



# **Removal Action Report for the P-Area Groundwater Operable Unit Non-Time Critical Removal Action**

**SEMS Number: 81**

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*Prepared for*  
**U.S. Department of Energy**  
**and**  
**Savannah River Nuclear Solutions, LLC**  
**Aiken, South Carolina**

## **EXECUTIVE SUMMARY**

Groundwater contaminated with trichloroethylene (TCE) concentrations above the maximum contaminant level (MCL) in Savannah River Site's P-Area is discharging to Steel Creek, a nearby surface water stream. In response, the United States Department of Energy, with concurrence from the United States Environmental Protection Agency and the South Carolina Department of Health and Environmental Control, implemented a non-time critical (NTC) removal action (RA) targeting the TCE plume in the P-Area Groundwater (PAGW) Operable Unit (OU). The TCE plume extends from the P-Reactor Building Complex to Steel Creek. The alternative selected was a Permeable Reactive Barrier (PRB) using Zero-Valent Iron (ZVI) to degrade TCE to harmless end-products. The selected location for this NTC RA is in an area where unique subsurface features cause the TCE plume to narrow, providing an opportunity for a targeted NTC RA that will achieve a high level of TCE mass removal.

The location for the NTC RA was chosen based on existing data, which showed evidence of the groundwater plume narrowing, controlled by a local geologic feature. The upgradient TCE vadose zone source was remediated in 2011, however an appreciable mass of TCE impacted the uppermost Upper Three Runs Aquifer (UTRA). Groundwater concentrations upgradient of the ZVI-PRB location are as high as 7,710 µg/L. Although the ZVI-PRB is constructed mid-plume, targeting the location where the TCE plume narrows allows for an optimized ZVI-PRB that will address a large amount of the upgradient TCE plume over a smaller cross-sectional treatment zone. Over time, as clean groundwater moves downgradient from the ZVI-PRB and through areas of high TCE concentrations, changes will begin to be observed in downgradient monitoring wells.

Before finalizing the ZVI-PRB, a pre-design investigation (PDI) was conducted to confirm the site lithology and plume extent. This investigation revealed extremely complex hydrogeologic conditions at the site consisting of large sandy-clay matrix layers, sections of medium to large sized cobble stones, and sections of stiff clay lenses, all at varying depths within approximately 250 feet. The PDI also showed inconsistent groundwater flow directions, which differed by as much as 55 degrees within the ZVI-PRB site location. Finally, chlorinated volatile organic compound (cVOC) concentrations were found to be much more prominent in the upper aquifer

zone of the Upper Three Runs Aquifer, and the highest concentrations were entrained in the low permeability sediments (Figure ES-1).

The realized complexities of this NTC RA site resulted in a much more extensive PDI than anticipated as well as a longer and shallower ZVI-PRB. This change in design resulted in more injection well locations, more resistivity strings for active resistance mapping, more ZVI, and an extended construction schedule. The data acquired led to a comprehensive understanding of the complex lithology, contaminant distribution, and flow orientation, leading to an optimized design for the ZVI-PRB. An expanded performance monitoring well network was designed, including four in-wall monitoring wells to directly measure ZVI TCE degradation efficiency.

Twenty two injection wells were used to construct the 264 feet long ZVI-PRB (Figure ES-2). Twenty three resistivity strings, each with up to 19 receivers, were installed 12 feet offset from the ZVI-PRB in order to monitor the ZVI injection propagations. Construction activities (ZVI injection) began August 7, 2019 and were completed with abandonment of resistivity strings and placement of injection wells in a closed state on January 14, 2020.

Verification of construction completion was provided through multiple lines of evidence including pore pressure relief, active resistance mapping, recording injected ZVI weight, and by adhering to quality assurance procedures. During ZVI injection, wells adjacent to the injection well were opened to atmospheric pressure and monitored for pore pressure relief, indicated by observing material from the injection mixture exiting the open well. Pore pressure relief is an indicator that the initiated fracture is propagating along the ZVI-PRB alignment. Active resistance mapping was conducted to ensure propagation of the ZVI toward adjacent injection wells and to ensure continuity of the ZVI-PRB. Sodium chloride in the ZVI mixture was energized with an electrical current and measured by resistivity receivers inside each of the resistivity strings. By measuring the electrical resistivity, the receivers were able to triangulate the ZVI injection geometry and produced a 2-dimensional image. Lastly, the weight of ZVI injected in each injection well was recorded with a high level of detail to ensure the correct weight, and therefore volume, of ZVI was emplaced. Through these lines of evidence, there is a high level of confidence that the ZVI-PRB was installed to meet the design.

Throughout the ZVI-PRB construction, the project team optimized the ZVI injection mixture and distribution in order to reduce the waste and to complete the ZVI-PRB ahead of schedule. The vendor estimated that about 10% over the designed emplacement weight should be assumed as waste (nearly 70 tons). At completion of the ZVI-PRB, only 18.9 US tons of ZVI waste (2.7% of the design weight) was realized. Due to the waste minimization, the project team agreed to readjust the amount of ZVI being injected so that the remaining ZVI (50.2 US tons) was distributed throughout the ZVI-PRB in locations with the highest TCE concentrations. This change will increase the long-term performance of the barrier in reducing TCE mass flux to Steel Creek.

Throughout the ZVI injections, process adjustments were made to optimize injection performance. Extreme heat in August and September impacted the gel mixture geochemistry, which was managed through smaller batch production and daily fresh water shipments. In cooler fall weather conditions, injection efficiency was significantly increased. Subsequently, the project team took advantage of the optimized conditions to increase ZVI injection rates. This resulted in completion of ZVI injections ahead of schedule.

The completed ZVI-PRB installed is 264 feet long, emplaced up to 90 feet vertically between 45 and 135 feet below ground surface, and on average approximately 4 inches thick. A total of 741.1 US tons of ZVI was emplaced; which exceeds the design target of 691 US tons. The ZVI-PRB was constructed in a zig-zag orientation to account for the varying groundwater flow and to maximize residence contact time with the ZVI. The constructed ZVI-PRB is anticipated to achieve the removal action objective for the NTC RA to reduce the mass and downgradient transport of cVOCs present in groundwater. This will ultimately reduce the mass flux to Steel Creek.

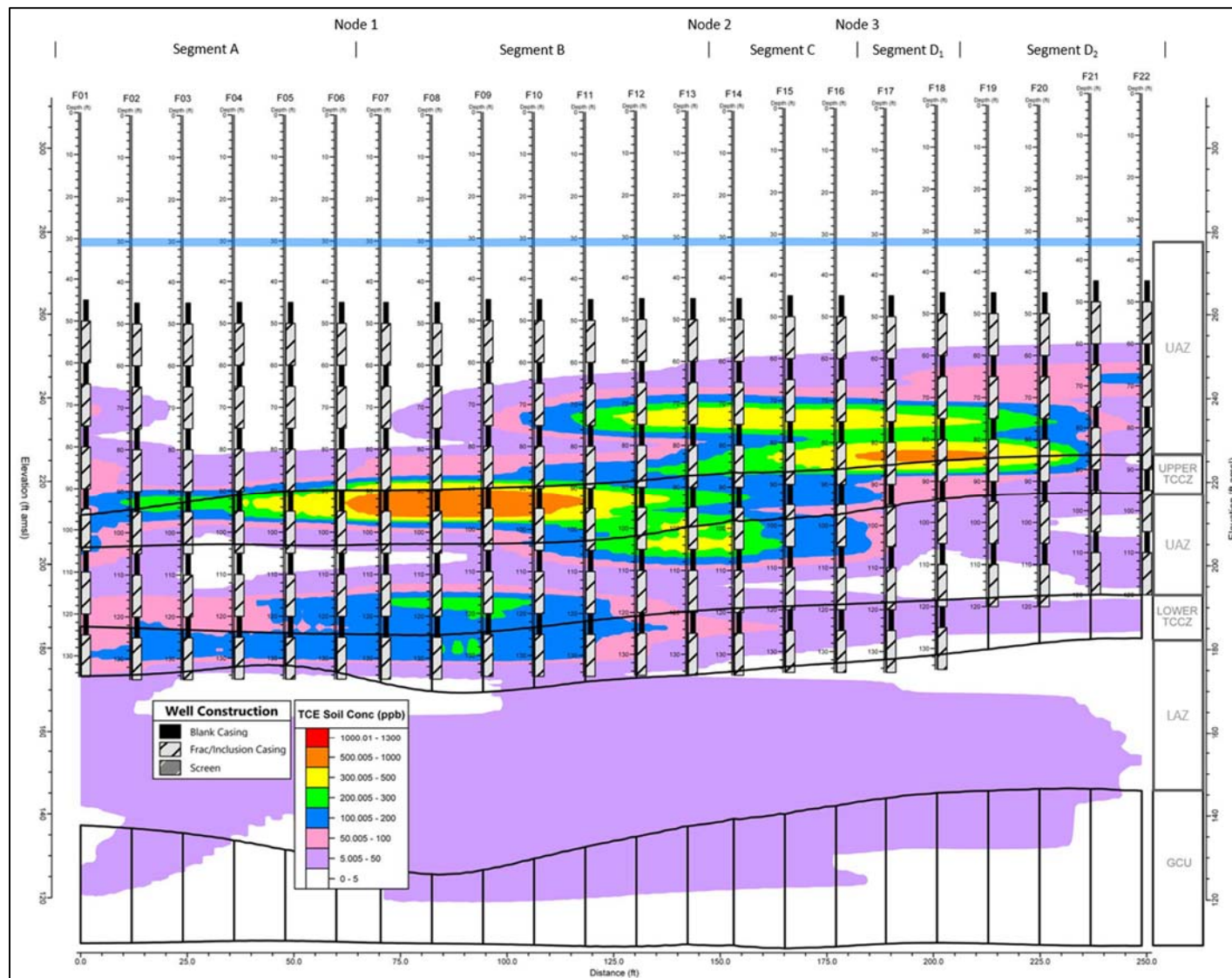


Figure ES-1. ZVI-PRB Expansion Casing Layout with TCE Plume

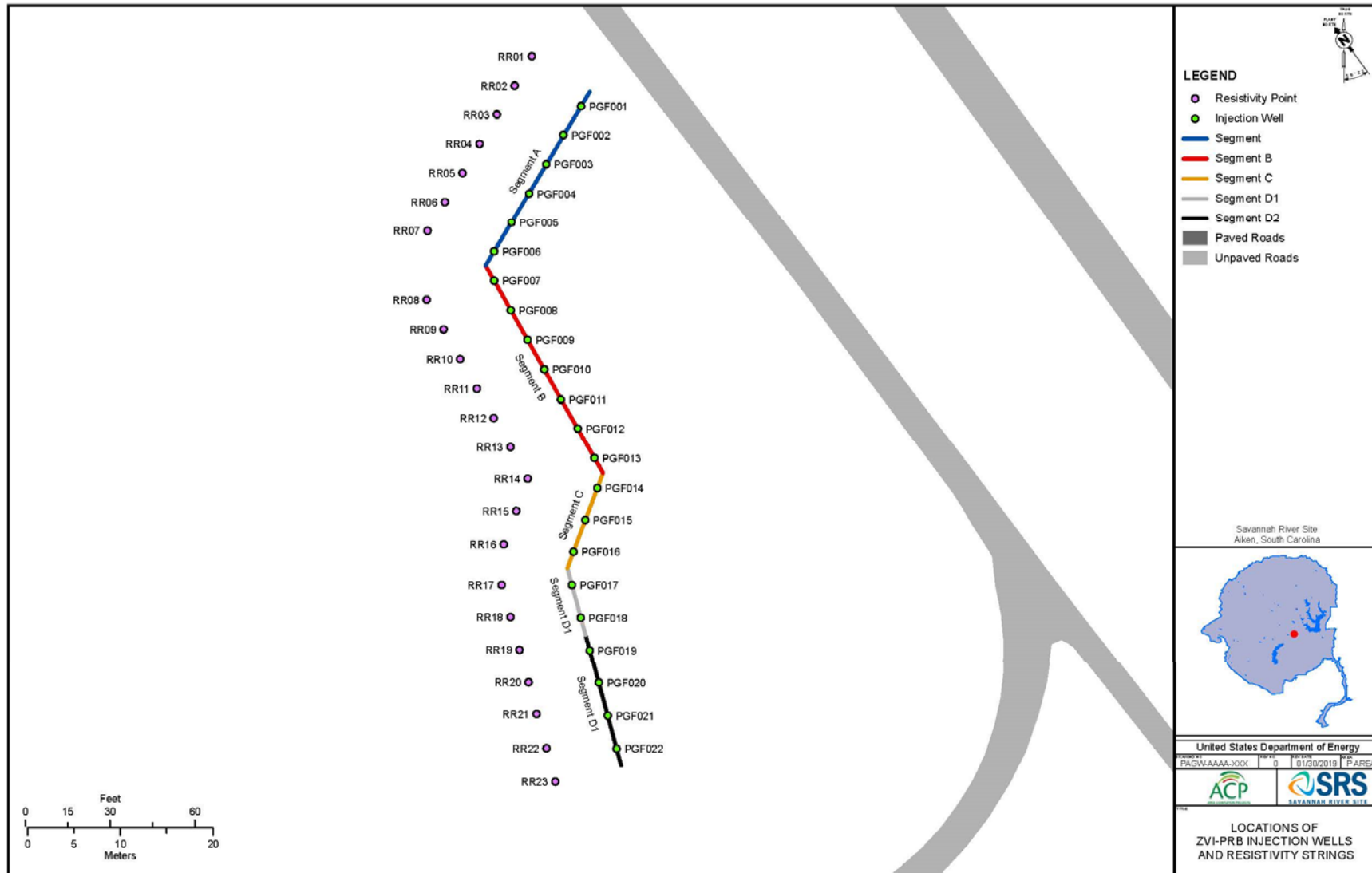


Figure ES-2. Plan View of the ZVI-PRB Injection Well and Resistivity String Layout

TABLE OF CONTENTS

<u>Section</u>	<u>Page No.</u>
LIST OF FIGURES .....	ix
LIST OF TABLES .....	x
LIST OF APPENDICES .....	x
LIST OF ABBREVIATIONS AND ACRONYMS .....	xi
<b>1.0 GENERAL DESCRIPTION .....</b>	<b>1</b>
<b>1.1 Purpose and Scope .....</b>	<b>1</b>
<i>1.1.1 Document Format .....</i>	<i>2</i>
<b>1.2 Operable Unit Background .....</b>	<b>2</b>
<i>1.2.1 General Description and Location of PAGW OU .....</i>	<i>2</i>
<i>1.2.2 Nature and Extent of Contamination in PAGW OU .....</i>	<i>3</i>
<b>1.3 Removal Action Requirements and Objective .....</b>	<b>4</b>
<i>1.3.1 Removal Action Objective .....</i>	<i>4</i>
<i>1.3.2 Selected Removal Action .....</i>	<i>4</i>
<b>1.4 Chronology of Events .....</b>	<b>5</b>
<b>2.0 CONSTRUCTION ACTIVITIES .....</b>	<b>5</b>
<b>2.1 Site Preparation .....</b>	<b>6</b>
<b>2.2 Expansion Casing and Resistivity String Installation .....</b>	<b>7</b>
<i>2.2.1 Expansion Casing Installation (PGF Wells) .....</i>	<i>7</i>
<i>2.2.2 Resistivity String Installation (RR Strings) .....</i>	<i>10</i>
<b>2.3 ZVI-PRB Construction Details .....</b>	<b>11</b>
<i>2.3.1 Panel A (36.6-41.1 m [120-135 ft] bgs) – PGF001 – PGF018 .....</i>	<i>13</i>
<i>2.3.2 Panel B (32.0-36.6 m [105-120 ft] bgs) – PGF001 – PGF022 .....</i>	<i>14</i>
<i>2.3.3 Panel C (27.4-32.0 m [90-105 ft] bgs) – PGF001 – PGF022 .....</i>	<i>14</i>
<i>2.3.4 Panel D (22.9-27.4 m [75-90 ft] bgs) – PGF001 – PGF022 .....</i>	<i>15</i>
<i>2.3.5 Panel E (18.3-22.9 m [60-75 ft] bgs) – PGF001 – PGF022 .....</i>	<i>16</i>
<i>2.3.6 Panel F (13.7-18.3 m [45-60 ft] bgs) – PGF001 – PGF022 .....</i>	<i>16</i>
<i>2.3.7 ZVI-PRB Construction Summary .....</i>	<i>17</i>
<b>2.4 ZVI-PRB In-Wall Monitoring Wells .....</b>	<b>18</b>
<b>2.5 Site Restoration and Demobilization .....</b>	<b>19</b>
<b>2.6 Construction Delays .....</b>	<b>20</b>
<b>2.7 Secondary Waste Disposal .....</b>	<b>20</b>
<b>3.0 DEVIATIONS FROM ORIGINAL DESIGN .....</b>	<b>21</b>
<b>4.0 VERIFICATION SAMPLING, TESTING AND ANALYSIS, PERFORMANCE STANDARDS, AND CONSTRUCTION QUALITY CONTROL .....</b>	<b>21</b>
<b>4.1 Performance Requirements/Standards .....</b>	<b>21</b>
<i>4.1.1 Achieving Design Requirements .....</i>	<i>23</i>
<b>4.2 Construction and Quality Assurance .....</b>	<b>25</b>
<i>4.2.1 Injection Gel Mixture .....</i>	<i>25</i>
<i>4.2.2 Injection Pressure .....</i>	<i>27</i>
<i>4.2.3 SRNS Quality Assurance Surveillance .....</i>	<i>27</i>

**5.0 Verification OF CONSTRUCTION COMPLETION AND FINAL INSPECTION.....28**

**5.1 Verification of Construction Completion .....28**

    5.1.1 *Active Resistance Mapping*.....29

    5.1.2 *Field Observations* .....29

    5.1.3 *Construction Quantities*.....30

    5.1.4 *Post-Construction HPIT*.....31

**5.2 Final Inspection for Acceptance of PAGW OU RA Construction Completion.....32**

**6.0 AS-BUILT DOCUMENTATION.....32**

    6.1 **As-Built Drawings**.....32

    6.2 **Well Modifications**.....33

**7.0 POST-Construction ACTIVITIES.....33**

    7.1 **Removal Action Effectiveness Monitoring** .....33

**8.0 PROJECT COSTS.....34**

**9.0 REFERENCES.....36**

**LIST OF FIGURES**

<u>Figure</u>	<u>Page No.</u>
FIGURE 1. NTC RA SITE LOCATION AT SRS .....	39
FIGURE 2. CROSS-SECTION OF ZVI-PRB TARGET AREA .....	40
FIGURE 3. PAOU REMEDIAL ACTION PSA-3A LOCATION .....	41
FIGURE 4. PAGW OU TCE PLUME MAP.....	42
FIGURE 5. PAGW OU TCE PLUME CROSS-SECTION FOR UAZ AND LAZ .....	43
FIGURE 6. ZVI-PRB EXPANSION CASING LAYOUT WITH TCE PLUME .....	44
FIGURE 7. ZVI-PRB RESISTIVITY STRING LAYOUT WITH LITHOLOGY CROSS-SECTION .....	45
FIGURE 8. LOCATIONS OF EMP WELLS .....	46
FIGURE 9. PLAN VIEW OF THE ZVI-PRB INJECTION WELL AND RESISTIVITY STRING LAYOUT .....	47
FIGURE 10. ACTIVE RESISTANCE MAPPING TIME-LAPSE IMAGING .....	48
FIGURE 11. PAGW OU UAZ GROUNDWATER FLOW DIRECTION AND POTENTIOMETRIC SURFACE .....	49
FIGURE 12. TYPICAL ZVI INJECTION PRESSURE GRAPH .....	50
FIGURE 13. COMPOSITE ACTIVE RESISTANCE MAPPING IMAGE OF COMPLETED ZVI-PRB .....	51
FIGURE 14. ZVI-PRB FINAL ZVI THICKNESS CALCULATIONS .....	52

