



Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

ARF-024199

MAY 31 2023

Ms. Susan B. Fulmer, P.G., Manager
Federal Remediation Section
Division of Site Assessment, Remediation and Revitalization
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Mr. Jon Richards
Savannah River Site Remedial Project Manager
Superfund Division
U. S. Environmental Protection Agency, Region 4
61 Forsyth Street, SW
Atlanta, Georgia 30303

Dear Ms. Fulmer and Mr. Richards:

SUBJECT: Savannah River Site's Responses to the Regulatory Comments on the Effectiveness Monitoring Report (EMR) for the P-Area Groundwater (PAGW) Operable Unit (OU) Zero Valent Iron Permeable Reactive Barrier (ZVI-PRB) Removal Action (U) April 2021 through March 2022 (SRNS-RP-2022-00565, Revision 0, October 2022) SEMS Number: 81

The U. S. Department of Energy (DOE) is submitting the subject comment responses for your review. The South Carolina Department of Health and Environmental Control (SCDHEC) approved the report on March 9, 2023, and U. S. Environmental Protection Agency (EPA) provided comments on the report on March 10, 2023. The report will not be revised; however, all comment responses will be included and/or addressed in the next report, as applicable. Please review these responses and provide your approval thirty (30) days from receipt. The time and effort that the SCDHEC and the EPA have given on the subject operable unit are greatly appreciated.

Questions from you or your staff may be directed to me at (803) 952-8365, or the DOE Program Manager, Mr. Philip Prater, at (803) 952-9333.

Sincerely,

Brian T. Hennessey Digitally signed by Brian T. Hennessey
Date: 2023.05.30 10:00:31 -04'00'

Brian T. Hennessey
FFA Project Manager, DOE-Savannah River
Remediation and Deactivation & Decommissioning Division

RDDD-23-009

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Ms. Susan Fulmer
Mr. Jon Richards

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Enclosure:

SRS Responses to the USEPA Comments on the Effectiveness Monitoring Report (EMR) for the P-Area Groundwater (PAGW) Operable Unit (OU) Zero Valent Iron Permeable Reactive Barrier (ZVI-PRB) Removal Action (U) April 2021 through March 2022 (SRNS-RP-2022-00565, Revision 0, October 2022) SEMS Number: 81

cc w/o encl:

J. Blalock, SCDHEC-Columbia
S. French, SCDHEC-Columbia
M. Reece, SCDHEC-Columbia
G. K. Taylor, SCDHEC-Columbia
G. Stewart, SCDHEC-Columbia
T. R. Fuss, SCDHEC-Aiken Environmental Affairs Office
G. O'Quinn, SCDHEC-Aiken Environmental Affairs Office
B. A. Cameron, SCDHEC-Aiken Environmental Affairs Office
K. L. Beatty, SCDHEC-Aiken Environmental Affairs Office
H. L. Herlong, SCDHEC-Aiken Environmental Affairs Office

cc w/ encl:

M. McRae, TechLaw, Inc.

SRS Responses to USEPA Comments on the Effectiveness Monitoring Report (EMR) for the P-Area Groundwater (PAGW) Operable Unit (OU) Zero Valent Iron Permeable Reactive Barrier (ZVI-PRB) Removal Action (U), April 2021 Through March 2022 Data
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GENERAL COMMENTS

