluation will consist of sampling of the remaining soil surface. Surface soil samples (0 in. to 6 in.) will be collected at 30-ft intervals along the sidewalls of the excavation and on a 30-ft by 30-ft grid on the floor of the excavation, if soil is present. In the ditch area and the northeast slope area, data indicate that excavation will extend to the top of the bedrock in most areas. Samples will be analyzed for Ra-226, Ra-228, Th-230, and U-238 to determine the levels that will remain after removal of impacted soils.

Removal of the impacted soils will be considered complete if all data obtained from the excavation are less than the appropriate criteria level (surface or subsurface). If a location exceeds the criteria levels, the location will be excavated and new samples will be obtained for reevaluation.

6. QUARRY RECLAMATION

The quarry area will be reclaimed under three work packages. The design criteria for these projects are summarized in the *Design Criteria for Work Package 508. Architect/Engineer Services VI, Task 4* (Ref. 17) and supporting documents. The design, as well as construction documents for these activities, will be provided in the specifications and design drawings for WP-513A, *Quarry Restoration Contaminated Materials Removal*, WP-513B, *Quarry Restoration Backfill*, and WP-529, *Quarry Interceptor Trench System Reclamation*.

6.1 Work Package 513A - Quarry Restoration Contaminated Materials Removal

This project includes the removal of contaminated structures and materials associated with bulk waste removal activities and residually contaminated soil from the ditch area, the northeast slope area, and the snake pit area (Section 5). Minimal soil excavation and placement will be performed, and it will consist primarily of backfilling contaminated soil excavations and installation of an access ramp to the upper bench of the quarry to facilitate removal of soil from the northeast slope area.

6.1.1 Removal of Contaminated Structures Associated with Bulk Waste Removal

As part of this project, contaminated structures and materials in the quarry area are to be dismantled and/or demolished. Major items included are:

- Transfer station and support building.
- Above ground storage tank support slab, dispenser slabs, and associated piping.
- Contaminated piping and associated potentially contaminated soils.
- Clarifier and concrete pad.
- Contaminated asphalt pavement.
- Trailer 20 and associated contaminated piping.

Contaminated materials and equipment will be segregated into two categories: soil/concrete and other debris. These materials will be hauled to the chemical plant via the quarry haul road for disposal in the on-site disposal cell. Materials will be transported in direct-haul trucks.

6.1.2 Excavation of Potentially Contaminated Soils

A 1-ft envelope of soil will be removed from below and around the sides of contaminated underground piping during the excavation of pipelines. The following piping is consider contaminated:

- Piping between the quarry pond and the equalization basin.
- Piping between the shower trailers and the decontamination pad sump.
- Piping between the fuel station above ground storage tanks and the fuel dispensers.
- Piping between the transfer station and the quarry pond.

Under best management practices, the areas will be scanned during the excavation activities. Locations exceeding 1.5 time background as measured with an NaI (2X2) meter will be evaluated for additional excavation. It is assumed that if leakage occurred, both radiological and chemical contamination would be colocated.

Characterization data from beneath the decontamination pad slab, adjacent to the decontamination pad sump and beneath the above-ground fuel storage tank slab and associated dispenser pads do not indicate impact to soils from the operation of these facilities. The samples from the decontamination pad were analyzed for Ra-226, Ra-228, isotopic thorium, U-238, arsenic, lead, nickel, selenium, nitroaromatic compounds, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Samples from beneath the fuel station were sampled for benzene, toluene, ethylbenzene, and xylenes (BTEX) and total petroleum hydrocarbons (TPH). Soil is not present beneath the transfer station; therefore, no samples were collected for analysis as outlined in the *Engineering Characterization Sampling Plan for the Quarry Staging Area* (Ref. 18). Data results are summarized in the *Completion Report for the Engineering Characterization of the Quarry Staging Area* (Ref. 19).

6.1.3 Excavation of Residually Contaminated Soil

Residually contaminated soil will be excavated from the ditch area, the northeast slope area, and the snake pit area in the quarry proper. A discussion regarding the excavation of these areas is presented in Sections 5, *Quarry Proper Soils*.

6.1.4 Construction of Access Ramp to Northeast Slope Area

Construction of an access ramp to the northeast slope area will be necessary to perform the removal of the residually contaminated soil. Borrow materials for the construction of the ramp will be obtained from the north and south slopes at the entrance of the quarry proper. Materials in the ramp will meet the specifications outlined in Section 6.2.1.

Several large aperture fractures are present on the floor and benches of the quarry floor beneath the footprint of the access ramp. These fractures will be filled to reduce the possibility of soil piping and ultimately settlement of the final graded soil surface. Lower permeability clay materials and grout will be used to backfill fractures. Some large vertical fractures are present in the north highwall that will require treatment to reduce soil piping and settlement. These fractures will be filled with shotcrete.

6.2 Work Package 513B - Quarry Restoration Backfill

Quarry restoration includes backfilling the quarry; removal of existing miscellaneous structures, utilities, and features; and development of a borrow area. The restoration of the quarry proper will include an intermediate grading plan to allow this work to proceed without impacting the operation of the quarry water treatment plant.

6.2.1 Backfilling of the Quarry Proper

The quarry proper will be restored through backfilling with soil to meet the following criteria:

- Minimize long-term physical hazards associated with the quarry high walls.
- Eliminate ponded water in the quarry.
- Reduce recharge to the groundwater within the quarry.
- Restore the quarry to a natural state.

The most significant hazard associated with the quarry proper is the presence of the highwalls along the north, east, and south sides of the quarry proper. Elevation differences along the highwalls range from 440 ft. to 552 ft. above mean sea level. Backfilling the quarry with any amount of soil will reduce fall hazards associated with this area.

An evaluation of the stability of the quarry highwalls was performed to assess: (1) the height of backfill placement, (2) the potential for slope failures or rock fall hazards after restoration is complete, and (3) the application of protective measures to minimize physical hazards during and after restoration. The highwalls of the quarry consist of hard to moderately hard limestone, which is moderately weathered, and exhibits solutioning along existing discontinuities in the rock mass. The orientation of the bedding planes and the wide spacing between rock joints are favorable conditions for inherent slope stability. Based on observations made during the evaluation, most of the quarry highwalls appear to be in a stable condition; therefore, an extensive rock stabilization program will not be required for this project. Small isolated sections along the north quarry wall have been identified as potential minor rockfall areas, primarily during construction activities.

Backfill will be selected and placed in a manner to:

- Minimize settling.
- Minimize the flow of groundwater through the quarry proper.
- Minimize infiltration of precipitation.
- Promote sheet-flow of surface runoff over the top of the backfill.

The quarry will be backfilled with a soil material with a lower permeability than the surrounding bedrock to promote regional horizontal groundwater flow around the quarry proper.

The permeability of the Kimmswick Limestone is defined as $2x10^{-4}$ cm/sec (Ref. 4). This lower permeability material will be placed to an elevation of 468 ft MSL, which is the modeled high static water level in the quarry. Above this elevation, a common fill material will be used to attain the desired fill elevations. A lower permeability cap, approximately 2 ft thick, will be placed over the backfill material to minimize infiltration of precipitation and promote sheet flow. Six inches of topsoil will be placed over the cap to allow for vegetative growth.

Borrow materials for backfilling of the quarry proper will be obtained from the Missouri River floodplain, southwest of the quarry (Figure 6-1). A contingency area (Figure 6-2) has been selected for use if the primary area cannot be completely developed due to wet conditions or flooding in the well field. Suitable lower permeability materials are soils that classify as CL and CH in accordance to ASTM D2487, *Standard Classification of Soils for Engineering Purposes.* Common fill includes all material types except MH, PT, OH, and OL. These materials will be selectively excavated and hauled to the quarry for placement.

The fill materials will be compacted in-place to reduce the possibility of settlement. All fill materials will be compacted to 90% of their respective maximum dry densities. Moisture control will be maintained to accommodate compaction of soils.

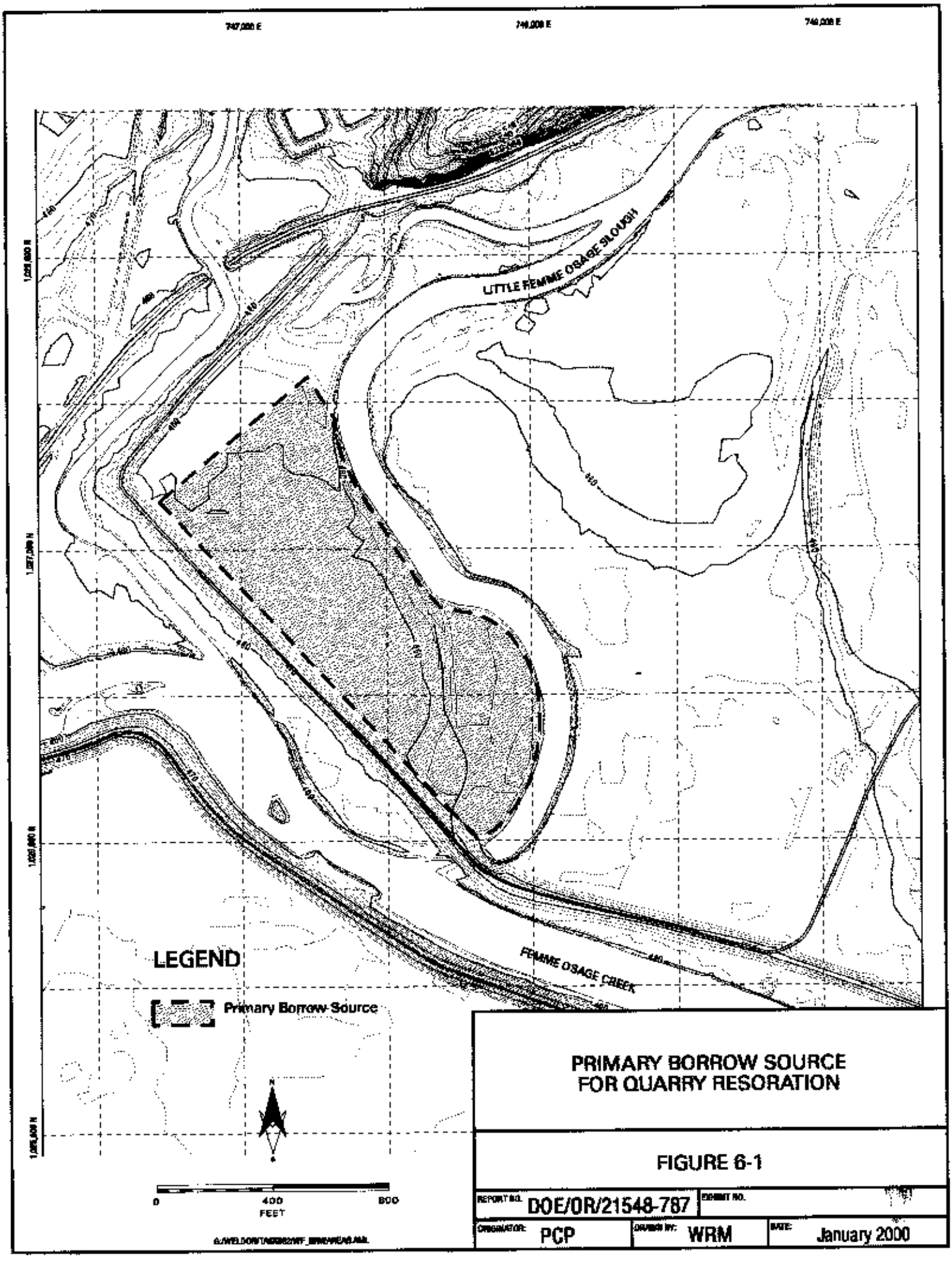
Several large aperture fractures are present on the floor and benches of the quarry floor. These large fractures will be filled to reduce the possibility of soil piping and ultimately settlement of the final graded soil surface. Lower permeability clay materials and grout will be used to backfill fractures. Some large vertical fractures are present in the north highwall that will require treatment to reduce soil piping and settlement. These fractures will be filled with shotcrete.

Final grades within the quarry proper will slope from the northeast corner to the Little Femme Osage Creek, with minimal grade changes in the flow path. Placement of materials and final grading will prevent ponding on the final graded surface. The area will be seeded to prevent erosion of the backfill surface and to promote the growth of natural vegetation.

6.2.2 Removal of Uncontaminated Facilities Associated with Bulk Waste Removal

As part of the quarry restoration, uncontaminated facilities in the quarry area are to be dismantled/ demolished. Major items included are:

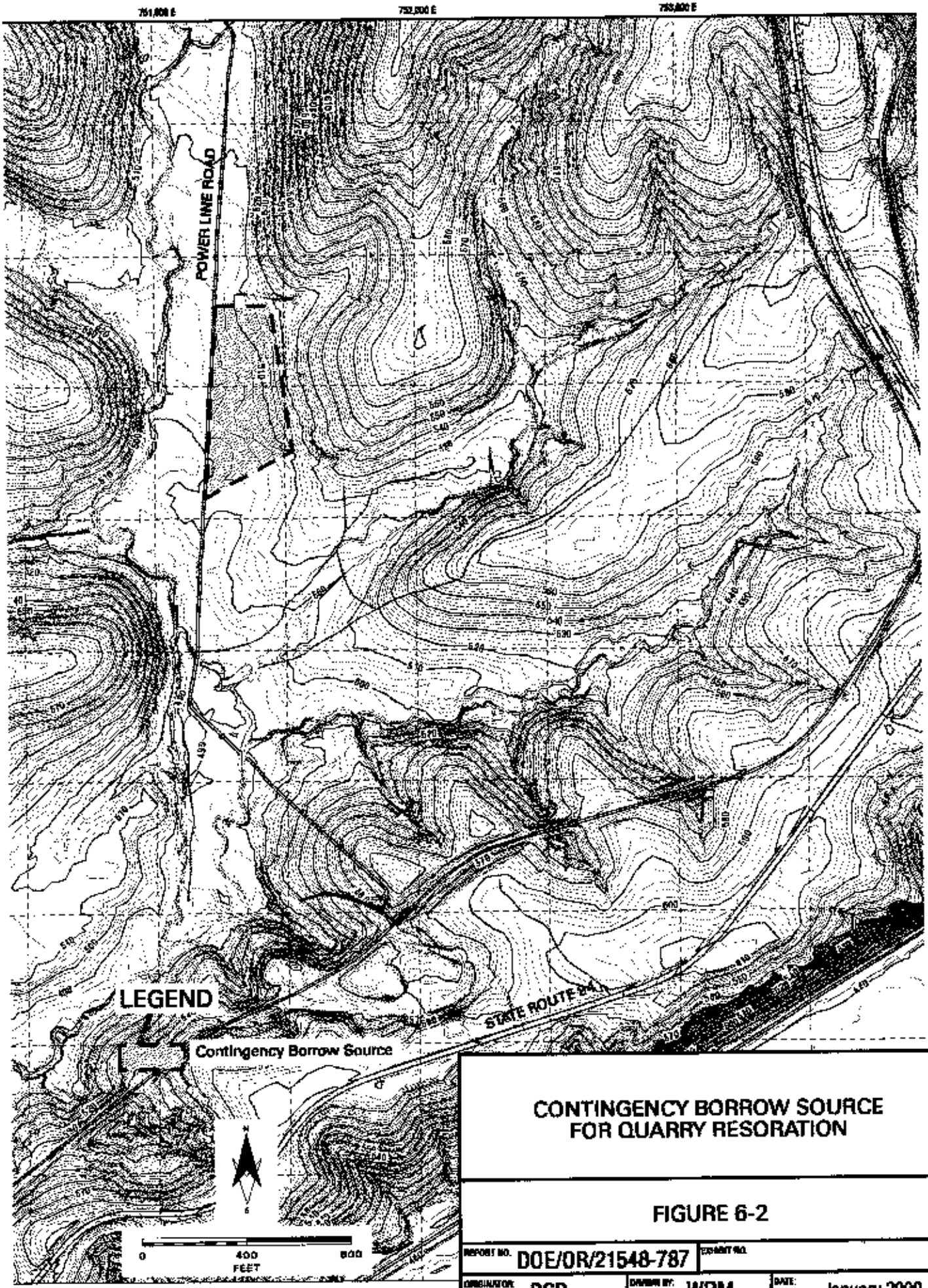
- Pavement (asphalt and concrete) (uncontaminated).



PRIMARY BORROW SOURCE
FOR QUARRY RESORATION

FIGURE 6-1

REPORT NO. DOE/OR/21548-787	EXHIBIT NO.		
ORIGINATOR: PCP	DRAWN BY: WRM	DATE: January 2000	



CONTINGENCY BORROW SOURCE
FOR QUARRY RESORATION

FIGURE 6-2

REPORT NO. DOE/OR/21548-787	EXHIBIT NO.		
ORIGINATOR: PCP	DRAWN BY: WRM	DATE: January 2000	

- Above ground and underground utilities (water, electric, septic tanks, drain lines) (uncontaminated).

Uncontaminated materials and equipment are to be removed from the quarry area and disposed of at an off-site facility.

6.2.3 Borrow Area Development

Development of an off-site borrow area is necessary to complete the restoration of the quarry proper. The primary borrow source will be located in the Missouri River floodplain (Figure 6-1). An approximately 25 acre area situated west of the quarry and north of the slough will be developed for this activity. A contingency borrow source will be located northeast of the quarry in the 5500 Drainage (Figure 6-2). This borrow area is approximately 3 acres and will be developed only if the primary source cannot be fully utilized due to flooding or extremely wet conditions in the well field. Borrow area operations, including excavation and transport of soils and reclamation of the area, will be provided in the specifications and drawings for Work Package 513B, *Quarry Restoration Backfill*.

Remedial actions at the Weldon Spring site, including the selected actions at the Quarry Residuals Operable Unit, are conducted in a manner that integrates the values of the *National Environmental Policy* Act (NEPA) and *Comprehensive Environmental Restoration, Compensation, and Liability Act* (CERCLA) procedural and documentational requirements. Under the integrated approach followed by the U.S. Department of Energy (DOE) for this site, the CERCLA process is supplemented, as appropriate, to incorporate NEPA values. A key element of the integrated CERCLA/NEPA process is the determination of the level of environmental analysis appropriate under NEPA. This determination is a function of many factors, including the complexity of the selected action, the likelihood for significant environmental impacts, and the potential for considerable public interest.

In support of borrow area development activities, environmental evaluations pertaining to the following were conducted:

- Cultural resource and historical sites.
- Floodplains and wetlands.
- Threatened and endangered species.

6.2.3.1 Cultural Resource and Historical Site Surveys

The quarry is located near the Missouri River in an area that contains a high density of archaeological remains. All major prehistoric periods spanning the last 11,000 years are represented in sites that typically occur along ridges or streams. Early Euro-American sites (e.g.,

farmsteads and cemeteries), as well as World War II-era sites, are also found in the vicinity of the quarry (Ref. 3).

Several cultural resource and historic site surveys have been conducted in the vicinity of the quarry and the Femme Osage Slough. These surveys include a non-intensive reconnaissance of the Little Femme Osage/River Hills area and intensive Phase I surveys of the quarry proper, quarry water treatment plant, and the quarry haul road (Ref. 3). The surveys documented the presence of numerous prehistoric and historic sites in the area, some of which may be considered eligible for the National Register of Historic Places (see Table 6-1).