**LIST OF TABLES**

<b><u>Table</u></b>		<b><u>Page No.</u></b>
<b>TABLE 1.</b>	<b>MAXIMUM cVOC CONCENTRATIONS IN THE PAGW OU GROUNDWATER PLUME.....</b>	<b>54</b>
<b>TABLE 2.</b>	<b>CHRONOLOGY OF EVENTS.....</b>	<b>55</b>
<b>TABLE 3.</b>	<b>ZVI-PRB INJECTION WELL CONSTRUCTION DETAILS .....</b>	<b>56</b>
<b>TABLE 4.</b>	<b>ZVI-PRB RESISTIVITY STRING CONSTRUCTION DETAILS .....</b>	<b>58</b>
<b>TABLE 5.</b>	<b>ZVI INJECTION QUANTITIES .....</b>	<b>62</b>
<b>TABLE 6.</b>	<b>IN-WALL MONITORING WELL CONSTRUCTION DETAILS .....</b>	<b>63</b>
<b>TABLE 7.</b>	<b>SUMMARY OF DEVIATIONS .....</b>	<b>64</b>
<b>TABLE 8.</b>	<b>ZVI GEL MIXTURE INGREDIENT QUANTITIES .....</b>	<b>66</b>
<b>TABLE 9.</b>	<b>GEL BATCH TESTING RESULTS.....</b>	<b>67</b>
<b>TABLE 10.</b>	<b>COMPARISON OF PRE- AND POST-CONSTRUCTION HPIT DATA .....</b>	<b>71</b>
<b>TABLE 11.</b>	<b>SRNS QA SURVEILLANCE FINDINGS AND RESPONSES .....</b>	<b>72</b>
<b>TABLE 12.</b>	<b>EMP WELL DETAILS.....</b>	<b>76</b>
<b>TABLE 13.</b>	<b>NTC RA COST COMPARISON SUMMARY .....</b>	<b>77</b>

**LIST OF APPENDICES**

**Appendix**

<b>Appendix A</b>	<b>ZVI-PRB Injection Well Construction Logs</b>
<b>Appendix B</b>	<b>ZVI-PRB Resistivity String Installation Reports</b>
<b>Appendix C</b>	<b>ZVI Injection Quantity Records</b>
<b>Appendix D</b>	<b>ZVI-PRB In-Wall Monitoring Well Construction Reports</b>
<b>Appendix E</b>	<b>ZVI-PRB Construction Supplier Deviation Disposition Request #6</b>
<b>Appendix F</b>	<b>ZVI-PRB Construction Field Observation Notes</b>
<b>Appendix G</b>	<b>Hydraulic Pulse Interference Testing Data</b>
<b>Appendix H</b>	<b>Installation Reports for Newly Installed EMP Monitoring Wells</b>
<b>Appendix I</b>	<b>ZVI-PRB Construction Supplier Deviation Disposition Request #7</b>
<b>Appendix J</b>	<b>ZVI-PRB As-Built Layout Drawings</b>

## LIST OF ABBREVIATIONS AND ACRONYMS

~	approximate, approximately
ac	acre
amsl	above mean sea level
AOC	area of contamination
bgs	below ground surface
Cascade	Cascade Drilling
cis-DCE	cis-1,2-dichloroethylene
cm	centimeter
cm/sec	centimeter per second
COA	certificate of analysis
ConeTec	ConeTec, Inc.
CPT	cone penetration technology
CQAPP	Construction Quality Assurance Project Plan
cVOC	chlorinated volatile organic compound
EMP	Effectiveness Monitoring Plan
EMR	Effectiveness Monitoring Report
FAI	final acceptance inspection
FFA	Federal Facility Agreement
FracTrac 1	injection trailer
FracTrac 2	monitoring trailer
ft	foot, feet
ft/day	foot per day, feet per day
ft <sup>2</sup>	square foot, square feet
gal	gallon
GeoSierra	GeoSierra Environmental, Inc.
ha	hectare
HPG	hydroxypropyl guar
HPIT	hydraulic pulse interference testing
in.	inch
kg	kilogram
kg/m <sup>3</sup>	kilogram per cubic meter
km	kilometer
kPa	kilopascal
kVA	kilovolt-ampere
L	liter
LAZ	Lower Aquifer Zone
lb	pound
LF	linear foot, linear feet
LM	linear meter
m	meter

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mm	millimeter
m/day	meter per day
m <sup>2</sup>	square meter
MCL	maximum contaminant level
MDL	minimum detection limit
mi	mile
NTC	Non-Time Critical
O&M	operation and maintenance
OU	Operable Unit
P.G.	Professional Geologist
PAGW	P-Area Groundwater
PAOU	P-Area Operable Unit
PCE	tetrachloroethylene
pcf	pound per cubic foot
PDI	Pre-Design Investigation
PPR	pore pressure relief
PRB	Permeable Reactive Barrier
P-RBC	P-Reactor Building Complex
PSA	Potential Source Area
psi	pound per square inch
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RA	Removal Action
RADP	Removal Action Design Plan
RAO	Removal Action Objective
RAR	Removal Action Report
RSER/EE/CA	Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis
SCDHEC	South Carolina Department of Health and Environmental Control
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
TBD	to-be-determined
TCCZ	tan clay confining zone
TCE	trichloroethylene
UAZ	Upper Aquifer Zone
µg/L	microgram per liter
UIC	Underground Injection Control
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
WSRC	Washington Savannah River Company, LLC
ZVI	Zero-Valent Iron

## **1.0 GENERAL DESCRIPTION**

### **1.1 Purpose and Scope**

This Removal Action Report (RAR) documents the completion of the Zero-Valent Iron (ZVI) Permeable Reactive Barrier (PRB) Non-Time Critical (NTC) Removal Action (RA) construction in the neck area of the trichloroethylene (TCE) groundwater plume of the P-Area Groundwater (PAGW) Operable Unit (OU). This RAR will serve as the United States Environmental Protection Agency (USEPA) Region 4 and South Carolina Department of Health and Environmental Control (SCDHEC) notification regarding completion and verification of construction activities. This report summarizes construction activities performed to implement the requirements defined within the Removal Action Design Plan (RADP) with Effectiveness Monitoring Plan (EMP) for the PAGW OU (Savannah River Nuclear Solutions, LLC [SRNS] 2019a). The planned post-construction activities are reported in Section 7.0 in accordance with the Federal Facility Agreement (FFA) (FFA 1993).

This report includes the following items:

- A brief description of the OU background, including a statement on the NTC RA requirements and objectives presented in the RADP;
- A chronology of events related to NTC RA completion;
- A summary of construction activities performed;
- Deviations from the approved RADP design;
- Performance standards and quality assurance (QA) inspections, including a summary of performance test results documenting verification of compliance with the acceptance criteria in the RADP;
- Final verification of the NTC RA completion;
- As-built documentation;
- Post-construction activities; and
- Project costs.

### **1.1.1 Document Format**

The format of this RAR was based on the Post-Construction Report/Corrective Measures Implementation Report/Remedial Action Completion Report protocol format, as applicable to the RAR, found in the *Environmental Compliance and Area Completion Projects Regulatory Document Handbook* (SRNS 2012a) approved by the USEPA and SCDHEC.

The PAGW OU NTC RA is complete and does not require long-term operation and maintenance (O&M) of constructed equipment or systems for treatment of contaminants in the source unit or in the groundwater. Rather the EMP will be implemented for five years to assess the performance of the NTC RA (SRNS 2019a).

## **1.2 Operable Unit Background**

P Area consists of a closed nuclear reactor building complex and several surface OUs. The P Area structures were previously characterized and identified as sources to soil and groundwater contamination (Washington Savannah River Company, LLC [WSRC] 2006). Groundwater within portions of the PAGW OU areal extent has been impacted by reactor and facility operations between 1954 and 1991, leading to contaminant plumes consisting primarily of tritium and chlorinated volatile organic compounds (cVOCs). A portion of the PAGW OU contamination is being addressed by the PAGW OU NTC RA under the Comprehensive Environmental Response, Compensation, and Liability Act.

### **1.2.1 General Description and Location of PAGW OU**

P Area is located in the central portion of the Savannah River Site (SRS) approximately (~) 4.0 kilometers (km) (2.5 miles [mi]) east-southeast of the geographical center of the SRS and about 6.4 km (4 mi) west of the nearest site boundary (Figure 1). The PAGW OU encompasses ~2,226 hectare (ha) (5,500 acres [ac]) of groundwater beneath P Area, extending northwest to Steel Creek, northeast toward PAR Pond and SRS Road F, and southeast to Meyers Branch. A shallow aquifer in the PAGW OU, the Upper Three Runs Aquifer, is split into the Upper Aquifer Zone (UAZ) and the Lower Aquifer Zone (LAZ)

by a local confining zone called the tan clay confining zone (TCCZ) (Figure 2). The UAZ extends from the water table (~10.7 meters [m] [35 feet {ft}] below ground surface [bgs]) to the TCCZ (~36.6 m [120 ft] bgs). The tan clay confining zone at times can be subdivided into an upper and lower TCCZ. The LAZ extends from the TCCZ to the Gordon Confining Unit (~50.3 m [165 ft] bgs).

### ***1.2.2 Nature and Extent of Contamination in PAGW OU***

The P Area surface units identified as posing a risk to human health, the environment, and contributing to groundwater contamination were remediated as part of the P-Area Operable Unit (PAOU) (SRNS 2008). Remedial action activities associated with surface units included in the PAOU have been completed and are documented in the PAOU Post Construction Report (SRNS 2012b). One surface unit, Potential Source Area (PSA)-3A, was determined to be the source of TCE plumes discharging to Steel Creek (Figure 3). PSA-3A was remediated in 2011 and the remedial goals were met using soil vapor extraction enhanced with soil fracturing and in-situ chemical oxidant injections.

The nature and extent of contamination in the PAGW OU was investigated using groundwater monitoring wells, direct-push technology, and surface water samples (SRNS 2013). Groundwater contamination associated with cVOCs is primarily exhibited in a narrow band north of the P-Reactor Building Complex (P-RBC) and extends toward the west to Steel Creek, where impact is known, and east towards an unnamed tributary to PAR Pond. The cVOC groundwater plumes can be described in three parts: 1) source area, 2) neck area, and 3) distal area (Figure 4). Maximum contaminant level (MCL) exceedances in groundwater occur over an area of ~6.9/8.5 ha (17/21 ac) for TCE in the UAZ/LAZ, respectively. Tetrachloroethylene (PCE) and cis-1,2-dichloroethylene (cis-DCE) plumes present in the UAZ and LAZ are contained within the TCE plume area as described and shown in the Sampling and Analysis Plan Addendum (SRNS 2018b). The source area represents most of the groundwater contamination and is centered north of the P-RBC within the P Area facility area. The neck area represents the zone where the cVOC groundwater plumes are controlled by a buried geologic feature thus creating a narrowing of the groundwater plumes and is located to the west just outside of the P Area facility area.

The distal area represents the area where the plumes are closest to Steel Creek. Table 1 lists the maximum reported concentrations for TCE, PCE, and cis-DCE in the UAZ and LAZ for the three areas during the fourth quarter sampling event in 2016 (SRNS 2018a). Surface water in Steel Creek is impacted by discharges of TCE contaminated groundwater above the MCL of 5 micrograms per liter ( $\mu\text{g/L}$ ). The area of impact is localized to the upper section of the creek. Maximum TCE concentrations were observed at 28.3  $\mu\text{g/L}$  in 2013 and more recently (2018) at 14.9  $\mu\text{g/L}$ .

A Pre-Design Investigation (PDI) was conducted in support of the RADP to finalize the extent of contamination within the neck area, gather a better understanding of the lithology, perform a treatability study, and finalize the location of the ZVI-PRB. Nine locations within the ZVI-PRB area were cored and soil plug samples were collected and analyzed for cVOCs. Results of the PDI soil plug data were used to generalize the TCE contaminant cross-section shown in Figure 5. The PDI results indicate the TCE concentrations in the UAZ are an order of magnitude higher than the LAZ, and the lateral extent of the plume is larger than initially expected. The results of this investigation led to optimizations in the ZVI-PRB design, captured in the RADP (SRNS 2019a).

### **1.3 Removal Action Requirements and Objective**

#### ***1.3.1 Removal Action Objective***

As detailed in the Action Memorandum (USDOE 2018), the removal action objective (RAO) for the PAGW OU NTC RA is to reduce the mass and downgradient transport of volatile organic compounds present in groundwater. This will reduce the mass flux downgradient to Steel Creek. As stated in the Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) (SRNS 2018a), the RAO will be achieved by implementing the NTC RA described below.

#### ***1.3.2 Selected Removal Action***

The United States Department of Energy (USDOE), USEPA, and SCDHEC determined cVOC groundwater contaminant plumes in the PAGW OU warranted a NTC RA. The

RSER/EE/CA (SRNS 2018a) evaluated five cleanup alternatives based on effectiveness, ease of implementation, and cost analysis. The RSER/EE/CA was approved in 2018 and the alternative selected in an Action Memorandum consisted of installing a ZVI-PRB in the neck area of the TCE groundwater plumes discharging to Steel Creek (USDOE 2018). The ZVI-PRB design was optimized based on data gathered during the PDI to confirm site subsurface characteristics and TCE plume extent. The final ZVI-PRB design was detailed in the RADP for the PAGW OU (SRNS 2019a) and included the following key elements:

- Nominal thickness of 10.2 centimeters (cm) (4 inches [in.]) to reduce TCE mass flux through the ZVI-PRB by at least 90%, including removal of degradation products (i.e., cis-DCE and vinyl chloride);
- Factor of safety (2.67) used to account for decrease in performance over time;
- Maintain degradation for at least 25 years;
- Keyed into the lower TCCZ to minimize contaminated groundwater flow under, over, or around the ZVI-PRB;
- Maintain hydraulic conductivity equal to or greater than the existing hydraulic conductivity of the permeable zones; and
- Total length of 80.5 linear meters (LM) (264 linear feet [LF]) with a cross-sectional area of 2,141 square meters (m<sup>2</sup>) (23,040 square feet [ft<sup>2</sup>]), requiring ~689 metric tons (760 US tons) of ZVI (with 10% allocated for waste).

## **1.4 Chronology of Events**

Table 2 provides the Chronology of Events.

## **2.0 CONSTRUCTION ACTIVITIES**

The PAGW OU construction team consisted of the following subcontractors: GeoSierra Environmental, Inc. (GeoSierra), Cascade Drilling (Cascade), and ConeTec, Inc. (ConeTec). GeoSierra was the primary subcontractor on the project, providing design and field implementation

support and labor. GeoSierra also provided Technical Oversight and Health and Safety Officer services. Cascade and ConeTec provided drilling services for installation of ZVI-PRB injection wells and resistivity strings. Cascade also provided services for installation of monitoring wells in support of the EMP. The construction of the ZVI-PRB at the site required a specific construction sequence:

1. Site preparation including mobilization and filling nearby monitoring wells with sand;
2. Drilling and installation of injection expansion casings;
3. Drilling and installation of active resistivity strings for monitoring ZVI placement;
4. Emplacement of the ZVI-PRB while conducting real-time installation monitoring;
5. Installation of four in-wall ZVI-PRB monitoring wells;
6. Site restoration and demobilization after ZVI-PRB installation; and
7. Post-construction hydraulic pulse interference testing (HPIT).

Each of these various tasks is discussed further below.

## **2.1 Site Preparation**

Mobilization was completed in two phases. The first phase began on May 29, 2019 with the pre-job meeting and included staging and receiving equipment in the ZVI-PRB installation area. GeoSierra mobilized a Moffett, dump hopper, washout skids, storage container, all expansion casings, and all resistivity strings. The second phase of mobilization was initiated upon completion of the drilling with a pre-job meeting on July 24, 2019. GeoSierra mobilized a diesel fuel tank, extended boom forklift, 70 kilovolt-ampere (kVA) generator, storage containers, frac tanks and pump, water truck, handwash station, and injection and monitoring trailers. A licensed electrician installed ground rods for the trailers, generators, and fuel tanks. GeoSierra setup the injection and monitoring systems, laydown yard, support areas, and safety eyewash and shower. GeoSierra connected the reference ground for the resistivity system at nearby well PGW035C, conducted baseline telemetry and tomography, and received materials for the ZVI-PRB injection mixture.

In order to protect the eight UAZ monitoring wells (DU and DL designation) within the ZVI-PRB area during injection activities, they were filled with #1A sand to grade prior to injections due to their proximity to the ZVI-PRB alignment and the potential for short-circuiting.

The area where the injection trailer (FracTrac 1) was staged was covered with a prefabricated containment pad constructed of 6 millimeter (mm) (0.24 in.) polyethylene sheeting. Hard mud mats were placed, where necessary, to add stabilization to the injection trailer setup. The monitoring trailer (FracTrac 2) was isolated from direct contact with the ground using plastic mud mats. This was critical to ensure that the monitoring system used only the reference ground to isolate the monitoring square wave from potential background voltage. The 70 kVA generator powered the FracTrac 2 and the dust box on the injection skid. Both FracTrac 1 and FracTrac 2 were staged in one location for the duration of the project. Following setup of all equipment and baseline testing, SRNS conducted a final acceptance inspection (FAI) prior to commencement of construction activities.

## **2.2 Expansion Casing and Resistivity String Installation**

On May 29, 2019, Cascade mobilized for the pre-job meeting and to begin installation of the injection wells with expansion casings along the ZVI-PRB alignment. As detailed on Table 3, the borehole bottom depth was targeted for ~41.8 m (137 ft) bgs, or ~37.5 m (123 ft) bgs, depending on location along the alignment, to support the ZVI-PRB installation. On June 10, 2019, ConeTec mobilized for a pre-job meeting and to begin installation of the resistivity strings parallel to the ZVI-PRB alignment. The resistivity strings were targeted for similar depths (Table 4), depending on location along the alignment, to monitor the propagation of the inclusions through active resistance mapping.

### **2.2.1 Expansion Casing Installation (PGF Wells)**

The installation of injection wells PGF001 to PGF022 commenced on May 29, 2019 under the oversight of a South Carolina Licensed Professional Geologist (P.G.) provided by GeoSierra. Sonic drilling with a 12.7 cm x 17.8 cm (5 in. x 7in.) dual tube was used for

casing installation on a ProSonic PS 150T drill rig. The rig progressed from north to south, averaging 0.9 wells per day.

The components of injection wells PGF001-PGF018 include the following materials from bottom to ground surface: 0.61 m (2 ft) aluminum stinger, 3.0 m (10 ft) aluminum expansion casing, 1.5 m (5 ft) carbon steel riser pipe, 3.0 m (10 ft) aluminum expansion casing, 1.5 m (5 ft) carbon steel riser pipe, 3.0 m (10 ft) aluminum expansion casing, 1.5 m (5 ft) carbon steel riser pipe, 3.0 m (10 ft) aluminum expansion casing, 1.5 m (5 ft) carbon steel riser pipe, 3.0 m (10 ft) aluminum expansion casing, 1.5 m (5 ft) carbon steel riser pipe, carbon steel riser pipe with fins, and carbon steel riser pipe to grade connected by steel couplings. Injection wells PGF019-PGF022 include one less 3.0 m (10 ft) aluminum expansion casing and 1.5 m (5 ft) carbon steel riser pipe. The aluminum expansion casings were prefabricated prior to mobilization, and the injection wells were assembled in the field by GeoSierra while the borehole was drilled by Cascade. All components are pre-marked along the azimuth of the expansion casing joint to ensure vertical alignment during installation.

The method of installation at each location included the following sequence:

- Hand auger to a depth of ~1.8 m (6 ft) bgs for utility clearance;
- Drill the borehole to target depth using dual tube casing;
- Flood the casing with bentonite to maintain borehole integrity for expansion casing installation;
- Lower the expansion casings, pre-marked along the azimuth, into the borehole followed by riser pipe; and
- Begin grouting borehole while extracting outer casing with minimal vibration as necessary to free the drill casing.

As the injection well sections were lowered into the borehole, all expansion casings were tightened by set screws to the 1.5 m (5 ft) riser pipes. Additionally, all riser pipe joints above the expansion casings were tack welded. Once installed, a compass confirmed the

casing orientation and markings. After each injection well was grouted, the well was flushed with clean water, and the bottom depth was confirmed. Some grout was later observed above the stinger in a few casings during confirmation of depth; however, this grout was washed out from flushing with water. As final confirmation, a downhole camera was used to confirm azimuth of the installed casing.