1. The EMR Report does not provide essential historical and current analytical tables to verify statements in the text. Examples include:
 - a) The EMR Report does not provide a table with all of the historical and current volatile organic compounds (VOC) data (i.e., starting with the baseline data), and the hydrographs presented in Appendix B (PAGW OU RA EMR Hydrographs) do not depict specific concentrations. As a result, it is not possible to verify statements in the text regarding concentration changes based on the data. For example, the text in Section 3.2.2 (Chlorinated Volatile Organic Compounds) indicates that trichloroethylene (TCE) concentrations for PRW007DL have increased from 6.62 micrograms per Liter ($\mu\text{g/L}$) in July 2020 to 31.6 $\mu\text{g/L}$ in February 2022; however, the hydrograph presented in Appendix C does not show these concentrations and can only be read in increments of 10 $\mu\text{g/L}$.
 - b) The EMR Report does not provide a separate table with current and historical field parameter data. For example, the text in Section 4.4 (SVI-PRB Reducing Environment) states, “Within the ZVI-PRB [zero-valent iron permeable reactive barrier], reducing conditions are evidenced by high negative ORP [oxygen reduction potential] values between -350 and -406 mV [millivolts] in 1Q22;” however, Table A (PAGW RA EMR Analytical Data 2021-2022) EMR Monitoring Well Data, 2Q21-1Q22) in Appendix A does not include the ORP parameters for wells PIW01, PIW02, PIW03, or PIW04. Please revise the EMR Report to provide a separate table with the current and historical field parameter data including ORP, dissolved oxygen (DO), turbidity, specific conductivity (SC), and pH.
 - c) The EMR Report does not provide a table with current and historical analyses for several compounds (e.g., calcium, sulfur, chloride, metals, ethylene, ethane, methane) to verify statements that are included in the text. For example, the text in Section 3.2.3 (Geochemical Analyses) states, “Methane concentrations remained elevated in the UAZ [Upper Aquifer Zone] between 2Q21 and 1Q22. The maximum methane concentration in the baseline sampling was 2,400 $\mu\text{g/L}$ and the 1Q22 background monitoring well results (P003U and P003L) were below the MDL [method detection limit] of 10 $\mu\text{g/L}$;” however, these concentrations cannot be verified because there is no summary table that includes the data.

Please revise the EMR Report to provide tables with all historical and current VOC data; a separate table with all current and historical field parameter data; and, a separate table with all historical analytes (e.g., calcium, sulfur, chloride, metals, ethylene, ethane, methane, etc.) to substantiate the statements regarding the data in the text.

Response: Clarification

It is not the intention of annual SRS Effectiveness Monitoring Reports (EMRs) to provide all historical data in EMR reports. Historical data, including field parameter data, are available in Appendix A of ZVI-PRB Removal Action EMRs for previous years. For this

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EMR, the data presented are for the dates of April 2021 through March 2022 which represents four quarters of analytical and field data.

Time-series plots and data tables are provided to illustrate changes occurring since the last submitted EMR. Time-series plots for key constituents that depict historical data are provided in the body of the document. For example, the time-series plot for TCE at PRW007DL is shown in Figure 13. For ease of comparison between well clusters and to standardize the various range of concentrations exhibited amongst the monitoring network, data from each well cluster are plotted on log-scale (10) with minor gridlines of base 10. The plots make it easier to track the overall trend of the data per well at each well cluster. Additionally, these plots aid in evaluating how constituents are reacting to treatment associated with the ZVI-PRB and matrix diffusion from low permeability sediments. Text is provided in the body of the document that discusses other geochemical changes that are observed. Additionally, Table 3 provides a range of the measured baseline data for each of the constituents prior to installation of the ZVI-PRB. Tables 4 and 5 provide comparisons of the current reported monitoring data to the baseline results.

SRS believes the time-series plots are a better illustration of the overall trends of how constituents are responding to the Removal Action versus tables of historical data. No revision to the document is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

SPECIFIC COMMENTS

1. **Section 4.4, ZVI-PRB Reducing Environment, Page 22 of 54 and Appendix A, PAGW RA EMR Analytical Data 2021-2022, Pages A-2 through A-4:** The text indicates that the wells inside the ZVI-PRB (PIW01, PIW02, PIW03, and PIW04) show reducing conditions that are evidenced by high, negative oxygen reduction potential (ORP) values between -350 and -406 mV in 1Q22. However, Table A (PAGW RA EMR Analytical Data 2021-2022) EMR Monitoring Well Data, 2Q21-1Q22) in Appendix A does not include data for wells PIW01, PIW02, PIW03, or PIW04. *Please revise Table A in Appendix A to include the appropriate water quality parameter data for the wells within the ZVI-PRB to substantiate that these wells show high, negative ORP values between -350 and -406 mV.*

Response: Clarification

The correct Station IDs for monitoring wells located inside the ZVI-PRB are PIW001D, PIW002D, PIW003D, and PIW004D. These Station IDs are provided in Appendix A with associated Field Data in the first 12 columns, including oxidation reduction potential (ORP) measurements. The last reported sampling event was completed in February of 2022 which corresponds to the first quarter of 2022 (1Q22) sample for the respective wells.