Table 6-1 Summary of Cultural Resources in the Vicinity of the Weldon Spring Quarry

SITE NUMBER	SITE TYPE	NRHP ELIGIBILITY	NOTES
23SC21	Funerary	Potentially eligible	Avoid or test
23SC80	Village/Campsite	Eligible	Avoid or mitigate
23SC81	Village	Eligible	Avoid or mitigate
23SC83	Campsite	Eligible	Avoid or mitigate
23SC90	Campsite	Not eligible	Lack of integrity
23SC92	Campsite	Unknown	Avoid or test
23SC93	Lithic scatter/Farmstead	Unknown	Avoid or test
23SC95	Village/Campsite	Potentially eligible	Avoid or test
23SC100	Bone Scatter	Unknown	Avoid or test
23SC143	Bone Scatter	Unknown	Not observed
23SC172	Campsite	Potentially eligible	Avoid or test
23SC173	Campsite	Potentially eligible	Avoid or test
23SC174	Campsite	Potentially eligible	Avoid or test
23SC176	Campsite	Potentially eligible	Avoid or test
23SC177	Campsite/Farmstead	Potentially eligible	Avoid or test
23SC178	Campsite	Not eligible	Lack of integrity
23SC185	Lithic scatter	Unknown	Avoid or test
23SC186	Lithic scatter	Unknown	Avoid or test
23SC708	Campsite	Not eligible	Lack of integrity
23SC709	Campsite	Not eligible	Lack of integrity
23SC751	Campsite	Potentially eligible	Avoid or test
23SC754	Campsite	Potentially eligible	Avoid or test
23SC755	Campsite	Potentially eligible	Avoid or test
23SC756	Farmstead/Guard-post	Potentially eligible	Avoid or test

Refs. 20, 21, 22, and 23.

A Phase I archaeological survey (Ref. 24) was performed in the well field area in April and May 1999. The survey consisted of pedestrian reconnaissance and a series of shovel probe tests. No archaeological resources were identified during the surveys. The survey concluded that the project should receive archaeological clearance from the Missouri Department of Natural Resources, Office of Historic Preservation (Ref. 24).

A Phase I archaeological survey (Ref. 25) was performed in the 5500 drainage area between April and August 1999. The survey consisted of pedestrian reconnaissance and a series of shovel probe tests. One previously unrecorded archaeological site was encountered and one

previously recorded site was relocated and evaluated. The contingency borrow area takes into account the boundaries of these two sites and provides for a buffer area to protect them from inadvertent damage. The survey concludes that the borrow area should receive archaeological clearance as long as avoidance and protective measures are maintained.

6.2.3.2 Floodplain Assessments and Wetland Delineation

Floodplain/wetland assessments evaluate the potential impacts to floodplains and wetlands from proposed activities. These assessments are prepared in accordance with Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*, and with DOE guidance and policy (10 CFR 1022) for compliance with these executive orders.

Wetland delineation has been performed along the Femme Osage Creek, the Little Femme Osage Creek, and the Femme Osage Slough in accordance with the U.S. Army Corp of Engineers guidelines. To qualify as a jurisdictional wetland under these guidelines, an area must have hydrophytic vegetation, wetland hydrology, and hydric soil. Impacts to jurisdictional wetlands are regulated by the U.S. Army Corp of Engineers under Section 404 of the *Clean Water Act*. These areas have been identified as wetlands on the U.S. Fish and Wildlife Service National Wetland Inventory map. Table 6-2 summarizes the determination for areas in the vicinity of the quarry.

Table 6-2 Wetland Determinations in the Vicinity of the Weldon Spring Quarry

AREA	DESCRIPTION
Femme Osage Slough	Open waters associated with the slough are classified in the National Wetlands Inventory as unconsolidated bottom, lower perennial riverine wetlands, or permanently flooded wetlands. Potential jurisdictional wetlands are located at the end of the northwest arm, where hydrophytic vegetation occurs along the banks of a shallow expansion of the slough. Jurisdictional wetland determination would require evaluation for hydric soils. Hydrophytic vegetation also occurs along the south bank of the slough (Ref. 3).
Little Femme Osage Creek	The creek is identified in the National Wetland Inventory as a lower perennial riverine wetland with an intermittently exposed, unconsolidated bottom. Temporarily flooded palustrine forested wetlands occur sporadically along portions of the creek. South of the Kay Trail, a portion of the creek is identified as a temporarily flooded, palustrine forested wetland and scrub-shrub wetland (Ref. 3).
Femme Osage Creek	The creek is classified in the National Wetland Inventory as a lower perennial riverine wetland with a permanently flooded unconsolidated bottom. A narrow band along the right side of the channel is identified as a temporarily flooded palustrine emergent wetland (Ref. 3).
Area between the Katy Trail and the Femme Osage Slough	The area is identified in the National Wetland Inventory as a forested, broad-leaved deciduous, palustrine wetland that is temporarily flooded. This area does not exhibit indicators of wetland hydrology or hydric soils and therefore is not considered a jurisdictional wetland (Ref. 26).

Table 6-2 Wetland Determinations in the Vicinity of the Weldon Spring Quarry (Continued)

AREA	DESCRIPTION
Former Vicinity Property 9	A small jurisdictional wetland (0.25 acres) is present in the northeast corner of the area. This wetland is classified as a forested, broad-leaved, deciduous, palustrine wetland that is seasonally flooded (Ref. 26).

Wetland surveys were conducted during the spring and summer of 1999 to determine if wetlands were present in or near the proposed borrow area and haul routes. These surveys are described in the *Floodplain/Wetlands Assessment for the Borrow Areas for the Remedial Action at the Weldon Spring Quarry Near the Weldon Spring Site, Weldon Spring, Missouri* (Ref. 27). The surveys included the delineation of jurisdictional wetlands, which are regulated under Section 404 of the *Clean Water Act*. The following wetlands (Figure 6-3) were identified within or near the proposed primary borrow area:

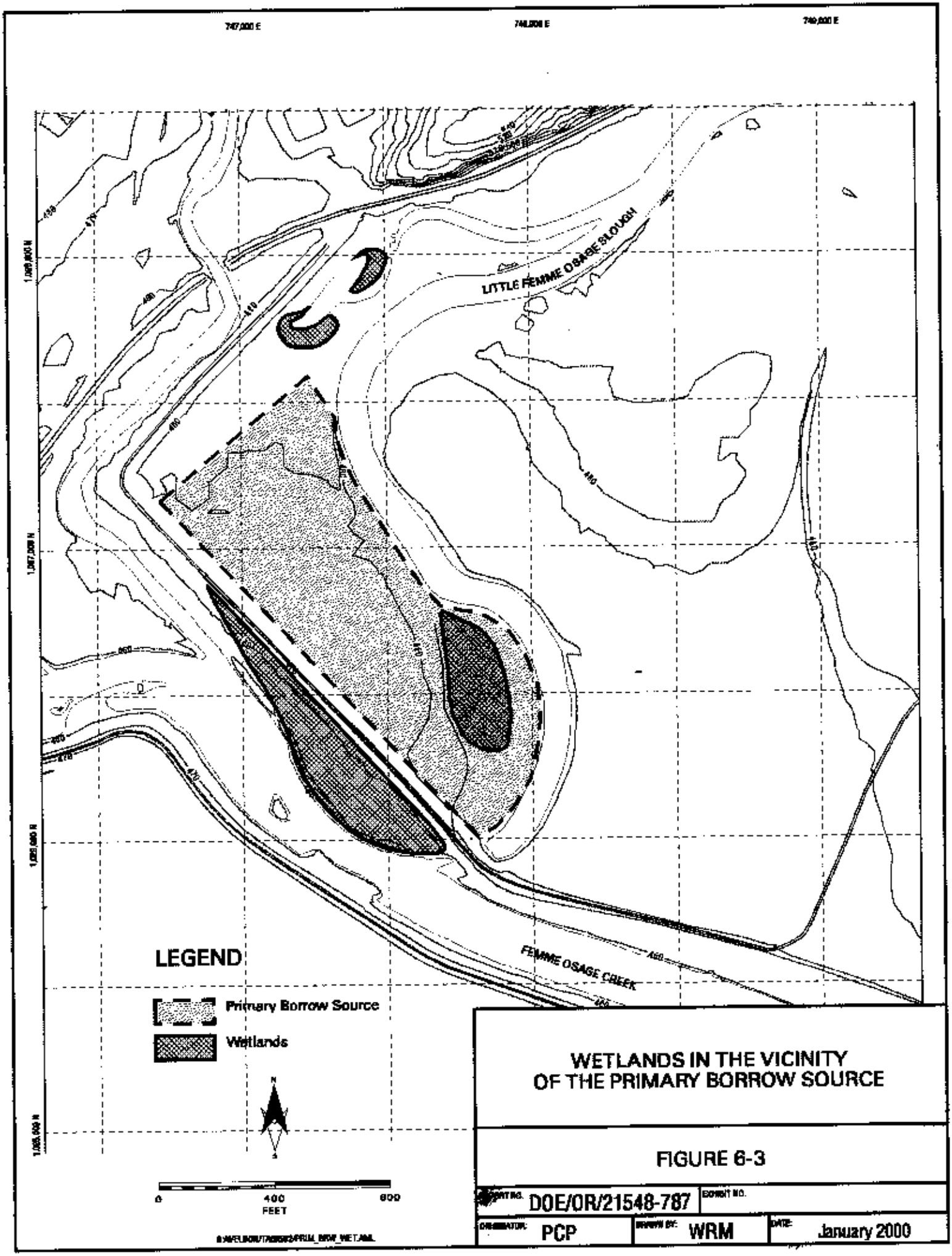
- A 1.7-acre jurisdictional wetland (palustrine forested, broad-leaved deciduous, temporarily flooded) is located in the southeast portion of the primary borrow area. This wetland is included in a larger area along the margin of the slough.

- A 3-acre jurisdictional wetland (palustrine forested, broad-leaved deciduous wetland that is temporarily to seasonally flooded) lies above the bank of the Femme Osage Creek to the west of the borrow area, and is separated from the borrow area by a levee.

- The Femme Osage Slough, a palustrine, unconsolidated bottom, lower perennial riverine wetland that is permanently flooded, is located east of the borrow area. A 50-ft buffer will be maintained between the area of excavation and the slough. The area of the slough in the vicinity of the borrow area is not a jurisdictional wetland; however, the slough is considered a waters of the United States and is protected under Section 404 of the *Clean Water Act*.

- A 1.2-acre wetland area (palustrine emergent wetland and palustrine unconsolidated bottom wetland) is located adjacent to the slough northeast of the Borrow Area.

- Portions of the area between the proposed borrow area and the slough are identified as forested, broad-leaved deciduous, palustrine wetlands that are temporarily flooded. These areas did not exhibit indicators of wetland hydrology or dominance of hydrophytic vegetation; therefore, these areas are not considered to be jurisdictional wetlands.



WETLANDS IN THE VICINITY OF THE PRIMARY BORROW SOURCE

FIGURE 6-3

REPORT NO. DOE/OR/21548-787	EXHIBIT NO.		
ORIGINATOR: PCP	DRAWN BY: WRM	DATE: January 2000	

The contingency borrow area in the 5500 drainage contains one wetland and portions of three additional wetlands. Several other wetlands are located in the vicinity of this borrow area. These areas (Figure 6-4) are:

- A 0.46-acre of a jurisdictional wetland (palustrine persistent emergent wetland that is temporarily to seasonally flooded) has been identified in the borrow area.

- Approximately 0.21 acres of a 0.92-acre jurisdictional wetland (palustrine persistent emergent wetland that is temporarily to seasonally flooded) lies within the southern potion of this borrow area and the haul route.

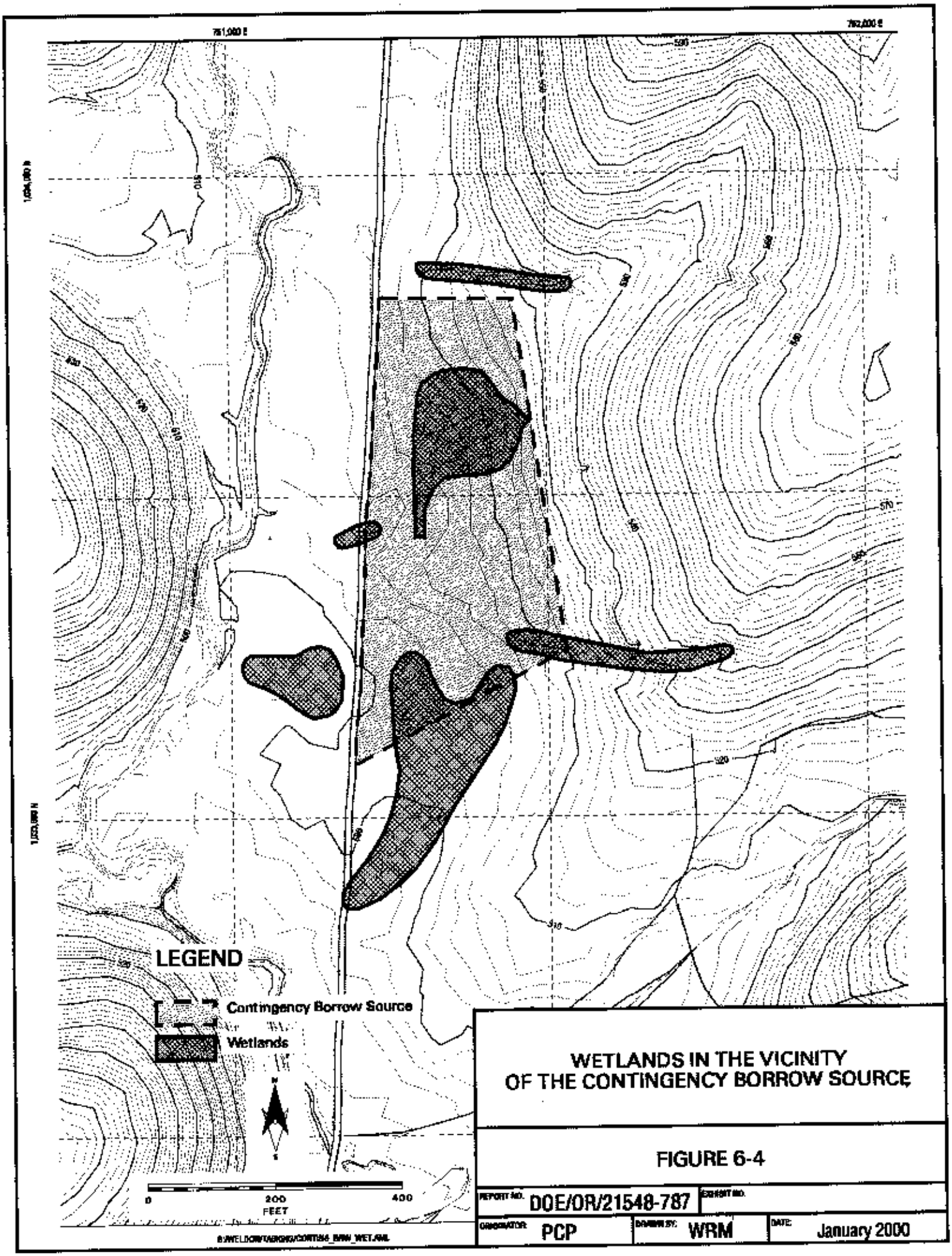
- Approximately 0.05 acres of a 0.2-acre jurisdictional wetland (palustrine forested, broad-leaved deciduous, temporarily to seasonally flooded) extends into the southeastern boundary of the area.

- Approximately 500 sq ft of a 700-sq ft jurisdictional wetland (palustrine persistent emergent wetland that is temporarily flooded) lies within the western side of the borrow area and the haul route.

- A 0.10-acre narrow intermittent riverine wetland is located approximately 20 ft north of the borrow area.

- A 130 sq ft jurisdictional wetland (palustrine persistent emergent wetland that is temporarily flooded) is located west of the excavation area and within the boundaries of the haul road.
- A 0.2-acre jurisdictional wetland (palustrine persistent emergent wetland that is temporarily to seasonally flooded) is located approximately 23 ft west of the area of excavation.

The 100-year floodplain of the Missouri River is relatively flat and extends to the base of the escarpment immediately northwest of the Katy Trail. Surface elevations range from approximately 451 ft to 462 ft above mean sea level (MSL). The 100-year floodplain elevation in the vicinity of the quarry is approximately 473 ft above MSL. Located within the floodplain is the Femme Osage Slough. A dike (elevation 470 ft MSL) is located along the Missouri River, bordering the St. Charles County well field and extending northwest along the Femme Osage Creek and Little Femme Osage Creek, to the Katy Trail. The levee is designed to reduce the frequency of flooding within the St. Charles County well field (Ref. 28)


LEGEND
Contingency Borrow Source
Wetlands
0
200
400
FEET
WETLANDS IN THE VICINITY
OF THE CONTINGENCY BORROW SOURCE
FIGURE 6-4
REPORT NO. DOE/OR/21548-787
EXHIBIT NO.
ORIGINATOR: PCP
DRAWN BY: WRM
DATE: January 2000

6.2.3.3 Threatened and Endangered Species Surveys

During the remedial investigation, threatened and endangered species surveys were conducted for four listed species, the bald eagle, loggerhead shrike, Swainson's hawk, and northern harrier, that have been observed in the QROU study area. These surveys were performed to determine if the area was being utilized for feeding, nesting, and/or roosting activities. Also, no designated critical habitats for threatened or endangered species currently exist at or near the quarry (Ref. 28).

The only State or Federal listed species observed during the surveys within the area of the operable unit was the bald eagle. Bald eagles were observed roosting on Howell Island, located across the Missouri River from the quarry, and periodically in trees along the levee of the well field. Many individuals were observed flying along the Missouri River, likely foraging for food. No individuals were observed flying, roosting, or foraging within the well field. A summary of the surveys performed in the area is presented in the *Remedial Investigation* (Ref. 4).

6.3 Work Package 529, Quarry Interceptor Trench System Reclamation

Quarry interceptor trench system reclamation includes demolition of the treatment plant and associated facilities, removal of the interceptor trench system, and possible removal of potentially contaminated residual soils in the quarry staging area. The reclamation of the quarry area will include the final grading of the area to near-natural conditions and installation of surface water control measures.

6.3.1 Quarry Water Treatment Plant Demolition

As part of the quarry interceptor trench project, the quarry water treatment plant and associated facilities are to be demolished. The major items included in this effort are:

- The quarry water treatment plant building and all piping and equipment related to the treatment plant (contaminated and uncontaminated).
- The equalization basin and all related piping and equipment (contaminated).
- Effluent ponds and all related piping and equipment (uncontaminated).
- Pump station and all related piping and equipment (uncontaminated).
- Quarry water treatment plant effluent pipeline (uncontaminated).
- Decontamination pad sump and all related piping (contaminated).

- Pavement (asphalt and concrete) (uncontaminated).
- Decontamination pad concrete slab (uncontamnated).
- Aboveground and underground utilities.
- Fencing.

Uncontaminated materials and equipment are to be removed from the quarry area and disposed of at an off-site facility. Contaminated materials and equipment will be disposed of at a licensed disposal facility capable of accepting chemically and radiologically contaminated materials.

6.3.2 Removal of the Interceptor Trench System

As part of the quarry interceptor trench project, the interceptor trench and associated facilities are to be removed or abandoned. The major items included in this effort are:

- Removal of sumps and associated equipment (contaminated).
- Removal of all underground piping (contaminated).
- Removal of all aboveground and underground utilities (uncontaminated).

