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St. Charles, MO 63304

Document Number:

▸▸Document Type: TR-MKFW-DOEW

Originators DCN:

SUBJECT CLOSURE REPORT FOR THE POST-REMEDIATION SAMPLING PLAN OF THE SOUTHEAST DRAINAGE

▸▸AUTHOR STEFFEN, DOUGLAS E. ▸▸TO DOCUMENT CONTROL ▸▸DATE 7-12-99

▸▸SUBJECT CODE/WORK PACKAGE NUMBER 6-5160/WP-470 & WP-470A

REFERENCED DOCUMENT(S)

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Weldon Spring Site Remedial Action Project

TRANSMITTAL OF CONTRACT DELIVERABLE

Date: **July 8, 1999** Transmittal No.: **CD-0210-00**

Title of Document: **Closure Report For The Post-Remediation Sampling Plan Of The Southeast Drainage**

Doc. Num.: 794 Rev. No.: **0** Date of Document: **July 1999**

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.

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Douglas E. Steffen
Project Director

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DOE/OR/21548-794
CONTRACT NO. DE-AC05-86OR21548

CLOSURE REPORT FOR THE POST-REMEDIAL SAMPLING PLAN OF THE SOUTHEAST DRAINAGE

WELDON SPRING SITE REMEDIAL ACTION PROJECT
WELDON SPRING, MISSOURI

JULY 1999 **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

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: A03
Microfiche: A01

062499

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MK-FERGUSON GROUP

Weldon Spring Site Remedial Action Project
Contract No. DE-AC05-86OR21548

Rev. No. 0

PLAN TITLE: Closure Report for the Post-Remediation Sampling of the Southeast Drainage

APPROVALS

QY-VP Project Manager	1 July 99 Date
Compliance Manager	7-1-99 Date
Data Administration Coordinator	7/2/99 Date
Engineering Manager	7-6-99 Date
Project Quality Manager	7/6/99 Date
Deputy Project Director	7-7-99 Date

DOE/OR/21548-794

Weldon Spring Site Remedial Action Project

Closure Report for the Post-Remediation Sampling Plan of the Southeast Drainage

Revision 0

July 1999

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

ABSTRACT

The *Closure Report for the Post-Remediation Sampling Plan for the Southeast Drainage* details the soil sampling activities performed in the drainage from January 26, 1998, to April 29, 1998. The sampling was coordinated with the remediation activities of Work Packages 470 and 470A. This report summarizes samples collected and analyzed, field instrumentation required, quality control results, and notes deviations or modifications from the original sampling plan. The data results from this sampling activity were used to calculate the public health risk reduction (residual risk) that was achieved by the remedial action in the Southeast Drainage.

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1. INTRODUCTION

1.1 Purpose

The purpose of this report is to summarize the sampling activities conducted under the *Post-Remediation Sampling Plan for the Southeast Drainage* (Ref. 1), in accordance with the *Sampling Management Guide* (Ref. 2).

1.2 Scope

This report documents the soil sampling activities performed in the drainage from January 26, 1998 to April 29, 1998, and summarizes samples collected and analyzed, field instrumentation required, quality control results, and notes deviations or modifications from the original sampling plan.

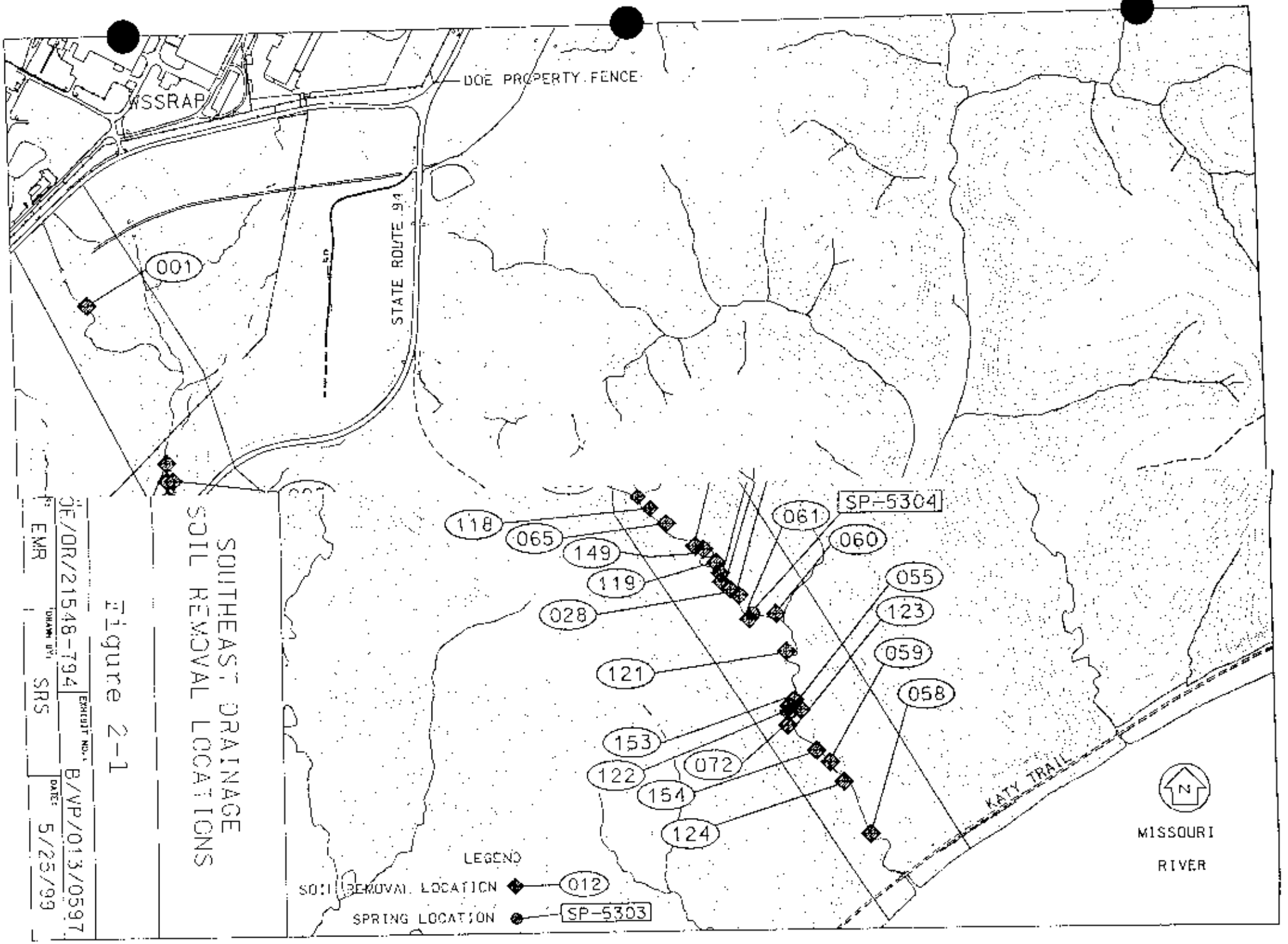
1.3 Background

The Department of Energy (DOE) decided to address remedial actions for the Southeast Drainage as a separate action under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA). An *Engineering Evaluation/Cost Analysis* (EE/CA) was prepared to evaluate the human and ecological health risks and to present cleanup alternatives for contaminated soils within the Southeast Drainage (Ref. 3). The risk analysis presented in the EE/CA indicated that sediment and surface water contamination in the Southeast Drainage did not pose an unacceptable risk to human health and the environment. The calculated risk fell within the EPA's acceptable risk range of 10^{-4} to 10^{-6}. The risk calculated was almost exclusively from radioactive contamination, primarily Ra-226 in sediments within specific areas of the drainage. The heterogeneous distribution of radioactive contamination in the drainage indicated that selective removal of contaminated areas would further reduce the risk to a potential receptor (Ref. 3). The proposed action for the Southeast Drainage was to remove select contaminated sediments above the 1×10^{-5} risk level in accessible areas of the drainage. This action would be protective to human health and the environment while minimizing the environmental impact to the area. Additional locations were also selected for removal based upon their proximity to the locations exceeding the 1×10^{-5} risk level. In total, 55 locations within the drainage were designated for soil removal. The removal action was completed under Work Packages 470 and 470A (WP-470A).