Measured ORP values in these wells ranged from -350 to -405 millivolts based on the data in Appendix A. The discrepancy between the range reported in Table A compared to the range reported in the text (-350 to -406 millivolts) is noted, and SRS will ensure the range for the reported values are correctly represented in the appendix and corresponding text in future reports. No change to the 2022 EMR is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

2. **Section 5.0, Summary and Recommendations, Page 25 of 54:** The text states that recent 1Q22 results west of the zero-valent iron permeable reactive barrier (ZVI-PRB) indicate a greater than 80% reduction in trichloroethylene (TCE) concentration compared to baseline, and that this reduction is being achieved in all monitoring wells except for PRW007DU. However, it should be noted that there were 1Q22 TCE concentration increases for Lower Aquifer Zone (LAZ) monitoring well PRW006C and Upper Aquifer Zone (UAZ) monitoring well PRW007DL, and the baseline TCE concentrations for PRW006C and PRW007DL wells are not included or depicted in the EMR Report. Section 3.3.2 (Chlorinated Volatile Organic Compounds) indicates that the TCE concentrations in PRW006C have increased, from 24.3 µg/L in July 2020 to 110 µg/L in February 2022. In addition, Section 3.2.2 (Chlorinated Volatile Organic Compounds) TCE concentrations in PRW007DL have increased from 6.62 µg/L in July 2020 to 31.6 µg/L in February 2022. It should also be noted that Figure C.39 (Time Series Plot for Trichloroethylene (TCE) at PRW006 Series Monitoring Wells) and Figure C.40 (Time Series Plot for Trichloroethylene (TCE) at PRW007 Series Monitoring

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Wells) depict a higher TCE concentration in 2022 than the initial TCE concentration presented in 2020 for wells PRW006C and PRW007DL. Therefore, it is unclear why PRW006C and PRW007DL are not discussed as exceptions to the reported reductions in TCE concentration compared to baseline. *Please revise Section 5.0 to include PRW006 and PRW007DL as exceptions.*

Response: Agree with Clarification

The primary focus of this Removal Action is associated with reducing VOCs (primarily TCE) in the UAZ, therefore, the LAZ was not emphasized in the conclusions. However, Section 4.5 states that observed impacts to the LAZ at this time are positive. This conclusion is supported by reduced TCE concentrations and increased reducing conditions near the ZVI-PRB. Even though the ZVI-PRB was constructed in the UAZ, some of the ZVI was injected into the upper LAZ as part of the injection process when keying the ZVI-PRB into the semi-confining tan clay confining zone (TCCZ) which separates the UAZ and LAZ. This provided added benefit of reducing TCE and other VOCs present in the LAZ. The reduction of VOCs in the LAZ is further enhanced by movement of reducing water vertically through the ZVI-PRB and into the LAZ. This is due to lower hydraulic heads exhibited at depth leading to an increased vertical gradient from the UAZ, into the LAZ.

As stated in the report, the PRW006 well cluster is further west of the ZVI-PRB and observed affects have not occurred from the ZVI-PRB at this point in monitoring. This is not unexpected due to the distance from the ZVI-PRB. For clarity, future EMRs for the ZVI-PRB will identify if any monitoring wells, including LAZ monitoring wells and the PRW006 cluster, are not achieving 80% reduction in TCE.

Direct baseline results are not available for the PRW005, PRW006, or PRW007 monitoring well clusters, as these monitoring wells were not installed prior to the ZVI-PRB. Due to the timing of when the wells were installed and the close proximity of PRW005 and PRW007 monitoring well clusters to the ZVI-PRB, the first sampling event from these monitoring wells were likely impacted by ZVI-PRB, and therefore would not represent a “baseline” condition. These monitoring well cluster results are compared to baseline conditions of the nearby monitoring wells with baseline results available.