Materials within the interceptor trench (sumps, utilities, pumps, etc.) will be removed. The granular backfill will be left in-place. Uncontaminated materials and equipment are to be removed from the quarry area and disposed of at an off-site facility. Contaminated materials and equipment will be disposed of at a licensed disposal facility capable of accepting radiologically contaminated materials.

6.3.3 Removal of Potentially Contaminated Soils

A 1-ft envelope of soil will be removed from below and around the sides of contaminated underground piping during the excavation of pipelines. A 1-ft envelope of soil will also be excavated from the bottom and sides of all contaminated concrete. The following items are considered contaminated:

- Piping between the equalization basin and the quarry water treatment plant.
- Piping between the interceptor trench and the equalization basin.
- Piping between the equalization basin and the leachate sump.
- Concrete floor of the treatment plant process area.

Under best management practices, the areas will be scanned during the excavation activities. Locations exceeding 1.5 time background as measured with a NaI (2X2) meter will be evaluated for additional excavation. It is assumed that if leakage were to have occurred, radiological and chemical contamination would be collocated.

Characterization of the soils beneath and adjacent to the equalization basin will be performed as outlined in the *Engineering Characterization Sampling Plan for the Quarry Staging Area* (Ref. 18). Samples will be analyzed for Ra-226, Ra-228, Th-230, Th-232, U-238, arsenic, lead, nickel, selenium, nitroaromatic compounds, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). This work cannot be performed until completion of the interceptor trench field study.

6.3.4 Restoration of the Quarry Haul Road

Haul road restoration will require the removal of gates, signs, posts, fencing, and other construction-use features. These materials are uncontaminated and will be removed from the quarry area and disposed of at an off-site facility. The aggregate road surface will not be removed.

6.3.5 Final Site Grading

The final grading of the quarry area will tie into the intermediate grading performed during quarry proper restoration. Grading will include the removal of the quarry water treatment plant foundation and basins. Excess soil will be distributed to create a gentle slope from the entrance to the quarry proper to the Little Femme Osage Creek. Slopes will be designed to promote sheet flow. The area will be seeded to prevent erosion and to allow for natural vegetation to become established.

7. CONSTRUCTION ACTIVITIES

Construction activities will be required for the following actions being implemented for the Quarry Residuals Operable Unit (QROU):

- Contaminated materials removal.
- Quarry restoration.
- Interceptor trench construction.
- Interceptor trench reclamation.
- Quarry water treatment plant dismantlement.
- Well installation and abandonment in support of long-term monitoring.

At the Weldon Spring Site Remedial Action Project (WSSRAP), construction tasks are summarized and implemented as work packages. Work packages contain all the specifications, construction drawings, and quality control guidance for the implementation of each project. A safe work plan, bonding, insurance, substance abuse program, subcontractor quality assurance/quality control program, work sequencing forecast, and schedule are required as initial submittals to the Project Management Contractor (PMC) before the subcontractor is given notice to proceed with the work.

The following sections generally discuss the construction activities required for each of these actions. A summary of the construction specifications for each work package will also be included.

7.1 Quarry Reclamation

Reclamation of the quarry area will be performed as three separate work packages. The packages are:

- WP-513A – *Quarry Restoration Contaminated Materials Removal*
- WP-513B - *Quarry Restoration Backfill*
- WP-529 - *Quarry Interceptor Trench System Reclamation*

7.1.1 Quarry Restoration Contaminated Materials Removal

Construction activities associated with the removal of contaminated materials at the quarry staging area and contaminated soil in the quarry proper include:

- Construction of an access ramp to the northeast slope area.
- Excavation of contaminated soil from the ditch area.
- Excavation of contaminated soil from the northeast slope area.

- Excavation of contaminated soil from the snake pit area.
- Removal of contaminated asphalt.
- Removal of contaminated piping and associated soils.
- Excavation, placement, and compaction of backfill materials to specified grades.
- Filling of specified fractures with low permeability soil, grout, or shotcrete.
- Installation of temporary surface water control measures.

The following is a list of specifications for Work Package 513A, *Quarry Restoration Contaminated Materials Removal*:

01010	Summary of Work
01025	Measurement and Payment
01300	Submittals
01420	Hold and Witness Points
01503	Temporary Facilities
01560	Emission Controls
01570	Traffic Regulations
01736	Haul Road Operations
02005	Surveying Services
02055	Facility Dismantlement/Demolition, Soil Removal and Transportation
02200	Earthwork
02270	Erosion Control
02485	Seeding
03660	Quarry Highwall/Floor Stabilization

7.1.2 Quarry Restoration Backfill

Construction activities associated backfilling the quarry proper include:

- Development of off-site, contractor-designated borrow sources and haul routes.
- Excavation and transport of borrow materials to the quarry proper.
- Placement and compaction of borrow material to specified grades.
- Filling of specified fractures with low permeability soil, grout, or shotcrete.
- Removal of uncontaminated asphalt and concrete pavement.
- Removal of fencing.
- Removal of utilities.
- Installation of permanent surface water control measures.

The following is a list of specifications for Work Package 513B, *Quarry Restoration Backfill*:

01010	Summary of Work
01025	Measurement and Payment
01300	Submittals
01420	Hold and Witness Points
01503	Temporary Facilities
01510	Temporary Utilities
01560	Emission Controls
01570	Traffic Regulations
01736	Haul Road Operations
02005	Surveying Services
02055	Facility Dismantlement/Demolition, Soil Removal and Transportation
02200	Earthwork
02270	Erosion Control
02485	Seeding
03660	Quarry Highwall / Floor Stabilization
15220	Piping

7.1.3 Quarry Interceptor Trench System Reclamation

Construction activities associated with the reclamation of the quarry interceptor trench includes demolition of the quarry water treatment plant and removal of the interceptor trench system. Tasks associated with the reclamation project include:

- Removal of equalization basin, effluent ponds (2), and any associated liners and piping.
- Dismantlement of the water treatment system.
- Demolition and removal of the water treatment building.
- Removal of pumps, piping, and structures associated with the pilot-scale interceptor trench.
- Demolition and removal of the decontamination pad.
- Excavation and transport of contaminated soils and materials, if necessary.

- Plugging of the quarry water treatment plant effluent pipeline.
- Demolition and removal of the effluent pipeline outfall structure.
- Removal of asphalt and concrete pavement.
- Removal of fencing.
- Excavation and transport of borrow materials to the quarry proper to attain final grades.
- Placement and compact of borrow material to specified grades.
- Final grading of the quarry water treatment plant and interceptor trench areas.
- Installation of permanent surface water control measures.

The following is a list of specifications for Work Package 529, *Quarry Interceptor Trench System Reclamation*:

01010	Summary of Work
01025	Measurement and Payment
01300	Submittals
01420	Hold and Witness Points
01503	Temporary Facilities
01510	Temporary Utilities
01560	Emission Controls
01570	Traffic Regulations
01736	Haul Road Operations
02005	Surveying Services
02055	Facility Dismantlement/Demolition, Soil Removal and Transportation
02200	Earthwork
02270	Erosion Control
02485	Seeding

7.2 Quarry Interceptor Trench System

Construction activities associated with the construction of the quarry interceptor trench system include installation of the 550-ft. interceptor trench and connection to the quarry water treatment plant. Specific tasks include:

- Excavation of the interceptor trench.
- Placement of granular backfill.
- Placement of piping, pumps, and vaults.
- Connection to the quarry water treatment plant.
- Installation of observation wells (see Section 7.3).
- Re-grading of the construction area.

The following is an initial list of specifications for Work Package 515, *Quarry Interceptor Trench System*:

01010	Summary of Work
01025	Measurement and Payment
01300	Submittals
01400	Quality Assurance
01420	Hold and Witness Points
01503	Temporary Facilities
01510	Temporary Utilities
01560	Emission Controls
01570	Traffic Regulations and Haul Road Operations
02005	Surveying Services
02050	Contaminated Material Management
02220	Excavation and Backfilling for Utility Trenches and Valve Vaults
02222	Installation of Groundwater Interceptor Trench Using Continuous Trenching Method
02270	Surface Water and Erosion Control
02485	Seeding
02733	Installation of Extraction Wells
03480	Precast Concrete Structures
11220	Submersible Pumps
11250	Pitless Units
15010	Mechanical General Provisions
15070	Process and Utility Piping
15100	Valves
16010	Basic Electrical Requirements
16030	Electrical Testing and Installation Check
16110	Raceways, Wire, and Cable
16195	Electrical Identifications
16420	Starter Control Panels
16450	Grounding

7.3 Monitoring Well Installation and Abandonment

Installation of new monitoring wells and observation wells and abandonment of existing wells that will not be utilized for monitoring will be performed in support of the long-term monitoring program. The following is a list of task performed in support of this effort.

- Soil augering.
- Soil sampling.
- Rock coring.
- Rock reaming.
- Packer testing.
- Installation of well screen and casing.
- Installing of filter pack and annular seal.
- Installation of protective casing and bollards.
- Over-drilling of well screen and casing.
- Reaming of well materials.
- Grouting of boreholes.

Monitoring well installation and abandonment will be performed under Work Package 487, *Well Installation and Abandonment*. The following is a list of specifications associated with this work package:

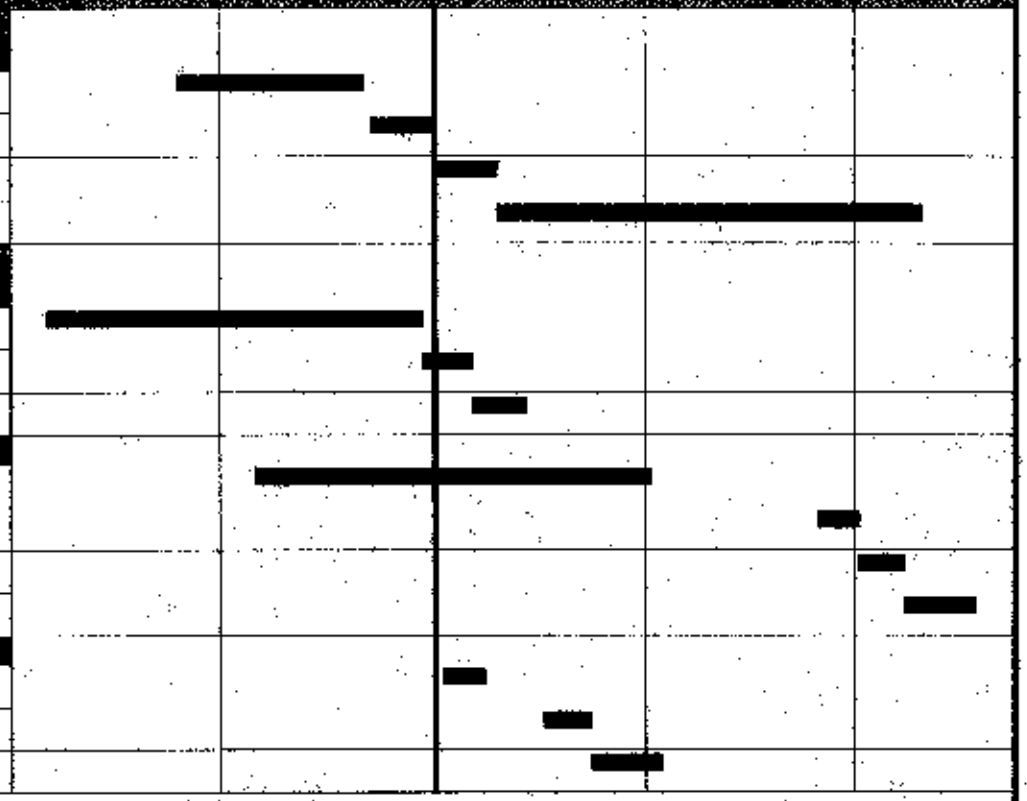
01400	Quality Assurance and Quality Control
02733	Well Installation and Abandonment

8. PROJECT SCHEDULE

The schedule (Figure 8-1) associated with the design, procurement, and construction of the following activities is provided in this section:

- Quarry Restoration Contaminated Materials Removal.
- Quarry Restoration Backfill – design and construction.
- Quarry Interceptor Trench System – design, construction, and operation.
- Quarry Reclamation – design and construction.

Quarry Area Interceptor Trench WP515			
QY515S28	QY Interceptor Trench Engineering	19OCT98A	03SEP99A
QY515S711	QY Interceptor Trench - Procurement	15SEP99A	07JAN00A
QY515S811	QY Interceptor Trench - Const/Functional Testing	05JAN00A	23APR00
QY515S911	QY Interceptor Trench - Operation	24APR00	23APR02
General Site Preparation WP505			
QY505XS01	Quarry Residual Contaminated Mat'l - Eng.	03MAR98A	14DEC99A
QY505XS02	Quarry Residual Contaminated Mat'l - Proc.	15DEC99A	09MAR00
QY505XS03	Quarry Residual Contaminated Mat'l - Const.	10MAR00	12JUN00
QITS / QWTP Reclamation WP529			
QY529S01	QITS / QWTP Reclamation 90% - Engineering	02MAR99A	12JAN01
QY529S03	QITS / QWTP Reclamation 100% - Engineering	30OCT01	06JAN02
QY529S04	QITS / QWTP Reclamation - Procurement	09JAN02	27MAR02
QY529S05	QITS / QWTP Reclamation - Demo	28MAR02	26JUL02
Quarry Restoration WP513B			
QYB513S01	Quarry Restoration - Engineering	17JAN00	31MAR00
QYB513S02	Quarry Restoration - Procurement	14JUL00	02OCT00
QYB513S03	Quarry Restoration - Construction	03OCT00	29JAN01



DOE/OR/21548-787

Project Start	16JUN98
Project Finish	26SEP02
Data Date	07JAN00
Run Date	13JAN00

© Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

WSRP:WSQY

QUARRY RESIDUALS OPERABLE UNIT
PROJECT SCHEDULE

FIGURE 8-1

9. SUMMARY OF PROJECT COSTS

Costs associated with the design and construction of the selected remedy are provided in the following sections. Costs are provided for the following components:

- Quarry Restoration Contaminated Materials Removal – design and construction.
- Quarry Restoration Backfill – design and construction.
- Quarry Interceptor Trench System – design, construction, and operation.
- Quarry Reclamation – design and construction.
- Long-term Monitoring – construction, field support, analysis.
- Northeast Corner Characterization – field support and analysis.
- Interceptor Trench Field Study – field support and analysis.
- Hydrogeologic Field Study – field support and analysis.

9.1 Quarry Reclamation

Table 9-1 summarizes the costs associated with design and construction for restoration of the quarry proper and reclamation of the quarry interceptor trench system, which includes demolition of the quarry water treatment plant and final site grading.

Table 9-1 Summary of Costs for Quarry Reclamation

PROJECT	TASK	COST
Quarry Restoration Contaminated Material Removal	Design[a]	$ 17,000
	Construction	$ 586,000
Quarry Restoration Backfill	Design	$ 483,000
	Construction	$ 2,161,000
Quarry Interceptor Trench System Reclamation	Design [b]	$ 50,000
	Construction	$ 2,921,000

Note: (a) 90% of design was performed under Quarry Restoration
(b) 90% of the design was performed under Quarry Proper Restoration

9.2 Quarry Interceptor Trench System

Table 9-2 summarizes the costs associated with design and construction for quarry interceptor trench system. Also included is the start-up of the system and operation for a 2-year period.

Table 9-2 Summary of Costs for the Quarry Interceptor Trench System

PROJECT	TASK	COST
Quarry Interceptor Trench System and Start-Up	Design	$ 156,000
	Construction	$ 656,000
Quarry Interceptor Trench System Operations	Design [1]	$ 25,000
	Operation	$ 1,103,000

Note: 80% of the design was performed under Quarry Interceptor Trench System and Start-Up

9.3 Long-Term Monitoring

Table 9-3 summarizes the costs associated with installation of new monitoring wells and the abandonment of those wells that are not incorporated into the monitoring network. Also included are costs associated with sample collection and analysis for the next 5 years.

Table 9-3 Summary of Costs for Long-Term Monitoring

PROJECT	COSTS
Monitoring well installation (1 well)	$22,000
Monitoring well abandonment (21 wells)	$147,000
Analytical Services [1]	$114,000

Note: See Section 2 of this report for collection frequency and analytical parameters

9.4 Field Studies

Table 9-4 summarizes the costs associated with the sample collection and analysis necessary for the performance of the interceptor trench field study and the hydrogeological field study.

Table 9-4 Summary of Costs for Hydrogeological Field Studies

PROJECT	TASK	COST
Interceptor Trench Field Study	Drilling/Well installation services	$ 75,000
	Analytical services	$170,000
Hydrogeologic/Geochemical Characterization Field Study	Drilling services	$ 50,000
	Analytical services	$ 18,000

10. QUALITY ASSURANCE PROGRAM

The Project Management Contract (PMC), as obligated by the Department of Energy (DOE) Order 414.1, *Quality Assurance* has developed the *Project Management Contractor Quality Assurance Program* (QAP) (Ref. 29). This plan describes not only the overall quality assurance program implemented at the Weldon Spring Site Remedial Action Project (WSSRAP), but also includes requirements for personnel training, quality improvement, documents and records, work processes, design, procurement, inspection and acceptance testing, and a routine assessment program.

10.1 Purpose

The PMC develops, implements, and maintains a written QAP. The QAP describes the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, achieving, and assessing adequacies of work. The QAP describes the management system, including planning, scheduling, and cost control considerations.

The QAP satisfies the requirements of:

- Morrison Knudsen Corporation Management.
- Jacobs Engineering Group, Inc. Management.
- DOE Order 414.1, *Quality Assurance.*
- 10 CFR 830.120, *Quality Assurance.*

American Society of Mechanical Engineers (ASME) NQA-1, U.S. Environmental Protection Agency (EPA) documents, and the American National Standards Institute/American Society for Quality (ANSI/ASQ) - E4 were also used as guidance documents with the applicable sections being incorporated, as appropriate.

In addition to the PMC QAP, the WSSRAP developed an *Environmental Quality Assurance Project Plan* (EQAPjP) (Ref. 30), subordinate to the PMC QAP, which focuses on the U.S. Environmental Protection Agency (EPA) requirements under the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) and meets the applicable requirements of EPA QA/R5, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations.* This plan addresses Project Management, Measurement/Data Acquisition, Data Management, and Assessments/Oversight.

10.2 Description

The PMC QAP reflects the mission, policies, and objectives for the WSSRAP. The program is a broad-based program that applies to every aspect and employee at the WSSRAP.

The QAP identifies mechanisms necessary for the planning, implementation, and assessment of quality-affecting activities. These mechanisms are applied using a graded approach, which takes into account that not all items, processes, or services have the same impact on the quality, safety, or reliability of an activity. Mechanisms outlined in the QAP are:

- Personnel indoctrination and training.
- Quality improvement.
- Documents and records.
- Work processes.
- Design.
- Procurement.
- Inspection and acceptance testing.
- Management assessment.
- Independent assessment.

10.3 Implementation

The PMC Project Quality Manager and his designees conduct independent assessments of the performance of the project in relation to the requirements of the QAP and departmental standard operating procedures and instructions. These assessments are performed in accordance with the QAP.