2. SAMPLE LOCATIONS

Of the 55 locations targeted for soil removal activities (Figure 2-1), 68 soil samples were taken. Specific sampling locations for post-remediation sampling were selected by randomly placing a 10 m x 10 m grid over the remediation location. Samples were collected at each grid node or center location within the 10 m x 10 m grid, ensuring at least one sample was collected at each remediation location. The topographical coordinates and sampling identification numbers of each remediation location were determined prior to the commencement of any remedial activities.

After completion of excavation by the WP-470A subcontractor, a surveyor provided by the WP-470A subcontractor surveyed coordinates of the pre-determined sample locations. The subtiered surveyor did not provide surface elevation coordinates to the PMC. Once the sample locations were established, soil samples were collected by the PMC at each location with offsets greater than 5 ft being noted. Two offset sample locations were noted. The original sample locations and sample location offsets are summarized in Table 3-1.



SOUTHEAST DRAINAGE
SOIL REMOVAL LOCATIONS

Figure 2-1

DE/OR/21548-794 | EXHIBIT NO.: B/VP/013/0597
BY: EMR | DRAWN BY: SRS | DATE: 5/25/99

3. SAMPLE COLLECTION AND ANALYSIS

Post-remediation sampling of the Southeast Drainage began on January 26, 1998, and was completed by April 29, 1998. Using a hand trowel, samples were collected at each location from the remediation cut surface to a depth of 6 in. The samples were containerized in 1 gal plastic bags and transported to the Weldon Spring Radiological Laboratory via the designated haul route for the Southeast Drainage. Radiological contaminants analyzed consisted of Ra-226, Ra-228, Th-230, and U-238. Analysis was performed under Chain-of-Custody Requests 3589-WSSRAP-RAD 343, 396, 411, 412, 413, 416, 419, and 439.

The analytical data from the post-remediation sampling were compared to the 1×10^{-5} risk level concentrations established by the U.S. Department of Energy (DOE). The following parameter concentrations contributed to the Engineering Evaluation/Cost Analysis (EE/CA) 1×10^{-5} risk level. 13 pCi/g for Ra-226, 13 pCi/g for Ra-228, 350 pCi/g for Th-230, and 290 pCi/g for U-238. After an individual comparison between post-remediation sample results and EE/CA concentrations was done, all sample results were combined to calculate a new risk value achieved from the soil removal (Appendix A). Sample locations, sample identification numbers, analytical data, and sample location coordinate locations are summarized in Table 3-1 and given in full detail within Appendix B.

Table 3-1 Southeast Drainage Post-Remediation Sample Summary

Location ID	Post-Remediation Sample ID #	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)	U-238 (pCi/g)	Northing	Easting	Surface Elevation
001	SO-495001-01	12.3	1.66	4.72	37.8	1041167.2	754800.0	No Data
005	SO-498005-A-01	4.73	2.86	22.9	10.9	1040401.6	755141.8	No Data
012	SO-498012-01	1.68	1.07	2.19	< 4.32	1038618.2	756386.3	No Data
025A	SO-498025-A-01	**24.9**	1.33	29.1	142.0	1038124.8	756434.7	No Data
025B	SO-498025-B-01	3.55	1.25	5.64	5.48	1038092.0	756434.7	No Data
027	SO-498027-01	**23.0**	6.58	14.6	26.7	1036597.7	757268.4	No Data
028	SO-498028-01	11.3	< 1.29	3.20	3.69	1035623.6	757399.1	471.5
055	SO-498055-01	4.30	0.99	5.63	8.82	1035101.0	757647.7	No Data
058	SO-498058-01	4.99	1.21	2.91	4.96	1034586.7	757958.5	No Data
059	SO-498059-01	4.86	< 1.40	46.5	10.4	1034891.8	757800.6	No Data
060A	SO-498060-A-01	2.18	< 0.81	3.02	7.54	1035518.6	757578.3	No Data
060B	SO-498060-B-01	**239.0**	**17.4**	**5090.0**	150.0	1035518.6	757545.5	No Data
061	SO-498061-01	**26.9**	0.99	17.6	70.2	1035495.7	757482.7	No Data
062	SO-498062-01	1.25	1.06	1.26	< 2.33	1035596.8	757437.0	472.0
063	SO-498063-01	10.8	< 1.46	3.16	6.05	1035654.6	757366.3	471.9
064A	SO-498064-A-01	2.14	1.44	3.96	7.48	1035786.2	757267.9	No Data
064B	SO-498064-B-01	3.58	1.10	5.43	12.8	1035819.0	757235.1	No Data
065A	SO-498065-A-01	3.64	1.25	8.04	16.9	1035950.2	757141.1	No Data
065B	SO-498065-B-01	**19.8**	4.18	49.2	58.9	1035917.4	757141.4	No Data
066	SO-498066-01	10.1	1.54	70.4	19.7	1036023.6	757027.0	No Data
067	SO-498067-01	1.50	1.23	1.34	< 3.94	1036380.8	757133.6	No Data
068	SO-498068-01	1.54	1.23	1.39	2.08	1036403.9	757174.1	487.9
072A	SO-498072-A-01	11.1	1.79	16.3	19.0	1035101.0	757679.9	No Data

Table 3-1 Southeast Drainage Post-Remediation Sample Summary (Continued)

Location ID	Post-Remediation Sample ID #	Ra-226 (pCi/g)	Ra-228 (pCi/g)	Th-230 (pCi/g)	U-238 (pCi/g)	Northing	Easting	Surface Elevation
072B	SO-498072-B-01	11.6	1.85	16.8	16.8	1035133.8	757679.9	No Data
092	SO-498092-01	5.43	1.53	38.4	50.0	1040467.2	755141.8	No Data
093	SO-498093-01	1.95	1.24	0.76	76.3	1040434.4	755141.8	No Data
094	SO-498094-01	3.80	1.20	8.89	17.4	1040348.3	755118.8	No Data
098A	SO-498098-A-01	2.44	1.13	5.38	2.65	1039145.6	756345.9	No Data
098B	SO-498098-B-01	2.51	1.07	2.10	2.48	1039112.7	756378.7	No Data
099	SO-498099-01	7.51	1.22	2.53	2.99	1038993.9	**756400.7**	No Data
101	SO-498101-01	**89.2**	6.78	**1920**	18.9	1038928.0	756335.1	No Data
102	SO-498102-01	2.76	1.26	6.36	9.93	1038660.6	756379.7	No Data
102.1	SO-498102.1-01	1.40	1.40	1.59	< 3.65	1038213.1	756243.3	No Data
103	SO-498103-01	1.33	0.77	1.51	< 2.72	1038157.6	756270.6	No Data
104A	SO-498104-A-01	2.17	0.93	1.45	6.72	1038124.8	756336.3	No Data
104B	SO-498104-B-01	6.05	1.18	17.1	15.4	1038124.8	756369.7	No Data
105	SO-498105-01	**16.2**	0.82	3.57	29.3	1038092.0	756369.4	No Data
106	SO-498106-01	1.26	1.29	1.33	< 2.91	1038124.8	756401.9	No Data
107	SO-498107-01	**33.9**	1.83	44.5	40.1	1037435.4	756567.1	No Data
108	SO-498108-01	5.29	1.06	4.74	10.7	1037324.4	756684.2	No Data
108.1	SO-498108.1-01	7.05	0.98	3.33	9.64	1037042.7	757000.2	No Data
110	SO-498110-01	4.26	1.15	2.86	24.0	1036977.1	757065.6	No Data
110.1	SO-498110.1-01	1.82	< 1.19	2.07	5.55	1036889.9	757154.9	No Data
111A	SO-498111-A-01	7.43	0.92	42.1	29.4	1036837.1	757154.9	No Data
111B	SO-498111-B-01	1.74	1.46	1.35	< 4.13	1036804.2	757154.9	No Data
112	SO-498112-01	11.2	< 0.95	10.3	9.13	1036856.4	757197.5	No Data
113	SO-498113-01	**36.2**	0.96	11.4	11.4	1036806.5	757219.9	No Data
114A	SO-498114-A-01	1.36	< 0.71	1.40	10.4	1036794.5	757268.4	No Data
114B	SO-498114-B-01	2.99	0.86	2.33	6.31	1036827.3	757268.4	No Data
114C	SO-498114-C-01	3.76	1.23	2.38	12.1	1036794.6	757301.0	No Data
115	SO-498115-01	4.64	0.93	7.28	7.26	1036728.9	757301.2	No Data
116	SO-498116-01	2.15	1.35	1.78	5.29	1036663.3	757301.2	No Data
117A	SO-498117-A-01	**17.8**	1.57	23.0	18.9	1036028.0	757133.8	No Data
117B	SO-498117-B-01	1.04	< 0.74	1.04	1.19	1036295.1	757133.8	No Data
118	SO-498118-01	17.1	6.66	60.0	69.5	1035972.3	757080.3	No Data
119	SO-498119-01	1.52	0.99	0.69	10.6	1035753.4	757333.5	No Data
120	SO-498120-01	8.78	0.62	2.57	< 5.67	1035687.9	757365.8	471.8
121	SO-498121-01	**14.8**	1.06	7.60	10.6	1035358.9	757626.0	466.6
122	SO-498122-01	1.66	1.40	1.10	2.66	1035133.8	757614.3	No Data
123	SO-498123-01	5.04	1.11	7.10	3.81	1035046.8	757627.0	No Data
124	SO-498124-01	8.70	1.56	12.4	9.38	1034803.4	757861.2	No Data
132	SO-498132-01	**65.3**	< 2.57	124.0	14.7	1038961.1	756335.1	No Data
141	SO-498141-01	2.14	0.92	4.89	2.91	1038993.9	756367.9	No Data
149	SO-498149-01	10.4	1.39	18.2	34.2	1035794.9	757292.9	No Data
153	SO-498153-01	7.27	1.23	3.47	6.41	1035133.8	757647.1	No Data
154	SO-498154-01	5.08	1.70	8.58	8.33	1034941.7	757743.6	No Data