After all wells were installed, they remained unfinished for the duration of the ZVI-PRB installation with only a coupling at grade for attachment of the wellhead. Upon completion of the ZVI-PRB installation, the riser pipe was cut and a 0.61 m (2 ft) steel riser was attached to a threaded coupling such that all points were at the same elevation above grade. The risers were painted safety yellow and secured with a well cap and a lock. A concrete pad was formed around the well and a well tag was placed on the riser pipe.

Since the alignment of the ZVI-PRB was offset from the soil borings collected during the PDI, the bottom 3 m (10 ft) of select injection well borings were cored and examined to confirm the lower section of the TCCZ since this was the lower confining zone of the ZVI-PRB. The following locations were cored, focusing mainly on the change in direction of the alignment:

- PGF002 – 38.4 – 41.5 m (126 - 136 ft) bgs
- PGF007 – 39.0 – 42.1 m (128 - 138 ft) bgs
- PGF009 – 39.3 – 42.4 m (129 - 139 ft) bgs
- PGF012 – 39.3 – 42.4 m (129 - 139 ft) bgs
- PGF014 – 36.6 – 42.4 m (120 - 139 ft) bgs
- PGF017 – 39.0 – 42.1 m (128 - 138 ft) bgs
- PGF022 – 34.7 – 37.8 m (114 - 124 ft) bgs

As shown on Figure 6, the depths of the bottom expansion casings, on average, maintained a depth of 41.8 m (137 ft) bgs since the elevation change along the alignment was minimal. The final installation details of the injection wells are included in Table 3 and well construction logs are included in Appendix A.

### **2.2.2 Resistivity String Installation (RR Strings)**

Installation of the resistivity strings (RR01-RR23) commenced on June 14, 2019, concurrent with installation of the PGF wells and under the oversight of a South Carolina Licensed P.G. provided by GeoSierra. A cone penetration technology (CPT) rig using 5.7 cm (2.25 in.) rods with expendable tips was used for string installation using one 22.7 metric ton (25 US ton) Vertek CPT truck. The rig started at RR01 then moved to RR23, maintaining a safe distance from the drill rig installing the expansion casings, averaging 2.1 strings per day.

The components of RR01-RR23 include the following materials: 2.5 cm (1 in.) polyvinyl chloride (PVC) outer tubing with 18-gauge wires connected each to a stainless steel receiver every 1.5 m (5 ft) from the bottom of the tubing to 13.7 m (45 ft) from the top of the tubing. An additional 1.5 m (5 ft) of PVC tubing was extended at the top to account for elevation changes and reel connections to FracTrac 2. RR01-RR19 had 19 receivers and RR20-RR23 had 16 receivers. The resistivity strings were fabricated by GeoSierra and all wires were checked for continuity.

The method of installation at each location included the following sequence:

- Hand auger to a depth of ~1.8 m (6 ft) bgs for utility clearance;
- Pull the bottom of the resistivity string through the lead CPT rod with the adapter and expendable tip and attach the adapter;
- Advance the lead rod;
- Thread tubing through additional CPT rods and attach to lead CPT rod while advancing to target depth;
- Once target depth is met, extract rods while leaving expendable tip, and therefore string, in place; and
- Apply bentonite pellets at surface to seal top of the resistivity string at grade.

After all strings were installed, they remained unfinished for direct wiring of reels to the monitoring system. Table 4 summarizes final installation details for the 23 resistivity

strings and installation reports for the resistivity strings are included in Appendix B. The cross-section of the resistivity strings is in Figure 7.

### **2.3 ZVI-PRB Construction Details**

In addition to the materials required for the expansion casings and resistivity strings, there was specific injection and monitoring equipment that was mobilized to the site at the start of installation activities. Equipment mobilized included:

- FracTrac 1
  - Two 11,360 liter (L) (3,000 gallon [gal]), stainless-steel mixing tanks;
  - Glove box pump skid;
  - 261 kilowatt (350 horsepower) hydraulic power unit;
  - Industrial scale/auger ZVI feed unit;
  - Blending skid;
  - Dust box;
- Three washout skids;
- Equipment storage and FracTrac 2
  - Office and break area;
  - Monitoring systems;
  - Field lab for hydroxypropyl guar (HPG) QA/quality control (QC);
  - Equipment and tool storage;
- Three 2,490 kilogram (kg) (5,500 pound [lb]) capacity concrete hoppers;
- 4,540 kg (10,000 lb) Lull and Moffett fork trucks;
- Air compressor;
- Smeal; and
- Other miscellaneous support equipment.

The ZVI-PRB is comprised of 22 injection wells, labeled PGF001 through PGF022. Construction of the ZVI-PRB commenced August 7, 2019 on the northern end at PGF001. The ZVI-PRB was completed from the bottom up by panels due to the length and the interest of maintaining consistency. Along each panel, the ZVI-PRB was constructed in well groups to minimize backpressure in the formation. As an example, odd numbered wells were completed concurrently one day, then even numbered wells were completed the next day.

To control injections into each panel (i.e., Panel A, B, C, D, E, F), mechanical packers were installed to isolate injections to the desired zone, or panel. For Panel A injections, packers were installed above Panel A expansion casings. Each casing required multiple injections in order to attain the ZVI weight calculated to achieve the nominal design thickness. Once construction of Panel A was completed, the packer and internal injection piping were lifted above Panel B. Each of the injection wells were filled with ZVI to ~0.61 to 0.91 m (2 to 3 ft) above the top of Panel A expansion casings. With the packer set and ZVI in place, Panel B was successfully isolated and ready for injection. Similarly, once all Panel B wells were completed, the packer and internal injection piping were lifted above Panel C and again filled with ZVI to 0.61 to 0.91 m (2 to 3 ft) above the top of the Panel B expansion casing to seal it prior to construction of Panel C. This sequence continued for the remaining three panels: Panel D, E, and F. Isolation of the panels was successful for all injection wells, except PGF022 which was damaged during installation. This deviation is described in more detail in Section 3.0 and is not anticipated to affect the performance of the ZVI-PRB. Upon completion of Panel F, all packers and injection piping were removed. To complete the ZVI-PRB construction, GeoSierra measured the depth to bottom of each injection well to confirm the depth to bottom was at the top of Panel F (i.e., 13.7 m [45 ft] bgs). Each well was filled with ZVI to a depth of 12.8 m (42 ft) bgs to capture seasonal groundwater fluctuations and sand from 12.8 m (42 ft) bgs to grade. All injections were completed on December 11, 2019.

For each panel, SRNS allocated a skid pan for waste, including discarded gel from GeoSierra's mixing skid (i.e., dumped weight) with ZVI due to low viscosity, equipment

failures, and inclement weather. Discarded gel that did not contain ZVI was applied to ground in accordance with SRNS waste management guidance. Injection well washouts (washout weight), which were performed between injections to clear the well for pore pressure relief (PPR) from adjacent wells, were also put in the skid pan. Weights of any dumped gel batches containing ZVI were recorded. When the panel was completed, the skid pan was weighed and used to calculate the washout weights from each panel. Washout weights were subtracted from the total final ZVI injection weight per panel to finalize nominal thickness per panel. ZVI loss due to washout was accounted for by ordering 10% excess ZVI material and observing the weight of ZVI being retained in the panels. Adjustments were made to the injected weight for each panel and injection well as described later in this report. Below is an example of the formula used to determine the washout weight and each panel weight loss is discussed below in the panel summaries. [Note: the weights per skid pan included minor water weight. Most of the water was decanted prior to weighing the pan. It was assumed the water content was minimal for calculations.]:

$$\text{Skid Pan Weight} - \text{Dumped Weight} = \text{Washout Weight}$$

### **2.3.1 Panel A (36.6-41.1 m [120-135 ft] bgs) – PGF001 – PGF018**

ZVI-PRB Panel A construction commenced at well PGF001 and ended at well PGF018 between August 7 and September 9, 2019, in sequence discussed above. Panel A had a cross-sectional area of 301 m<sup>2</sup> (3,240 ft<sup>2</sup>). In order to meet the design thickness outlined in the RADP, 88,178 kg (194,400 lbs) of ZVI was required. A total of 92,587 kg (204,120 lbs) of ZVI was injected to build Panel A as summarized on Table 5. The final weight of the skid pan for Panel A was 4,354 kg (9,600 lbs), which included 1,315 kg (2,900 lbs) of discarded material. The remaining weight of ~3,039 kg (6,700 lbs) was from washout, or 3.3% of the total injected weight. The resulting weight in this panel is 89,548 kg (197,420 lbs) remaining in Panel A from PGF001 to PGF018, which exceeds the design.

PPR was observed at every well except PGF013 and PGF017. A few wells exhibited PPR as far as two to three wells from the respective injection well. During injections, all wells

exhibited average casing opening and injection pressures except PGF005 to PGF007, where injection pressures were higher. PGF005 to PGF007 also experienced backpressure resulting in the injection hose and equipment sanding off or clogging. Although backpressure was observed during injections at these wells, subsequent injections were successful in emplacing the target ZVI weight.

### **2.3.2 Panel B (32.0-36.6 m [105-120 ft] bgs) – PGF001 – PGF022**

ZVI-PRB Panel B construction commenced at well PGF001 and ended at well PGF021 between September 11 and October 2, 2019, in sequence to Panel A construction. Panel B had a cross-sectional area of 368 m<sup>2</sup> (3,960 ft<sup>2</sup>). In order to meet the design thickness outlined in the RADP, 107,774 kg (237,600 lbs) of ZVI was required. A total of 108,019 kg (238,142 lbs) of ZVI was injected to build Panel B as summarized on Table 5. The final weight of the skid pan for Panel B was 3,211 kg (7,080 lbs), which included 680 kg (1,500 lbs) of discarded material. The remaining weight of ~2,531 kg (5,580 lbs) was from washout, or 2.3% of the total injected weight. PGF022 was unable to be injected into due to an issue isolating the interval with a packer, described in more detail in Section 3.0. Therefore, the total weight required for Panel B to meet the design thickness was 102,875 kg (226,800 lbs). The resulting weight in this panel is 105,488 kg (232,562 lbs), which exceeds the design for 21 locations.

PPR was observed at every well except PGF005, PGF009, and PGF010. Three wells exhibited PPR as far as two wells from the respective injection well. During injections at PGF003 and PGF017, backpressure resulted in sanding off in the injection hose and equipment. Although backpressure was observed during injections at these wells, subsequent injections were successful in emplacing the target ZVI weight.

### **2.3.3 Panel C (27.4-32.0 m [90-105 ft] bgs) – PGF001 – PGF022**

ZVI-PRB Panel C construction commenced at well PGF001 and ended at well PGF021 between October 3 and October 21, 2019, in sequence to Panel A and B construction. Panel C had a cross-sectional area of 368 m<sup>2</sup> (3,960 ft<sup>2</sup>). In order to meet the design thickness

outlined in the RADP, 107,774 kg (237,600 lbs) of ZVI was required. A total of 135,282 kg (298,245 lbs) of ZVI was injected to build Panel C as summarized on Table 5. The final weight of the skid pan for Panel C was 3,438 kg (7,580 lbs), which included 454 kg (1,000 lbs) of discarded material. The remaining weight of ~2,985 kg (6,580 lbs) was from washout, or 2.2% of the total injected weight. PGF022 was unable to be injected due to an issue isolating the interval with a packer, described in more detail in Section 3.0. Therefore, the total weight required for Panel C to meet the design thickness was 102,875 kg (226,800 lbs). The resulting weight in this panel is 132,297 kg (291,665 lbs), which exceeds the design for 21 locations.

PPR was observed at all locations along the ZVI-PRB Panel C. Two wells exhibited PPR at least two to three wells from the respective injection well. Two wells exhibited backpressure, PGF007 and PGF009, resulting in sanding off in the equipment. Although backpressure was observed, subsequent injections were successful in emplacing the target ZVI weight.

#### **2.3.4 Panel D (22.9-27.4 m [75-90 ft] bgs) – PGF001 – PGF022**

ZVI-PRB Panel D construction commenced at well PGF001 and ended at well PGF021 between October 24 and November 15, 2019, in sequence to Panel A, B, and C construction. Panel D had a cross-sectional area of 368 m<sup>2</sup> (3,960 ft<sup>2</sup>). In order to meet the design thickness outlined in the RADP, 107,774 kg (237,600 lbs) of ZVI was required. A total of 146,647 kg (323,301 lbs) of ZVI was injected to build Panel D as summarized on Table 5. The final weight of the skid pan for Panel D was 2,930 kg (6,460 lbs), which included 1,588 kg (3,500 lbs) of discarded material. The remaining weight of ~1,343 kg (2,960 lbs) was from washout, or 0.9% of the total injected weight. PGF022 was unable to be injected into due to an issue isolating the interval with a packer, described in more detail in Section 3.0. Therefore, the total weight required for Panel D to meet the design thickness was 102,875 kg (226,800 lbs). The resulting weight in this panel is 145,304 kg (320,341 lbs), which exceeds the design for 21 locations.

PPR was observed at all injection wells except PGF002, PGF007, PGF008, PGF010, PGF014, and PGF020. Heavy PPR was exhibited at PGF007 during PGF006 injections and at PGF016 during PGF015 injections. Backpressure resulting in sanding off occurred at PGF012. Although backpressure was observed, subsequent injections were successful in emplacing the target ZVI weight.

### **2.3.5 Panel E (18.3-22.9 m [60-75 ft] bgs) – PGF001 – PGF022**

ZVI-PRB Panel E construction commenced at well PGF001 and ended at well PGF021 between November 19 and December 4, 2019, in sequence to Panel A, B, C, and D construction. Panel E had a cross-sectional area of 368 m<sup>2</sup> (3,960 ft<sup>2</sup>). In order to meet the design thickness outlined in the RADP, 107,774 kg (237,600 lbs) of ZVI was required. A total of 132,058 kg (291,138 lbs) of ZVI was injected to build Panel E as summarized on Table 5. The final weight of the skid pan for Panel E was 2,023 kg (4,460 lbs). There was no discarded material in this panel, resulting in the entire weight as washout or 1.5% of the total injected weight. PGF022 was unable to be injected into due to an issue isolating the interval with a packer, described in more detail in Section 3.0. Therefore, the total weight required for Panel E to meet the design thickness was 102,875 kg (226,800 lbs). The resulting weight in this panel is 130,035 kg (286,678 lbs), which exceeds the design for 21 locations.

PPR was observed at all injection wells except PGF005, PGF009, PGF015, PGF016, PGF019, and PGF021. Five injection wells, PGF003, PGF007, PGF008, PGF012, and PGF014 exhibited PPR upwards of two to three wells away. Although backpressure was observed at PGF011, subsequent injections were successful in emplacing the target ZVI weight.

### **2.3.6 Panel F (13.7-18.3 m [45-60 ft] bgs) – PGF001 – PGF022**

ZVI-PRB Panel F construction commenced at well PGF001 and ended at well PGF022 between December 5 and December 11, 2019, in sequence to Panel A, B, C, D, and E construction. Panel F had a cross-sectional area of 368 m<sup>2</sup> (3,960 ft<sup>2</sup>). In order to meet the

revised design thickness (See Section 3.0), 53,887 kg (118,800 lbs) of ZVI was required. A total of 69,903 kg (154,110 lbs) of ZVI was injected to build Panel F as summarized on Table 5. The final weight of the skid pan for Panel F was 1,162 kg (2,560 lbs), which included 227 kg (500 lbs) of discarded material, as well as 635 kg (1,400 lbs) of excess ZVI that was not injected. The remaining weight of ~299 kg (660 lbs) was from washout, or 0.4% of the total injected weight. The resulting weight in this panel is 69,604 kg (153,450 lbs) remaining in Panel F from PGF001 to PGF022, which meets the required ZVI weight.

Minimal PPR was observed in Panel F. Only eight wells exhibited PPR mostly along the southern end, with PPR observed two wells away while injecting into PGF019.

### **2.3.7 ZVI-PRB Construction Summary**

In summary, the ZVI-PRB was constructed from the bottom up in six panels and all panels were injected with more than the minimum ZVI required to meet the target thickness for each interval. Table 5 summarizes the total ZVI-PRB construction quantities. Actual quantities for each casing are included in Appendix C. The following averages are noted:

- Panel A required 24 days to complete, averaging ~3.9 metric tons/day (4.3 US tons/day);
- Panel B required 16 days to complete, averaging 6.7 metric tons/day (7.4 US tons/day);
- Panel C required 13 days to complete, averaging 10.4 metric tons/day (11.5 US tons/day);
- Panel D required 19 days to complete, averaging 7.7 metric tons/day (8.5 US tons/day);
- Panel E required 10 days to complete, averaging 13.2 metric tons/day (14.6 US tons/day); and
- Panel F required 5 days to complete, averaging 14.0 metric tons/day (15.4 US tons/day).

A total of 689,460 kg (1,520,000 lbs), or 689.5 metric tons (760 US tons) of ZVI was delivered in support of the ZVI-PRB NTC RA. Discarded waste accounted for ~4.9 metric tons (5.4 US tons) of ZVI, resulting in 684.5 metric tons (754.6 US tons) of ZVI that was injected into the 22 injection wells. ZVI in washout of the injection wells totaled ~12.2 metric tons (13.5 US tons). Therefore, 672.3 metric tons (741.1 US tons) of ZVI remains in-situ to construct the 80.5 LM (264 LF) ZVI-PRB. In anticipation of ZVI losses due to discarded material, washout, etc., 10% extra ZVI was ordered. Installation of the ZVI-PRB was performed with high efficiency and only 2.7% of the delivered ZVI weight was not emplaced. Therefore, 107.3% of the required ZVI weight for a nominal thickness of 10.2 cm (4 in.) across the entire ZVI-PRB was emplaced.

#### **2.4 ZVI-PRB In-Wall Monitoring Wells**

In order to further monitor and evaluate ZVI-PRB performance, four of the PGF injection wells (PGF005, PGF011, PGF017, and PGF021) were converted to monitoring wells for groundwater sampling in support of the EMP. The locations of the monitoring wells and screen intervals were chosen based on the highest levels of TCE observed from soil plug data collected during the PDI.

Cascade mobilized on December 16, 2019 to begin conversion of the injection wells to monitoring wells. The method of installation included water jetting to total depth to remove existing ZVI. Once the target depth was met, Cascade installed a 2.5 cm (1 in.) Schedule 40 PVC well comprised of a 6.1 m (20 ft), 0.025 cm (0.010 in.) slot screen, riser pipe to 0.76 m (2.5 ft) above grade, and a well cap. The annulus of the well was backfilled with ZVI as a filter pack to 12.8 m (42 ft) bgs, maintaining the continuity of the installed ZVI-PRB. Above the ZVI filter pack, Cascade installed #2 filter sand to 0.91 m (3 ft) bgs followed by bentonite hole plug to grade. All four wells were secured with an aluminum cap and locked. Well tags were placed on the riser stickups and in the concrete pad. All wells were installed under the oversight of a South Carolina Licensed P.G. Figure 8 depicts the location of the monitoring wells and Table 6 includes the well construction details. The well construction logs are included in Appendix D.

## **2.5 Site Restoration and Demobilization**

Following completion of all ZVI injection activities, the injection wells were filled with ZVI to ~12.8 m (42 ft) bgs to ensure continuity of the ZVI-PRB, and then filled with #2 sand to grade. Injection wells were left this way to allow for reinjection if required at a later date for enhancing the ZVI-PRB performance, increasing the ZVI thickness, injecting amendments to address precipitation or biofouling, etc. The entire well column was not filled with ZVI because, if exposed to air, the ZVI would oxidize and therefore would not be able to be removed for future access to the injection wells. Resistivity strings posed a potential for creating a preferential vertical flow path for contaminated groundwater. Therefore, resistivity strings were abandoned by excavating 15.2 cm (6 in.) bgs, cutting the strings as close to ground as possible, and capping with grout.

Concurrently with the abandonment of resistivity strings, Cascade evacuated all the UAZ monitoring wells of sand and redeveloped them for post-construction HPIT. It was noted that there was no ZVI present in these monitoring well pairs located ~6.1 to 7.6 m (20 to 25 ft) from the ZVI-PRB alignment. The sand was placed in the wells before injection activities to eliminate any short-circuiting of ZVI to the monitoring wells.