The QAP, together with implementing procedures and instruction, form an integrated management that ensures compliance with specified standards, personnel safety, and protection of the environment. The significant features of the QAP are:

- Quality verification and overview of activities that demonstrate the completeness and appropriateness of achieved quality.

- Assurance that activities are performed to specified requirements.

- Assurance that structures, systems, and components will perform as intended.

Quality is achieved by ensuring that managers at all level are responsible and accountable for achieving and improving upon quality. All PMC personnel are responsible for the quality of the work at the WSSRAP.

The quality assurance/quality control (QA/QC) requirements for specific task performed under the scope of this work plant will be addressed future documents. The QA/QC requirements for construction activities will be presented in the technical specifications for the

appropriate work packages. The QA/QC requirements for sampling and characterization activities will be address in the appropriate sampling or monitoring plans.

11. CONTINGENCY PLAN

11.1 Purpose

The Project Management Contractor (PMC) has prepared the *Emergency Plan* (Ref. 31), which establishes the planning, preparedness, and response concepts for operational emergencies and other emergencies at the Weldon Spring Site Remedial Action Project (WSSRAP). The emergency management response measures established by the *Emergency Plan* are intended to afford protection for the health and safety of on-site personnel and the public, limit damage to facilities and equipment, minimize impact to on-site operations, and limit adverse impacts on the environment. The plan is implemented whenever an emergency situation is declared or conditions exist that constitute, or could result in, an operational emergency at the WSSRAP. Appropriate parts of the plan may be implemented by a responsible authority for emergencies that do not reach the severity of an Operation Emergency, but require a structured response pursuant to environmental or health and safety regulations or sound management practices. The plan also outlines the interfaces and coordination with off-site private organizations, and Federal, State, and local government agencies with roles in emergency response.

11.2 Description

The *Emergency Plan* is designed to address planning for all categories of emergencies arising at or as a result of, operations conducted by the WSSRAP that could affect people, property, or the environment. The scope and extent of the planning is commensurate with the hazards present at the WSSRAP.

The *Emergency Plan* addresses specific categories of events and defines basic response actions to be followed for each type of incident. Topics discussed are:

- WSSRAP emergency response organization.
- Off-site response interfaces.
- Emergency event classification.
- Notification and communication.
- Hazard assessment process.
- Protective actions.
- Medical support.
- Reentry and recovery.
- Public Information.
- Emergency facilities and equipment.
- Training.
- Drills and exercises.
- Emergency management program administration.

This plan implements the requirements of 40 CFR 264 and 10 CSR 25-7.264 for a *RCRA Contingency Plan*. This plan also incorporates the requirements of 40 CFR 112 for a *Spill Prevention Control and Countermeasures Plan*, and 29 CFR 1910.120 and 29 CFR 1926.65 for an *Emergency Response Plan*. Outside agency hazardous material incident notification guidance is contained in the *WSSRAP Reportable Release Notification Guide* (Ref. 32).

11.3 Implementation

It is the policy of the U.S. Department of Energy (DOE) and the WSSRAP management to conduct operations in a responsible manner so as to be protective of human health and the environment. The primary focus of site management is the prevention of accidents, emergency situations, and other incidents, which could adversely affect on-site personnel, the public, property, or the environment. These objectives are attained through the implementation of effective planning and preparedness for emergencies during the initial stages of site activities. Also, the use of protective actions and training maintains an awareness of potential emergencies and the appropriate responses required for prevention or mitigation of problems that could occur.

Specific provisions for responding to emergencies that are unique to individual tasks in the remedial action activities are incorporated into job-specific health and safety plans, safe work plans, and/or task specific safety assessments. For each activity, the health and safety plan is the primary working document that governs initial safety, health, and emergency response requirements. The health and safety plan also provide subcontractors with the process for identifying potential emergency conditions and notifying the appropriate WSSRAP contact.

12. POST-ROD DOCUMENTATION

This section outlined the primary and secondary documents that have been, or will be, prepared to support the design and implementation of the selected remedy for the Quarry Residuals Operable Unit. Preparation of these documents is carried out in accordance with the *Federal Facilities Agreement* (FFA) (Ref. 2). The schedule for these documents is included and updated in the FFA quarterly reports.

12.1 Primary Documents

Primary documents include those documents that are major, discrete portions of the remedial design and remedial action activities. Secondary documents typically provide information or data for primary documents and are incorporated into the appropriate primary document. The final design submittal, operation and maintenance plan, contingency plans, and sampling plans are considered as primary documents.

12.1.1 Final Design Submittals

The final design submittal includes drawing and specifications that are ready for bid advertisement. Each submittal will contain:

- Design analysis.
- Final construction drawings.
- Final construction specifications.
- Construction quality control standards.
- Cost estimate.

Final design submittals will be issued for the following components:

- WP-513A, *Quarry Restoration Contaminated Materials Removal*
- WP-513B, *Quarry Restoration Backfill*
- WP-515, *Quarry Interceptor Trench System*
- WP-529, *Quarry Reclamation*

12.1.2 Sampling Plans

Sampling plans have been or will be prepared to provide data to decision making, contamination fate and transport evaluations, and design activities. These plans outline the objectives for sampling activities, sample collection methods, and quality control. Table 12-1 outlines the sampling plans prepared in support of this operable unit.

Table 12-1 RD/RA Sampling Plans for the Quarry Residuals Operable Unit

TITLE	SUMMARY
Hydrogeologic Characterization Sampling Plan in Support of the QROU Field Studies (Ref. 12).	Plan includes the scope and methodology for collection of hydrologic and geologic characterization data from the area north of the slough to be used as a supplemental data for the fate and transport conceptual model and design of the interceptor trench field study. Data collection was performed during January and February 1999.
Geochemical Characterization Sampling Plan in Support of the QROU Field Studies (Draft)	Plan will include the scope and methodology for collection of data to be used to determine attenuation mechanisms for uranium north of the slough.
Sampling Plan for the Radiological Characterization of the Northeast Corner of the Weldon Spring Quarry (Ref. 14).	Plan includes scope and methodology for collection of data to delineate the extent of radiological contamination in the soils in the northeast slope area of the quarry. Data will be used to design excavation limits for soil removal. Data collection was performed during October 1999.
Sampling Plan for the Radiological Characterization of the Ditch Area of the Weldon Spring Quarry (Ref. 15).	Plan include scope and methodology for collection of data to delineate the extent of radiological contamination in the soils in the ditch area of the quarry. Data will be used to design excavation limits for soil removal. Data collection was performed during May and June 1999.
Sampling Plan for the Radiological Characterization of the Snake Pit Area of the Weldon Spring Quarry (Draft).	Plan will includes scope and methodology for collection of data to delineate the extent of radiological contamination in the soils in the snake pit area of the quarry. Data will be used to design excavation limits for soil removal.
Sampling Plan for the Quarry Residuals Operable Unit Interceptor Trench Field Study (Draft)	Plan will include scope and methodology for collection of samples from the interceptor trench and nearby monitoring wells to monitor the performance of the trench system and to confirm the predictive model on uranium removal using field data.

12.1.3 Field Study Evaluations

The *Evaluation of the Performance of the Interceptor Trench Field Study* will summarize the data collected during the field study and present the comparison to the modeled performance of the trench. Conclusions will be made regarding the benefits of uranium removal through groundwater extraction from the area north of the slough. Data from completion reports (Section 12.2.2) for the field studies will be used in this evaluation.

12.1.4 Operation and Maintenance Plan

Operations and maintenance will be outlined in a series of three documents: *Weldon Spring Stewardship Document for Operations and Maintenance*, *Long-Term Monitoring Plan for the Weldon Spring Site*, and *Institutional Controls Plan for the Weldon Spring Site*. The *Weldon Spring Stewardship Document for Operations and Maintenance* will outline the framework for the *Long-Term Monitoring Plan* and the *Institutional Controls Plan*, as well as the basis for the roles and responsibilities of stakeholders regarding stewardship and long-term care of Weldon Spring site. Each operable unit will be included as a separate section in these plans.

Specifics regarding monitoring locations, parameters, and frequencies, as well as data interpretation and documentation will be presented in the *Long-Term Monitoring Plan*. Also, specifics regarding establishing and enforcing institutional controls on groundwater usage in the area north of the slough, and controls in other areas, will be outlined in the *Institutional Controls Plan*.

12.1.5 Contingency Plan

The *Emergency Plan* (Ref. 31) will be used to fulfill the requirement for preparation of a contingency plan for work being performed for this operable unit.

12.1.6 Remedial Action Report

A remedial action report documents the completion of an operable unit. The report indicates that the operable unit has met the objectives of the *Record of Decision* (Ref. 1) and provides summary information for subsequent inclusion in the preliminary and final closeout reports.

12.2 Secondary Documents

Secondary documents are typically feeder documents to a primary document. A secondary document may be finalized in the primary document that supports or it may be issued as a stand-alone document. Preparation of these documents is carried out in accordance with the *Federal Facilities Agreement* (FFA) (Ref. 2). The schedule for these documents is included and updated in FFA quarterly reports.

12.2.1 Preliminary Design Submittals

The preliminary design submittal consists of the 60% design effort for each component outlined in Section 12.1.1 of this plan. Each submittal will contain:

- 60% construction drawings.

- 60% construction specifications.
- Preliminary construction quality control standards.

12.2.2 Completion Reports

A report detailing sample collection activities, analytical results, and quality control issues will be prepared for closure of each sampling event. Any deviations or modifications to the original sampling plan will be discussed. Table 12-2 outlines the completion reports prepared in support of this operable unit.

Table 12-2 RD/RA Completion Reports for the Quarry Residuals Operable Unit

TITLE	SUMMARY
Completion Report for Hydrogeological Field Studies in Support of the QROU (Ref. 13)	This report summarizes the field activities and data results obtained from the characterization performed in the area north of the slough. This data will be incorporated into the *Evaluation of the Performance of the Interceptor Trench Field Study* and the design of the interceptor trench in WP-515.
Completion Report for Radiological Characterization of the Northeast Corner of the Weldon Spring Quarry (Draft)	This report will summarize the field activities and data results obtained from the characterization effort. Data from this completion report will be used to determine the excavation limits for contaminated soil removal, which will be documented in the construction documents for WP-513A.
Completion Report for Radiological Characterization of the Ditch Area at the Weldon Spring Quarry (Ref. 16)	This report summarizes the field activities and data results obtained from the characterization effort. Data from this completion report will be used to determine the excavation limits for contaminated soil removal, which will be documented in the construction documents for WP-513A.
Completion Report for Radiological Characterization of the Snake Pit Area of the Weldon Spring Quarry (Draft)	This report will summarize the field activities and data results obtained from the characterization effort. Data from this completion report will be used to determine the excavation limits for contaminated soil removal, which will be documented in the construction documents for WP-513A.
Completion Report for the Geochemical Sampling Performed in Support of the QROU Field Studies	This report will summarize the field activities and data results obtained from the characterization performed in the area north of the slough. This data will be incorporated into the *Evaluation of the Performance of the Interceptor Trench Field Study*.
Completion Report for the Quarry Residuals Operable Unit Interceptor Trench Field Study	This report will summarize the sampling activities and data results obtained from the sampling of the interceptor trench and nearby monitoring wells. This data will be incorporated into the *Evaluation of the Performance of the Interceptor Trench Field Study*.

12.2.3 Well Field Contingency Plan

This plan will outline the contingencies to be considered if long-term monitoring indicates an impact to the potable water supply form the St. Charles County well field. Emphasis will be placed on information necessary to support the development of a replacement well field and design criteria for design and construction of this well field if necessary. This document is a secondary document to the *Weldon Spring Stewardship Document for Operations and Maintenance*.

12.2.4 Construction Progress Reports

The *Federal Facilities Agreement* quarterly reports will fulfill the requirements of the *Construction Progress Report* for this operable unit. Copies of daily, weekly, and monthly reports submitted by the subcontractor, as well as quality control inspections, are maintained at the site. Upon request, these documents can be made available to the regulators for inspection.

13. REFERENCES

1. Argonne National Laboratory. *Record of Decision for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-725. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1998.

2. U.S. Environmental Protection Agency. *First Amended Federal Facilities Agreement,* Docket No. CERCLA-VII-85-F-0057. Prepared for U.S. Department of Energy, Weldon Spring Site. St. Charles, MO. January 28, 1992.

3. Argonne National Laboratory. *Work Plan for the Remedial Investigation/Feasibility Study-Environmental Assessment for the Quarry Residuals Operable Unit at the Weldon Spring Site.* DOE/OR/21548-243. Prepared for the U.S. Department of Energy, Weldon Spring Site Remedial Action Project by the Environmental Assessment Division. St. Charles, MO. January 1994.

4. MK-Ferguson Company and Jacobs Engineering Group. *Remedial Investigation for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring Missouri.* Rev. 2. Final. DOE/OR/21548-587. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. February 1998.

5. Argonne National Laboratory. *Baseline Risk Assessment for the Quarry Residuals Operable Unit of the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-594. Prepared by the Environmental Assessment Division for the U.S. Department of Energy, Weldon Spring Site Remedial Action Project, Weldon Spring, Missouri. July 1997.

6. Argonne National Laboratory, Environmental Assessment Division. *Feasibility Study for Remedial Action for the Quarry Residuals Operable Unit at the Weldon Spring Site, Weldon Spring, Missouri.* DOE/OR/21548-595. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. March 1998.

7. Argonne National Laboratory. *Proposed Plan for Remedial Action at the Quarry Residuals Operable Unit of the Weldon Spring Site.* DOE/OR/21548-724. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. March 1998.

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

9. MK-Ferguson Company and Jacobs Engineering Group. *Well Field Contingency Plan*, Rev. 0. DOE/OR/21548-340. Prepared for the U.S. Department of Energy, Oak Ridge Field Office. St. Charles, MO. November 1992.

10. U.S. Environmental Protection Agency. "Ground Water." *Methods for Evaluating the Attainment of Cleanup Standards*. Vol. 2. EPA 230-R-92-014. Office of Policy, Planning, and Evaluation, Environmental Statistics and Information Division (PM-222). July 1992.

11. MK-Ferguson Group, Inc. *Design Criteria, Work Package 508, Architect/Engineer Services VI Task 6, Quarry Area Interceptor Trench System Design*. Rev. 1. Prepared for the U.S. Department of Energy. February 1999.

12. MK-Ferguson Company and Jacobs Engineering Group. *Hydrogeologic Characterization Sampling Plan in Support of the QROU Field Studies*. Rev. 0. DOE/OR/21548-764. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. November 1998.

13. MK-Ferguson Company and Jacobs Engineering Group. *Completion Report for the Hydrogeological Field Studies in Support of the Quarry Residuals Operable Unit*. Rev. 0. DOE/OR/21548-803. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. August 1999.

14. MK-Ferguson Company and Jacobs Engineering Group. *Sampling Plan for Radiological Characterization of the Northeast Corner of the Quarry Proper*. Rev. 0. DOE/OR/21548-815. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1999

15. MK-Ferguson Company and Jacobs Engineering Group. *Sampling Plan for Radiological Characterization of the Ditch Area at the Weldon Spring Quarry*. Rev. 0. DOE/OR/21548-790. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. May 1999.

16. MK-Ferguson Company and Jacobs Engineering Group. *Completion Report for Radiological Characterization of the Ditch Area at the Weldon Spring Quarry*. Rev. 0. DOE/OR/21548-817. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1999.

17. MK-Ferguson Company. *Design Criteria for WP-508, Architect/Engineer Services VI: Task 4*, Rev 0. St. Charles, MO.

18. MK-Ferguson Company and Jacobs Engineering Group. *Engineering Characterization Sampling Plan for the Quarry Staging Area.* Rev. 0. DOE/OR/21548-753. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1998.

19. MK-Ferguson Company and Jacobs Engineering Group. *Completion Report for the Engineering Characterization Sampling for the Quarry Staging Area.* Rev. 0. DOE/OR/21548-786. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. April 1999.

20. Walters, G.R. *A Phase I Cultural Resources Survey and Evaluation of the Weldon Spring Quarry Site Remedial Action Project Area, St. Charles County, Missouri.* TRS Cultural Resource Management Report Number 105. Prepared for the U.S. Department of Energy by Triad Research Services. Columbia, MO. November 1, 1988.

21. Walters, Gary Rex. *A Phase I Survey and Evaluation of the Proposed Weldon Spring Quarry to Weldon Spring Chemical Plant Site Bulk Waste Haulage Road Project Area, St. Charles County, Missouri*, Report Number 172. Prepared for U.S. Department of Energy and MK-Ferguson Company, by Triad Research Services. Columbia, Missouri. December 1990.

22. Walters, Gary Rex. *A Phase I Survey and Evaluation of the Weldon Spring Quarry Potable Waterline Project and Phase II Testing of Archeological Sites 23SC80, 23SC81, and 23SC83, St. Charles County, Missouri.* Prepared for the U.S. Department of Energy and MK-Ferguson Company, by Triad Research Services. Columbia, Missouri. October 1989.

23. Walters, Gary Rex. *A Phase I Survey and Evaluation of the Proposed Weldon Spring Quarry Stockpile Site, St. Charles County, Missouri.* TRS Cultural Resource Management Report Number 156. May 1990.

24. Argonne National Laboratory. *A Phase I Archaeological Survey of the Well Field for the Weldon Spring Site Remedial Action Project, Quarry Restoration Borrow Investigation, St. Charles County, Missouri.* K.L. Wescott, Principal Investigator. Prepared for the U.S. Department of Energy by the Environmental Assessment Division. August 1999.

25. Wescott, K.L. *A Phase I Archaeological Survey of the 5500 Drainage for the Weldon Spring Site Remedial Action Project, Quarry Restoration Borrow Investigation, St. Charles County, Missouri.* Prepared for the U.S. Department of Energy by Argonne National Laboratory, Environmental Assessment Division. Argonne, IL. November 1999.

26. Van Lonkhuyzen, R. *Floodplain/Wetlands Assessment for the Remediation of Vicinity Property 9 at the Weldon Spring Site, Weldon Spring, Missouri.* ANL/EAD/TM-49. Prepared for the Environmental Assessment Division, Argonne National Laboratory. Argonne, IL. November 1995.

27. Van Lonkhuyzen, R.A. *Floodplain/Wetlands Assessment for the Borrow Areas for the Restoration of the Weldon Spring Quarry, Weldon Spring Site, Missouri.* ANL/EAD/TM-87. Prepared for the United States Department of Energy by Argonne National Laboratory, Environmental Assessment Division. Argonne, IL. October 1999.

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

29. MK-Ferguson Company and Jacobs Engineering Group. *Project Management Contractor Quality Assurance Program*, Rev. 5. DOE/OR/21548-333. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. July 1999.

30. MK-Ferguson Company and Jacobs Engineering Group. *Environmental Quality Assurance Project Plan.* Rev. 4. DOE/OR/21548-352. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1999.

31. MK-Ferguson Company and Jacobs Engineering Group. *Emergency Plan.* Rev. 4. DOE/OR/21548-531. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. March 1999.

32. MK-Ferguson Company and Jacobs Engineering Group. *WSSRAP Reportable Release Notification Guide*, Rev. 5. DOE/OR/21548-218. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September 1998

33. Layne Western Company, Inc. *Groundwater Hydrology Investigation, Weldon Spring, Missouri.* Vol. I. Hydrology Division. Kansas City. January 8, 1986.