Bolded entries either exceed the EE/CA 1×10^{-5} risk level or are an offset sample location greater than 5 ft.

4. QUALITY ASSURANCE

Data evaluation was performed on the analytical data generated from the post-remediation sampling of the Southeast Drainage to determine whether Weldon Spring Site Remedial Action Project (WSSRAP) data quality objectives were met and to ensure overall data quality results were generated. Data evaluation was performed in accordance with the *Project Management Contractor Quality Assurance Program* (QAP) (Ref 4) and the *Environmental Quality Assurance Project Plan* (Ref. 5). The data evaluation process was completed by data verification, data review, data validation and data management activities.

4.1 Data Verification

Data verification was conducted in accordance with procedure ES&H 4.9.1, *Environmental Monitoring Data Verification*, to ensure that documentation and data were reported in compliance with established reporting requirements and standard operating procedures (SOPs), and to ensure that all analyses were performed. Analytical results received from the laboratory were reviewed to verify samples were properly handled according to WSSRAP protocol. The following factors were reviewed and evaluated: sample identification, chain-of-custody, holding times, sample preservation requirements, sample analysis request forms, data reviews, laboratory tracking, data reporting requirements, and the database transfer.

4.2 Data Review

Data packages were reviewed to ensure the final data were properly identified, analyzed, reported, and met data quality requirements (DQRs). The data were also reviewed to check for inconsistencies with the field quality control samples. Final analytical results were compared to the preliminary analytical results to identify any changes in data.

The sampling plan for the Southeast Drainage post-remediation samples indicated that quality control samples (matrix duplicates and equipment blanks) would be taken at a frequency of 1 per 20 samples or 5%. Three quality control samples were collected during the sampling activities within the Southeast Drainage. The quality control samples included a matrix duplicate and field replicates only. No matrix spike or matrix spike duplicates were specified in the sampling plan for this activity.

4.2.1 Matrix Duplicates/Secondary Duplicates/Field Replicates

Matrix duplicate samples (DU) are aliquots taken from the parent sample at the laboratory. Field replicates (FR) and secondary duplicates (SD) are split in the field from the parent sample and placed in a separate container. The field replicate is sent to the same laboratory as the parent, while the secondary duplicate is sent to a different laboratory. The FR,

SD, and DU results are compared to the parent sample and the relative percent difference (RPD) is calculated for each. The recommended RPD for radiological and chemical parameters is less than, or equal to, 50% and 35% respectively. RPDs are not calculated when one or both of the results are not detected by the laboratory (non detects). Also, if one or both of the results are less than five times the detection limit; the RPD value is considered of limited value due to higher tolerance limits near the analytical detection limit and, therefore, no further analysis is required. In those cases where the RPDs are greater than the recommended limit, the data are further evaluated.

One matrix duplicate and two field replicates were taken during the post-remediation sampling of the Southeast Drainage. RPDs for the matrix duplicate (DU) were within recommended limits. Calculated RPDs exceeded the recommended limits, however, for the parameters Ra-226, Ra-228, and U-238 in sample SO-498066-01-FR and Ra-226, Th-230, and U-238 in sample SO-498105-01-FD. U-238 concentrations were less than five times the detection levels; hence, no further analysis was performed. RPDs for the other parameters of the two samples were probably a result of sample non-homogeneity. The RPDs for the three quality control samples ranged between 1.47% - 138.5% and are detailed in Appendix C.

4.2.2 Equipment Blanks

Equipment blanks (EB) are used to evaluate potential cross contamination from the field sampling equipment. The post-remediation sampling at the Southeast Drainage deviated from the sampling plan in that no equipment blanks were sent off-site for analysis. Re-usable sampling equipment (hand trowels) was used during the sampling activity. Although the sampling equipment was decontaminated between sampling locations, the potential for cross contamination was not evaluated through the collection and analyses of equipment blanks.

4.3 Data Validation

Data validation is performed on 10% of the environmental analytical data generated from all WSSRAP sampling activities and is conducted in accordance with ES&H 4.9.2, *Environmental Monitoring Data Validation*. None of the laboratory data packages associated with the post-remediation sampling of the Southeast Drainage were chosen for data validation.

5. REFERENCES

1. MK-Ferguson Company and Jacobs Engineering Group. *Post-Remediation Sampling Plan for the Southeast Drainage*. Rev. 0. DOE/OR/21548-616. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. July 1997.

2. MK-Ferguson Company and Jacobs Engineering Group. *Sample Management Guide*. Rev. 1. DOE/OR/21548-499. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St Charles, MO. August 1997.

3. Argonne National Laboratory. *Engineering Evaluation/Cost Analysis for the Proposed Removal Action at the Southeast Drainage Near the Weldon Spring Site, Weldon Spring, Missouri*. DOE/OR/21548-584 Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1995.

4. MK-Ferguson Company and Jacobs Engineering Group. *Project Management Contractor Quality Assurance Program*. Rev. 4. DOE/OR/21548-333. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. April 1999.

5. MK-Ferguson Company and Jacobs Engineering Group. *Environmental Quality Assurance Project Plan*. Rev. 3. DOE/OR/21548-352. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. October 1998.

PROCEDURES

ES&H 4.9.1, *Environmental Monitoring Data Verification*
ES&H 4.9.2, *Environmental Monitoring Data Validation*

APPENDIX A
Southeast Drainage Post-Cleanup Evaluation

Department of Energy
Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
7295 Highway 94 South
St. Charles, Missouri 63304

October 5, 1998

Mr. Douglas E. Steffen
Project Director
MK-Ferguson Company
7295 Highway 94 South
St. Charles, MO 63304

Dear Mr. Steffen:

POST-CLEANUP EVALUATION FOR THE SOUTHEAST DRAINAGE

Enclosed find the subject evaluation performed by Argonne National Lab for the purpose of determining the amount of risk reduction achieved by the removal action. The results of the post-cleanup assessment indicate that risk reduction was achieved in each segment of the drainage. At locations where sediment was removed, levels remaining after cleanup are near or below the 1×10^{-5} risk level for the hypothetical child scenario.