Demobilization of the ZVI-PRB installation equipment and materials was completed the week of December 16, 2019 concurrent with ZVI-PRB in-wall monitoring well installation. GeoSierra staged all downhole injection tooling and packers for radiation screening out on December 16, 2019. All equipment on FracTrac 1 was secured and FracTrac 2 was loaded with ancillary equipment, piping, hoses, and packers. All secondary containment was disposed of and grounding rods were removed. FracTrac 1 was demobilized offsite on December 19, 2019 and FracTrac 2 was moved to the laydown yard for post-construction HPIT, to be completed in January 2020.

A second demobilization was completed on January 30, 2020 by GeoSierra concurrently with performance of post-construction HPIT. FracTrac 2, the Smeal, Moffett, hoppers, fuel tank, storage container, and handwash station were demobilized during this event. A FAI was conducted on January 27, 2020 with final acceptance pending due to a hose clamp

issue that needed action. Upon fixing the issue, final acceptance was completed effective March 2, 2020.

## **2.6 Construction Delays**

No major delays were encountered during the construction of this NTC RA. While minor planning and operational delays were encountered, the overall time spent in the field injecting ZVI into the subsurface met expectations. Installation of the injection wells and resistivity strings was performed concurrently, taking ~25 workdays. Construction of the ZVI-PRB took ~97 total workdays, with 69 days of injection to emplace 684.6 metric tons (754.6 US tons) of ZVI.

## **2.7 Secondary Waste Disposal**

All waste generated throughout this project was handled in accordance with the requirements set by applicable SRS manuals and procedures and with waste management guidance. During drilling, all generated fluids were discharged to ground within the area of contamination (AOC). Water generated during decontamination of CPT rods following resistivity string installation was applied to ground within the AOC.

Two waste streams were created during ZVI injections, gel with ZVI and gel without ZVI. Batches of gel (mixture of HPG, acetic acid, sodium chloride, and water) were tested prior to adding ZVI to ensure the properties of the mixture were adequate to hold the ZVI in suspension. Batches that were not able to be used due to low viscosity, equipment failures, and inclement weather and that did not contain ZVI were discharged to ground within the AOC. Unused batches of gel that contained ZVI, as well as washout fluids from the expansion casings, were put into a skid pan. After setting, the water was decanted off the skid pan and discharged to ground within the AOC. ZVI and solids from the gel mixture that were left in the skid pan were disposed of at the Three Rivers Solid Waste Authority Class Three Landfill (Permit #024202-1101). All job control waste and personal protective equipment was disposed of as sanitary waste.

### **3.0 DEVIATIONS FROM ORIGINAL DESIGN**

Several deviations were needed during construction of the NTC RA to resolve problems or to optimize the ZVI-PRB implementation. The project team reviewed all changes prior to implementation to ensure compliance with regulatory requirements in the RSER/EE/CA and the RADP. Consistent with the RADP, notifications were made to USEPA and SCDHEC prior to implementation, as appropriate. Table 7 provides a summary of all such changes. The basis and resolution of deviations from the original design are detailed in the table. Where applicable, a statement is provided on whether the deviation still meets a performance criterion.

### **4.0 VERIFICATION SAMPLING, TESTING AND ANALYSIS, PERFORMANCE STANDARDS, AND CONSTRUCTION QUALITY CONTROL**

#### **4.1 Performance Requirements/Standards**

The PAGW OU RADP with EMP (SRNS 2019a) and the PAGW OU Underground Injection Control (UIC) Permit Application (SRNS 2019b) specify the performance requirements for the PAGW OU NTC RA as follows:

- a) Installation of 22 injection wells and 23 resistivity strings along four segments. The locations and depths per the design are detailed in Table 3 and Table 4 and shown in Figure 9.
- b) Suspension of ZVI in a proprietary gel mixture with adequate viscosity to initiate a fracture and inject ZVI into the subsurface. The gel mixture would consist of HPG, acetic acid, sodium chloride, a proprietary cross-linker, a proprietary enzyme, and ZVI. The maximum mass for each ingredient per the UIC Permit Application is included in Table 8. The ratios of ingredients was expected to vary with each batch depending on variables such as temperature, humidity, and source water geochemistry.
- c) Injection of 627 metric tons (691 US tons) (689 metric tons [760 US tons] including 10% waste) of ZVI into the subsurface through 22 injection wells to produce a 2,140 m<sup>2</sup> (23,040 ft<sup>2</sup>) ZVI-PRB with a nominal thickness of 10.2 cm (4 in.). The resulting barrier was envisioned to be 80.5 LM (264 LF) in total length along a zig-zag alignment

with four segments. The anticipated segment lengths and depths are shown in Figure 6 and Figure 9 and detailed below:

- i. Segment A – Consist of six injection wells (PGF001-PGF006) for a length of 22 LM (72 LF). Each injection well to be constructed using six expansion casings with a target depth interval of 13.7-41.1 m (45-135 ft) bgs (Panel A-F).
  - ii. Segment B – Consist of seven injection wells (PGF007-PGF013) for a length of 26 LM (84 LF). Each injection well to be constructed using six expansion casings with a target depth interval of 13.7-41.1 m (45-135 ft) bgs (Panel A-F).
  - iii. Segment C – Consist of three injection wells (PGF014-PGF016) for a length of 11 LM (36 LF). Each injection well to be constructed using six expansion casings with a target depth interval of 13.7-41.1 m (45-135 ft) bgs (Panel A-F).
  - iv. Segment D<sub>1</sub> – Consist of two injection wells (PGF017-PGF018) for a length of 7.3 LM (24 LF). Each injection well to be constructed using six expansion casings with a target depth interval of 13.7-41.1 m (45-135 ft) bgs (Panel A-F).
  - v. Segment D<sub>2</sub> – Consist of four injection wells (PGF019-PGF022) for a length of 15 LM (48 LF). Each injection well to be constructed using five expansion casings with a target depth interval of 13.7-36.6 m (45-120 ft) bgs (Panel B-F).
- d) The installed ZVI-PRB was anticipated to intersect groundwater flow and was not expected to decrease the hydraulic conductivity of the subsurface in the treatment zone. ZVI injections would be monitored using active resistance mapping to show evidence of injection propagation and complete coalescence of the barrier. Active resistance mapping was to be performed using 23 resistivity strings. Records of field indicators, active resistance mapping images, and qualitative results from post-construction HPIT would be used to demonstrate the ZVI-PRB was completed as intended per the design.

- e) Following completion of the ZVI-PRB construction, four in-wall monitoring wells were to be installed within injection wells PGF005, PGF011, PGF017, and PGF021 at depths specified in Table 6. The injection wells would be abandoned by filling with ZVI to ensure continuity of the ZVI-PRB. The resistivity strings would be cut at ground surface and abandoned in place.

#### ***4.1.1 Achieving Design Requirements***

The design requirements, as detailed above, are compared against the field performance to determine if the requirements have been met. The following discussion will describe how the performance requirements were met with approved deviations in Section 3.0.

All injection wells were installed in the correct location without issue. The injection wells were installed with a target depth of 41.8 m (137 ft) bgs, which deviated from the design as described in item 3 of Table 7. All resistivity strings were installed as intended with the exception of RR01 and RR11-RR14, as described in item 2 of Table 7 and Appendix A. All resistivity strings were successfully installed at the target depth, as shown in Table 4 and Appendix B.

The amounts of each ingredient mixed for each batch of gel are provided in Table 9. The amounts used in Table 9 are totals for each ingredient, including bad batches that were not injected into the injection wells. Therefore, these totals are conservative when compared with the UIC Permit. The total amounts of each ingredient used did not exceed the limits set by the UIC Permit, and therefore there were no nonconformities in the injected amounts of materials.

At completion of ZVI-PRB construction, 684.6 metric tons (754.6 US tons) of ZVI were injected into the 22 injection wells and ~672.3 metric tons (741.1 US tons) of ZVI was retained in the subsurface. This exceeds the required 626.9 metric tons (691 US tons) by 7.2%. The final ZVI-PRB thickness met or exceeded 10.2 cm (4 in.) at all intervals, except in Panel F (13.7-18.3 m [45-60 ft] bgs) for all injection wells and in injection well PGF022 in all panels. The project team agreed that the TCE concentrations in Panel F were

significantly lower, and therefore agreed that the reduced thickness in this panel would provide sufficient residence time to degrade the cVOCs at the influent concentrations by at least 90%, therefore meeting the performance objective. Injection well PGF022 was damaged during construction and could not be used to inject for Panel B-E. As discussed in item 5 of Table 7, a deviation to the design was considered and approved by the project team that would ensure the performance objective was still met across the entire ZVI-PRB. Overall, the nominal thickness of the entire ZVI-PRB still exceeds 10.2 cm (4 in.) and the barrier is expected to achieve an overall reduction in influent TCE concentrations of at least 90% even considering the reduction in ZVI thickness in Panel F.

Active resistance mapping was conducted to ensure the ZVI injections were propagating as intended and to complete coalescence of the ZVI-PRB was achieved. Active resistance mapping images were monitored in real-time as shown in Figure 10. The change in resistance in the images provided evidence of ZVI propagation toward adjacent injection wells. Evidence of ZVI propagation was observed at each injection casing, and no voids in ZVI coverage were observed.

The final constructed ZVI-PRB was installed with a “zig-zag” alignment due to varying groundwater flow directions in the UAZ (Figure 11). This alignment increased the angle that groundwater intersected the barrier, thus promoting groundwater flow through the ZVI-PRB. To provide assurance that the ZVI-PRB did not decrease the hydraulic conductivity of the subsurface, post-construction HPIT was conducted and compared with pre-construction testing. The results are shown in Table 10. It is important to note that well pairs for this testing did not allow for testing to be conducted parallel to groundwater flow direction, as the test is intended. Therefore, the data is interpreted qualitatively as opposed to quantitatively. The results indicate that there was not a significant reduction in hydraulic conductivity across the ZVI-PRB, and communication was observed in all well pairs post-construction. In conclusion, the constructed ZVI-PRB is not anticipated to alter the groundwater flow path through the treatment area.

In support of the EMP for the NTC RA, four in-wall monitoring wells were installed within injection wells PGF005, PGF011, PGF017, and PGF021. In-wall monitoring wells were

installed with screen depths that differed from the design slightly (Table 6). This was an expected deviation, as the screen depths were to be optimized based on observations of the boring core and from analyses of soil plug samples taken from the core. In-wall monitoring wells were installed without issue.

After completion of all ZVI injections, resistivity strings were abandoned and injection wells were filled with ZVI and #2 filter sand as described in Section 2.5, therefore meeting the performance objective.

## **4.2 Construction and Quality Assurance**

As outlined in the design, construction QA procedures were followed to ensure the ZVI-PRB was installed in accordance with the Construction Quality Assurance Project Plan (CQAPP). Criteria of focus in the CQAPP included:

- Well installation details will be checked versus design and deviations will be noted;
- ZVI bulk density and sieve analysis will be within technical specifications;
- HPG mix parameters including pH, resistivity, viscosity and cross link breaking time (gel only) will be monitored and recorded;
- Density of gel/ZVI mix will be within technical specifications;
- Wellhead injection pressures will be monitored and recorded;
- Well injection flow rates will be monitored and recorded;
- Batch feed rates of ZVI will be monitored and recorded; and
- Active resistance mapping will be monitored for ZVI-PRB geometry deficiencies.

Important aspects of the CQAPP and a QA Surveillance conducted by SRNS are described in more detail below.

### **4.2.1 Injection Gel Mixture**

Seventy-two batches of gel (~747,240 L [197,400 gal]) were mixed to complete injections of 684.6 metric tons (754.6 US tons) of ZVI and cleanout of equipment at the site. After

mixing the gel, a sample of the batch mixture was tested in FracTrac 2's field lab for temperature, viscosity, pH, and resistance to determine if it meets the specifications for injection. In the event a batch of gel could not be injected, typically due to inclement weather or equipment issues, the gel was retested the next day to determine if it could be reused for injections. Thirteen batches were tested the second day, totaling 85 total gel tests. Results of the batch testing are included in Table 9. If the gel was out of specification, the gel was dumped to the ground in the AOC per the waste guidance. A total of 50,000 L (13,200 gal) of gel were discarded to the ground.

Initial batch mixtures of gel in support of Panel A injections faced difficulty suspending ZVI, although the gel test results indicated viscosity was within specification. High ambient temperatures and humidity caused the gel to breakdown quicker as the day progressed, resulting in a thinner gel that could not suspend the ZVI long enough for emplacement. The gel recipe was adjusted to target a higher viscosity to extend the time of ZVI suspension, which resulted in viscosities out of specification with the original CQAPP. Other factors that may have influenced the carrier fluid include a larger diameter pump on the injection skid and a less dense ZVI based on the adjusted grain size from the design. The gel specification included in the design was based on tests that were prepared using a smaller diameter pump and ZVI with a bulk density of 2,883 kilograms per cubic meter ( $\text{kg/m}^3$ ) (pounds per cubic foot [180 pcf]). While these factors may or may not have contributed to the changes in the gel recipe, only five tests were within specifications. This variance was determined to have no major effect on the ZVI injections or performance of the ZVI-PRB.

Over the course of the project, the resistance was also measured to ensure the ranges met the requirements for active resistance mapping. Typically, the amount of salt is also field adjusted based on the quality of images obtained. For this project, six measurements were higher than the specification. Although higher readings exceeded the specification, this did not affect the quality of imaging or use of the active resistance mapping for confirmation of injection geometry and coalescence of the ZVI-PRB.

As described in Section 3.0, and in Appendix E, the bulk density of the ZVI delivered to the site was significantly lower than the ZVI bulk density used in the ZVI-PRB design. The change in bulk density was due to an error updating the ZVI properties in the design after the ZVI gradation was optimized for site specific conditions. The design called for a 2,883 kg/m<sup>3</sup> (180 pcf) ZVI, while the certificate of analysis' (COA's) for the delivered ZVI had an average bulk density of 2,419 kg/m<sup>3</sup> (151 pcf). The difference in the ZVI bulk density affects the density of ZVI in the gel mixture to be injected, and therefore affects the thickness of the constructed ZVI-PRB. The project team discussed this and agreed that the change would not result in a reduction in the ZVI-PRB performance and would actually result in an increase in the ZVI-PRB thickness.

#### **4.2.2 *Injection Pressure***

Wellhead injection pressures were monitored throughout the duration of injections. In general, injection wellhead pressures averaged between 689 to 862 kilopascal (kPa) (100 to 125 pounds per square inch [psi]) although random higher pressures were noted predominantly during backpressure or sanding off events in the injection hose and equipment. Pressures noted during opening of the casings ranged between 1,034 and 1,379 kPa (150 and 200 psi). A typical injection pressure graph in Figure 12 shows a full injection from the beginning with the casing opening, pump start/stop, and injection. Not every graph will be "typical." After the first injection, which initiates the fracture to adjacent injection wells, the spike in pressure will likely not be apparent in subsequent injections. Injection pressures remained within specification throughout the ZVI-PRB installation.

#### **4.2.3 *SRNS Quality Assurance Surveillance***

SRNS performed a QA surveillance of the ZVI-PRB construction to ensure the criteria outlined in the QA procedures were being followed. Observations from the QA surveillance and resolutions are listed in Table 11. The significant issues resulting from the QA surveillance were:

- Discrepancy on the COA's of analyses for the delivered ZVI;

- No QC test of the first 181 metric tons (200 US tons) of delivered ZVI, as recommended in the subcontractor's design report; and
- Evidence of recording field notes on important QC parameters for the gel mixture and ZVI injections was not apparent.

All identified concerns from the QA surveillance were explained to satisfaction in the field except for some action items, as identified in Table 11. All action items were resolved to satisfaction from the project team.

## **5.0 VERIFICATION OF CONSTRUCTION COMPLETION AND FINAL INSPECTION**

Construction activities required for the NTC RA have met the performance requirements established in the approved RADP with EMP for the PAGW OU (SRNS 2019a) and the approved PAGW OU UIC Permit Application (SRNS 2019b), with acceptable deviations as detailed in Section 3.0. The NTC RA described in this RAR is expected to achieve the RAO outlined in the RSER/EE/CA for PAGW OU (SRNS 2018a). Verification of NTC RA completion is addressed in Section 5.1. The NTC RA implementation was accepted based on a FAI detailed in Section 5.2.

### **5.1 Verification of Construction Completion**

Members of the SRNS project team maintained constant coverage of the NTC RA implementation. Verification of injection well and resistivity string installation was provided through oversight by a South Carolina Licensed P.G. provided by GeoSierra. The Cascade driller performing installations and the P.G. also provided well construction logs (Appendix A) and CPT installation reports (Appendix B) for further verification.

Verification of the ZVI-PRB installation was provided by the subcontractor through the following evidence:

- Active resistance mapping images;
- Recorded field notes including PPR observations;

- Records of injected ZVI weight; and
- Post-construction HPIT results compared with pre-construction HPIT.

The NTC RA is expected to meet the RAO through field implementation of the NTC RA per the approved RADP (SRNS 2019a). Verification is based on the discussion in this section, as well as the FAI described in Section 5.2. It is concluded that the PAGW OU NTC RA has been completed satisfactorily in accordance with the requirements of the PAGW OU RADP. As detailed in the RADP, an EMP will be implemented for the next five years, described in more detail in Section 7.0.

### ***5.1.1 Active Resistance Mapping***

During construction of the ZVI-PRB, active resistance mapping was utilized to track the propagation of the ZVI/gel mixture through the subsurface by real-time measurement of voltage changes surrounding the injection casings. The captured images depict the lateral propagation during an injection. An example of a time lapse sequence of a ZVI injection at PGF014 is included in Figure 10. The resistivity outputs were used as a guide to ensure continuity and coalescence of the injected ZVI during construction.

From observations of the resistivity images over time, it was estimated that propagations extended laterally up to 7.3 to 7.9 m (24 to 26 ft) along the azimuth of the barrier. With a 3.7 m (12 ft) center-to-center spacing of the injection wells, this results in an overlap of ZVI distribution, thereby, achieving complete coalescence along the entire ZVI-PRB. Figure 13 represents a composite image of resistivity images indicating a coalesced ZVI-PRB. Using the estimated propagations from the active resistance mapping images, thickness calculations were performed and are presented on Figure 14.

### ***5.1.2 Field Observations***

Detailed field notes summarizing visual evidence of panel propagation and overlap were maintained. Visual evidence can be in the form of surface cracks along the ZVI-PRB alignment, although none were observed for this project, or through PPR. PPR is an

important phenomenon that provides concrete evidence that lateral distribution of ZVI or continuity of the ZVI-PRB has been achieved. A summary of notable observations is provided in Appendix F.

PPR was observed throughout this project with all injection well panels either achieving PPR during injections or experiencing PPR from adjacent well injections, with the exception of Panel B at PGF010, Panel D at PGF001, Panel E at PGF009, and Panel F at PGF001-PGF003 and PGF005-PGF007. Panel F received less ZVI injections than the rest of the ZVI-PRB, which may be a factor in the injections wells not experiencing PPR at six locations. At the completion of the ZVI-PRB, 115 of 124 expansion casings that received injections experienced PPR. Therefore, strong evidence was provided through visual observations that ZVI was propagating along the azimuth of the ZVI-PRB for the entire length of the barrier.

### **5.1.3 Construction Quantities**

Installation of the ZVI-PRB concluded with a total of 684.5 metric tons (754.6 US tons) of ZVI injected, as shown in Table 5 and in Appendix C. Accounting for the weight of ZVI in the washout of each injection well, the final total amount of ZVI that was emplaced in the subsurface is 672.3 metric tons (741.1 US tons). The completed ZVI-PRB installation is ~80.5 LM (264 LF) with a height of 27.4 m (90 ft) for 65.8 LM (216 LF) and 22.9 m (75 ft) for the remaining 14.6 LM (48 LF) to the south with varying thicknesses, depending on the “hot-spot” locations along the alignment as well as adjustments to Panel F. Using the bulk density of the delivered ZVI (2,419 kg/m<sup>3</sup> [151 pcf]), the average thickness is 13.0 cm (5.11 in.), which is 28% greater than the design thickness to achieve the RAO. Across the ZVI-PRB Panels A through Panel E, the maximum thickness is 17.0 cm (6.71 in.) and the minimum thickness is 12.3 cm (4.84 in.). The thickness in Panel F at all locations is 7.82 cm (3.08 in.). Therefore, the thickness at all locations across the ZVI-PRB exceeds the design specifications, with deviations described in Section 3.0.