APPENDIX A
Long-Term Monitoring Location Evaluation

A. LONG-TERM MONITORING LOCATION EVALUATION

Monitoring locations were selected to meet the following criteria:

1. Monitor changes and establish trends in contaminant levels in the area of known impact.

2. Intercept potential migration pathways from north of the slough to south of the slough.

3. Provide water quality data from the productive portions of the Missouri River alluvium.

The geochemistry of the shallow aquifer will be monitored at all locations selected for this plan. The geochemistry will not be a factor for adding or deleting monitoring wells into the long-term program.

A.1 Monitor Contaminant Levels in the Area of Known Impact

The horizontal and vertical extent of groundwater contaminant at the quarry has remained nearly constant over the past 13 years of monitoring (Figure 2-1). Concentrations within the area of impact have exhibited downward trends since bulk water removal. Some discrete locations have exhibited upward trends in uranium. Statistical analysis of the data for seasonality has indicated that contaminant levels do not exhibit seasonal variability.

Wells that presently exhibit elevated uranium levels or detectable concentrations of nitroaromatic compounds will be used for this monitoring program. Figure 2-1 will be used to identify wells that are within the area of known uranium and nitroaromatic compound impact. Locations, which may require the installation of new wells, will also be determined from this figure.

A.2 Migration Pathways from North to South of the Slough

Lateral groundwater flow in the bedrock comprising the quarry is predominantly to the south. Flow in the Missouri River alluvial aquifer south of the quarry is generally southeast to east, due to the gradient imposed by the Missouri River. Groundwater flow is captured by the production wells of the St. Charles County well field.

Wells that are screened within the alluvial materials and the Decorah Group north of the Femme Osage Slough are situated within the migration pathway from the quarry area to south of the slough. Wells that are screened at the base of the alluvium, typically near the top of bedrock,

directly south of the slough intercept groundwater originating from the area north of the slough and flow south. Vertical gradients in the bedrock south of the slough are upward; therefore, bedrock south of the slough does not require monitoring.

In the alluvial aquifer north and immediately south of the slough, groundwater gradient is downward. In the same area, the hydraulic head in the underlying bedrock units is typically higher than or equals the head in the overlying alluvium, indicating upward flow form the bedrock. These two flows likely converge in the coarse-grained base materials present south of the slough and flow laterally toward the Missouri River.

A.3 Productive Portions of the Missouri River Alluvium

The coarse-grained materials present at the base of the alluvium south of the slough constitute the productive portion of the aquifer. Hydraulic conductivity values can vary by one order of magnitude between these two types of materials, indicating that groundwater movement through the coarse-grained materials is higher than that of the upper fine-grained materials. Transmissivity values also increase in areas with a thicker sequence of coarse-grained materials.

Wells that are screened in the coarse-grained materials at the base of the alluvium south of the slough monitor the productive portions of the Missouri River alluvial aquifer. This section of the alluvium also collects converging groundwater flow from the overlying fine-grained materials and the underlying bedrock.

A.4 Geochemistry of the Shallow Aquifer

Uranium is the major quarry-related groundwater contaminant and is the only radiological constituent of the bulk waste materials that is readily dissolved in groundwater. Uranium is soluble under oxidizing conditions, but precipitates in a number of insoluble phases under reducing conditions (Ref. 4). Uranium is sorbed onto solid materials, especially iron-manganese oxides and organic matter, as observed in soil borings north of the slough (Ref. 4). In the shallow aquifer, uranium activity decreases abruptly near the northern margin of the slough, in response to the sudden decrease in the oxidation potential, which results in precipitation of dissolved uranium in groundwater (Ref. 4). The sharp decrease in uranium levels indicates that sorption, which typically generates more diffuse boundaries, is not the only process attenuating the uranium in groundwater. Sorption, however, may be the primary geochemical process along the eastern and western margins of the plume, which shows a gradual decrease in uranium levels.

Nitroaromatic compounds, although relatively soluble water, area susceptible to various transformation processes and are likely confined to the north side of the slough primarily by a combination of biodegradation and reduction-oxidation reactions. Reducing conditions near the slough provide lower oxidation potentials to enhance the degradation of these products.

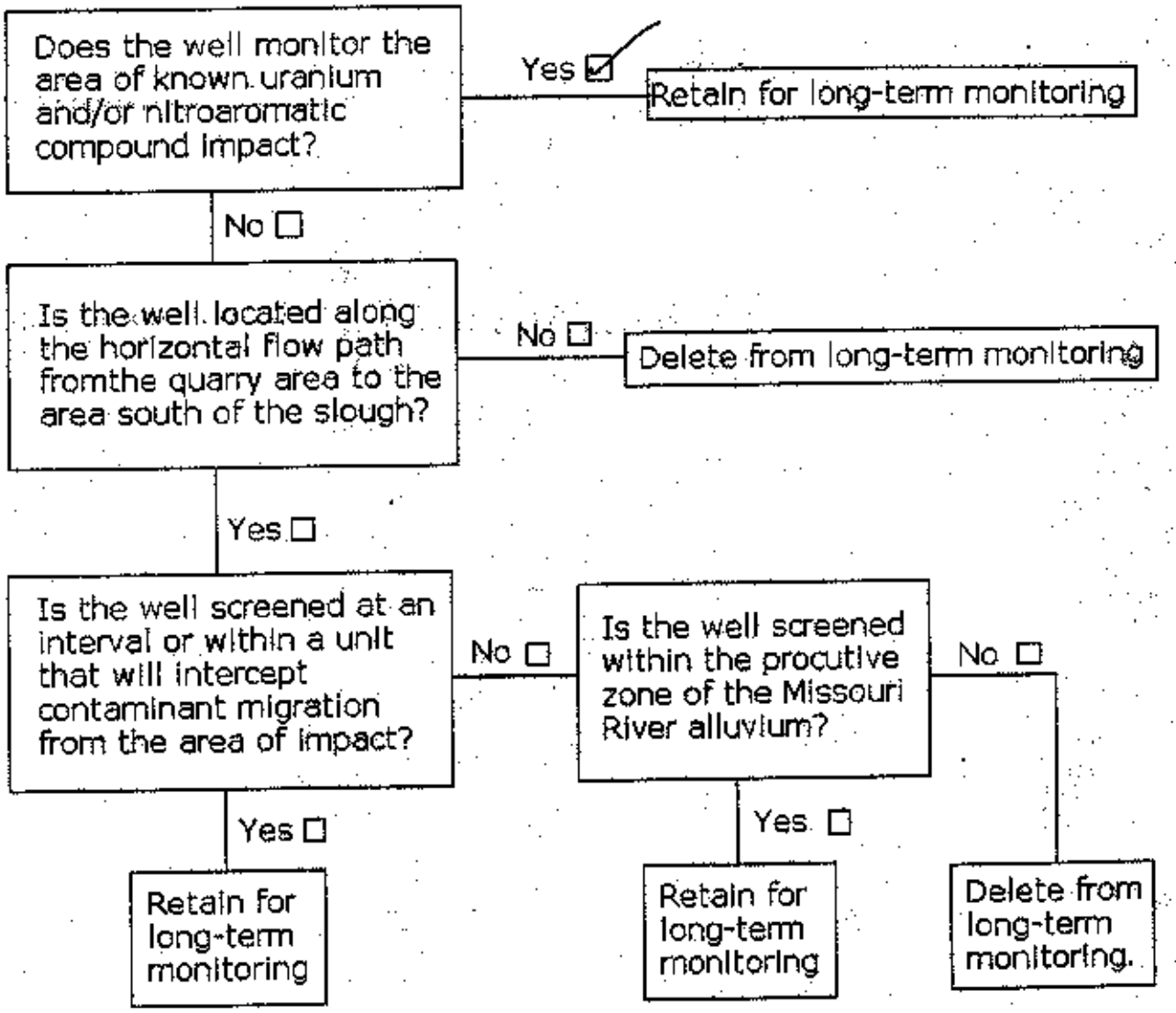
Wells within the area of known groundwater impact monitor the geochemical conditions of the aquifer that have a controlling influence on the distribution of uranium and nitroaromatic compounds into the groundwater north of the slough. Wells along the fringe of the known areas of impact and south of the slough monitor the geochemical controls on the migration of these contaminants south of the slough. These factors will not have a primary influence on the selection of monitoring locations.

Well ID: MW-1002
Location: Quarry rim
Unit Monitored: Kimmswick/Decorah
Screened Interval: 110.4 – 115.2 (no seal)
Contaminant Concentrations (98 ave.)
Uranium: 16 pCi/l
1,3,5-TNB: 19.0 µg/l
1,3-DNB: 0.13 µg/l
2,4,6-TNT: 5.28 µg/l
2,4-DNT: 0.06 µg/l
2,6-DNT: 5.00 µg/l
Nitrobenzene: ND (<0.015 µg/l)

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the productive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1004
Location: Quarry rim
Unit Monitored: Kimmswick/Decorah
Screened Interval: ~~[illegible]~~ (no scal) 86.4-91.0'
Contaminant Concentrations (98 ave.)
Uranium: 2,200 pCi/l
1,3,5-TNB: 0.21 µg/l
1,3-DNB: ND (< 0.045 µg/l)
2,4,6-TNT: 1.06 µg/l
2,4-DNT: 0.10 µg/l
2,6-DNT: 0.32 µg/l
Nitrobenzene: ND (< 0.015 µg/l)

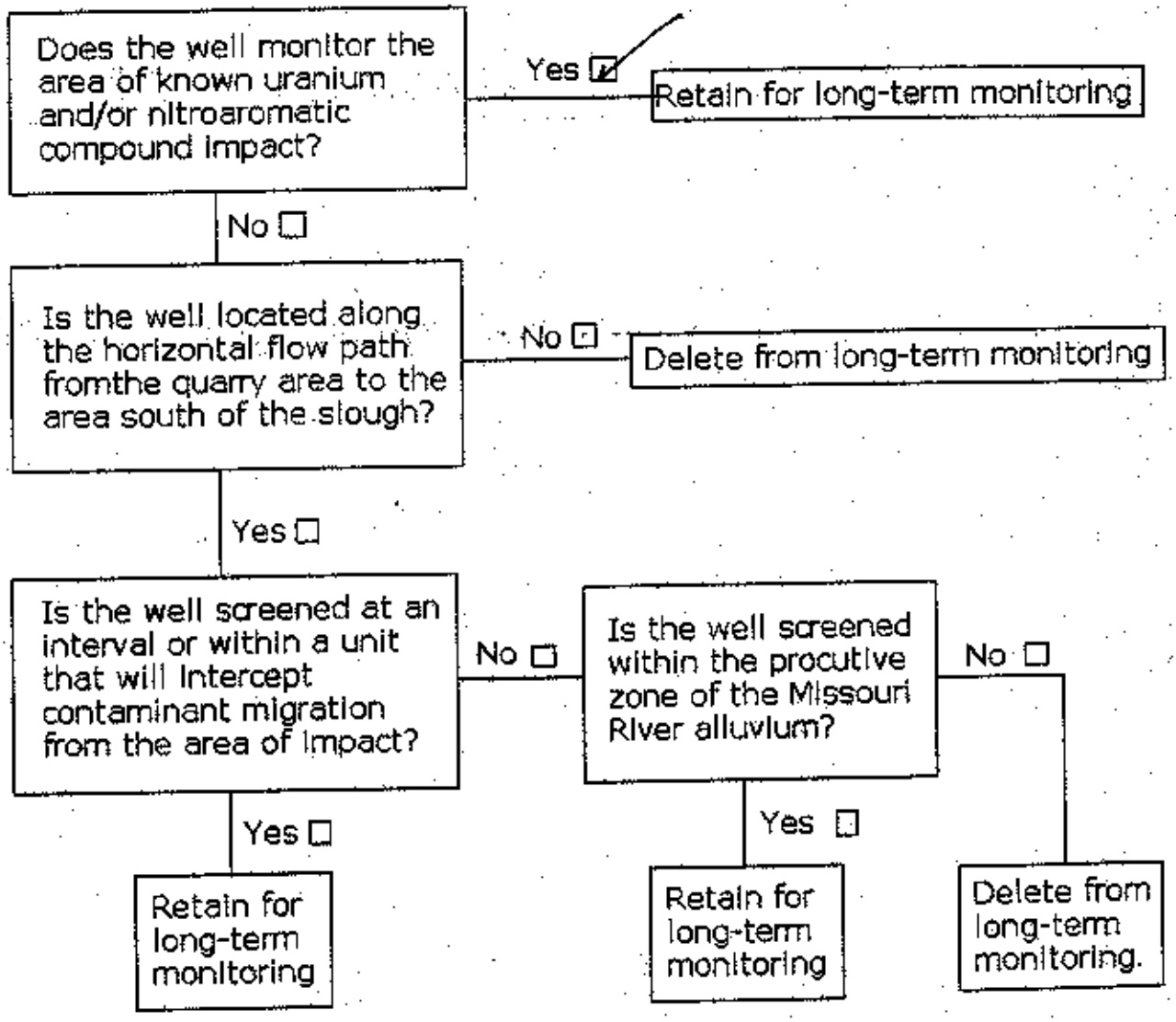


Well ID: MW-1005
Location: Quarry rim
Unit Monitored: Kimmswick / Decorah
Screened Interval: 95.2 - 99.7' (no seal)
Contaminant Concentrations (98 ave.)
Uranium: 2887 pCi/l (1997 data)
1,3,5-TNB: ND (1997 data)
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: 0.014 µg/l
2,6-DNT: 0.041 µg/l
Nitrobenzene: ND

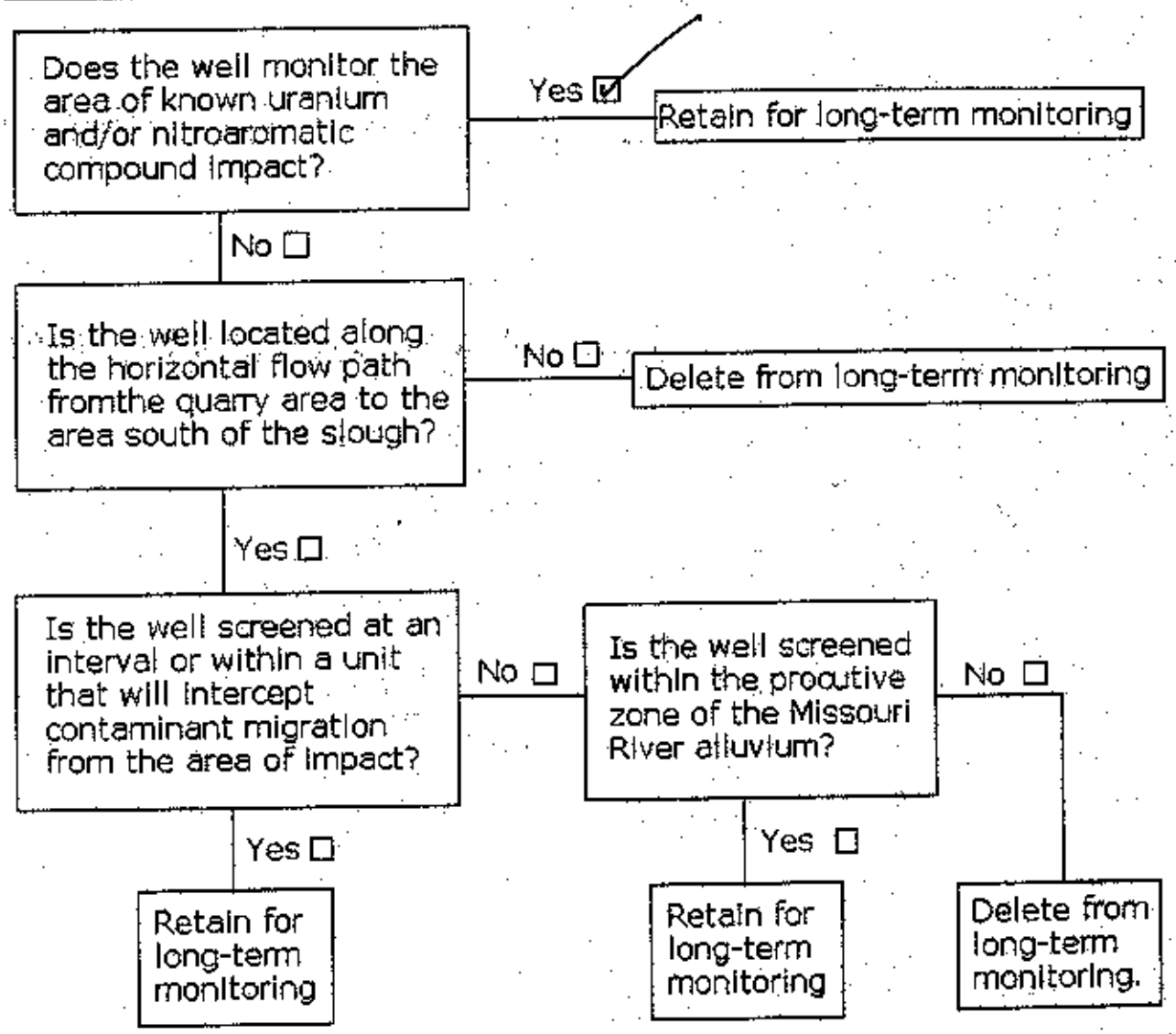
Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the productive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

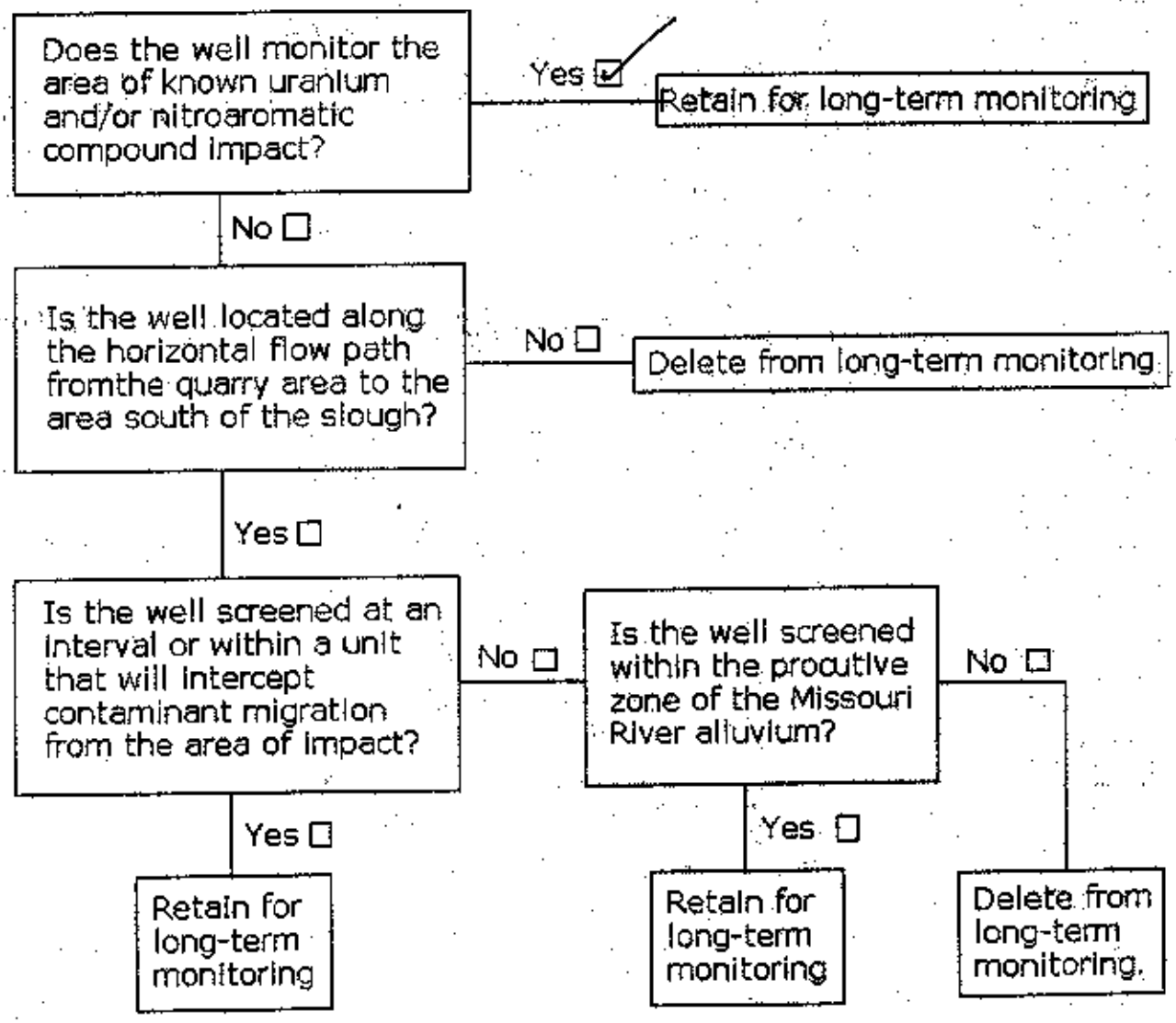
Well ID: MW-1006
Location: North of slough
Unit Monitored: F4. Alluvium
Screened Interval: 3' - 11'
Contaminant Concentrations (98 ave.)
Uranium: 1,935 pCi/l
1,3,5-TNB: 29.3 µg/l
1,3-DNB: 0.045 µg/l
2,4,6-TNT: 1.44 µg/l
2,4-DNT: 0.10 µg/l
2,6-DNT: 0.64 µg/l
Nitrobenzene: ND (<0.015 µg/l)