Per our discussions, two areas (locations 60 and 101) have been identified for follow-up investigation and evaluation for a possible additional limited removal effort. Please work closely with Tom Pauling.

Sincerely,

Stephen H. McCracken
Project Manager
Weldon Spring Site
Remedial Action Project

Enclosure:
As stated.

cc w/enclosure:
Gene Valett, PMC
Rebecca Cato, PMC
Mary Picel, ANL

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August 7, 1998

Mr. Tom Pauling
U.S. Department of Energy
Weldon Spring Remedial Action Project
7295 Highway 94 S.
St. Charles, MO 63304

Dear Mr. Pauling:

As requested, we have performed a post-cleanup evaluation of human health risks in the Southeast Drainage using the post-remediation data. The purpose of the evaluation is to determine the amount of risk reduction achieved by the removal action. The removal action targeted contaminated sediment in accessible areas of the drainage, removing as much contaminated sediment as possible without causing extensive ecological drainage. Thirty-eight locations were targeted for removal in the *Engineering Evaluation/Cost Analysis* prepared for the drainage. An additional seventeen locations in the lower reaches of the drainage were determined to be accessible during the field planning stage and were also remediated.

The results of the post-cleanup assessment (as detailed in the Attachment) indicate that risk reduction was achieved in each segment of the drainage. At locations where sediment was removed, levels remaining after cleanup are near or below the 1×10^{-5} risk level for the hypothetical child scenario.

If you have any questions or comments, please do not hesitate to call.

Sincerely,

Mary Picel
Argonne National Laboratory

Enclosure (1)

022552
AUG 10 1998

ATTACHMENT: POST-CLEANUP RISK ASSESSMENT FOR THE SOUTHEAST DRAINAGE

This attachment presents the results of the post-cleanup risk assessment performed for the Southeast drainage. The purpose of the assessment was to determine the amount of risk reduction achieved by the removal action.

Risk calculations were performed using the same methodology as used in the EE/CA (DOE 1996). Risks were estimated for the current hunter and future child scenarios. The exposure routes evaluated include incidental ingestion of sediment and external irradiation. Risk reduction achieved at specific locations is presented in Table 1. Risk estimates for the child scenario for all locations targeted in the EE/CA are shown. Seventeen additional locations were also cleaned up in the lower portion of Segment C and upper portion of Segment D because these locations were determined to be accessible during the planning stages of the removal action. These additional locations are indicated with an asterisk (*). Exposure point concentrations used to calculate potential post-cleanup risks were those obtained after removal was completed. Post-cleanup concentrations for each radionuclide at the various locations are shown in Table 1. At locations where more than one sample was taken, the data for each radionuclide were averaged.

Table 1. Location Specific Risk Estimates for the Child Scenario

	Exposure Point Concentration (pCi/g)				Cumulative Risk	
Location ID	Ra-226	Ra-228	Th-230	U-238	Baseline[a]	Post-Cleanup
001	12	1.7	4.7	38	9×10^{-5}	1×10^{-5}
005	4.7	2.9	23	11	2×10^{-4}	7×10^{-6}
012	1.7	1.1	2.2	ND	4×10^{-5}	2×10^{-6}
025	15	1.3	21	74	3×10^{-4}	3×10^{-5}
027*	23	6.6	15	27	2×10^{-5}	2×10^{-5}
028	11	ND	3.2	3.7	3×10^{-5}	1×10^{-5}
055	4.3	0.99	5.6	8.8	2×10^{-5}	5×10^{-6}
058	5	1.2	2.9	5.0	5×10^{-5}	5×10^{-6}
059	4.9	ND	46	10	5×10^{-5}	6×10^{-6}
060	120	17	2,500	79	5×10^{-5}	2×10^{-4}
061	27	0.99	18	70	8×10^{-5}	3×10^{-5}
062	1.3	1.1	1.3	ND	1×10^{-5}	2×10^{-6}
063	11	ND	3.2	6.1	5×10^{-5}	1×10^{-5}
064	2.9	1.3	4.7	10	2×10^{-5}	4×10^{-6}
065	12	2.6	29	30	6×10^{-5}	2×10^{-5}
066*	10	1.5	70	16	5×10^{-5}	1×10^{-5}
067*	1.5	1.2	1.3	ND	3×10^{-5}	2×10^{-6}
068*	1.5	1.2	1.3	2.1	9×10^{-5}	2×10^{-6}
072	11	1.8	16	18	1×10^{-5}	1×10^{-5}
092	5.4	1.5	38	80	2×10^{-5}	9×10^{-6}

	Exposure Point Concentration (pCi/g)				Cumulative Risk	
Location ID	Ra-226	Ra-228	Th-230	U-238	Baseline[a]	Post-Cleanup
093	1.9	1.2	0.76	76	2×10^{-5}	5×10^{-6}
094	3.8	1.2	8.9	17	1×10^{-5}	5×10^{-6}
098	2.5	1.1	3.7	2.5	3×10^{-4}	3×10^{-6}
099	2.5	1.2	2.5	3.0	5×10^{-5}	3×10^{-6}
101	89	6.8	1,900	19	2×10^{-4}	1×10^{-4}
102.1	1.4	1.4	1.6	ND	9×10^{-5}	2×10^{-6}
102	2.8	1.3	6.4	9.9	2×10^{-5}	4×10^{-6}
103	1.3	0.77	1.5	ND	4×10^{-5}	2×10^{-6}
104	4.1	1.1	9.4	11	1×10^{-4}	6×10^{-6}
105	16	0.82	3.4	29	3×10^{-5}	1×10^{-5}
106	1.3	1.3	1.3	ND	6×10^{-6}	2×10^{-6}
107*	34	1.8	45	40	4×10^{-5}	3×10^{-5}
108.1*	7.3	0.98	3.3	9.6	3×10^{-5}	7×10^{-6}
108*	5.3	1.1	4.7	11	2×10^{-5}	5×10^{-6}
110*	4.3	1.1	2.9	24	3×10^{-5}	5×10^{-6}
110.1*	1.8	ND	2.1	5.6	1×10^{-5}	3×10^{-6}
111*	4.6	1.2	22	29	4×10^{-5}	9×10^{-6}
112*	11	ND	10	9.1	1×10^{-4}	1×10^{-5}
113*	36	0.96	11	11	6×10^{-5}	3×10^{-5}
114*	2.7	1.0	2.0	6.1	2×10^{-5}	3×10^{-6}
115*	4.6	0.93	7.3	7.3	5×10^{-5}	5×10^{-6}
116*	2.2	1.4	1.8	5.3	2×10^{-5}	3×10^{-6}
117*	9.4	1.6	12	10	9×10^{-5}	9×10^{-6}
118*	17	6.7	60	70	2×10^{-5}	2×10^{-6}
119	1.5	0.99	0.69	11	2×10^{-5}	2×10^{-6}
120	8.8	0.62	2.4	ND	1×10^{-4}	8×10^{-6}
121	15	1.1	7.8	11	2×10^{-5}	1×10^{-5}
122	1.7	1.4	1.1	2.7	3×10^{-5}	2×10^{-6}
123	5.0	1.1	7.1	3.8	5×10^{-5}	5×10^{-6}
124	6.7	1.6	12	9.4	1×10^{-4}	7×10^{-6}
132	65	ND	120	15	1×10^{-4}	6×10^{-5}
141	2.1	0.92	4.9	2.9	5×10^{-5}	2×10^{-6}
149	10	1.4	18	34	2×10^{-5}	1×10^{-5}
153	7.3	1.2	3.5	6.4	9×10^{-6}	7×10^{-6}
154	5.1	1.7	8.6	8.3	5×10^{-5}	5×10^{-6}

a Based on pre-removal data as presented in the EE/CA (DOE 1996).