#### 5.1.4 Post-Construction HPIT

HPIT was conducted prior to and following the installation of the ZVI-PRB to qualitatively verify that installation of the ZVI-PRB did not impact the natural groundwater flow. HPIT is highly sensitive and defines the degree of hydraulic continuity between a source and receiver well pair. Post-construction HPIT was conducted on four monitoring well pairs beginning January 27, 2020 along the ZVI-PRB alignment with upgradient wells as the source wells and downgradient wells as the receiver wells. The same pairs were tested in reverse for repeatability. A majority of the well pairs tested post-construction were the same as the pairs tested pre-construction of the ZVI-PRB, allowing for a direct comparison.

The HPIT arrangement, typical data, and type-curve matching are shown on outputs in Appendix G. The HPIT was conducted across the monitoring well pairs as follows with the last four pairs measured for repeatability:

<u>Source Well</u>	<u>Receiver Well</u>
1DU	2DU
1DL	2DL
3DU	4DU
3DL	4DL
2DU	1DU
2DL	1DL
4DU	3DU
4DL	3DL

The hydraulic conductivity and storativity values computed for each well pair are detailed in Table 10 for comparison between pre- and post-construction HPIT results. The hydraulic conductivity calculated for the ZVI-PRB ranged from 0.09 to 146 meters per day (m/day) (0.30 to 479 feet per day [ft/day]) with an average of 37.1 m/day (122 ft/day). The calculated storativity values ranged from  $5.84 \times 10^{-6}$  to  $1.28 \times 10^{-4} \text{ m}^{-1}$  ( $1.78 \times 10^{-6}$  to  $3.91 \times 10^{-5} \text{ ft}^{-1}$ ).

HPIT is intended to be conducted parallel to groundwater flow direction for reliable data. In the case of this project, the available monitoring well pairs and varying flow directions of the UAZ in the ZVI-PRB area did not allow for ideal HPIT conditions. Therefore, the

data was assessed qualitatively and was not considered to be reliable results for subsurface properties in the ZVI-PRB area. In comparing the data of the post-construction and pre-construction HPIT, there are discernable responses in the receiver wells, indicating the well pairs are communicating and providing confidence that there is flow through the ZVI-PRB. While this is a qualitative evaluation, the results indicate that the ZVI-PRB installation did not cause any negative impacts to the natural aquifer characteristics or to the natural groundwater flow through the area targeted by the NTC RA. This provides further confidence that the ZVI-PRB achieves the performance criteria.

## **5.2 Final Inspection for Acceptance of PAGW OU RA Construction Completion**

An internal FAI was performed on 02/05/2020 by the PAGW OU project team, SRNS safety and operations personnel, and USDOE. The FAI was accepted by SRNS on 03/02/2020, marking completion of construction of the ZVI-PRB. Performance of the NTC RA will be monitored and assessed as identified in the EMP.

## **6.0 AS-BUILT DOCUMENTATION**

### **6.1 As-Built Drawings**

The following as-built drawings are provided for the completion of the PAGW OU NTC RA:

- Appendix J.1 – PAGW OU NTC RA As-Built of Resistivity Strings and Injection Wells, Plan View
- Appendix J.2 – PAGW OU NTC RA As-Built of Monitoring Wells in Support of the EMP, Plan View
- Appendix J.3 – PAGW OU NTC RA As-Built of the ZVI-PRB Trace, Plan View

## **6.2 Well Modifications**

In support of this NTC RA, seven downgradient groundwater monitoring wells (PRW005DL, PRW005DU, PRW006C, PRW006DL, PRW006DU, PRW007DL, and PRW007DU) and four in-wall groundwater monitoring wells (PIW001D, PIW002D, PIW003D, and PIW004D) were installed in the PAGW OU for effectiveness monitoring (Figure 8). The newly installed wells will be sampled and analyzed under the EMP in support of this NTC RA, as described in Section 7.1. Well records and soil boring installation reports for the newly installed wells are provided in Appendix H, and in Appendix D for the new in-wall monitoring wells.

## **7.0 POST-CONSTRUCTION ACTIVITIES**

Construction activities in support of the ZVI-PRB NTC RA at the PAGW OU are complete. Land use of the entire PAGW OU area will be controlled consistent with the SRS Land Use Control Assurance Plan (WSRC 1999). There is no current or projected future use of groundwater or surface water as a drinking water source at the PAGW OU and site access is controlled by SRS facility security and administrative controls. Site specific land use controls are expected to be addressed as part of the final remedial action for the PAGW OU. Post-construction effectiveness monitoring for the ZVI-PRB will be completed through the implementation of the EMP, as detailed below.

### **7.1 Removal Action Effectiveness Monitoring**

The RAO to protect human health and the environment is to reduce the mass and downgradient transport of volatile organic compounds present in groundwater. This will reduce the mass flux downgradient to Steel Creek. The PAGW OU NTC RA, consisting of initiating vertical fractures perpendicular to groundwater flow, and injecting a ZVI mixture that will leave, in-situ, a permeable barrier. The ZVI-PRB will degrade cVOCs in groundwater to harmless end products, and is expected to achieve the mass flux reduction in TCE that is required to meet the RAO. Verification will be provided by the results of the approved EMP in support of the RADP (SRNS 2019a).

The EMP consists of eight upgradient monitoring wells, 14 downgradient monitoring wells, and four in-wall monitoring wells. Table 12 and Figure 8 depict the location and construction details of the monitoring wells to be used for the EMP. Wells will be sampled quarterly for all wells, except one well cluster farthest downgradient of the ZVI-PRB (PRW006), which will be sampled annually. Sampling will be conducted for five years and results will be reported annually in an Effectiveness Monitoring Report (EMR). In accordance with the closure requirements of the RADP, the annual EMRs for the PAGW OU NTC RA will evaluate the overall effectiveness of the NTC RA in reducing TCE mass flux in the contaminated groundwater as well as the sustainability of the ZVI-PRB. Any potential future actions will be addressed by the USDOE, USEPA, and SCDHEC as part of the PAGW OU final remedial decision process.

## **8.0 PROJECT COSTS**

Table 13 provides a cost comparison of the final costs for the NTC RA to the original RSER/EE/CA cost estimate. The RSER/EE/CA capital cost estimate was \$2,901,583 and the O&M cost estimate was \$1,709,506, for a total project cost estimate of \$4,611,089 (SRNS 2018a). There was a significant difference in actual cost versus the estimate in the total capital cost for this project and therefore the costs have been broken down in Table 13 for further explanation below.

The capital cost incurred in each phase is detailed in Table 13 with a combined total actual capital cost of \$9,349,456, which is 222% higher than estimated in the RSER/EE/CA. The ZVI-PRB project activities, and respective costs, occurred in three phases, the data design acquisition plan (DDAP) phase, the design phase, and the construction phase. Due to the unique subsurface at the ZVI-PRB target location, an extensive DDAP was required to optimize the NTC RA design which consisted of installing two upgradient monitoring well clusters (consisting of 3 wells/cluster), installing two downgradient monitoring well clusters (consisting of 3 wells/cluster), continuous coring, soil sampling and analysis, and geophysical logging at nine locations, treatability study to determine contaminant degradation rates and long-term performance of the ZVI, and pre-construction HPIT. This effort was not accounted for in the RSER/EE/CA cost estimate and therefore is a major factor in the large overall variance in cost. The design phase consisted of

analyzing the DDAP data and producing a final design report. The cost of the design phase was in line with the estimate.

The construction phase cost is most comparable to the majority of the RSER/EE/CA estimate and was just slightly above the estimate for SRNS costs. The main contributor to the large delta cost in this project was the subcontractor costs in the construction phase of this project. This difference in cost can be attributed in part to the increase in total length of the ZVI-PRB, requiring additional drilling for injection wells and resistivity strings, more material for the injection casing construction, and more ZVI for the additional injection volume to construct the barrier. In addition to increasing the ZVI-PRB size, the larger extent of the barrier required additional monitoring wells. These changes to the NTC RA design were necessary based on the contaminant distributions that were identified during the DDAP phase. O&M costs for this NTC RA are to-be-determined (TBD), as O&M is ongoing through performance monitoring of the ZVI-PRB.

## **9.0 REFERENCES**

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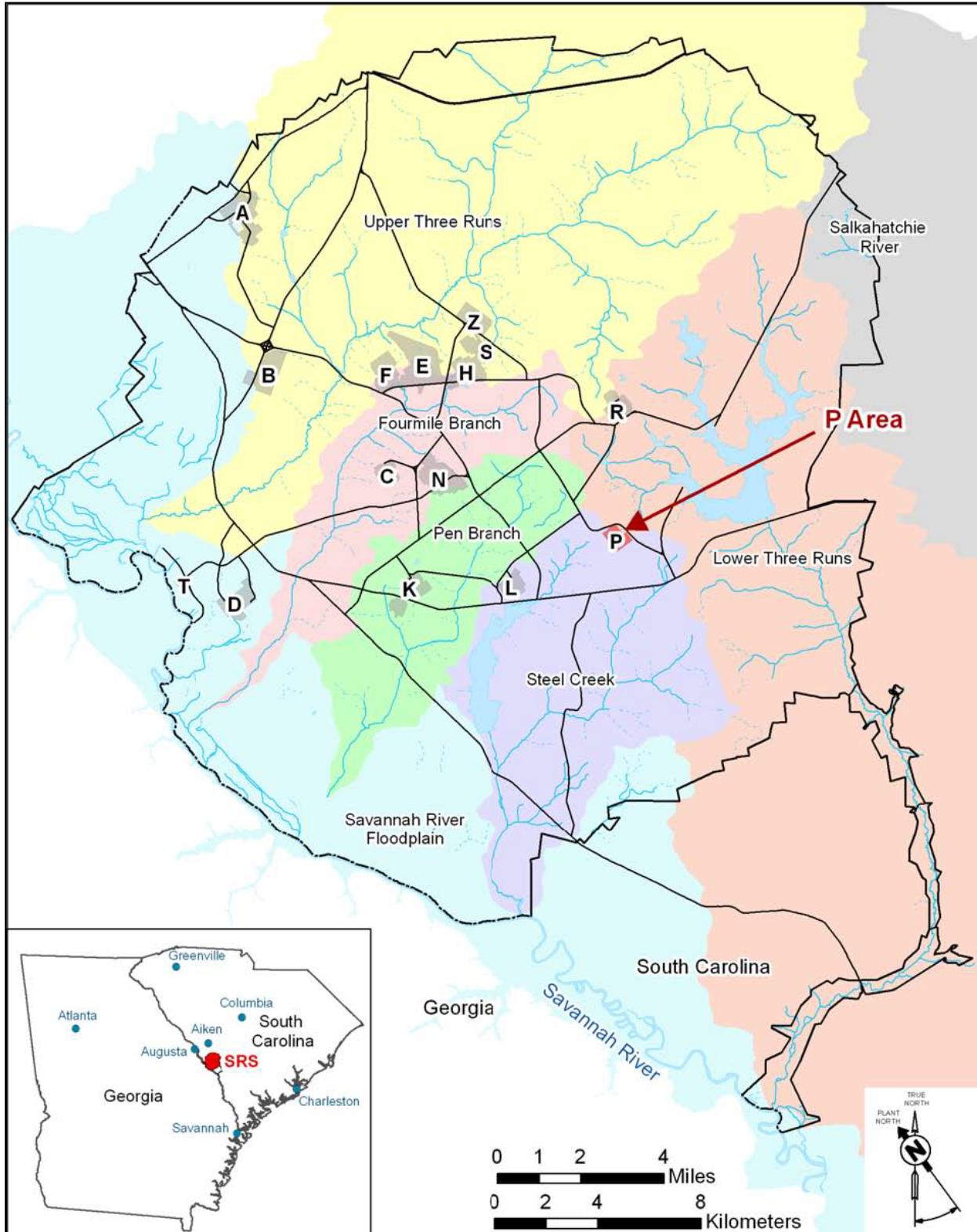