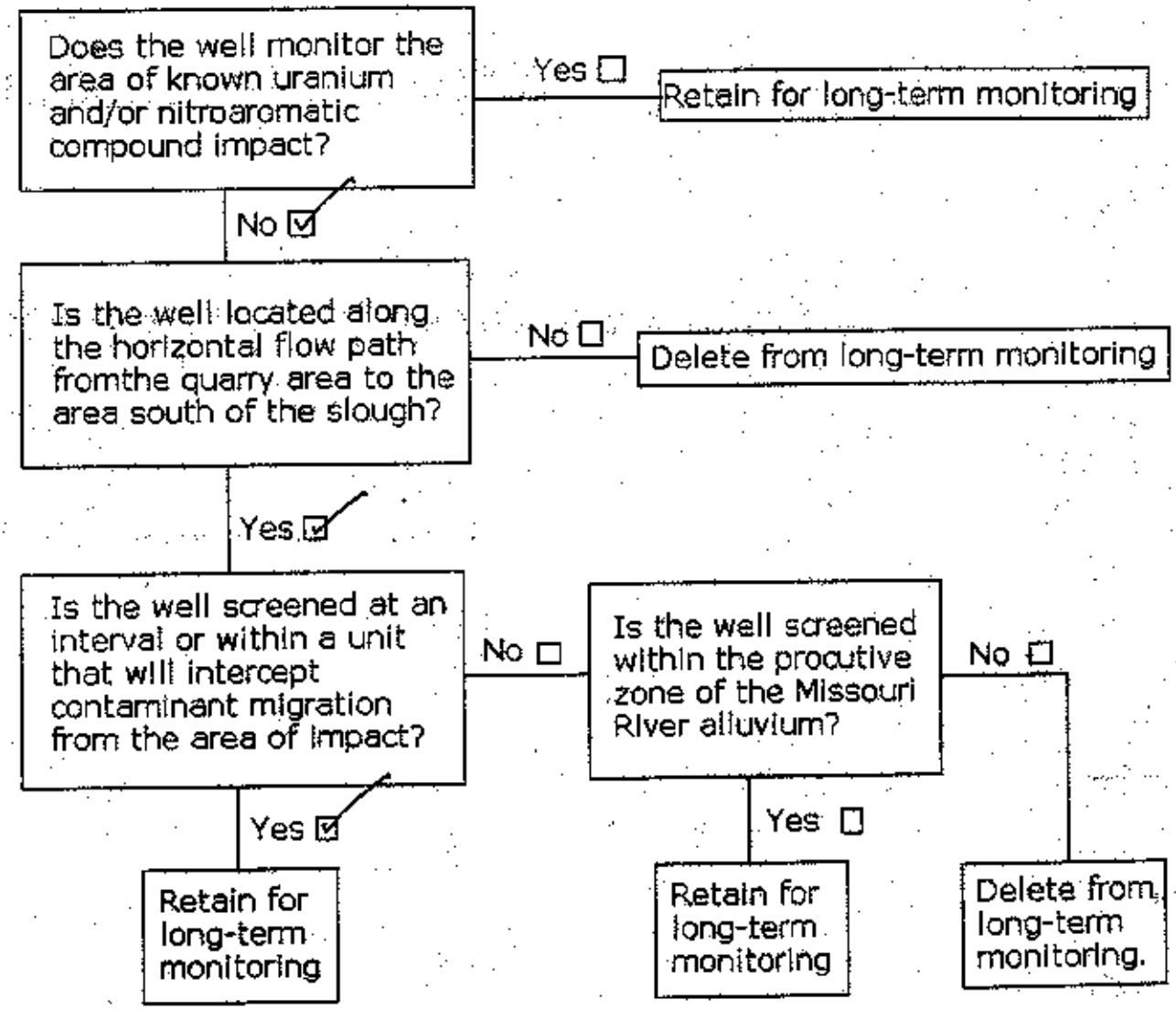
Well ID: MW-1007
Location: North of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 6 - 11.5'
Contaminant Concentrations (98 ave.)
Uranium: 62 pCi/l
1,3,5-TNB: 0.02 µg/l
1,3-DNB: ND (< 0.045 µg/l)
2,4,6-TNT: ND (< 0.015 µg/l)
2,4-DNT: ND (< 0.015 µg/l)
2,6-DNT: ND (< 0.005 µg/l)
Nitrobenzene: ND (< 0.016 µg/l)



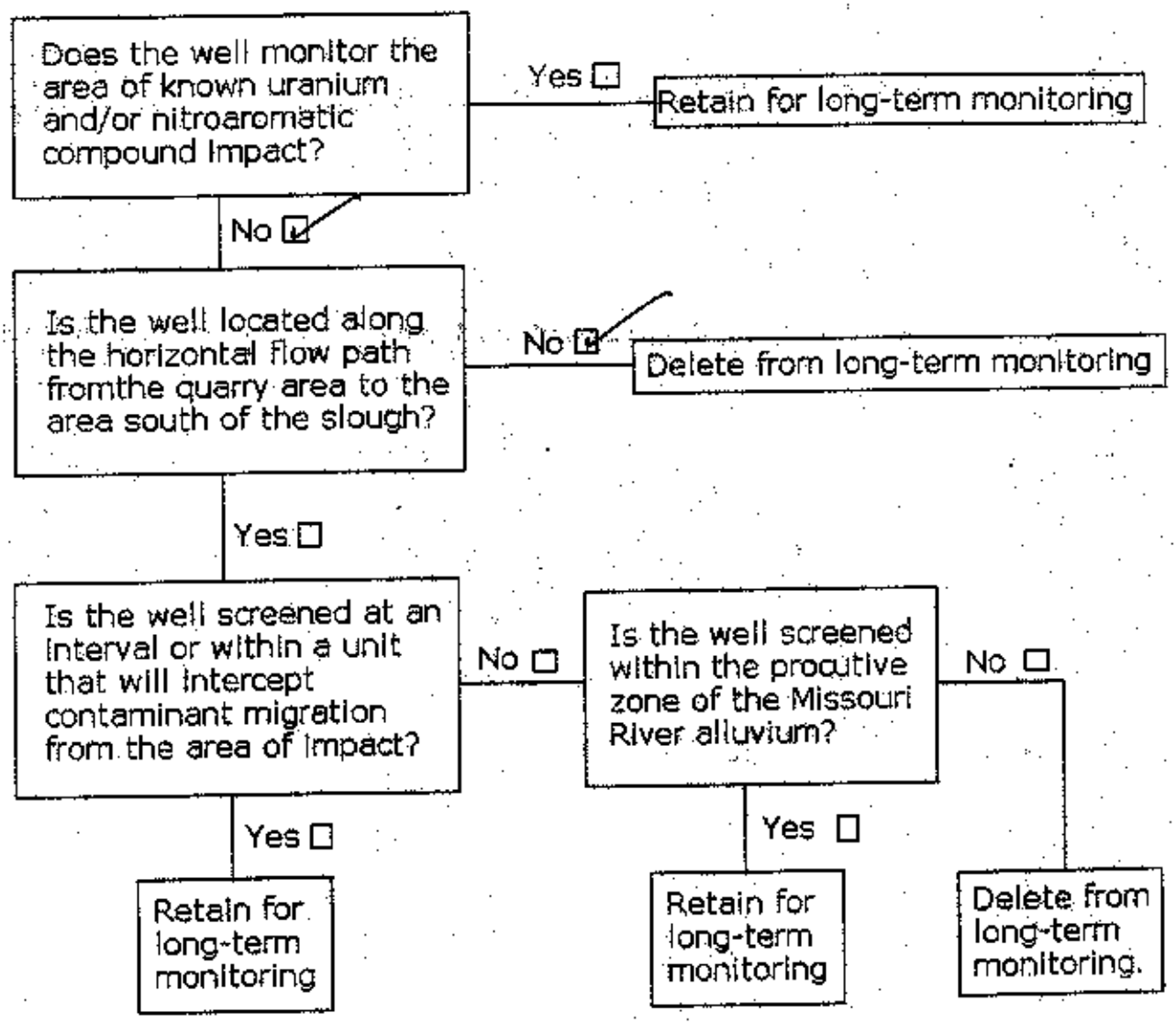
Well ID: MW-1008
Location: North of slough
Unit Monitored: E.G. Alluvium
Screened Interval: 5-10'
Contaminant Concentrations (98 ave.)
Uranium: 1,600 pCi/l
1,3,5-TNB: ND (< 0.015 µg/l)
1,3-DNB: ND (< 0.045 µg/l)
2,4,6-TNT: ND (< 0.015 µg/l)
2,4-DNT: ND (< 0.015 µg/l)
2,6-DNT: ND (< 0.005 µg/l)
Nitrobenzene: ND (< 0.015 µg/l)



Well ID: MW-1009
Location: North of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 7.7 - 15.0'
Contaminant Concentrations (98 ave.)
Uranium: 8.7 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1010
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 17 – 27.5'
Contaminant Concentrations (98 ave.)
Uranium: 0.27 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1011
Location: South of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 7.6 - 17.5'
Contaminant Concentrations (98 ave.)
Uranium: 4.25 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1012
Location: North of quarry
Unit Monitored: Decorah
Screened Interval: 68.0 – 99.8'
Contaminant Concentrations (98 ave.)
Uranium: 2.23 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☐

Is the well screened within the procutive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☐ → Delete from long-term monitoring.

Well ID: MW-1013
Location: North of slough
Unit Monitored: Decorah
Screened Interval: 20.0 - 35.0'
Contaminant Concentrations (98 ave.)
Uranium: 520 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: 0.016 µg/l
2,6-DNT: 0.006 µg/l
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

Yes ☑ → Retain for long-term monitoring

No ☐ →

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

No ☐ → Delete from long-term monitoring

Yes ☐ →

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

Yes ☐ → Retain for long-term monitoring

No ☐ →

Is the well screened within the procutive zone of the Missouri River alluvium?

Yes ☐ → Retain for long-term monitoring

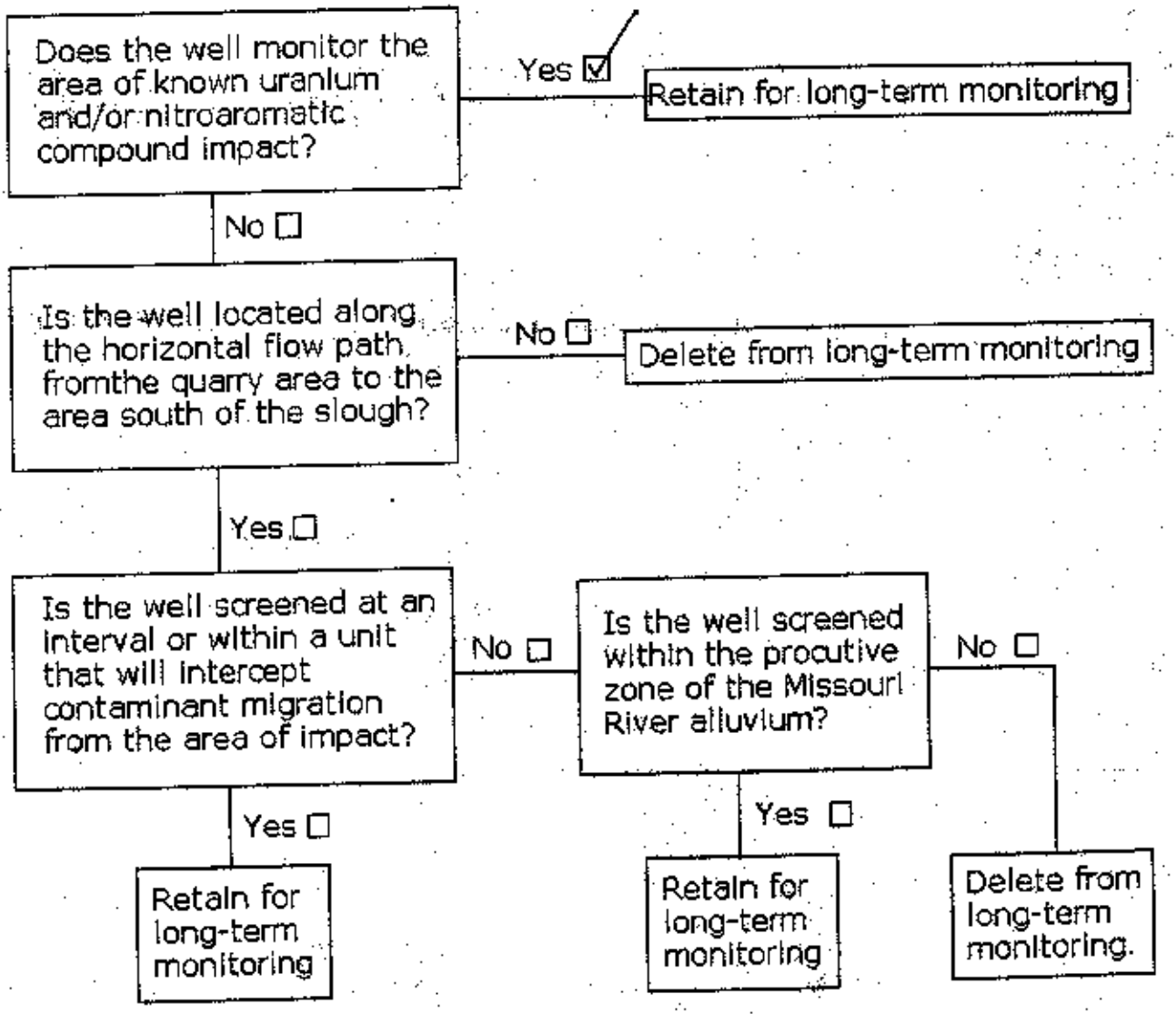
No ☐ → Delete from long-term monitoring.

Well ID: MW-1014
Location: North of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 13.0 – 21.3'
Contaminant Concentrations (98 ave.)
Uranium: 57.0 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1015
Location: North of slough
Unit Monitored: Decorah
Screened Interval: 15.6-30.5'
Contaminant Concentrations (98 ave.)
Uranium: 216 pCi/l
1,3,5-TNB: 2.65 µg/l
1,3-DNB: 0.10 µg/l
2,4,6-TNT: 1.15 µg/l
2,4-DNT: 0.03 µg/l
2,6-DNT: 0.16 µg/l
Nitrobenzene: ND



Well ID: MW-1016
Location: North of slough
Unit Monitored: Eq. Alluvium
Screened Interval: 8.0 - 15.5'
Contaminant Concentrations (98 ave.)
Uranium: 145 pCi/l
1,3,5-TNB: 0.12 µg/l
1,3-DNB: ND
2,4,6-TNT: 0.08 µg/l
2,4-DNT: ND
2,6-DNT: 0.03 µg/l
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

Yes ☑ → Retain for long-term monitoring

No ☐ →

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

No ☐ → Delete from long-term monitoring

Yes ☐ →

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

Yes ☐ → Retain for long-term monitoring

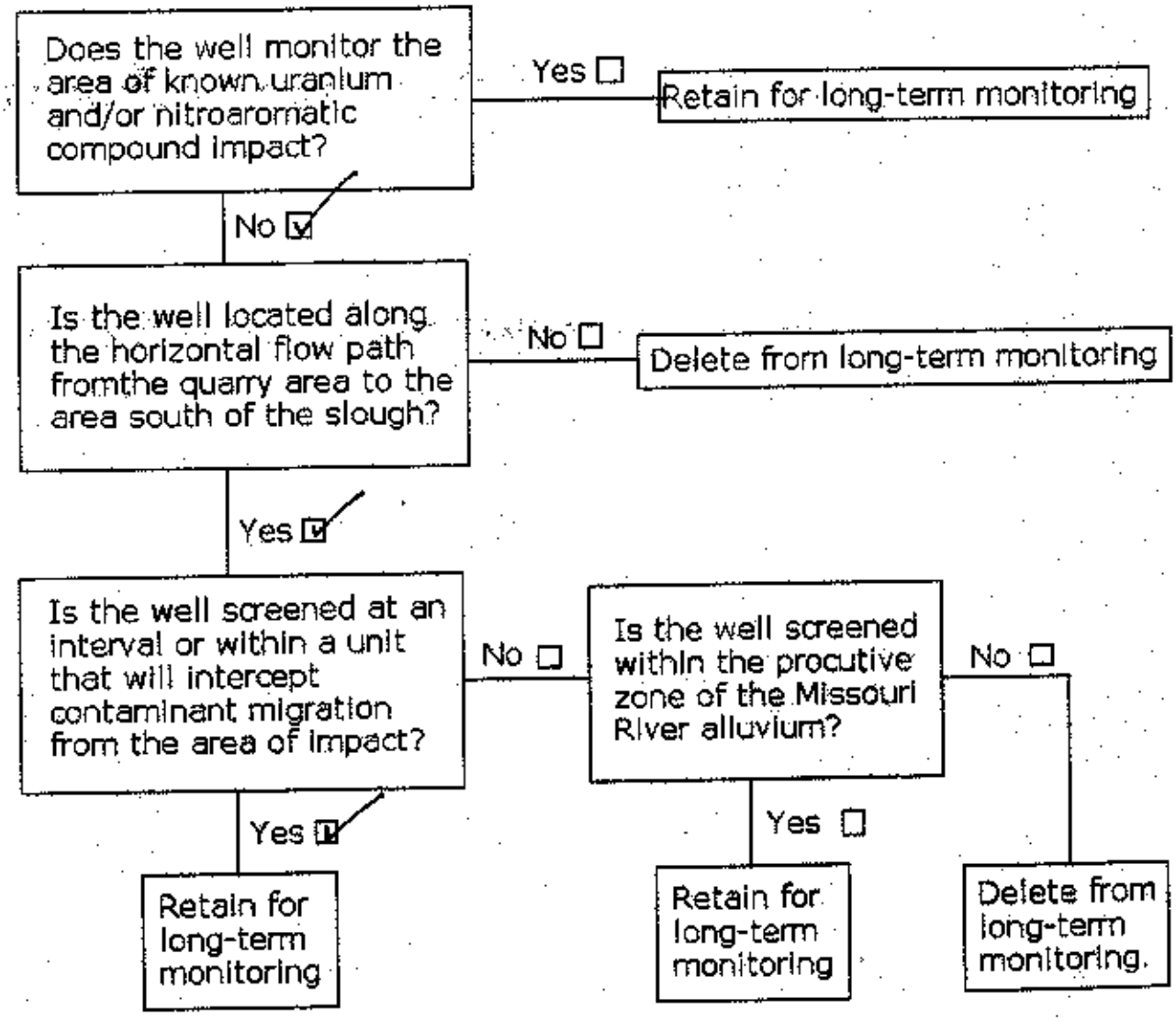
No ☐ →

Is the well screened within the procutive zone of the Missouri River alluvium?