Based on the above clarifications, PRW006 monitoring well cluster will be excluded from consideration of an 80% reduction. SRS agrees, without direct baseline comparison and due to increasing concentrations, monitoring well PRW007DL should be included as an exception if concentrations remain consistent or increase further. Considerations for PRW006 monitoring well cluster and monitoring well PRW007DL will be carried through in future ZVI-PRB EMRs. No change to the 2022 EMR is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

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3. **Table 4, Baseline Concentration Comparison with Most Recent Results for UAZ (1Q22), Page 52 of 54 and Figure 11, TCE Results for ZVI-PRB UAZ Monitoring Wells Sampled in 1Q22, Page 40 of 54:** It is unclear why there are baseline concentration comparisons presented in Table 4 that include these wells, but Figure 11 indicates that these wells were installed post-PRB and have no baseline concentration values. Table 4 includes a baseline concentration comparison for well clusters west of the ZVI-PRB, including wells PRW007DU and PRW007DL; however, the Notes Section on Figure 11 states that there are no baseline reported results for PRW007DU and PRW007DL, and indicates that these wells were installed post-PRB. *Please revise the EMR to clarify if wells PRW007DU and PRW007DL have baseline concentrations, and if the date of the baseline sampling for these wells differs from other wells, provide a footnote to explain how the baseline event was established.*

Response: Agree

The PRW005 and PRW007 monitoring well clusters do not have baseline results available due to being installed after ZVI-PRB completion and proximity to the ZVI-PRB. The Notes Section for Table 4 will be revised as indicated in Table CR-1 (included with these responses) for future ZVI-PRB EMRs. No change to the 2022 EMR is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

4. **Table 5, Baseline Concentration Comparison with Most Recent Results for LAZ (1Q22), Page 53 of 54:** Table 5 does not include baseline concentrations for comparison with the most recent results for ZVI-PRB monitoring wells PRW006DU, PRW006C, and PRW006DL. It is understood that these wells were constructed after the PRB was installed, which may suggest that the initial sampling event in these wells could be considered as the baseline event. *Please revise Table 5 to include the baseline data for comparison with most recent results for monitoring wells PRW006DU, PRW006C, and PRW006DL. If the date of the baseline sampling for these wells differs from other wells, please provide a footnote to explain how the baseline event was established.*

Response: Clarification

Baseline data reported in Tables 4 and 5 are from the PRW001, -002, -003, and -004 well clusters which were installed prior to construction of the ZVI-PRB. These data best represent conditions prior to installation of the ZVI-PRB, where post-construction data can be compared to determine overall impact of the ZVI-PRB on removal of VOCs from groundwater. Data from the PRW006 well cluster is primarily evaluated to determine long-term effects on groundwater quality at a distance further from the ZVI-PRB. It is not expected that groundwater quality at this well cluster will be positively impacted for many years due to changes in groundwater geochemistry near the ZVI-PRB. This is primarily due to the slow groundwater flow rate, distance from the ZVI-PRB, and matrix diffusion of VOCs from the low permeability sediments near the ZVI-PRB that will

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continue to impact clean groundwater as it moves through the system. For these reasons, the data from the PRW006 monitoring well cluster was not compared to the baseline concentrations in Table 4 or Table 5.

No change to the 2022 EMR is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

5. **Table 4, Baseline Concentration Comparison with Most Recent Results for UAZ (1Q22), Page 52 of 54 and Table 5, Baseline Concentration Comparison with Most Recent Results for LAZ (1Q22), Page 53 of 54:** It should be noted that the titles for Tables 4 (Baseline Concentration Comparison with Most Recent Results for UAZ (1Q22)) and Table 5 (Baseline Concentration Comparison with Most Recent Results for LAZ (1Q22)) occur at the bottom of the previous page. *Please revise the EMR Report to address these formatting issues.*

Response: Agree

This formatting issue will be corrected in future ZVI-PRB EMRs. No revision to the 2022 EMR is proposed.