Additional calculations were also performed to show risk reduction achieved for each segment. Exposure point concentrations for sediment were calculated for each exposure unit (i.e., segment) by using the one-tailed 95% upper confidence limit of the arithmetic average (UCL) or the maximum, whichever was lower (per EPA guidance). Post-cleanup data for each segment were aggregated with data from locations in each segment that were not targeted for cleanup. (Note that some locations that were not targeted for cleanup because they are not accessible have contaminant concentrations that exceed risk-based cleanup criteria). At locations where more than one sample was

collected, the data were averaged to obtain a representative concentrations for that location prior to aggregating the data for each segment. A summary of the data used in the risk calculations is presented in Table 2.

Table 2: Summary of Residual Contamination in the Southeast Drainage

Radionuclide	Radionuclide Concentration (pCi/g)							
	Segment A		Segment B		Segment C		Segment D	
	Range	UCL	Range	UCL	Range	UCL	Range	UCL
Radium-226	1.3-39	23	1.2-110	40	1.1-36	12	1.1-120	19
Radium-228	0.64-5.0	2.3	0.74-6.8	2.7	0.77-6.6	2.0	0.62-86	7.4
Thorium-230	0.20-38	18	0.27-1,900	370	1.3-45	12	0.69-2,500	180
Uranium-238	11-200	77	2.5-59	30	1.3-74	22	2.0-200	34

Results of the post-cleanup risk calculations for each segment are presented in Table 3. For comparison purposes, baseline risk calculations are also shown. Significant risk reduction (i.e., 40% or higher) was achieved for each segment with the highest amount of reduction observed in Segment C (i.e., 90%). The added risk reduction achieved in Segment C from removal of 14 additional locations not originally targeted in the EE/CA reduced the residual risk from 4×10^{-5} to 1×10^{-5}. Additional removal of three locations in Segment D did not result in further risk reduction in this segment.

Table 3: Estimated Risk Reduction from Exposure to Sediment

	Hunter		Child	
Segment	Baseline	Post-Cleanup	Baseline	Post-Cleanup
A	1×10^{-5}	5×10^{-6}	5×10^{-5}	2×10^{-5}
B	2×10^{-5}	1×10^{-5}	1×10^{-4}	5×10^{-5}
C	2×10^{-5}	3×10^{-6}	9×10^{-5}	1×10^{-5}
D	1×10^{-5}	5×10^{-6}	5×10^{-5}	3×10^{-5}

APPENDIX B
Southeast Drainage Analytical Data

Southeast Drainage Post Remediation Samples

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	ERR	DL	UNITS	COMMENTS
SD-498001-01	01/26/98	RADIUM-226	12.3	0.39	0.75	PCI/G	
SD-498001-01	01/26/98	RADIUM-228	1.66	0.25	0.92	PCI/G	
SD-498001-01	01/26/98	THORIUM-230	4.72	0.61	0.62	PCI/G	
SD-498001-01	01/26/98	URANIUM-238	37.8	4.67	7.77	PCI/G	
SD-498005-A-01	02/03/98	RADIUM-226	4.73	0.21	0.38	PCI/G	
SD-498005-A-01	02/03/98	RADIUM-228	2.86	0.25	0.77	PCI/G	
SD-498005-A-01	02/03/98	THORIUM-230	22.9	1.31	0.62	PCI/G	
SD-498005-A-01	02/03/98	URANIUM-238	10.9	2.13	5.95	PCI/G	
SD-498012-01	02/12/98	RADIUM-226	1.68	0.13	0.37	PCI/G	
SD-498012-01	02/12/98	RADIUM-228	1.07	0.15	0.37	PCI/G	
SD-498012-01	02/12/98	THORIUM-230	2.19	0.38	0.62	PCI/G	
SD-498012-01	02/12/98	URANIUM-238	ND		4.32	PCI/G	
SD-498025-A-01	02/12/98	RADIUM-226	24.9	0.63	1.06	PCI/G	
SD-498025-A-01	02/12/98	RADIUM-228	1.33	0.30	1.12	PCI/G	
SD-498025-A-01	02/12/98	THORIUM-230	29.1	1.54	0.62	PCI/G	
SD-498025-A-01	02/12/98	URANIUM-238	142	12.7	12.5	PCI/G	
SD-498025-B-01	02/12/98	RADIUM-226	3.55	0.15	0.33	PCI/G	
SD-498025-B-01	02/12/98	RADIUM-228	1.25	0.15	0.49	PCI/G	
SD-498025-B-01	02/12/98	THORIUM-230	5.64	0.61	0.62	PCI/G	
SD-498025-B-01	02/12/98	URANIUM-238	5.48	0.95	2.70	PCI/G	
SD-498027-01	02/05/98	RADIUM-226	23.0	0.61	1.14	PCI/G	
SD-498027-01	02/05/98	RADIUM-228	6.58	0.45	1.62	PCI/G	
SD-498027-01	02/05/98	THORIUM-230	14.6	1.29	0.62	PCI/G	
SD-498027-01	02/05/98	URANIUM-238	26.7	4.14	9.67	PCI/G	
SD-498028-01	04/29/98	RADIUM-226	11.3	0.36	0.40	PCI/G	
SD-498028-01	04/29/98	RADIUM-228	ND		1.29	PCI/G	
SD-498028-01	04/29/98	THORIUM-230	3.20	0.43	0.62	PCI/G	
SD-498028-01	04/29/98	URANIUM-238	(3.69)	1.63	5.06	PCI/G	
SD-498055-01	01/29/98	RADIUM-226	4.30	0.17	0.42	PCI/G	
SD-498055-01	01/29/98	RADIUM-228	0.99	0.14	0.49	PCI/G	
SD-498055-01	01/29/98	THORIUM-230	5.63	0.70	0.62	PCI/G	
SD-498055-01	01/29/98	URANIUM-238	8.82	1.22	2.36	PCI/G	
SD-498058-01	02/13/98	RADIUM-226	4.99	0.18	0.43	PCI/G	
SD-498058-01	02/13/98	RADIUM-228	1.21	0.13	0.46	PCI/G	
SD-498058-01	02/13/98	THORIUM-230	2.91	0.41	0.62	PCI/G	
SD-498058-01	02/13/98	URANIUM-238	4.96	0.93	2.48	PCI/G	
SD-498059-01	02/13/98	RADIUM-226	4.86	0.22	0.48	PCI/G	
SD-498059-01	02/13/98	RADIUM-228	ND		1.40	PCI/G	
SD-498059-01	02/13/98	THORIUM-230	46.5	1.77	0.62	PCI/G	
SD-498059-01	02/13/98	URANIUM-238	10.4	1.97	5.30	PCI/G	
SD-498060-A-01	02/04/98	RADIUM-226	2.18	0.12	0.25	PCI/G	
SD-498060-A-01	02/04/98	RADIUM-228	ND		0.81	PCI/G	
SD-498060-A-01	02/04/98	THORIUM-230	3.02	0.54	0.62	PCI/G	
SD-498060-A-01	02/04/98	URANIUM-238	7.54	1.06	2.56	PCI/G	
SD-498060-B-01	02/04/98	RADIUM-226	239	4.15	3.03	PCI/G	
SD-498060-B-01	02/04/98	RADIUM-228	17.4	1.01	2.90	PCI/G	
SD-498060-B-01	02/04/98	THORIUM-230	5090	23.6	0.62	PCI/G	
SD-498060-B-01	02/04/98	URANIUM-238	150	16.2	19.3	PCI/G	
SD-498061-01	02/04/98	RADIUM-226	26.9	0.59	0.70	PCI/G	
SD-498061-01	02/04/98	RADIUM-228	0.99	0.22	0.81	PCI/G	
SD-498061-01	02/04/98	THORIUM-230	17.6	1.20	0.62	PCI/G	
SD-498061-01	02/04/98	URANIUM-238	70.2	6.75	6.86	PCI/G	
SD-498062-01	04/29/98	RADIUM-226	1.25	0.09	0.25	PCI/G	
SD-498062-01	04/29/98	RADIUM-228	1.06	0.12	0.36	PCI/G	
SD-498062-01	04/29/98	THORIUM-230	1.25	0.27	0.62	PCI/G	
SD-498062-01	04/29/98	URANIUM-238	ND		2.33	PCI/G	
SD-498063-01	04/29/98	RADIUM-226	10.8	0.36	0.40	PCI/G	
SD-498063-01	04/29/98	RADIUM-228	ND		1.46	PCI/G	
SD-498063-01	04/29/98	THORIUM-230	3.16	0.41	0.62	PCI/G	
SD-498063-01	04/29/98	URANIUM-238	6.05	1.54	4.68	PCI/G	
SD-498064-A-01	02/04/98	RADIUM-226	2.14	0.15	0.33	PCI/G	
SD-498064-A-01	02/04/98	RADIUM-228	1.44	0.20	0.52	PCI/G	
SD-498064-A-01	02/04/98	THORIUM-230	3.96	0.47	0.62	PCI/G	
SD-498064-A-01	02/04/98	URANIUM-238	7.48	1.61	4.44	PCI/G	
SD-498064-B-01	02/04/98	RADIUM-226	3.58	0.16	0.34	PCI/G	
SD-498064-B-01	02/04/98	RADIUM-228	1.10	0.13	0.52	PCI/G	