Yes ☐ → Retain for long-term monitoring

No ☐ → Delete from long-term monitoring.

Well ID: MW-1017
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 24.0 - 55.6'
Contaminant Concentrations (98 ave.)
Uranium: 2.15 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1018
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 29.0 - 49.0'
Contaminant Concentrations (98 ave.)
Uranium: 4.00 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1019
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 25.0 - 68.0'
Contaminant Concentrations (98 ave.)
Uranium: 2.165 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1020
Location: South of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 16.0 - 37.7'
Contaminant Concentrations (98 ave.)
Uranium: 2.75 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well screened within the productive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Delete from long-term monitoring.

Well ID: MW-1021
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 57.5 – 78.8'
Contaminant Concentrations (98 ave.)
Uranium: 2.85 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1022
Location: South of Slough
Unit Monitored: F.G. Alluvium
Screened Interval: 14.0 - 42.5'
Contaminant Concentrations (98 ave.)
Uranium: 3.35 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1023
Location: South of slough
Unit Monitored: F.G. Alluvium
Screened Interval: 14.8-37.5'
Contaminant Concentrations (98 ave.)
Uranium: 6.2 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1024
Location: South of slough
Unit Monitored: F.G. / C.G. Alluvium
Screened Interval: 14.5 - 38.8'
Contaminant Concentrations (98 ave.)
Uranium: 0.8 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1026
Location: Northwest of quarry
Unit Monitored: Overburden/Platte
Screened Interval: 58.0 - 60.2'
Contaminant Concentrations (98 ave.)
Uranium: 0.35 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

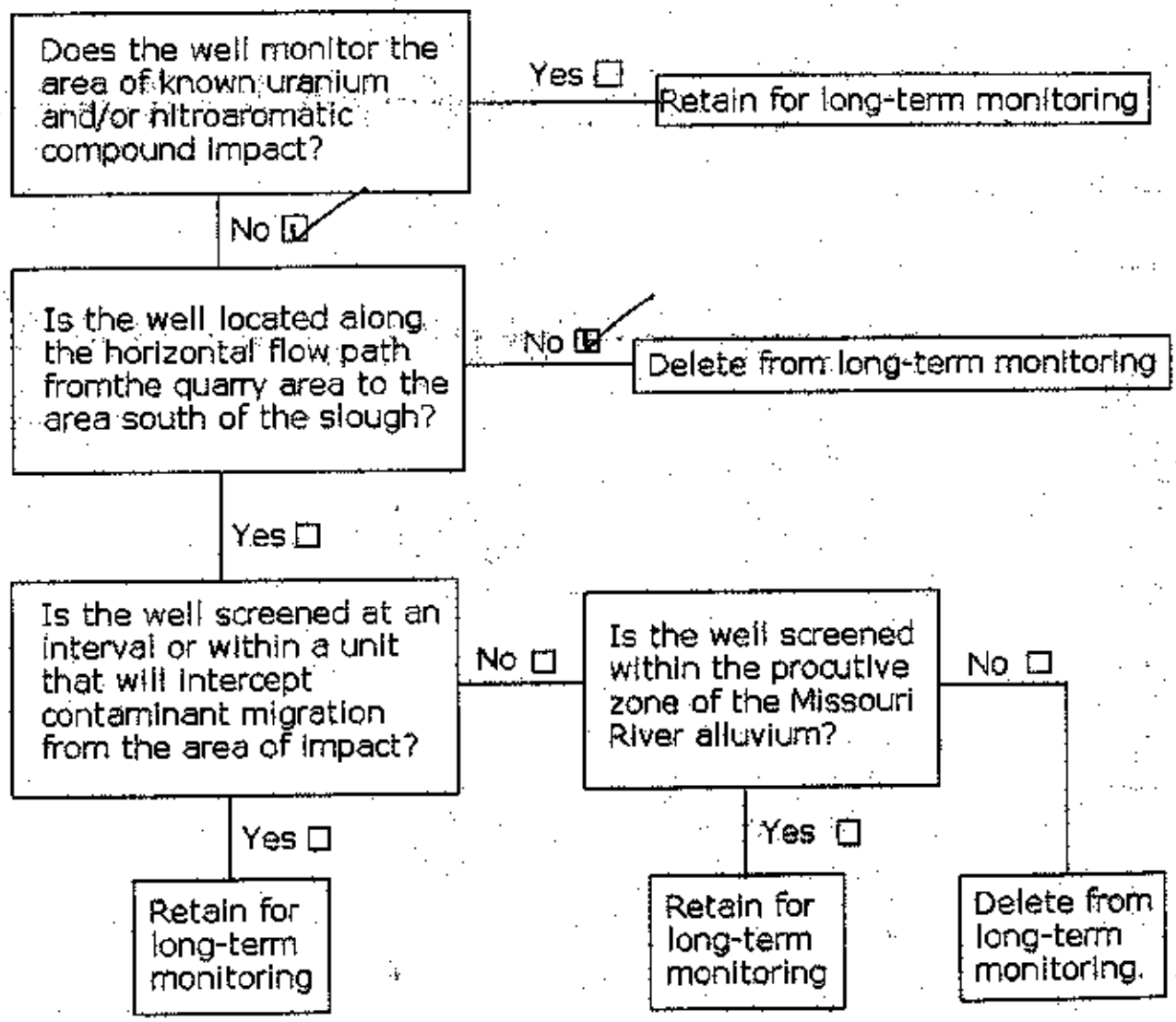
- Yes ☐ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1027
Location: West of quarry
Unit Monitored: Deccan
Screened Interval: ft. 22.3-45.2'
Contaminant Concentrations (98 ave.)
Uranium: 118 pCi/l
1,3,5-TNB: 0.03 µg/l
1,3-DNB: ND
2,4,6-TNT: 1.38 µg/l
2,4-DNT: 0.46 µg/l
2,6-DNT: 1.13 µg/l
Nitrobenzene: ND

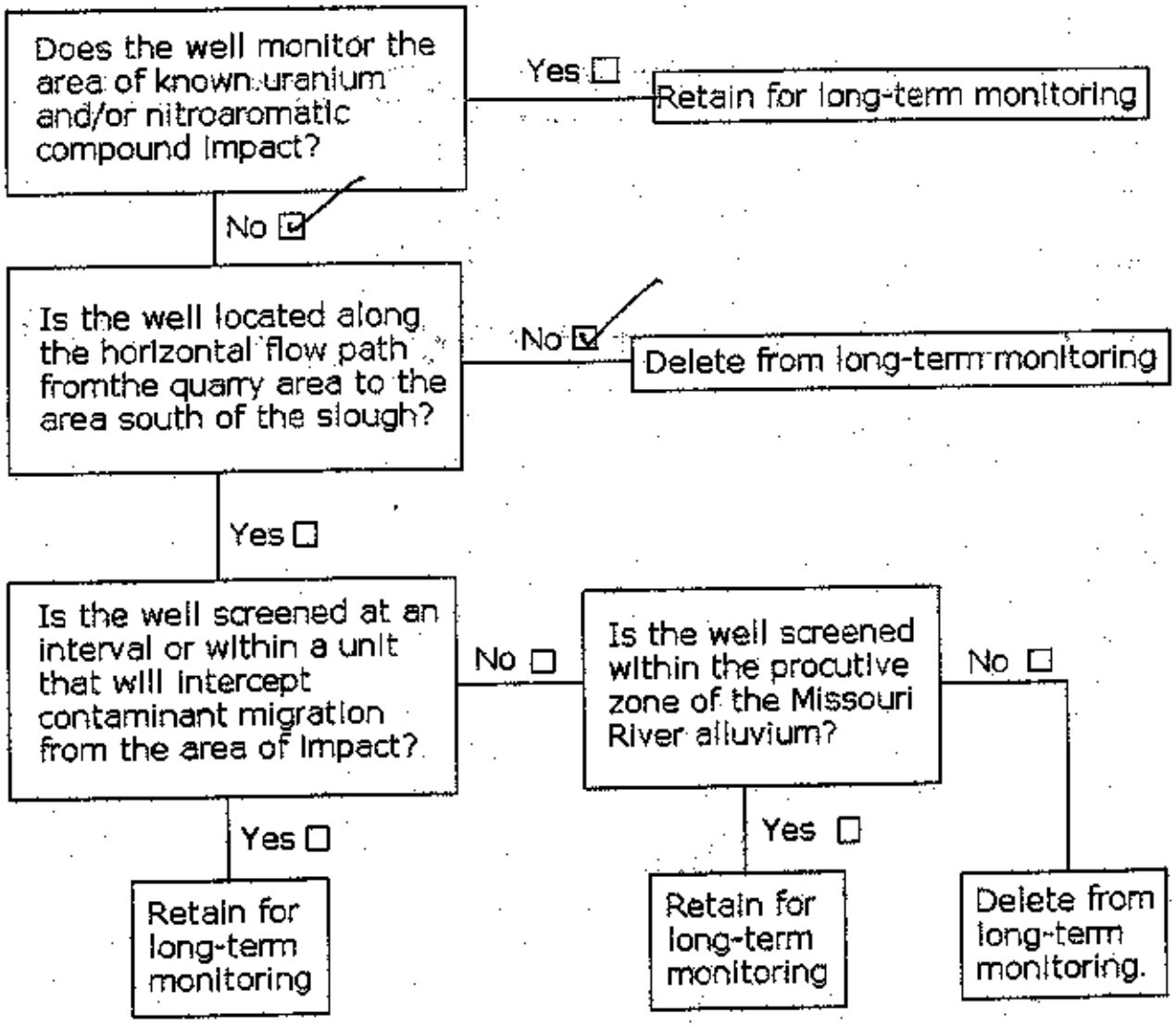
Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1028
Location: North of slough
Unit Monitored: Plattin
Screened Interval: 24.0-47.2'
Contaminant Concentrations (98 ave.)
Uranium: 4.1 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1029
Location: Quarry rim
Unit Monitored: Kimmswick/Decorah
Screened Interval: 95.0 - 111'
Contaminant Concentrations (98 ave.)
Uranium: 3.88 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW - 1030
Location: Quarry rim
Unit Monitored: Kimmswick/Decorah/Platteville
Screened Interval: 72.0 - 95.0'
Contaminant Concentrations (98 ave.)
Uranium: 28 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: 0.014 µg/l
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

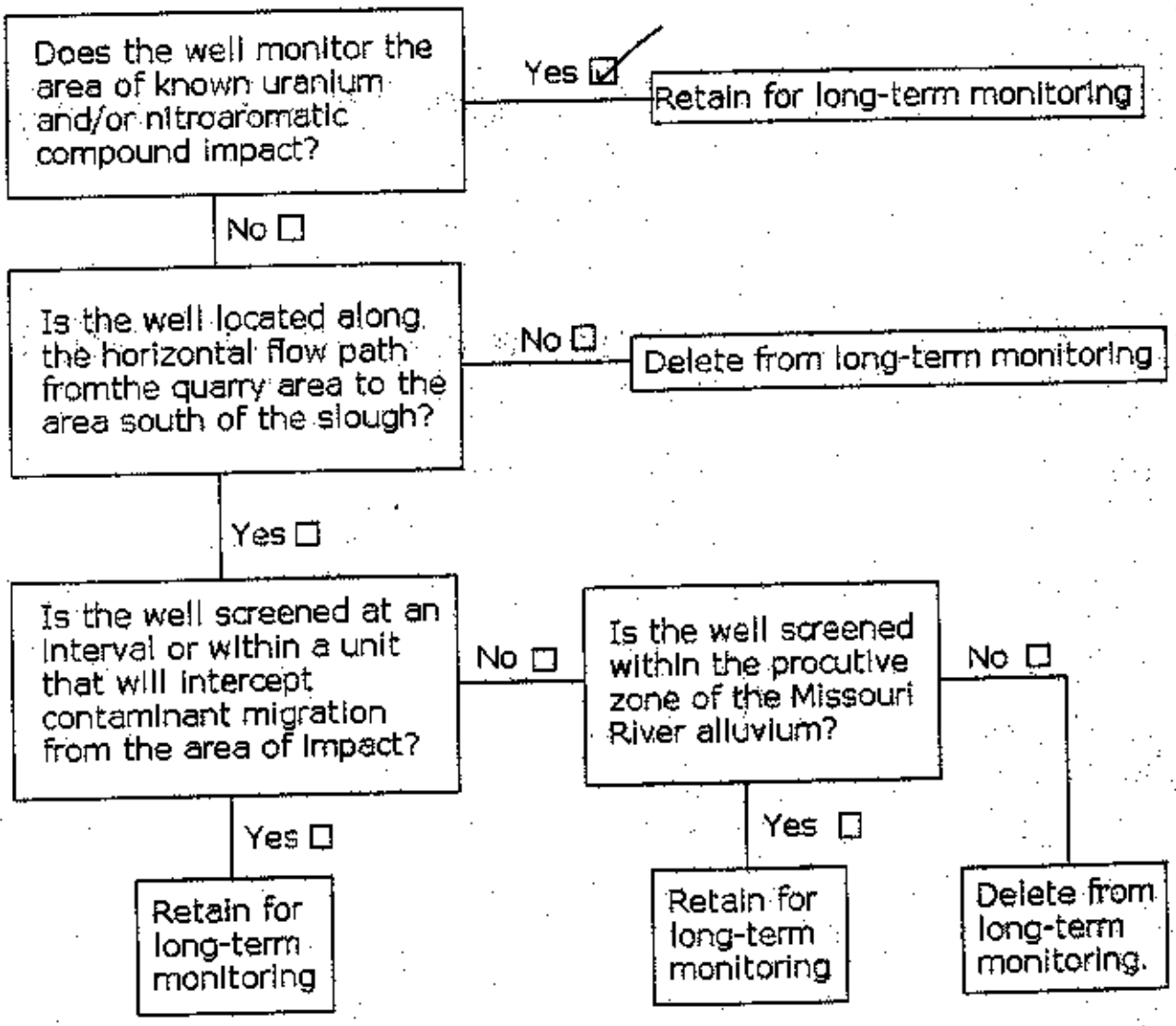
- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the productive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1031
Location: North of Slough
Unit Monitored: Plattin
Screened Interval: 39.5-53.5'
Contaminant Concentrations (98 ave.)
Uranium: 160 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1032
Location: North of slough
Unit Monitored: Decorah
Screened Interval: 17.0 - 30.0
Contaminant Concentrations (98 ave.)
Uranium: 1,100 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: 0.006 µg/l
Nitrobenzene: ND



Well ID: MW-1033
Location: South of slough
Unit Monitored: Platte
Screened Interval: 85.0 - 77.5'
Contaminant Concentrations (98 ave.)
Uranium: 3.95 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

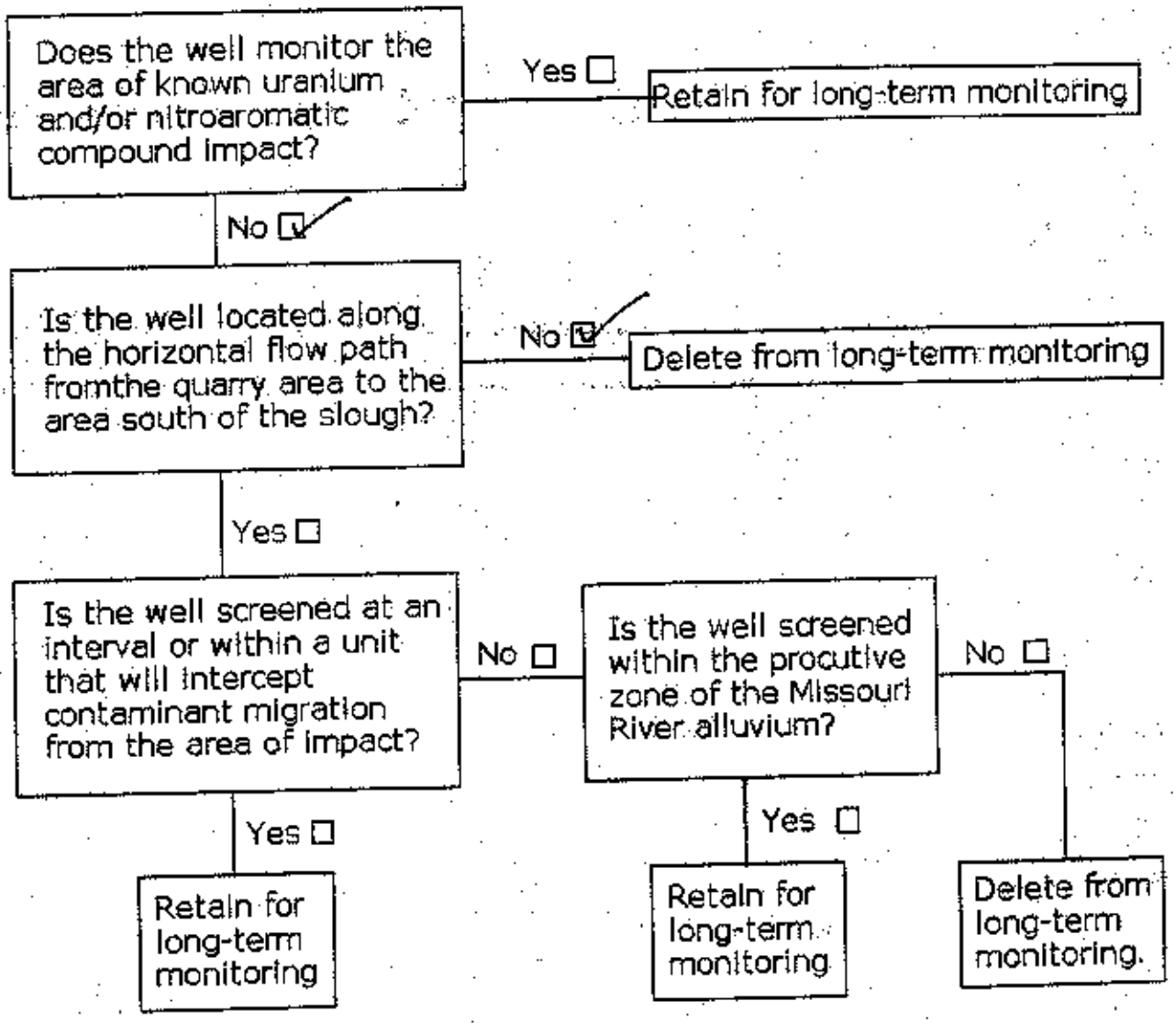
Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well screened within the procutive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Delete from long-term monitoring.