Figure 1. NTC RA Site Location at SRS

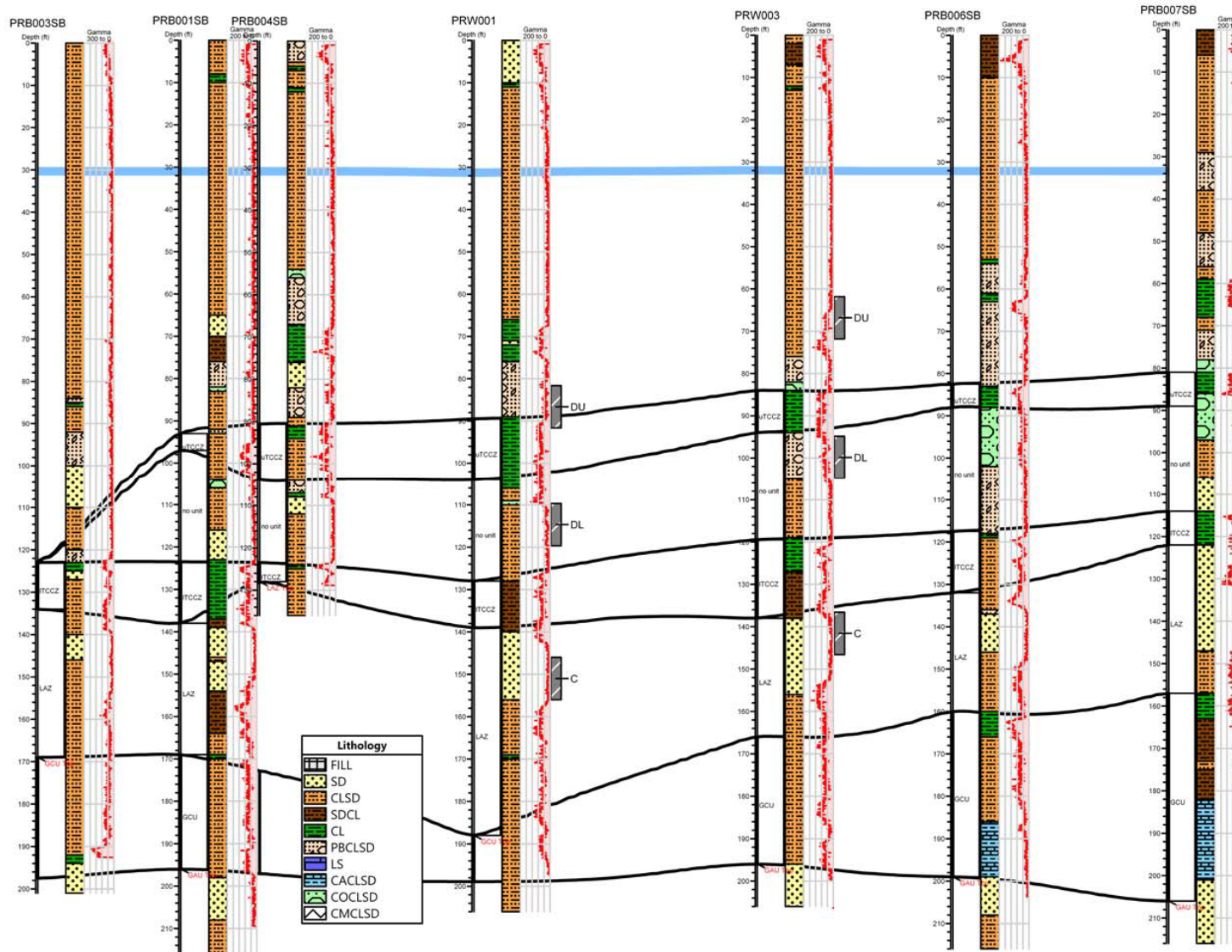


Figure 2. Cross-Section of ZVI-PRB Target Area

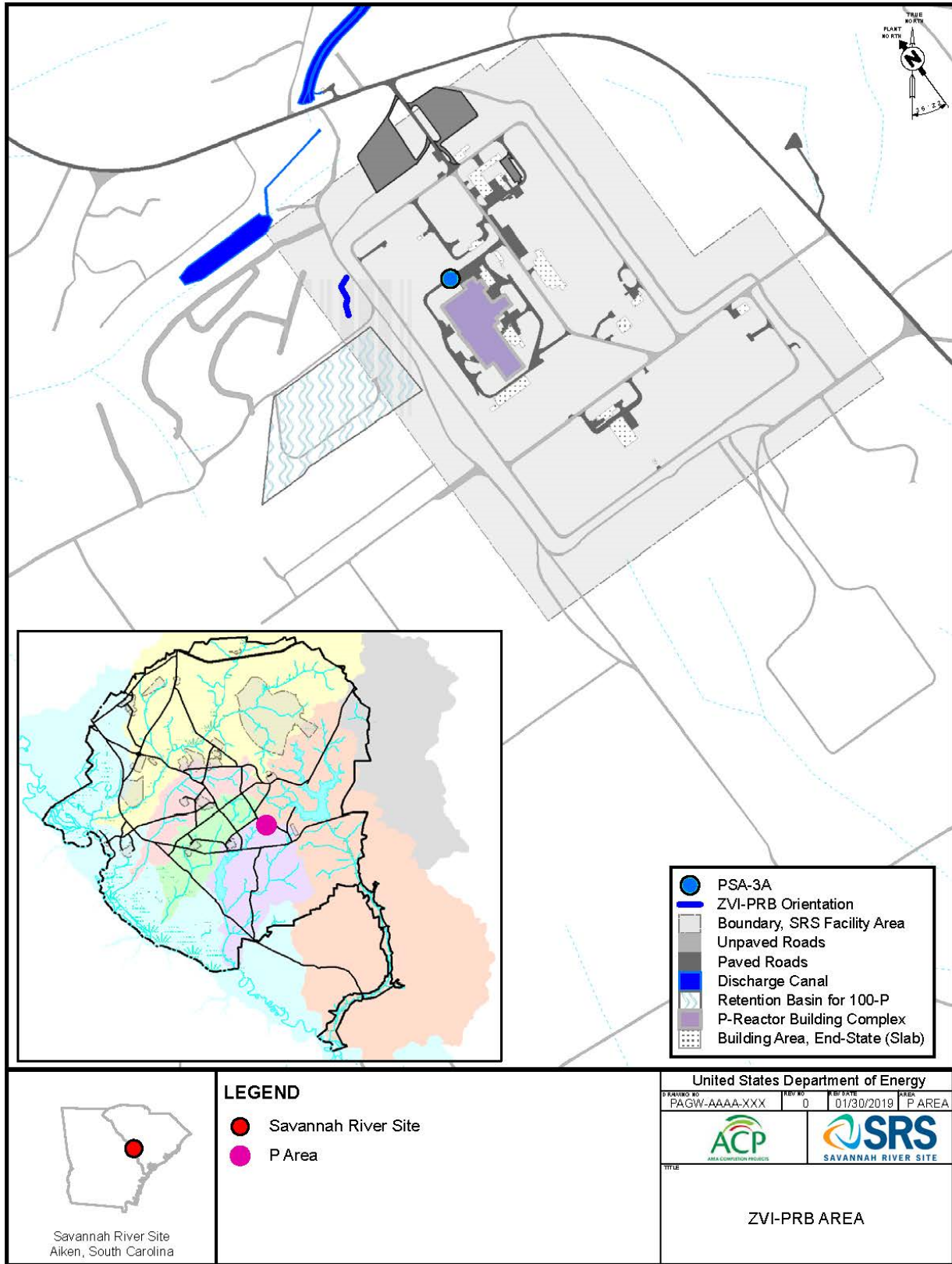


Figure 3. PAOU Remedial Action PSA-3A Location

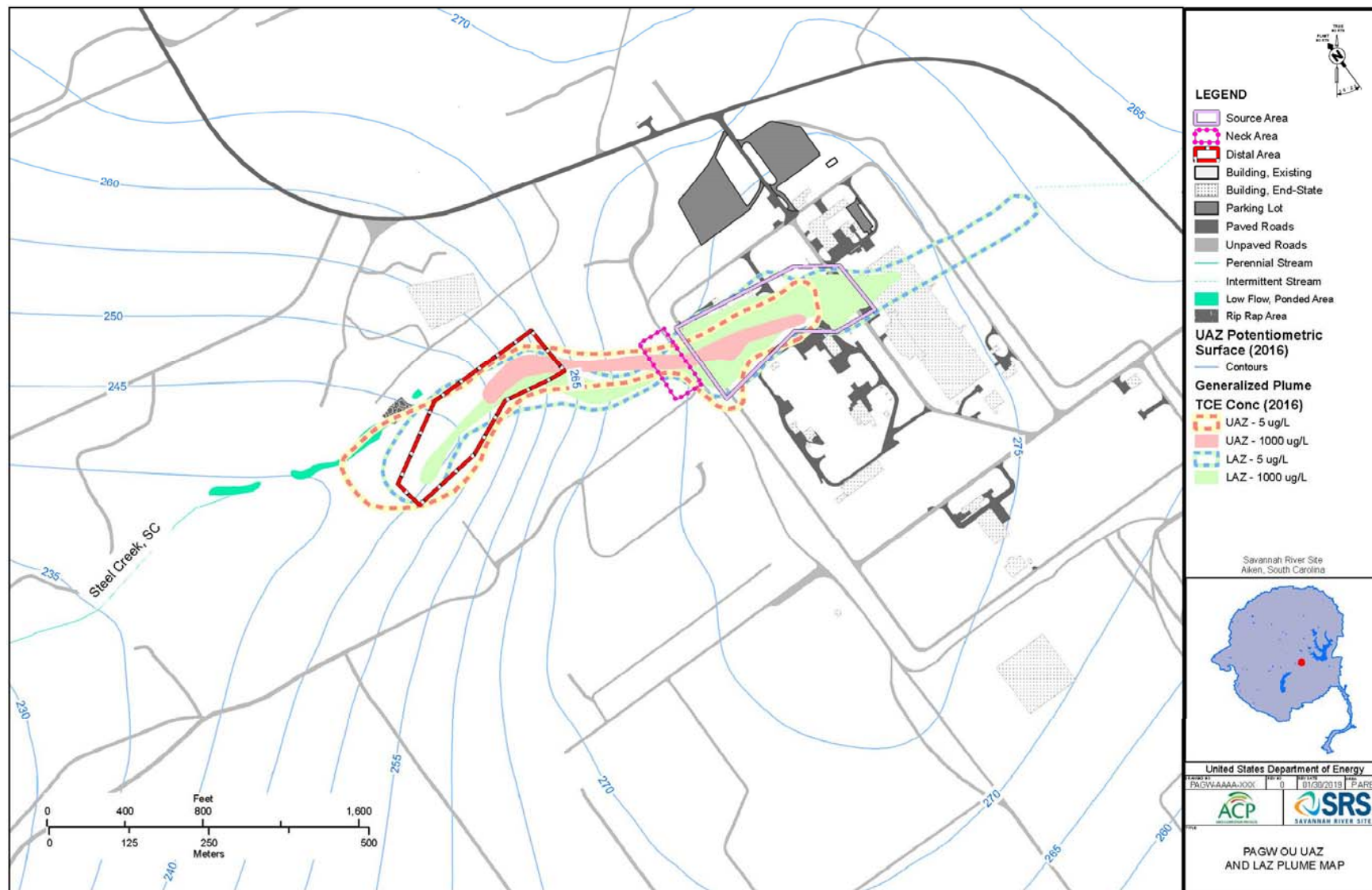


Figure 4. PAGW OU TCE Plume Map

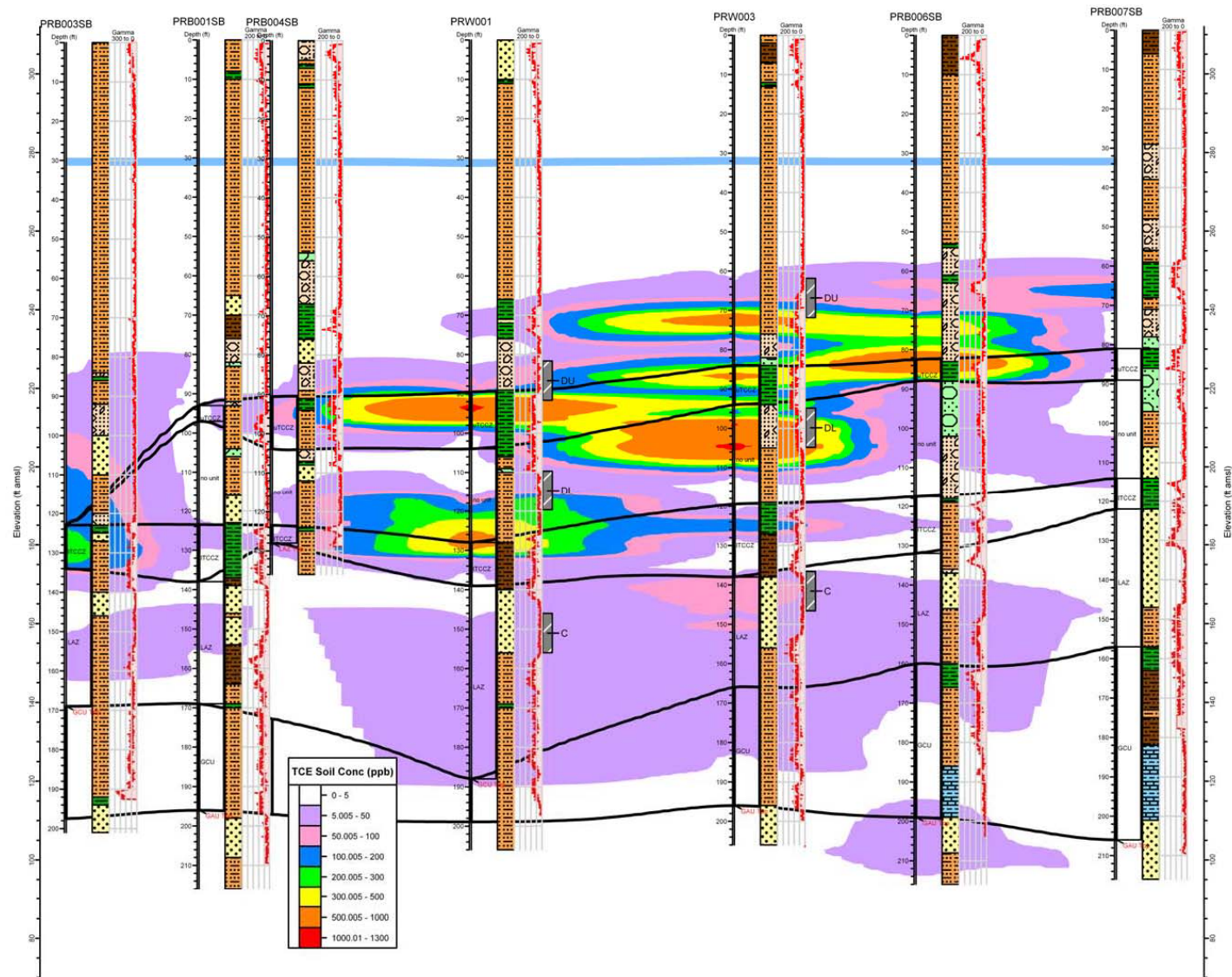


Figure 5. PAGW OU TCE Plume Cross-Section for UAZ and LAZ

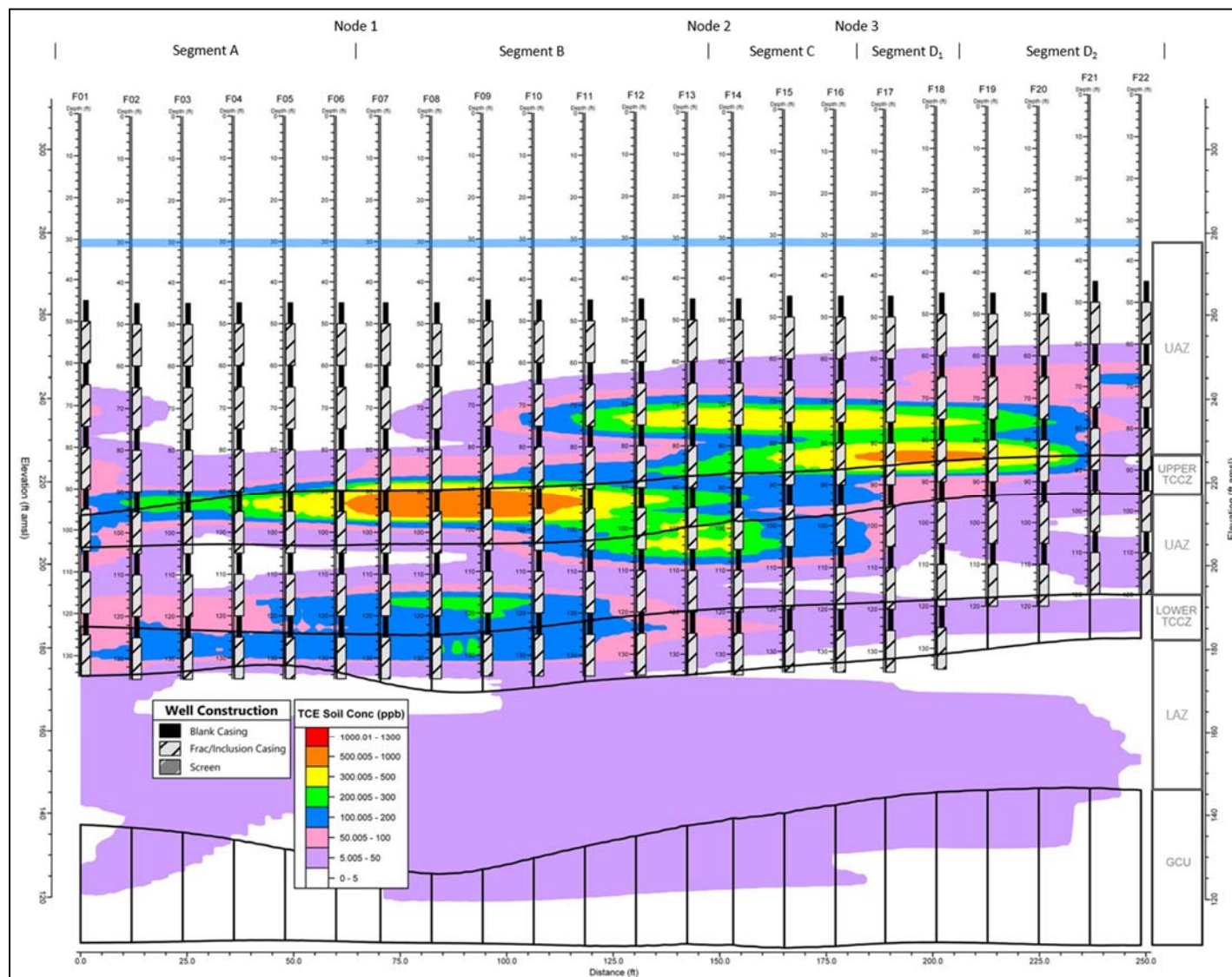


Figure 6. ZVI-PRB Expansion Casing Layout with TCE Plume

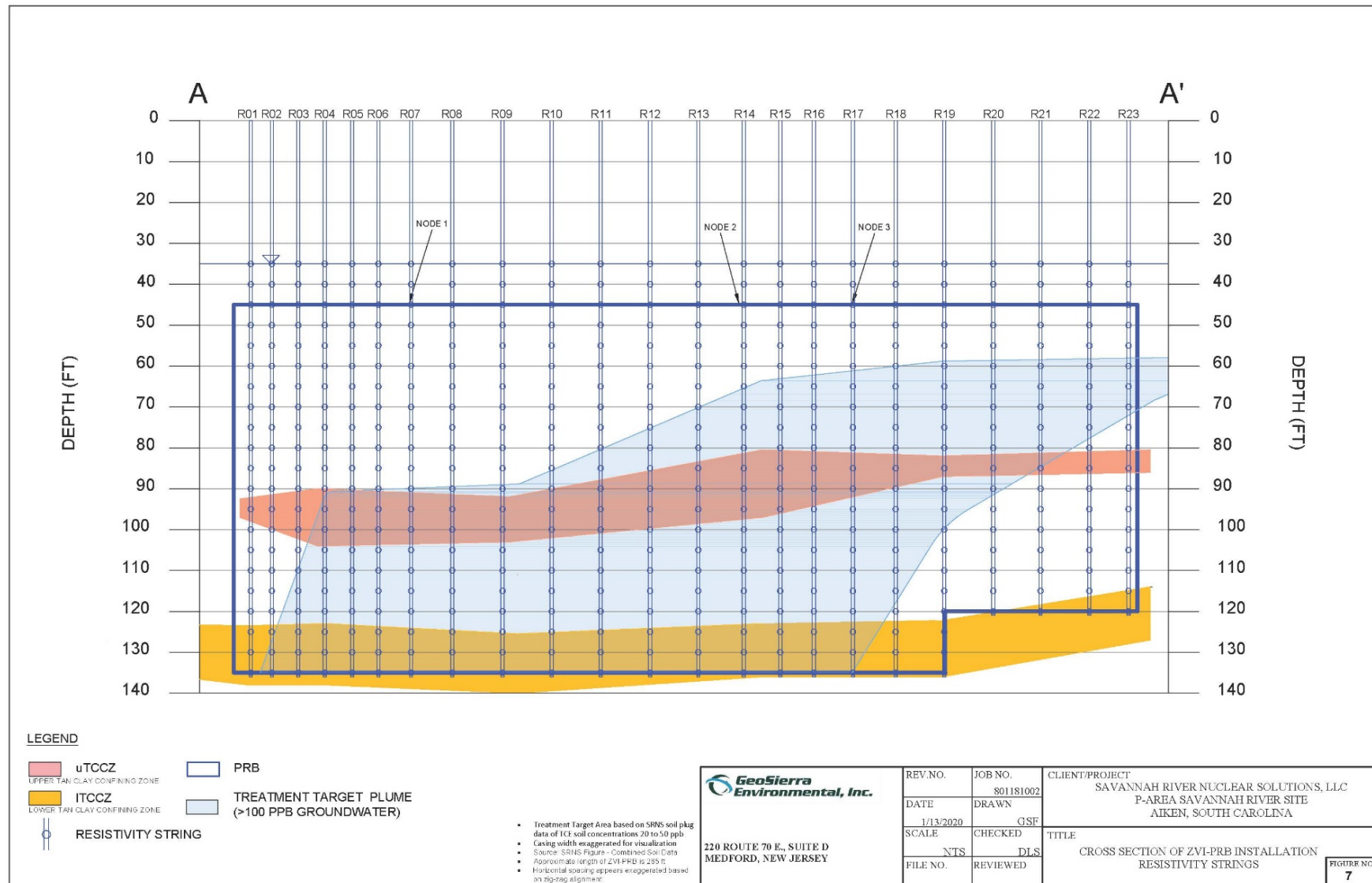


Figure 7. ZVI-PRB Resistivity String Layout with Lithology Cross-Section

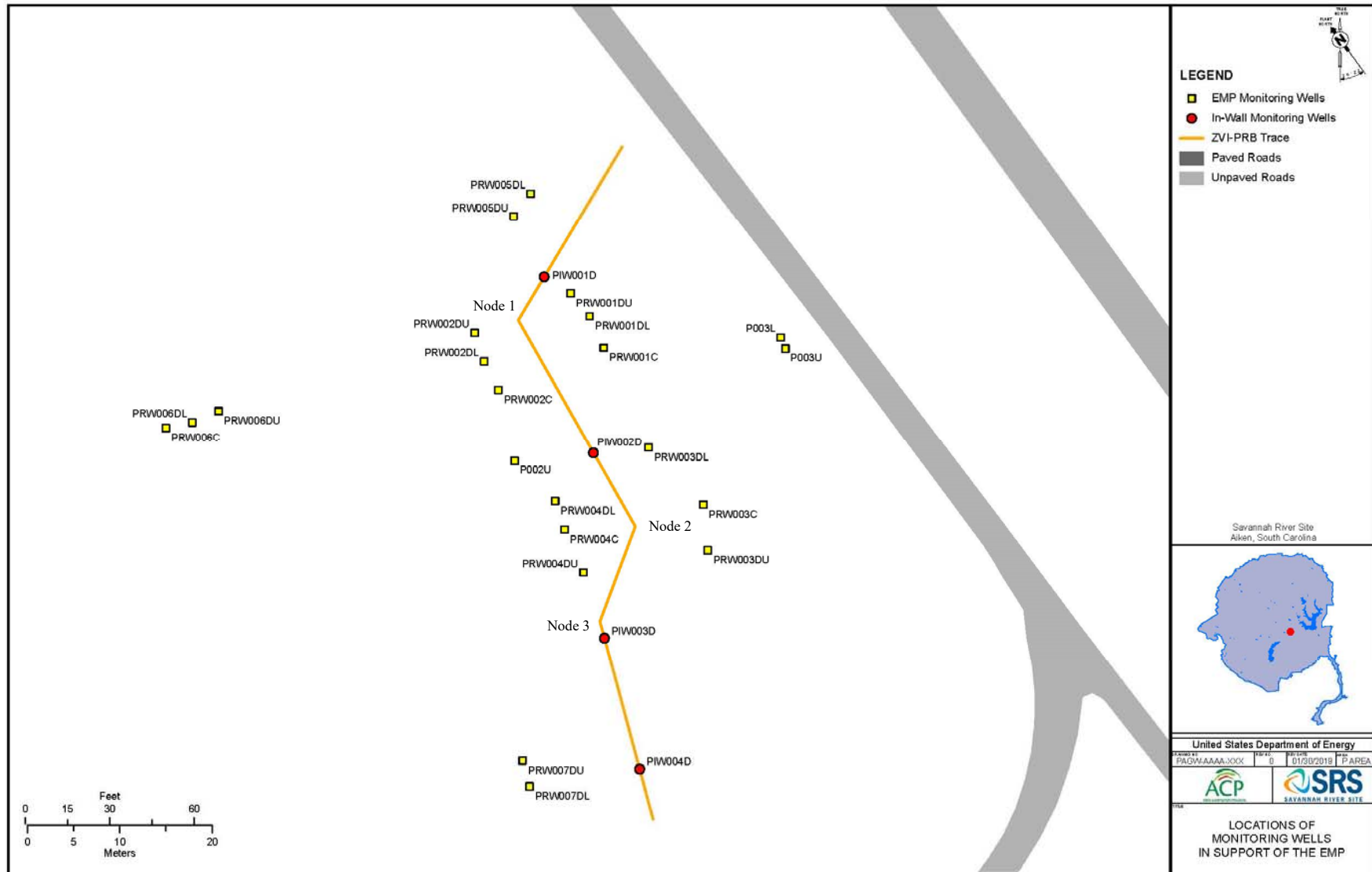


Figure 8. Locations of EMP Wells



Figure 9. Plan View of the ZVI-PRB Injection Well and Resistivity String Layout

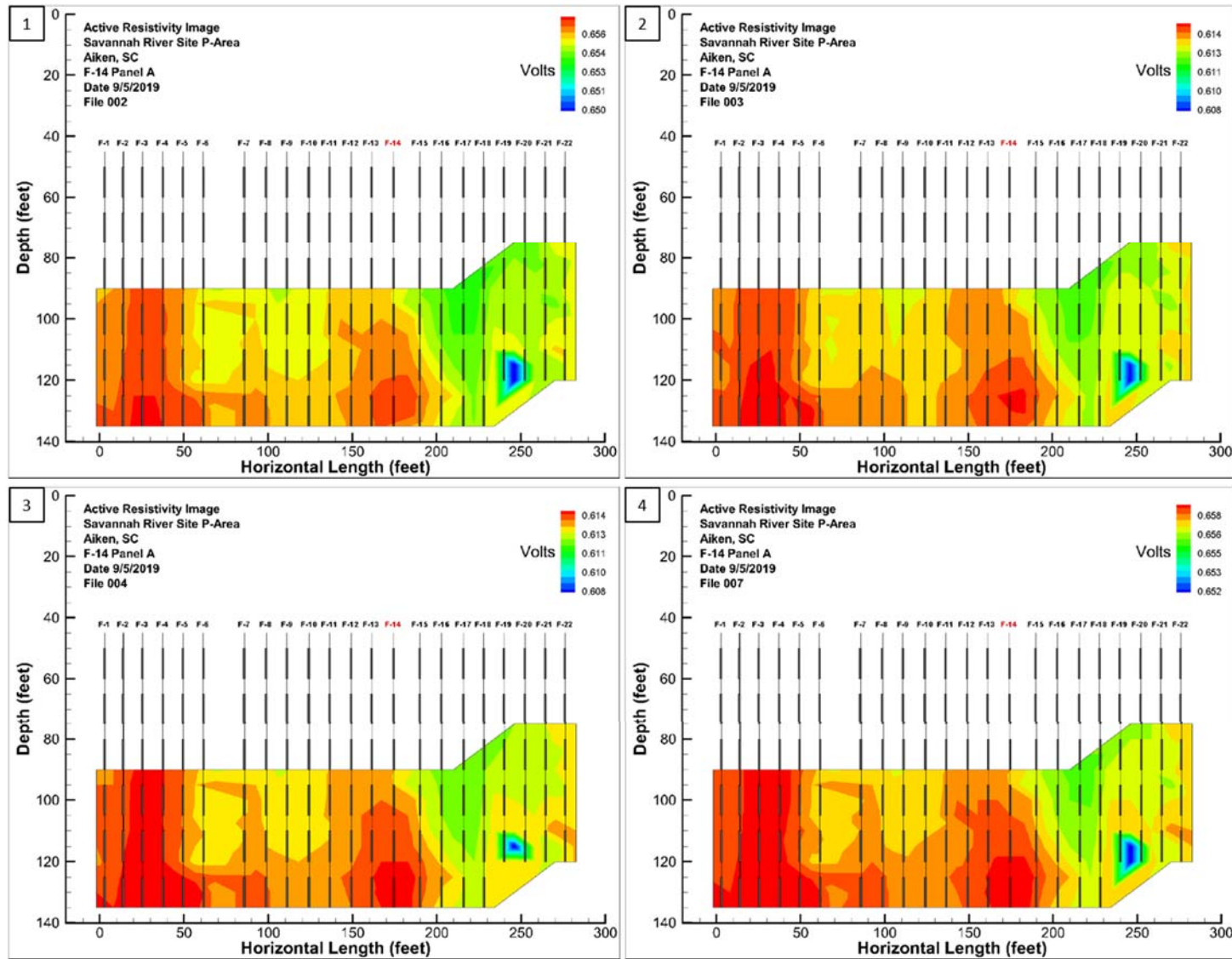


Figure 10. Active Resistance Mapping Time-Lapse Imaging



Figure 11. PAGW OU UAZ Groundwater Flow Direction and Potentiometric Surface

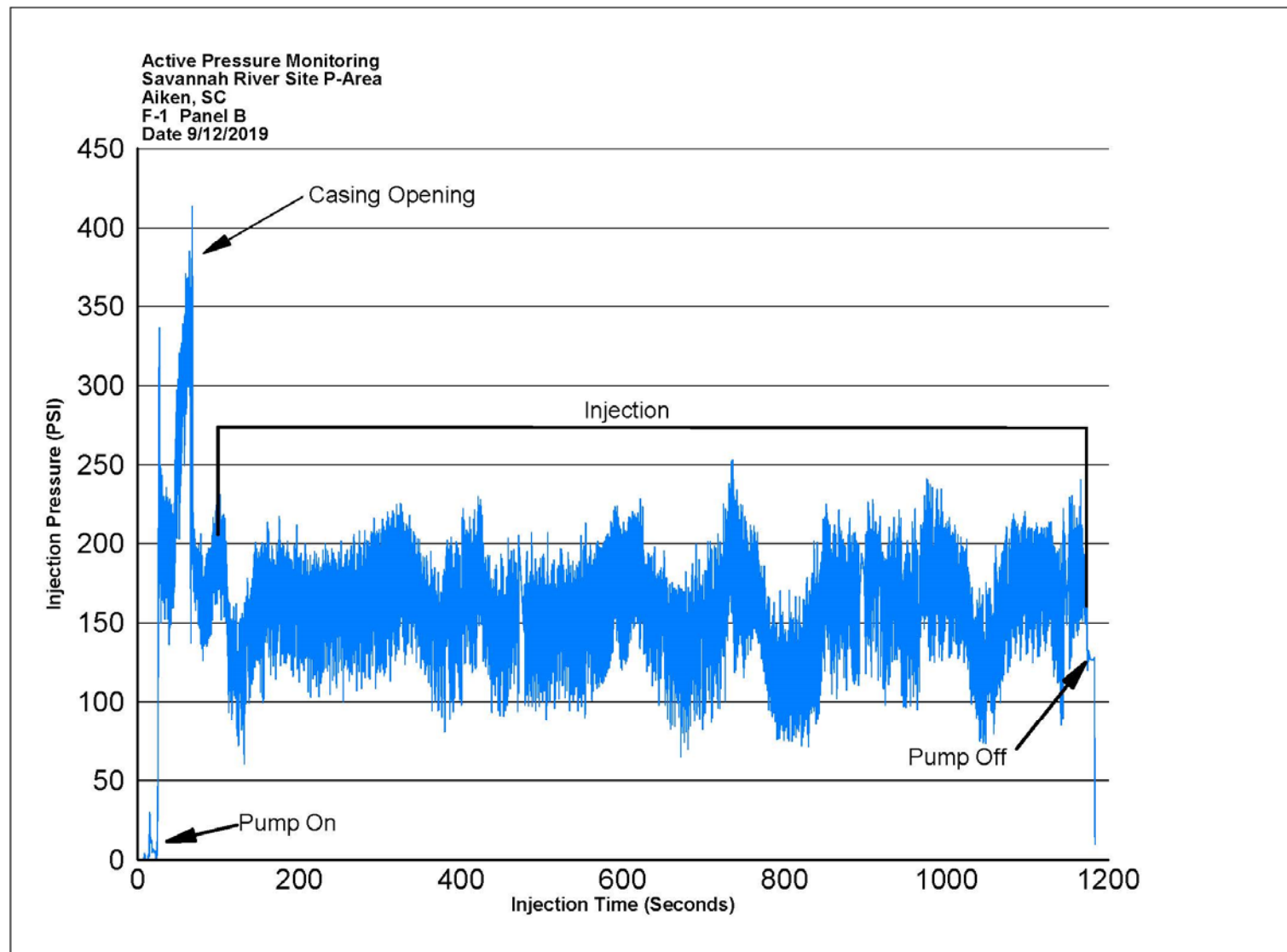


Figure 12. Typical ZVI Injection Pressure Graph

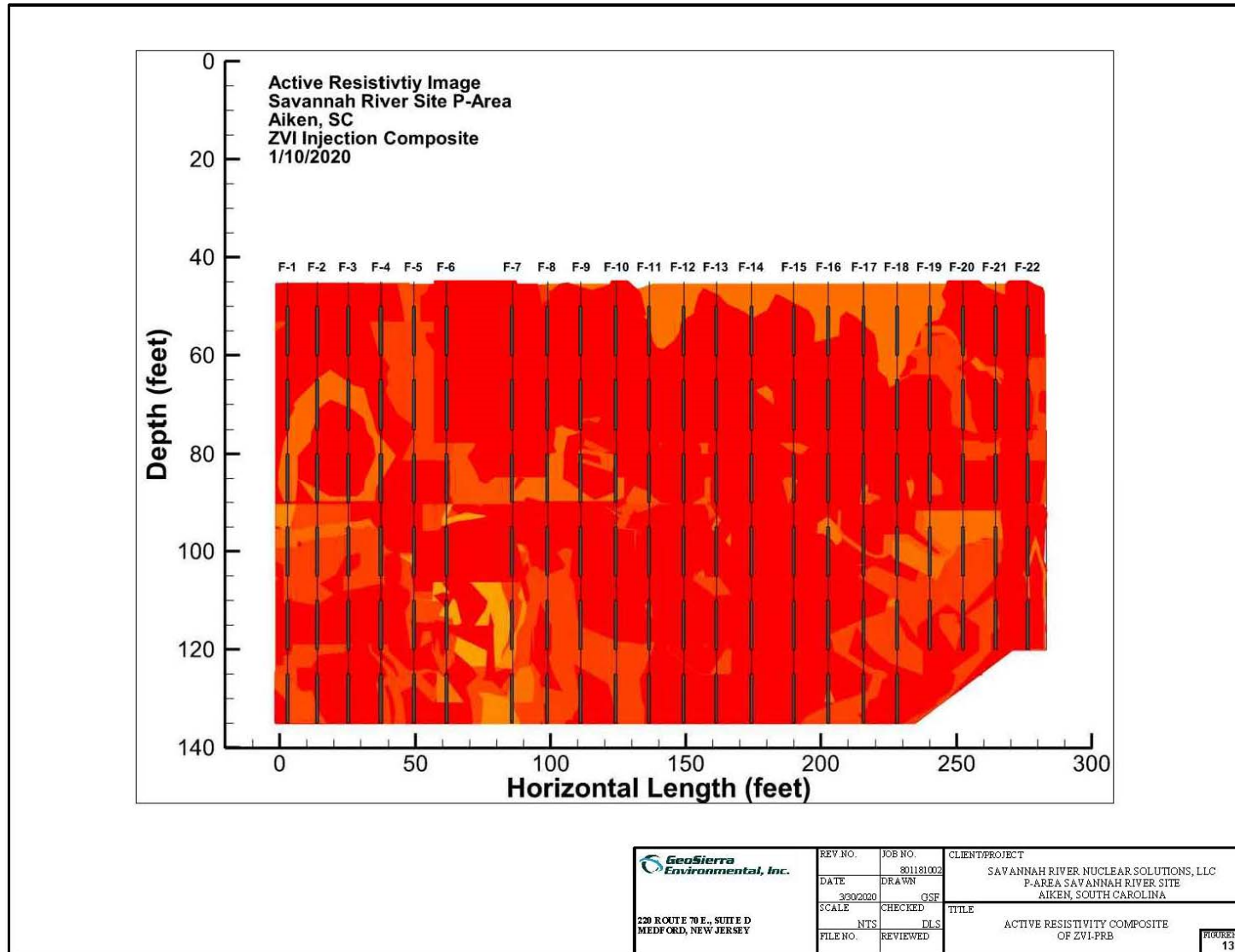


Figure 13. Composite Active Resistance Mapping Image of Completed ZVI-PRB

ZVI-PRB As-Built Thickness [in.]							
Panel	PGF001	PGF002-PGF009	PGF010-PGF016	PGF017-PGF018	PGF019-PGF020	PGF021	PGF022
Panel A	3.08	3.08	3.08	3.08	3.08	3.08	3.08
Panel B	4.91	4.91	6.68	6.68	6.68	5.96	-
Panel C	4.94	6.71	6.71	6.71	6.71	5.92	-
Panel D	4.87	6.64	6.64	4.87	4.87	4.87	-
Panel E	4.89	4.89	4.89	4.89	4.89	4.89	-
Panel F	4.84	4.84	4.84	4.84	-	-	-

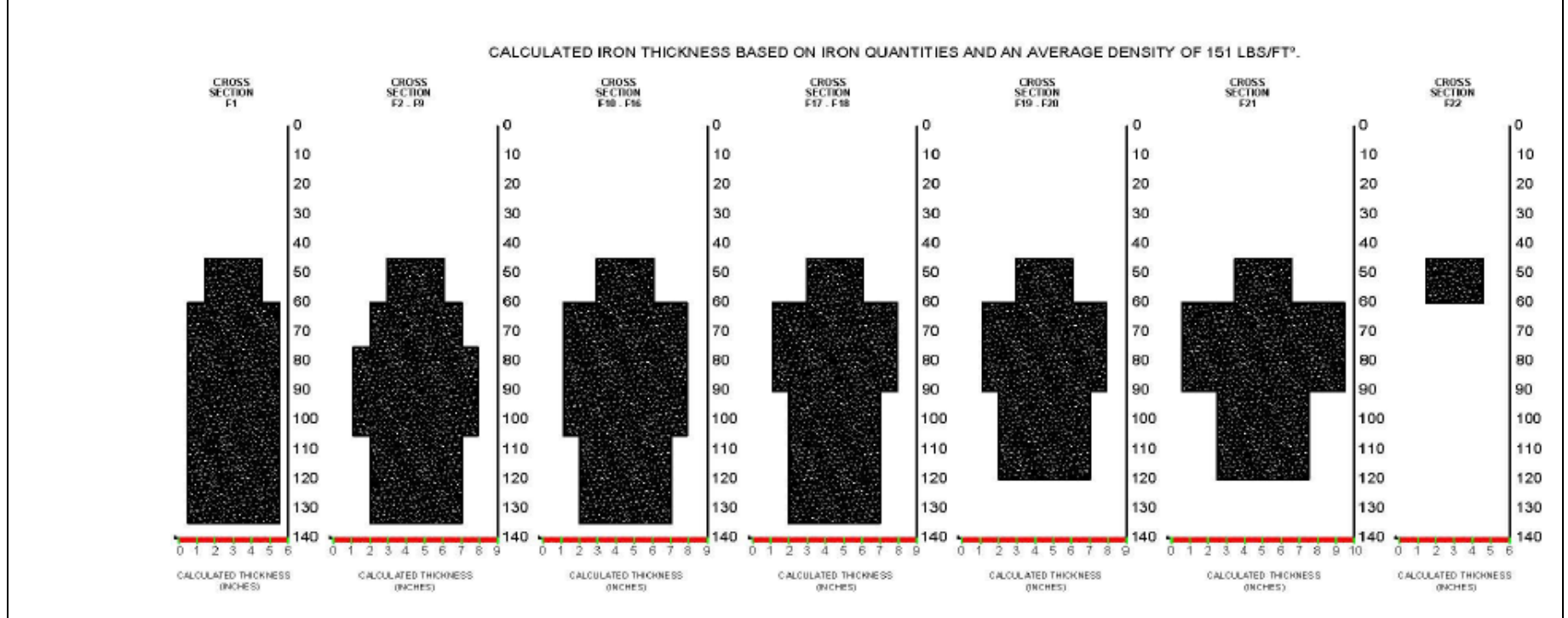


Figure 14. ZVI-PRB Final ZVI Thickness Calculations

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Table 1. Maximum cVOC Concentrations in the PAGW OU Groundwater Plume

Contaminant	MCL ( $\mu\text{g/L}$ )	Maximum Concentration in UAZ ( $\mu\text{g/L}$ )			Maximum Concentration in LAZ ( $\mu\text{g/L}$ )		
		Source Area	Neck Area	Distal Area	Source Area	Neck Area <sup>1</sup>	Distal Area
TCE	5	3140	4120	7440	7710	1500	7600
PCE	5	260	50	25	100	<MDL	2.09
cis-DCE	70	4720	107	432	104	400	200

<sup>1</sup> Based on 2011 DPT data; no LAZ wells in this area

Based on 4Q2016 data unless otherwise noted

MCL - maximum contaminant level

MDL - minimum detection limit

Table 2. Chronology of Events

<b>Description of Activity</b>	<b>Date</b>
Action Memorandum and Responsiveness Summary Submitted to SCDHEC and USEPA	5/29/2018
PDI Field Activities	9/2018 – 1/2019
Subcontractor Submitted Final Design Report to SRNS	3/28/2019
SCDHEC Issues UIC Permit to Construct ZVI Injection Wells	4/25/2019
RA Field Activities Start	5/29/2019
Installation of ZVI-PRB Injection Wells	5/29/2020
SCDHEC Issues Approval of Program Plan to Install Resistivity Strings and In-Wall Monitoring Wells	6/3/2019
Installation of Resistivity Strings	6/10/2020
RADP with EMP (Rev. 1) Submitted to SCDHEC and USEPA	7/8/2019
SCDHEC Issues UIC Permit to Operate 34 Wells (22 Injection Wells and 12 Monitoring Wells)	7/23/2019
ZVI Injections Begin	8/7/2019
ZVI-PRB Site Visit by USEPA and SCDHEC	8/20/2019 & 10/8/2019
ZVI Injections Completed	12/11/2019
Installation of 4 In-Wall Monitoring Wells	12/17/2019
Placement of Injection Wells (18 of 22) in Closed State	1/14/2020
Abandonment of 23 Resistivity Strings	1/14/2020
Post-Construction HPIT	1/27/2020
ZVI-PRB Construction Demobilization Completed	1/30/2020