Southeast Drainage Post Remediation Samples

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	ERR	DL	UNITS	COMMENTS
SD-498064-B-01	02/04/98	THORIUM-230	5.43	0.86	0.62	PCI/G	
SD-498064-B-01	02/04/98	URANIUM-238	12.8	1.68	3.36	PCI/G	
SD-498065-A-01	02/04/98	RADIUM-226	3.64	0.19	0.41	PCI/G	
SD-498065-A-01	02/04/98	RADIUM-228	1.25	0.19	0.64	PCI/G	
SD-498065-A-01	02/04/98	THORIUM-230	8.04	0.96	0.62	PCI/G	
SD-498065-A-01	02/04/98	URANIUM-238	16.9	2.43	4.84	PCI/G	
SD-498065-B-01	02/04/98	RADIUM-226	19.8	0.46	0.65	PCI/G	
SD-498065-B-01	02/04/98	RADIUM-228	4.18	0.27	0.88	PCI/G	
SD-498065-B-01	02/04/98	THORIUM-230	49.2	2.47	0.62	PCI/G	
SD-498065-B-01	02/04/98	URANIUM-238	58.9	5.84	6.74	PCI/G	
SD-498066-01	02/05/98	RADIUM-226	10.1	0.34	0.76	PCI/G	
SD-498066-01	02/05/98	RADIUM-228	1.54	0.23	0.84	PCI/G	
SD-498066-01	02/05/98	THORIUM-230	70.4	2.54	0.62	PCI/G	
SD-498066-01	02/05/98	URANIUM-238	15.7	2.69	7.08	PCI/G	
SD-498067-01	02/05/98	RADIUM-226	1.50	0.13	0.35	PCI/G	
SD-498067-01	02/05/98	RADIUM-228	1.23	0.16	0.43	PCI/G	
SD-498067-01	02/05/98	THORIUM-230	1.34	0.25	0.62	PCI/G	
SD-498067-01	02/05/98	URANIUM-238	ND		3.94	PCI/G	
SD-498068-01	04/29/98	RADIUM-226	1.54	0.10	0.24	PCI/G	
SD-498068-01	04/29/98	RADIUM-228	1.23	0.15	0.32	PCI/G	
SD-498068-01	04/29/98	THORIUM-230	1.32	0.36	0.62	PCI/G	
SD-498068-01	04/29/98	URANIUM-238	2.38	0.54	1.87	PCI/G	
SD-498072-A-01	02/03/98	RADIUM-226	11.1	0.31	0.44	PCI/G	
SD-498072-A-01	02/03/98	RADIUM-228	1.79	0.19	0.73	PCI/G	
SD-498072-A-01	02/03/98	THORIUM-230	16.3	1.33	0.62	PCI/G	
SD-498072-A-01	02/03/98	URANIUM-238	19.0	2.28	4.10	PCI/G	
SD-498072-B-01	02/03/98	RADIUM-226	11.6	0.37	0.74	PCI/G	
SD-498072-B-01	02/03/98	RADIUM-228	1.85	0.31	1.04	PCI/G	
SD-498072-B-01	02/03/98	THORIUM-230	16.8	1.13	0.62	PCI/G	
SD-498072-B-01	02/03/98	URANIUM-238	16.8	2.88	7.22	PCI/G	
SD-498092-01	01/29/98	RADIUM-226	5.43	0.20	0.36	PCI/G	
SD-498092-01	01/29/98	RADIUM-228	1.53	0.16	0.61	PCI/G	
SD-498092-01	01/29/98	THORIUM-230	38.4	1.70	0.62	PCI/G	
SD-498092-01	01/29/98	URANIUM-238	80.0	7.07	5.31	PCI/G	
SD-498093-01	01/29/98	RADIUM-226	1.95	0.15	0.45	PCI/G	
SD-498093-01	01/29/98	RADIUM-228	1.24	0.20	0.68	PCI/G	
SD-498093-01	01/29/98	THORIUM-230	0.76	0.21	0.62	PCI/G	
SD-498093-01	01/29/98	URANIUM-238	76.3	7.53	5.69	PCI/G	
SD-498094-01	01/29/98	RADIUM-226	3.80	0.15	0.34	PCI/G	
SD-498094-01	01/29/98	RADIUM-228	1.20	0.14	0.58	PCI/G	
SD-498094-01	01/29/98	THORIUM-230	8.89	0.77	0.62	PCI/G	
SD-498094-01	01/29/98	URANIUM-238	17.4	2.38	3.65	PCI/G	
SD-498098-A-01	02/12/98	RADIUM-226	2.44	0.13	0.38	PCI/G	
SD-498098-A-01	02/12/98	RADIUM-228	1.13	0.13	0.42	PCI/G	
SD-498098-A-01	02/12/98	THORIUM-230	5.38	0.56	0.62	PCI/G	
SD-498098-A-01	02/12/98	URANIUM-238	2.65	0.69	2.26	PCI/G	
SD-498098-B-01	02/12/98	RADIUM-226	2.31	0.16	0.31	PCI/G	
SD-498098-B-01	02/12/98	RADIUM-228	1.07	0.18	0.48	PCI/G	
SD-498098-B-01	02/12/98	THORIUM-230	2.10	0.36	0.62	PCI/G	
SD-498098-B-01	02/12/98	URANIUM-238	(2.48)	1.29	4.08	PCI/G	
SD-498099-01	02/12/98	RADIUM-226	2.51	0.12	0.32	PCI/G	
SD-498099-01	02/12/98	RADIUM-228	1.22	0.13	0.36	PCI/G	
SD-498099-01	02/12/98	THORIUM-230	2.53	0.34	0.62	PCI/G	
SD-498099-01	02/12/98	URANIUM-238	2.99	0.75	2.55	PCI/G	
SD-498101-01	02/12/98	RADIUM-226	89.2	1.75	1.76	PCI/G	
SD-498101-01	02/12/98	RADIUM-228	6.79	0.59	1.74	PCI/G	
SD-498101-01	02/12/98	THORIUM-230	192.0	13.0	0.62	PCI/G	
SD-498101-01	02/12/98	URANIUM-238	18.9	3.71	12.8	PCI/G	
SD-498102-01	02/12/98	RADIUM-226	2.76	0.13	0.31	PCI/G	
SD-498102-01	02/12/98	RADIUM-228	1.26	0.14	0.35	PCI/G	
SD-498102-01	02/12/98	THORIUM-230	6.35	0.74	0.62	PCI/G	
SD-498102-01	02/12/98	URANIUM-238	9.93	1.33	2.58	PCI/G	
SD-498102.1-01	02/12/98	RADIUM-226	1.40	0.17	0.22	PCI/G	
SD-498102.1-01	02/12/98	RADIUM-228	1.40	0.19	0.43	PCI/G	
SD-498102.1-01	02/12/98	THORIUM-230	1.59	0.27	0.62	PCI/G	
SD-498102.1-01	02/12/98	URANIUM-238	ND		3.65	PCI/G	