Responsible Party: Adam Willey, (803) 646-4944, adam.willey@srs.gov

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Table CR-1. Baseline Concentration Comparison with Most Recent Results for UAZ (1Q22)

Analyte	Units	East of ZVI-PRB ^A		West of ZVI-PRB ^A		In-Wall ^A
		Baseline	1Q22	Baseline	1Q22	1Q22
PCE	µg/L	0.34 - 1.43	1.00 - 11.8	0.7 - 5.15	0.37 - 0.87	ND (1) ^c
TCE	µg/L	1.65 - 686	0.61 - 961	0.96 - 1,090	0.77 - 617	10.4 ^b
cis-DCE	µg/L	0.45 - 47.5	0.42 - 60.7	2.08 - 28.4	1.41 - 76.6	41.3 ^b
trans-DCE	µg/L	0.57 ^b	ND (10) ^c	0.54 ^b	0.69 ^b	ND (1) ^c
1,1-DCE	µg/L	ND (1) ^c	ND (10) ^c	ND (1) ^c	0.37 ^b	ND (1) ^c
VC	µg/L	ND (1) ^c	ND (10) ^c	ND (1) ^c	ND (25) ^c	0.80 ^b
Alkalinity	mg/L	5.8 - 37	0 - 84	2.2 - 38.4	5 - 48	104 - 295
Calcium	µg/L	1,190 - 4,810	NS ^d	850 - 2,230	NS ^d	47,400 - 128,000
Chloride	mg/L	2.82 - 3.18	2.46 - 44.8	2.11 - 3.64	2.89 - 37.4	13.8 - 53.2
DOC	mg/L	0.461 - 0.638	0.594 - 13.7	0.488 - 0.683	1.29 - 14.3	27.4 - 59.8
Ethane	µg/L	0.12 ^b	15.9 - 17.9	ND (0.1) ^c	15.7 - 54.0	17.4 - 87.8
Ethylene	µg/L	0.55 ^b	ND (25) ^c	0.11 ^b	ND (25) ^c	52.4 ^b
Ferric Iron	mg/L	ND (0.5) ^c	NS ^d	ND (0.5) ^c	NS ^d	0.13 - 1.00
Ferrous Iron	mg/L	ND (0.5) ^c	NS ^d	0.87 ^b	NS ^d	ND (0.05) ^c
Total Iron	µg/L	53.3 - 178	NS ^d	148 - 741	245 - 15,100	33 - 149
Magnesium	µg/L	341 - 1,360	NS ^d	376 - 1,070	NS ^d	10.3 - 132
Manganese	µg/L	9.1 - 24.1	NS ^d	5.07 - 174	NS ^d	1.05 - 3.04
Methane	µg/L	0.93 - 2,400	15.2 - 25,700	1.9 - 600	49.6 - 10,200	1,250 - 6,170
Nitrate	mg/L	0.217 - 2.82	NS ^d	0.278 - 2.6	NS ^d	ND (0.5) ^c
Phosphate	mg/L	0.0456 - 0.0736	NS ^d	0.0449 - 0.0891	NS ^d	0.0201 - 0.0223
Potassium	µg/L	255 - 11,000	NS ^d	556 - 16,800	NS ^d	1,210 - 4,650
Sodium	µg/L	2,630 - 14,400	NS ^d	3,240 - 12,200	NS ^d	7,990 - 22,800
Sulfate	mg/L	0.533 - 13.4	NS ^d	0.589 - 6.22	NS ^d	0.221 - 1.09
TDS	mg/L	40 - 47.1	NS ^d	4.29 - 65.7	NS ^d	187 - 509
TOC	mg/L	0.362 - 0.533	0.487 - 10.1	0.38 - 0.595	0.608 - 11.5	25.7 - 57.7

^A Wells included in each set are:

East of ZVI-PRB: PRW001DU, PRW001DL, PRW003DU, PRW003DL

West of ZVI-PRB: PRW002DU, PRW002DL, PRW004DU, PRW004DL (Baseline and 1Q22)

PRW005DU, PRW005DL, PRW007DU, PRW007DL (1Q22 Only)

In-Wall: PIW001D, PIW002D, PIW003D, PIW004D

^b Only one value reported above MDL.

^c No detections; Maximum PQL reported in parenthesis.

^d Not sampled.