Acceptance of FAI Documenting Completion of ZVI Injection, In-Wall Monitoring Well Installation, Resistivity String Abandonment, Placement of Injection Wells in Closed State	3/2/2020
Installation and Development of Additional Monitoring Wells Begin	3/9/2020
Installation and Development of Additional Monitoring Wells Completed	6/2/2020
Acceptance of FAI Documenting Completion of 8 Additional Monitoring Wells	6/8/2020
Placement of Access Controls (Concrete Jersey Barriers, Barricades, Signage) at the ZVI-PRB Site	6/24/2020

Table 3. ZVI-PRB Injection Well Construction Details

PRB Information				Boring Information		Panel A				Panel B				Panel C			
Station ID		Number of Expansion Casings	Bottom PRB Target Depth [ft bgs]	Surface Elevation of Boring [ft amsl]	Total Depth of Boring [ft bgs]	Bottom Elevation of A Casing [ft amsl]	Bottom of A Casing [ft bgs]	Top Elevation of A Casing [ft amsl]	Top of A Casing [ft bgs]	Bottom Elevation of B Casing [ft amsl]	Bottom of B Casing [ft bgs]	Top Elevation of B Casing [ft amsl]	Top of B Casing [ft bgs]	Bottom Elevation of C Casing [ft amsl]	Bottom of C Casing [ft bgs]	Top Elevation of C Casing [ft amsl]	Top of C Casing [ft bgs]
Old ID	New ID																
F01	PGF001	6	136.5	309.80	138.5	172.80	137.0	182.80	127.0	187.80	122.0	197.80	112.0	202.80	107.0	212.80	97.0
F02	PGF002	6	136.5	309.83	138.5	172.83	137.0	182.83	127.0	187.83	122.0	197.83	112.0	202.83	107.0	212.83	97.0
F03	PGF003	6	136.8	310.07	138.5	173.07	137.0	183.07	127.0	188.07	122.0	198.07	112.0	203.07	107.0	213.07	97.0
F04	PGF004	6	136.9	310.17	139.5	172.17	138.0	182.17	128.0	187.17	123.0	197.17	113.0	202.17	108.0	212.17	98.0
F05	PGF005	6	136.7	310.38	138.5	173.38	137.0	183.38	127.0	188.38	122.0	198.38	112.0	203.38	107.0	213.38	97.0
F06	PGF006	6	137.4	310.80	142.1	170.20	140.6	180.20	130.6	185.20	125.6	195.20	115.6	200.20	110.6	210.20	100.6
F07	PGF007	6	137.5	310.94	140.1	172.34	138.6	182.34	128.6	187.34	123.6	197.34	113.6	202.34	108.6	212.34	98.6
F08	PGF008	6	137.8	311.22	139.2	173.52	137.7	183.52	127.7	188.52	122.7	198.52	112.7	203.52	107.7	213.52	97.7
F09	PGF009	6	138.1	311.46	139.8	173.16	138.3	183.16	128.3	188.16	123.3	198.16	113.3	203.16	108.3	213.16	98.3
F10	PGF010	6	138.2	311.59	139.8	173.29	138.3	183.29	128.3	188.29	123.3	198.29	113.3	203.29	108.3	213.29	98.3
F11	PGF011	6	137.0	311.81	138.5	174.81	137.0	184.81	127.0	189.81	122.0	199.81	112.0	204.81	107.0	214.81	97.0
F12	PGF012	6	137.2	312.03	139.5	174.03	138.0	184.03	128.0	189.03	123.0	199.03	113.0	204.03	108.0	214.03	98.0
F13	PGF013	6	137.3	312.18	139.5	174.18	138.0	184.18	128.0	189.18	123.0	199.18	113.0	204.18	108.0	214.18	98.0
F14	PGF014	6	137.5	312.40	139.4	174.50	137.9	184.50	127.9	189.50	122.9	199.50	112.9	204.50	107.9	214.50	97.9
F15	PGF015	6	137.7	312.55	139.3	174.75	137.8	184.75	127.8	189.75	122.8	199.75	112.8	204.75	107.8	214.75	97.8
F16	PGF016	6	136.4	312.75	137.8	176.45	136.3	186.45	126.3	191.45	121.3	201.45	111.3	206.45	106.3	216.45	96.3
F17	PGF017	6	136.5	312.87	137.9	176.47	136.4	186.47	126.4	191.47	121.4	201.47	111.4	206.47	106.4	216.47	96.4
F18	PGF018	6	136.9	313.26	138.7	176.06	137.2	186.06	127.2	191.06	122.2	201.06	112.2	206.06	107.2	216.06	97.2
F19	PGF019	5	122.6	313.64	125.4					189.74	123.9	199.74	113.9	204.74	108.9	214.74	98.9
F20	PGF020	5	123.0	314.02	125.9					189.62	124.4	199.62	114.4	204.62	109.4	214.62	99.4
F21	PGF021	5	122.3	314.39 <sup>1</sup>	124.2					191.69	122.7	201.69	112.7	206.69	107.7	216.69	97.7
F22	PGF022	5	122.6	314.91	124.0					192.41	122.5	202.41	112.5	207.41	107.5	217.41	97.5