Southeast Drainage Post Remediation Samples

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	ERR	DL	UNITS	COMMENTS
SO-498103-01	02/12/98	RADIUM-226	1.33	0.10	0.35	PCI/G	
SO-498103-01	02/12/98	RADIUM-228	0.77	0.11	0.44	PCI/G	
SO-498103-01	02/12/98	THORIUM-230	1.51	0.26	0.62	PCI/G	
SO-498103-01	02/12/98	URANIUM-238	ND		2.72	PCI/G	
SO-498104-A-01	02/12/98	RADIUM-226	2.17	0.15	0.40	PCI/G	
SO-498104-A-01	02/12/98	RADIUM-228	0.93	0.14	0.60	PCI/G	
SO-498104-A-01	02/12/98	THORIUM-230	1.48	0.27	0.62	PCI/G	
SO-498104-A-01	02/12/98	URANIUM-238	6.72	1.47	3.47	PCI/G	
SO-498104-B-01	02/12/98	RADIUM-226	6.05	0.21	0.44	PCI/G	
SO-498104-B-01	02/12/98	RADIUM-228	1.18	0.15	0.49	PCI/G	
SO-498104-B-01	02/12/98	THORIUM-230	17.4	1.32	0.62	PCI/G	
SO-498104-B-01	02/12/98	URANIUM-238	15.4	1.82	3.24	PCI/G	
SO-498105-01	02/12/98	RADIUM-226	16.2	0.47	0.81	PCI/G	
SO-498105-01	02/12/98	RADIUM-228	0.82	0.23	0.82	PCI/G	
SO-498105-01	02/12/98	THORIUM-230	3.57	0.57	0.62	PCI/G	
SO-498105-01	02/12/98	URANIUM-238	29.3	3.79	7.71	PCI/G	
SO-498106-01	02/12/98	RADIUM-226	1.26	0.09	0.27	PCI/G	
SO-498106-01	02/12/98	RADIUM-228	1.29	0.13	0.37	PCI/G	
SO-498106-01	02/12/98	THORIUM-230	1.33	0.24	0.62	PCI/G	
SO-498106-01	02/12/98	URANIUM-238	ND		2.91	PCI/G	
SO-498107-01	02/12/98	RADIUM-226	33.9	0.80	1.14	PCI/G	
SO-498107-01	02/12/98	RADIUM-228	1.83	0.34	1.38	PCI/G	
SO-498107-01	02/12/98	THORIUM-230	44.5	2.00	0.62	PCI/G	
SO-498107-01	02/12/98	URANIUM-238	40.1	5.13	8.23	PCI/G	
SO-498108-01	02/12/98	RADIUM-226	5.29	0.19	0.41	PCI/G	
SO-498108-01	02/12/98	RADIUM-228	1.06	0.14	0.52	PCI/G	
SO-498108-01	02/12/98	THORIUM-230	4.74	0.74	0.62	PCI/G	
SO-498108-01	02/12/98	URANIUM-238	10.7	1.44	3.00	PCI/G	
SO-498108.1-01	02/09/98	RADIUM-226	7.05	0.27	0.40	PCI/G	
SO-498108.1-01	02/09/98	RADIUM-228	(0.98)	0.27	1.13	PCI/G	
SO-498108.1-01	02/09/98	THORIUM-230	3.33	0.57	0.62	PCI/G	
SO-498108.1-01	02/09/98	URANIUM-238	9.64	2.24	7.37	PCI/G	
SO-498110-01	02/09/98	RADIUM-226	4.26	0.17	0.39	PCI/G	
SO-498110-01	02/09/98	RADIUM-228	1.15	0.16	0.55	PCI/G	
SO-498110-01	02/09/98	THORIUM-230	2.85	0.49	0.62	PCI/G	
SO-498110-01	02/09/98	URANIUM-238	24.0	2.67	3.36	PCI/G	
SO-498110.1-01	02/09/98	RADIUM-226	1.82	0.14	0.39	PCI/G	
SO-498110.1-01	02/09/98	RADIUM-228	ND		1.19	PCI/G	
SO-498110.1-01	02/09/98	THORIUM-230	2.07	0.49	0.62	PCI/G	
SO-498110.1-01	02/09/98	URANIUM-238	5.55	1.18	3.17	PCI/G	
SO-498111-A-01	02/09/98	RADIUM-226	7.45	0.23	0.44	PCI/G	
SO-498111-A-01	02/09/98	RADIUM-228	0.92	0.14	0.55	PCI/G	
SO-498111-A-01	02/09/98	THORIUM-230	42.1	2.06	0.62	PCI/G	
SO-498111-A-01	02/09/98	URANIUM-238	29.4	3.41	4.41	PCI/G	
SO-498111-B-01	02/09/98	RADIUM-226	1.74	0.13	0.28	PCI/G	
SO-498111-B-01	02/09/98	RADIUM-228	1.46	0.22	0.61	PCI/G	
SO-498111-B-01	02/09/98	THORIUM-230	1.35	0.30	0.62	PCI/G	
SO-498111-B-01	02/09/98	URANIUM-238	ND		4.13	PCI/G	
SO-498112-01	02/09/98	RADIUM-226	11.2	0.30	0.50	PCI/G	
SO-498112-01	02/09/98	RADIUM-228	ND		0.95	PCI/G	
SO-498112-01	02/09/98	THORIUM-230	10.3	1.06	0.62	PCI/G	
SO-498112-01	02/09/98	URANIUM-238	9.13	1.54	4.33	PCI/G	
SO-498113-01	02/09/98	RADIUM-226	36.7	0.83	1.12	PCI/G	
SO-498113-01	02/09/98	RADIUM-228	(0.96)	0.31	1.30	PCI/G	
SO-498113-01	02/09/98	THORIUM-230	11.4	1.18	0.62	PCI/G	
SO-498113-01	02/09/98	URANIUM-238	11.4	3.03	9.43	PCI/G	
SO-498114-A-01	02/09/98	RADIUM-226	1.36	0.10	0.24	PCI/G	
SO-498114-A-01	02/09/98	RADIUM-228	ND		0.71	PCI/G	
SO-498114-A-01	02/09/98	THORIUM-230	1.40	0.27	0.62	PCI/G	
SO-498114-A-01	02/09/98	URANIUM-238	10.4	1.28	2.25	PCI/G	
SO-498114-B-01	02/09/98	RADIUM-226	2.99	0.17	0.43	PCI/G	
SO-498114-B-01	02/09/98	RADIUM-228	0.86	0.16	0.35	PCI/G	
SO-498114-B-01	02/09/98	THORIUM-230	2.33	0.43	0.62	PCI/G	
SO-498114-B-01	02/09/98	URANIUM-238	6.31	1.45	3.58	PCI/G	
SO-498114-C-01	02/09/98	RADIUM-226	3.76	0.16	0.40	PCI/G	
SO-498114-C-01	02/09/98	RADIUM-228	1.23	0.17	0.48	PCI/G	