Well ID: MW-1034
Location: North of quarry
Unit Monitored: Kimmeswick
Screened Interval: 58.0-75.0'
Contaminant Concentrations (98 ave.)
Uranium: 1.53 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1035
Location: West of quarry (QWTP)
Unit Monitored: F.G. Alluvium
Screened Interval: 18.0 - 30.5'
Contaminant Concentrations (98 ave.)
Uranium: 0.44 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

Yes ☐ → Retain for long-term monitoring

No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

No ☑ → Delete from long-term monitoring

Yes ☐

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

Yes ☐ → Retain for long-term monitoring

No ☐

Is the well screened within the procutive zone of the Missouri River alluvium?

Yes ☐ → Retain for long-term monitoring

No ☐ → Delete from long-term monitoring.

Well ID: MW-1036
Location: West of quarry (QWTP)
Unit Monitored: F.G. & Alluvium
Screened Interval: 27.0 - 41.0'
Contaminant Concentrations (98 ave.)
Uranium: 9.55 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1037
Location: West of quarry (QWTP)
Unit Monitored: F.G. ALLUVIUM
Screened Interval: 27.0 - 41.0'
Contaminant Concentrations (98 ave.)
Uranium: 1.52 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

Yes ☐ → Retain for long-term monitoring

No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

No ☐ → Delete from long-term monitoring

Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

Yes ☐ → Retain for long-term monitoring

No ☑

Is the well screened within the procutive zone of the Missouri River alluvium?

Yes ☐ → Retain for long-term monitoring

No ☑ → Delete from long-term monitoring.

Well ID: MW-1038
Location: West of quarry (QWTP)
Unit Monitored: F.G. Alluvium
Screened Interval: 22.0 - 36.0'
Contaminant Concentrations (98 ave.)
Uranium: 3.36 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1039
Location: West of quarry
Unit Monitored: F.6 Alluvium
Screened Interval: 28.0 - 40.5'
Contaminant Concentrations (98 ave.)
Uranium: 0.37 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well screened within the procutive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Delete from long-term monitoring.

Well ID: MW-1040
Location: West of quarry (QNTP)
Unit Monitored: E.G. Alluvium
Screened Interval: 24.0 – 40.0'
Contaminant Concentrations (98 ave.)
Uranium: 7.98 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1041
Location: West of quarry (QWTP)
Unit Monitored: F.G. Alluvium
Screened Interval: ~~5.69~~ 24.0 - 40.0'
Contaminant Concentrations (98 ave.)
Uranium: 5.69 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well screened within the procutive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Delete from long-term monitoring.

Well ID: MW-1042
Location: North of quarry
Unit Monitored: PLATTIN LIMESTONE
Screened Interval: 80.0 - 94.0'
Contaminant Concentrations (98 ave.)
Uranium: 1.31 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1043
Location: North of quarry
Unit Monitored: Decorah Group
Screened Interval: 62.0 - 66.1'
Contaminant Concentrations (98 ave.)
Uranium: 1.04 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☑ → Delete from long-term monitoring
- Yes ☐

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☐

Is the well screened within the procutive zone of the Missouri River alluvium?

- Yes ☐ → Retain for long-term monitoring
- No ☐ → Delete from long-term monitoring.

Well ID: MW-1044
Location: South of slough
Unit Monitored: C.G. Alluvium
Screened Interval: 27.5-41.0'
Contaminant Concentrations (98 ave.)
Uranium: 3.65 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: MW-1045
Location: West of quarry
Unit Monitored: F.G. Alluvium
Screened Interval: 9.0 - 24.3'
Contaminant Concentrations (98 ave.)
Uranium: NOT ANALYZED
1,3,5-TNB: ND (1996 data)
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑

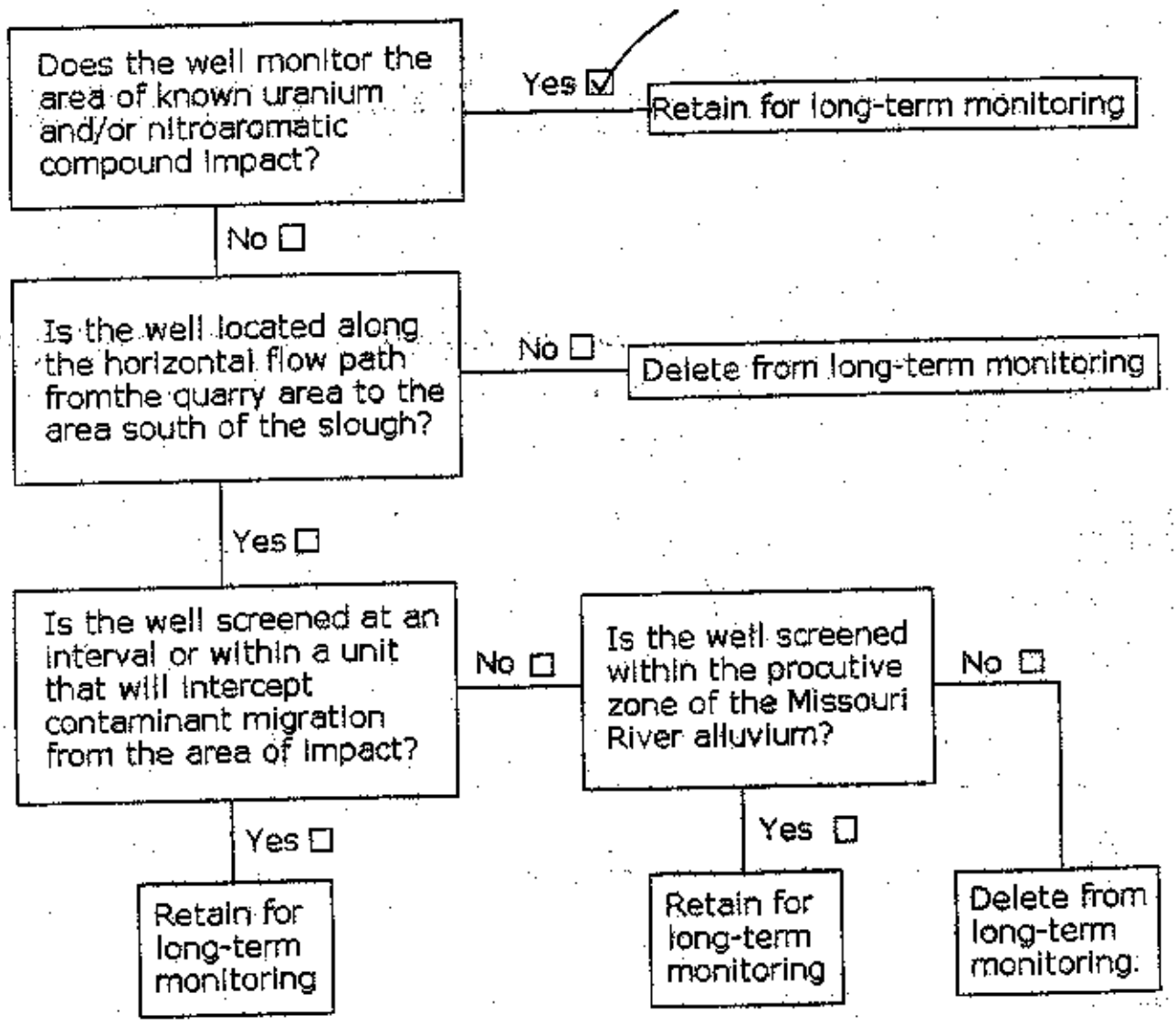
Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑

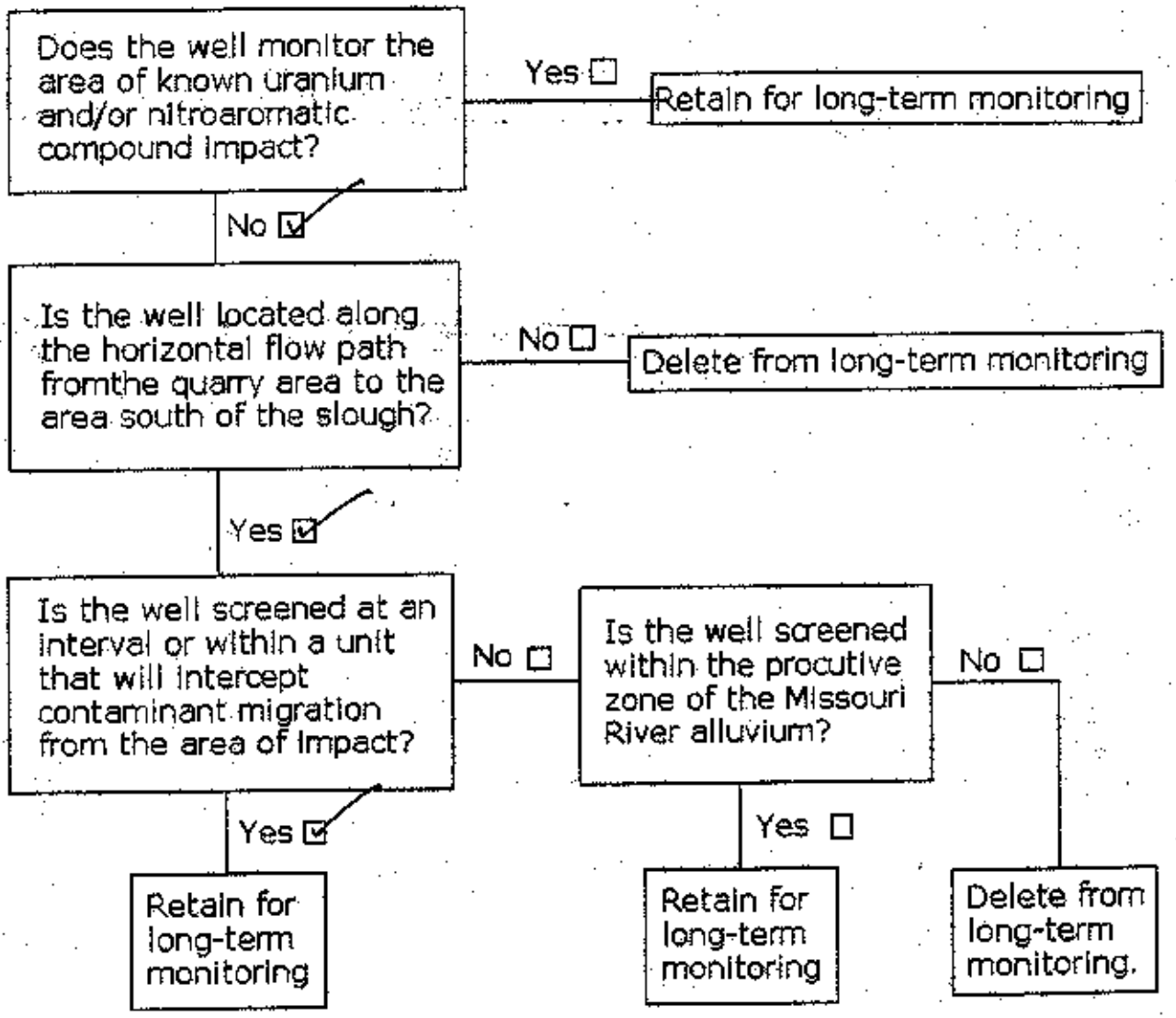
Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☑ → Delete from long-term monitoring.

Well ID: MW-1046
Location: North of slough
Unit Monitored: Platte
Screened Interval: 42.0 - 56.3'
Contaminant Concentrations (98 ave.)
Uranium: 10.35 pCi/l
1,3,5-TNB: ND (1996 data)
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1047
Location: North of slough
Unit Monitored: Platten
Screened Interval: 39.0-58.0'
Contaminant Concentrations (98 ave.)
Uranium: 3.7 pCi/l
1,3,5-TNB: ND (1996 data)
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: MW-1048
Location: North of slough
Unit Monitored: Platten
Screened Interval: 39.0 - 57.0'
Contaminant Concentrations (98 ave.)
Uranium: 613 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?
  - No ☐ → Delete from long-term monitoring
  - Yes ☐ → Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?
    - Yes ☐ → Retain for long-term monitoring
    - No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
      - Yes ☐ → Retain for long-term monitoring
      - No ☐ → Delete from long-term monitoring.

Well ID: MW-1049
Location: North of slough
Unit Monitored: F.G./C.G. Alluvium
Screened Interval: 24.0 - 38.0'
Contaminant Concentrations (98 ave.)
Uranium: 0.34 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

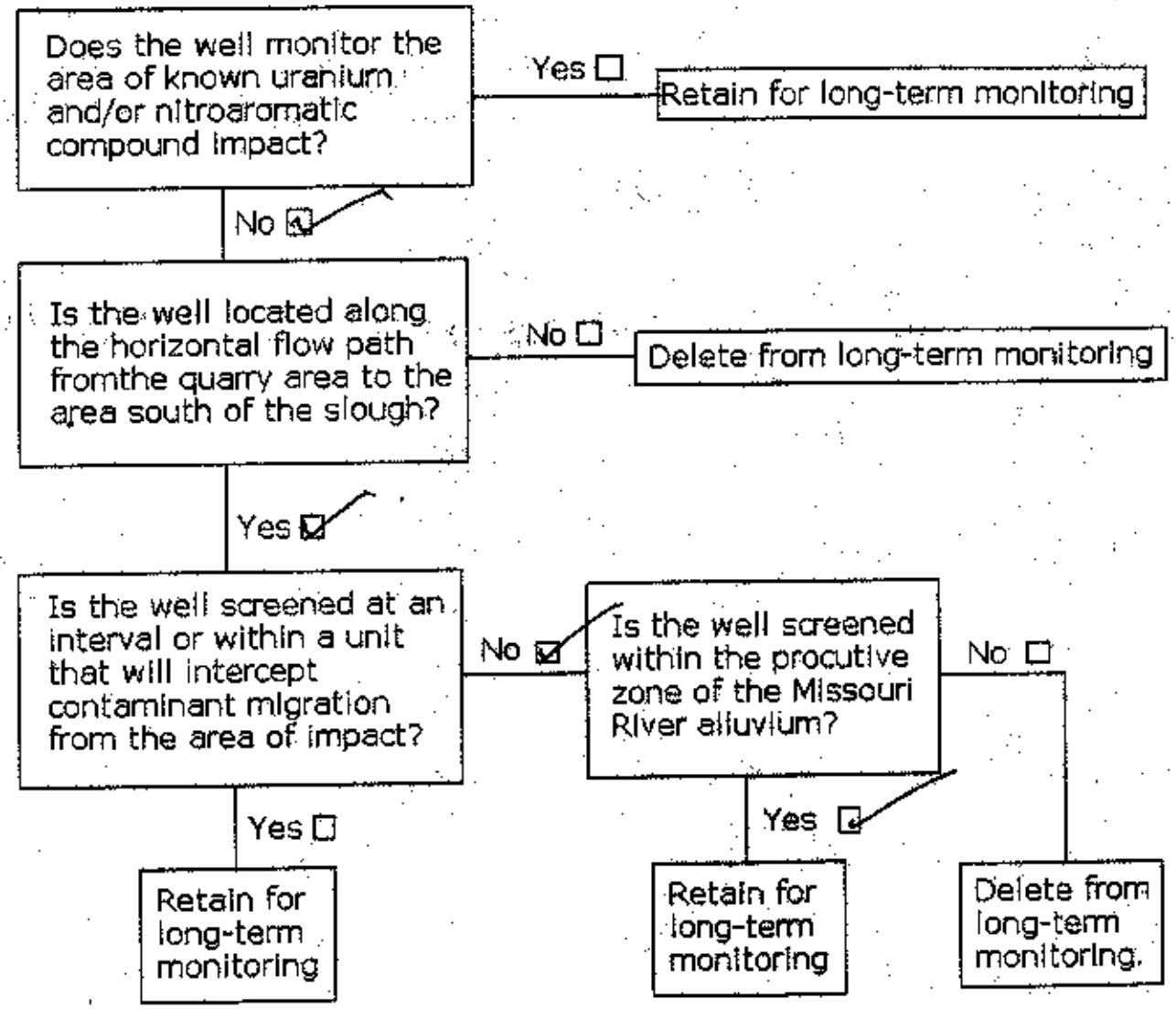
Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☑ → Retain for long-term monitoring
- No ☐ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☐ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: RMW-1
Location: St. Charles Co. Well Field
Unit Monitored: C.G. Alluvium
Screened Interval: 4.3 - 27.0'
Contaminant Concentrations (98 ave.)
Uranium: 0.76 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND



Well ID: RMW-2
Location: St. Charles Co. Weldon Field
Unit Monitored: C.G. Alluvium
Screened Interval: 17.3 - 19.5'
Contaminant Concentrations (98 ave.)
Uranium: 3.78 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☑ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: BMW-3
Location: St. Charles Co. Well Field
Unit Monitored: C.G. Alluvium
Screened Interval: 6.5 - 13.5'
Contaminant Concentrations (98 ave.)
Uranium: 0.75 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☑ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Well ID: BMW-4
Location: St. Charles Co. Well Field
Unit Monitored: S.G. Alluvium
Screened Interval: 18.0-19.0'
Contaminant Concentrations (98 ave.)
Uranium: 1.48 pCi/l
1,3,5-TNB: ND
1,3-DNB: ND
2,4,6-TNT: ND
2,4-DNT: ND
2,6-DNT: ND
Nitrobenzene: ND

Does the well monitor the area of known uranium and/or nitroaromatic compound impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ ↓

Is the well located along the horizontal flow path fromthe quarry area to the area south of the slough?

- No ☐ → Delete from long-term monitoring
- Yes ☑ ↓

Is the well screened at an interval or within a unit that will intercept contaminant migration from the area of impact?

- Yes ☐ → Retain for long-term monitoring
- No ☑ → Is the well screened within the procutive zone of the Missouri River alluvium?
  - Yes ☑ → Retain for long-term monitoring
  - No ☐ → Delete from long-term monitoring.

Printed in the United States of America. Available from the National Technical Information Service, NTIS, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

NTIS Price Codes - Printed Copy: A07
Microfiche: A01

85997

MK-Ferguson Company
Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **January 19, 2000** Transmittal No.: **CD-0202-00**

Title of Document: **Remedial Design/Remedial Action Work Plan For The Quarry Residuals Operable Unit**

Doc. Num.: **787** Rev. No.: **0** Date of Document: **January 2000**

Purpose of Transmittal: Request for Department of Energy acceptance of contract deliverable.

In compliance with the Project Management Contract, MK-Ferguson Company hereby delivers the attached document to the U.S. Department of Energy, Weldon Spring Site Office. The document has been reviewed and approved by Project Management Contractor management.

The document will be considered accepted unless we receive written notification to the contrary within 30 days of the date of this transmittal.

Number of copies transmitted: **15**

Douglas E. Steffen
Project Director

TMP: Form Contract Deliverable