Southeast Drainage Post Remediation Samples

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	ERR	DL	UNITS	COMMENTS
SO-498114-C-01	02/09/98	THORIUM-230	2.38	0.45	0.62	PCI/G	
SO-498114-C-01	02/09/98	URANIUM-238	12.1	1.57	2.89	PCI/G	
SO-498115-01	02/06/98	RADIUM-226	4.64	0.22	0.49	PCI/G	
SO-498115-01	02/06/98	RADIUM-228	0.93	0.20	0.64	PCI/G	
SO-498115-01	02/06/98	THORIUM-230	7.28	0.80	0.62	PCI/G	
SO-498115-01	02/06/98	URANIUM-238	7.26	1.70	4.33	PCI/G	
SO-498116-01	02/05/98	RADIUM-226	2.15	0.11	0.22	PCI/G	
SO-498116-01	02/05/98	RADIUM-228	1.35	0.13	0.47	PCI/G	
SO-498116-01	02/05/98	THORIUM-230	1.78	0.50	0.62	PCI/G	
SO-498116-01	02/05/98	URANIUM-238	5.29	0.85	2.07	PCI/G	
SO-498117-A-01	02/05/98	RADIUM-226	17.8	0.50	0.71	PCI/G	
SO-498117-A-01	02/05/98	RADIUM-228	1.57	0.29	1.23	PCI/G	
SO-498117-A-01	02/05/98	THORIUM-230	23.0	1.58	0.62	PCI/G	
SO-498117-A-01	02/05/98	URANIUM-238	18.9	3.03	7.56	PCI/G	
SO-498117-B-01	02/05/98	RADIUM-226	1.04	0.08	0.22	PCI/G	
SO-498117-B-01	02/05/98	RADIUM-228	ND		0.74	PCI/G	
SO-498117-B-01	02/05/98	THORIUM-230	1.04	0.32	0.62	PCI/G	
SO-498117-B-01	02/05/98	URANIUM-238	(1.16)	0.47	1.71	PCI/G	
SO-498118-01	02/05/98	RADIUM-226	17.1	0.49	0.87	PCI/G	
SO-498118-01	02/05/98	RADIUM-228	6.66	0.44	1.45	PCI/G	
SO-498118-01	02/05/98	THORIUM-230	60.0	2.61	0.62	PCI/G	
SO-498118-01	02/05/98	URANIUM-238	69.5	7.40	9.91	PCI/G	
SO-498119-01	02/04/98	RADIUM-226	1.52	0.12	0.38	PCI/G	
SO-498119-01	02/04/98	RADIUM-228	0.99	0.16	0.57	PCI/G	
SO-498119-01	02/04/98	THORIUM-230	0.69	0.27	0.62	PCI/G	
SO-498119-01	02/04/98	URANIUM-238	10.6	1.77	3.99	PCI/G	
SO-498120-01	04/29/98	RADIUM-226	8.78	0.31	0.66	PCI/G	
SO-498120-01	04/29/98	RADIUM-228	(0.62)	0.19	0.71	PCI/G	
SO-498120-01	04/29/98	THORIUM-230	2.37	0.33	0.62	PCI/G	
SO-498120-01	04/29/98	URANIUM-238	ND		5.67	PCI/G	
SO-498121-01	04/29/98	RADIUM-226	14.8	0.37	0.47	PCI/G	
SO-498121-01	04/29/98	RADIUM-228	1.06	0.19	0.64	PCI/G	
SO-498121-01	04/29/98	THORIUM-230	7.80	0.84	0.62	PCI/G	
SO-498121-01	04/29/98	URANIUM-238	10.6	1.53	3.72	PCI/G	
SO-498122-01	02/03/98	RADIUM-226	1.66	0.10	0.25	PCI/G	
SO-498122-01	02/03/98	RADIUM-228	1.40	0.13	0.42	PCI/G	
SO-498122-01	02/03/98	THORIUM-230	1.10	0.30	0.62	PCI/G	
SO-498122-01	02/03/98	URANIUM-238	2.66	0.67	2.47	PCI/G	
SO-498123-01	02/03/98	RADIUM-226	5.04	0.18	0.36	PCI/G	
SO-498123-01	02/03/98	RADIUM-228	1.11	0.14	0.54	PCI/G	
SO-498123-01	02/03/98	THORIUM-230	7.10	0.86	0.62	PCI/G	
SO-498123-01	02/03/98	URANIUM-238	3.81	0.92	3.18	PCI/G	
SO-498124-01	02/13/98	RADIUM-226	6.70	0.22	0.45	PCI/G	
SO-498124-01	02/13/98	RADIUM-228	1.56	0.16	0.55	PCI/G	
SO-498124-01	02/13/98	THORIUM-230	12.4	0.95	0.62	PCI/G	
SO-498124-01	02/13/98	URANIUM-238	9.38	1.55	3.72	PCI/G	
SO-498132-01	02/12/98	RADIUM-226	65.3	1.34	1.51	PCI/G	
SO-498132-01	02/12/98	RADIUM-228	ND		2.57	PCI/G	
SO-498132-01	02/12/98	THORIUM-230	124	2.74	0.62	PCI/G	
SO-498132-01	02/12/98	URANIUM-238	14.7	3.60	9.86	PCI/G	
SO-498141-01	02/12/98	RADIUM-226	2.14	0.11	0.31	PCI/G	
SO-498141-01	02/12/98	RADIUM-228	0.92	0.12	0.40	PCI/G	
SO-498141-01	02/12/98	THORIUM-230	4.89	0.63	0.62	PCI/G	
SO-498141-01	02/12/98	URANIUM-238	2.91	0.71	2.39	PCI/G	
SO-498149-01	02/04/98	RADIUM-226	10.4	0.35	0.55	PCI/G	
SO-498149-01	02/04/98	RADIUM-228	1.39	0.25	0.99	PCI/G	
SO-498149-01	02/04/98	THORIUM-230	18.2	1.60	0.62	PCI/G	
SO-498149-01	02/04/98	URANIUM-238	34.2	4.00	5.78	PCI/G	
SO-498153-01	02/03/98	RADIUM-226	7.27	0.23	0.39	PCI/G	
SO-498153-01	02/03/98	RADIUM-228	1.23	0.15	0.55	PCI/G	
SO-498153-01	02/03/98	THORIUM-230	3.47	0.52	0.62	PCI/G	
SO-498153-01	02/03/98	URANIUM-238	6.41	1.14	3.26	PCI/G	
SO-498154-01	02/13/98	RADIUM-226	5.08	0.19	0.38	PCI/G	
SO-498154-01	02/13/98	RADIUM-228	1.70	0.16	0.44	PCI/G	
SO-498154-01	02/13/98	THORIUM-230	8.58	0.85	0.62	PCI/G	
SO-498154-01	02/13/98	URANIUM-238	8.33	1.39	4.10	PCI/G	

APPENDIX C
Southeast Drainage Quality Assurance Data

Southeast Drainage Post Remediation QC Samples

WSSRAP_ID	DATE_SAM	PARAMETER	CONC	ERR	DL	UNITS	COMMENTS
SD-498005-A-01-DU	02/03/98	RADIUM-226	4.80	0.23	0.60	PCI/G	RPD: 1.47
SD-498005-A-01-DU	02/03/98	RADIUM-228	2.68	0.25	0.84	PCI/G	RPD: 6.50
SD-498005-A-01-DU	02/03/98	THORIUM-230	22.3	1.52	0.62	PCI/G	RPD: 2.61
SD-498005-A-01-DU	02/03/98	URANIUM-238	12.8	2.22	5.99	PCI/G	RPD: 15.77
SD-498066-01-FR	02/05/98	RADIUM-226	18.6	0.45	0.64	PCI/G	
SD-498066-01-FR	02/05/98	RADIUM-228	6.40	0.33	1.14	PCI/G	
SD-498066-01-FR	02/05/98	THORIUM-230	62.2	2.20	0.62	PCI/G	
SD-498066-01-FR	02/05/98	URANIUM-238	86.4	7.74	6.42	PCI/G	
SD-498105-01-FD	02/12/98	RADIUM-226	6.70	0.22	0.44	PCI/G	
SD-498105-01-FD	02/12/98	RADIUM-228	1.00	0.14	0.51	PCI/G	
SD-498105-01-FD	02/12/98	THORIUM-230	6.76	0.75	0.62	PCI/G	
SD-498105-01-FD	02/12/98	URANIUM-238	16.5	2.07	3.52	PCI/G	