Table 3. ZVI-PRB Injection Well Construction Details (Continued)

PRB Information			Boring Information		Panel D				Panel E				Panel F				
Station ID		Number of Expansion Casings	Bottom PRB Target Depth [ft bgs]	Surface Elevation of Boring [ft amsl]	Total Depth of Boring [ft bgs]	Bottom Elevation of D Casing [ft amsl]	Bottom of D Casing [ft bgs]	Top Elevation of D Casing [ft amsl]	Top of D Casing [ft bgs]	Bottom Elevation of E Casing [ft amsl]	Bottom of E Casing [ft bgs]	Top Elevation of E Casing [ft amsl]	Top of E Casing [ft bgs]	Bottom Elevation of F Casing [ft amsl]	Bottom of F Casing [ft bgs]	Top Elevation of F Casing [ft amsl]	Top of F Casing [ft bgs]
Old ID	New ID																
F01	PGF001	6	136.5	309.80	138.5	217.80	92.0	227.80	82.0	232.80	77.0	242.80	67.0	247.80	62.0	257.80	52.0
F02	PGF002	6	136.5	309.83	138.5	217.83	92.0	227.83	82.0	232.83	77.0	242.83	67.0	247.83	62.0	257.83	52.0
F03	PGF003	6	136.8	310.07	138.5	218.07	92.0	228.07	82.0	233.07	77.0	243.07	67.0	248.07	62.0	258.07	52.0
F04	PGF004	6	136.9	310.17	139.5	217.17	93.0	227.17	83.0	232.17	78.0	242.17	68.0	247.17	63.0	257.17	53.0
F05	PGF005	6	136.7	310.38	138.5	218.38	92.0	228.38	82.0	233.38	77.0	243.38	67.0	248.38	62.0	258.38	52.0
F06	PGF006	6	137.4	310.80	142.1	215.20	95.6	225.20	85.6	230.20	80.6	240.20	70.6	245.20	65.6	255.20	55.6
F07	PGF007	6	137.5	310.94	140.1	217.34	93.6	227.34	83.6	232.34	78.6	242.34	68.6	247.34	63.6	257.34	53.6
F08	PGF008	6	137.8	311.22	139.2	218.52	92.7	228.52	82.7	233.52	77.7	243.52	67.7	248.52	62.7	258.52	52.7
F09	PGF009	6	138.1	311.46	139.8	218.16	93.3	228.16	83.3	233.16	78.3	243.16	68.3	248.16	63.3	258.16	53.3
F10	PGF010	6	138.2	311.59	139.8	218.29	93.3	228.29	83.3	233.29	78.3	243.29	68.3	248.29	63.3	258.29	53.3
F11	PGF011	6	137.0	311.81	138.5	219.81	92.0	229.81	82.0	234.81	77.0	244.81	67.0	249.81	62.0	259.81	52.0
F12	PGF012	6	137.2	312.03	139.5	219.03	93.0	229.03	83.0	234.03	78.0	244.03	68.0	249.03	63.0	259.03	53.0
F13	PGF013	6	137.3	312.18	139.5	219.18	93.0	229.18	83.0	234.18	78.0	244.18	68.0	249.18	63.0	259.18	53.0
F14	PGF014	6	137.5	312.40	139.4	219.50	92.9	229.50	82.9	234.50	77.9	244.50	67.9	249.50	62.9	259.50	52.9
F15	PGF015	6	137.7	312.55	139.3	219.75	92.8	229.75	82.8	234.75	77.8	244.75	67.8	249.75	62.8	259.75	52.8
F16	PGF016	6	136.4	312.75	137.8	221.45	91.3	231.45	81.3	236.45	76.3	246.45	66.3	251.45	61.3	261.45	51.3
F17	PGF017	6	136.5	312.87	137.9	221.47	91.4	231.47	81.4	236.47	76.4	246.47	66.4	251.47	61.4	261.47	51.4
F18	PGF018	6	136.9	313.26	138.7	221.06	92.2	231.06	82.2	236.06	77.2	246.06	67.2	251.06	62.2	261.06	52.2
F19	PGF019	5	122.6	313.64	125.4	219.74	93.9	229.74	83.9	234.74	78.9	244.74	68.9	249.74	63.9	259.74	53.9
F20	PGF020	5	123.0	314.02	125.9	219.62	94.4	229.62	84.4	234.62	79.4	244.62	69.4	249.62	64.4	259.62	54.4
F21	PGF021	5	122.3	314.39 <sup>1</sup>	124.2	221.69	92.7	231.69	82.7	236.69	77.7	246.69	67.7	251.69	62.7	261.69	52.7
F22	PGF022	5	122.6	314.91	124.0	222.41	92.5	232.41	82.5	237.41	77.5	247.41	67.5	252.41	62.5	262.41	52.5

<sup>1</sup> F21 (PGF021) surface elevation is an approximation.

amsl - above mean sea level

Table 4. ZVI-PRB Resistivity String Construction Details

Station ID	Number of Receivers	Target End of Tip [ft bgs]	Surface Elevation [ft amsl]	Actual End of Tip [ft bgs]	Location Along Alignment <sup>1</sup> [ft]	Elevation of Black Receiver [ft amsl]	Depth of Black Receiver [ft bgs]	Elevation of White Receiver [ft amsl]	Depth of White Receiver [ft bgs]	Elevation of Red Receiver [ft amsl]	Depth of Red Receiver [ft bgs]	Elevation of Green Receiver [ft amsl]	Depth of Green Receiver [ft bgs]	Elevation of Orange Receiver [ft amsl]	Depth of Orange Receiver [ft bgs]
RR01	19	137.0	309.56	137.3	-2.0	173.26	136.3	178.26	131.3	183.26	126.3	188.26	121.3	193.26	116.3
RR02	19	137.2	309.76	137.3	8.2	173.46	136.3	178.46	131.3	183.46	126.3	188.46	121.3	193.46	116.3
RR03	19	137.2	309.83	137.3	20.2	173.53	136.3	178.53	131.3	183.53	126.3	188.53	121.3	193.53	116.3
RR04	19	137.3	309.99	137.3	32.7	173.69	136.3	178.69	131.3	183.69	126.3	188.69	121.3	193.69	116.3
RR05	19	136.9	310.07	137.0	44.3	174.07	136.0	179.07	131.0	184.07	126.0	189.07	121.0	194.07	116.0
RR06	19	137.6	310.29	137.5	56.5	173.79	136.5	178.79	131.5	183.79	126.5	188.79	121.5	193.79	116.5
RR07	19	136.0	310.22	136.1	68.3	175.12	135.1	180.12	130.1	185.12	125.1	190.12	120.1	195.12	115.1
RR08	19	136.3	310.52	136.3	92.7	175.22	135.3	180.22	130.3	185.22	125.3	190.22	120.3	195.22	115.3
RR09	19	136.9	310.78	136.3	105.5	175.48	135.3	180.48	130.3	185.48	125.3	190.48	120.3	195.48	115.3
RR10	19	137.1	310.96	137.0	117.8	174.96	136.0	179.96	131.0	184.96	126.0	189.96	121.0	194.96	116.0
RR11	19	137.6	311.34	137.5	130.8	174.84	136.5	179.84	131.5	184.84	126.5	189.84	121.5	194.84	116.5
RR12	19	137.9	311.61	137.7	142.9	174.91	136.7	179.91	131.7	184.91	126.7	189.91	121.7	194.91	116.7
RR13	19	135.6	311.96	135.7	155.2	177.26	134.7	182.26	129.7	187.26	124.7	192.26	119.7	197.26	114.7
RR14	19	136.0	312.28	136.6	167.0	176.68	135.6	181.68	130.6	186.68	125.6	191.68	120.6	196.68	115.6
RR15	19	136.4	312.16	136.4	183.0	176.76	135.4	181.76	130.4	186.76	125.4	191.76	120.4	196.76	115.4
RR16	19	136.4	312.20	136.4	195.9	176.80	135.4	181.80	130.4	186.80	125.4	191.80	120.4	196.80	115.4
RR17	19	134.2	312.37	134.4	209.7	178.97	133.4	183.97	128.4	188.97	123.4	193.97	118.4	198.97	113.4
RR18	19	135.9	312.79 <sup>2</sup>	136.1	222.2	177.69	135.1	182.69	130.1	187.69	125.1	192.69	120.1	197.69	115.1
RR19	19	136.3	313.19	136.3	234.2	177.89	135.3	182.89	130.3	187.89	125.3	192.89	120.3	197.89	115.3
RR20	16	122.5	313.56	122.5	246.1	192.06	121.5	197.06	116.5	202.06	111.5	207.06	106.5	212.06	101.5
RR21	16	122.9	314.02	123.5	258.6	191.52	122.5	196.52	117.5	201.52	112.5	206.52	107.5	211.52	102.5
RR22	16	121.7	314.35	121.7	270.2	193.65	120.7	198.65	115.7	203.65	110.7	208.65	105.7	213.65	100.7
RR23	16	122.0	314.65	121.9	282.5	193.75	120.9	198.75	115.9	203.75	110.9	208.75	105.9	213.75	100.9

Table 4. ZVI-PRB Resistivity String Construction Details (Continued)

Station ID	Number of Receivers	Target End of Tip [ft bgs]	Surface Elevation [ft amsl]	Actual End of Tip [ft bgs]	Location Along Alignment <sup>1</sup> [ft]	Elevation of Yellow Receiver [ft amsl]	Depth of Yellow Receiver [ft bgs]	Elevation of Blue Receiver [ft amsl]	Depth of Blue Receiver [ft bgs]	Elevation of Purple Receiver [ft amsl]	Depth of Purple Receiver [ft bgs]	Elevation of Gray Receiver [ft amsl]	Depth of Gray Receiver [ft bgs]	Elevation of Brown Receiver [ft amsl]	Depth of Brown Receiver [ft bgs]
RR01	19	137.0	309.56	137.3	-2.0	198.26	111.3	203.26	106.3	208.26	101.3	213.26	96.3	218.26	91.3
RR02	19	137.2	309.76	137.3	8.2	198.46	111.3	203.46	106.3	208.46	101.3	213.46	96.3	218.46	91.3
RR03	19	137.2	309.83	137.3	20.2	198.53	111.3	203.53	106.3	208.53	101.3	213.53	96.3	218.53	91.3
RR04	19	137.3	309.99	137.3	32.7	198.69	111.3	203.69	106.3	208.69	101.3	213.69	96.3	218.69	91.3
RR05	19	136.9	310.07	137.0	44.3	199.07	111.0	204.07	106.0	209.07	101.0	214.07	96.0	219.07	91.0
RR06	19	137.6	310.29	137.5	56.5	198.79	111.5	203.79	106.5	208.79	101.5	213.79	96.5	218.79	91.5
RR07	19	136.0	310.22	136.1	68.3	200.12	110.1	205.12	105.1	210.12	100.1	215.12	95.1	220.12	90.1
RR08	19	136.3	310.52	136.3	92.7	200.22	110.3	205.22	105.3	210.22	100.3	215.22	95.3	220.22	90.3
RR09	19	136.9	310.78	136.3	105.5	200.48	110.3	205.48	105.3	210.48	100.3	215.48	95.3	220.48	90.3
RR10	19	137.1	310.96	137.0	117.8	199.96	111.0	204.96	106.0	209.96	101.0	214.96	96.0	219.96	91.0
RR11	19	137.6	311.34	137.5	130.8	199.84	111.5	204.84	106.5	209.84	101.5	214.84	96.5	219.84	91.5
RR12	19	137.9	311.61	137.7	142.9	199.91	111.7	204.91	106.7	209.91	101.7	214.91	96.7	219.91	91.7
RR13	19	135.6	311.96	135.7	155.2	202.26	109.7	207.26	104.7	212.26	99.7	217.26	94.7	222.26	89.7
RR14	19	136.0	312.28	136.6	167.0	201.68	110.6	206.68	105.6	211.68	100.6	216.68	95.6	221.68	90.6
RR15	19	136.4	312.16	136.4	183.0	201.76	110.4	206.76	105.4	211.76	100.4	216.76	95.4	221.76	90.4
RR16	19	136.4	312.20	136.4	195.9	201.80	110.4	206.80	105.4	211.80	100.4	216.80	95.4	221.80	90.4
RR17	19	134.2	312.37	134.4	209.7	203.97	108.4	208.97	103.4	213.97	98.4	218.97	93.4	223.97	88.4
RR18	19	135.9	312.79 <sup>2</sup>	136.1	222.2	202.69	110.1	207.69	105.1	212.69	100.1	217.69	95.1	222.69	90.1
RR19	19	136.3	313.19	136.3	234.2	202.89	110.3	207.89	105.3	212.89	100.3	217.89	95.3	222.89	90.3
RR20	16	122.5	313.56	122.5	246.1	217.06	96.5	222.06	91.5	227.06	86.5	232.06	81.5	237.06	76.5
RR21	16	122.9	314.02	123.5	258.6	216.52	97.5	221.52	92.5	226.52	87.5	231.52	82.5	236.52	77.5
RR22	16	121.7	314.35	121.7	270.2	218.65	95.7	223.65	90.7	228.65	85.7	233.65	80.7	238.65	75.7
RR23	16	122.0	314.65	121.9	282.5	218.75	95.9	223.75	90.9	228.75	85.9	233.75	80.9	238.75	75.9

Table 4. ZVI-PRB Resistivity String Construction Details (Continued)

Station ID	Number of Receivers	Target End of Tip [ft bgs]	Surface Elevation [ft amsl]	Actual End of Tip [ft bgs]	Location Along Alignment <sup>1</sup> [ft]	Elevation of B/Red Receiver [ft amsl]	Depth of B/Red Receiver [ft bgs]	Elevation of B/White Receiver [ft amsl]	Depth of B/White Receiver [ft bgs]	Elevation of B/Green Receiver [ft amsl]	Depth of B/Green Receiver [ft bgs]	Elevation of B/Yellow Receiver [ft amsl]	Depth of B/Yellow Receiver [ft bgs]	Elevation of B/Blue Receiver [ft amsl]	Depth of B/Blue Receiver [ft bgs]
RR01	19	137.0	309.56	137.3	-2.0	223.26	86.3	228.26	81.3	233.26	76.3	238.26	71.3	243.26	66.3
RR02	19	137.2	309.76	137.3	8.2	223.46	86.3	228.46	81.3	233.46	76.3	238.46	71.3	243.46	66.3
RR03	19	137.2	309.83	137.3	20.2	223.53	86.3	228.53	81.3	233.53	76.3	238.53	71.3	243.53	66.3
RR04	19	137.3	309.99	137.3	32.7	223.69	86.3	228.69	81.3	233.69	76.3	238.69	71.3	243.69	66.3
RR05	19	136.9	310.07	137.0	44.3	224.07	86.0	229.07	81.0	234.07	76.0	239.07	71.0	244.07	66.0
RR06	19	137.6	310.29	137.5	56.5	223.79	86.5	228.79	81.5	233.79	76.5	238.79	71.5	243.79	66.5
RR07	19	136.0	310.22	136.1	68.3	225.12	85.1	230.12	80.1	235.12	75.1	240.12	70.1	245.12	65.1
RR08	19	136.3	310.52	136.3	92.7	225.22	85.3	230.22	80.3	235.22	75.3	240.22	70.3	245.22	65.3
RR09	19	136.9	310.78	136.3	105.5	225.48	85.3	230.48	80.3	235.48	75.3	240.48	70.3	245.48	65.3
RR10	19	137.1	310.96	137.0	117.8	224.96	86.0	229.96	81.0	234.96	76.0	239.96	71.0	244.96	66.0
RR11	19	137.6	311.34	137.5	130.8	224.84	86.5	229.84	81.5	234.84	76.5	239.84	71.5	244.84	66.5
RR12	19	137.9	311.61	137.7	142.9	224.91	86.7	229.91	81.7	234.91	76.7	239.91	71.7	244.91	66.7
RR13	19	135.6	311.96	135.7	155.2	227.26	84.7	232.26	79.7	237.26	74.7	242.26	69.7	247.26	64.7
RR14	19	136.0	312.28	136.6	167.0	226.68	85.6	231.68	80.6	236.68	75.6	241.68	70.6	246.68	65.6
RR15	19	136.4	312.16	136.4	183.0	226.76	85.4	231.76	80.4	236.76	75.4	241.76	70.4	246.76	65.4
RR16	19	136.4	312.20	136.4	195.9	226.80	85.4	231.80	80.4	236.80	75.4	241.80	70.4	246.80	65.4
RR17	19	134.2	312.37	134.4	209.7	228.97	83.4	233.97	78.4	238.97	73.4	243.97	68.4	248.97	63.4
RR18	19	135.9	312.79 <sup>2</sup>	136.1	222.2	227.69	85.1	232.69	80.1	237.69	75.1	242.69	70.1	247.69	65.1
RR19	19	136.3	313.19	136.3	234.2	227.89	85.3	232.89	80.3	237.89	75.3	242.89	70.3	247.89	65.3
RR20	16	122.5	313.56	122.5	246.1	242.06	71.5	247.06	66.5	252.06	61.5	257.06	56.5	262.06	51.5
RR21	16	122.9	314.02	123.5	258.6	241.52	72.5	246.52	67.5	251.52	62.5	256.52	57.5	261.52	52.5
RR22	16	121.7	314.35	121.7	270.2	243.65	70.7	248.65	65.7	253.65	60.7	258.65	55.7	263.65	50.7
RR23	16	122.0	314.65	121.9	282.5	243.75	70.9	248.75	65.9	253.75	60.9	258.75	55.9	263.75	50.9

Table 4. ZVI-PRB Resistivity String Construction Details (Continued)

Station ID	Number of Receivers	Target End of Tip [ft bgs]	Surface Elevation [ft amsl]	Actual End of Tip [ft bgs]	Location Along Alignment <sup>1</sup> [ft]	Elevation of B/Purple Receiver [ft amsl]	Depth of B/Purple Receiver [ft bgs]	Elevation of B/Orange Receiver [ft amsl]	Depth of B/Orange Receiver [ft bgs]	Elevation of W/Blue Receiver [ft amsl]	Depth of W/Blue Receiver [ft bgs]	Elevation of W/Red Receiver [ft amsl]	Depth of W/Red Receiver [ft bgs]
RR01	19	137.0	309.56	137.3	-2.0	248.26	61.3	253.26	56.3	258.26	51.3	263.26	46.3
RR02	19	137.2	309.76	137.3	8.2	248.46	61.3	253.46	56.3	258.46	51.3	263.46	46.3
RR03	19	137.2	309.83	137.3	20.2	248.53	61.3	253.53	56.3	258.53	51.3	263.53	46.3
RR04	19	137.3	309.99	137.3	32.7	248.69	61.3	253.69	56.3	258.69	51.3	263.69	46.3
RR05	19	136.9	310.07	137.0	44.3	249.07	61.0	254.07	56.0	259.07	51.0	264.07	46.0
RR06	19	137.6	310.29	137.5	56.5	248.79	61.5	253.79	56.5	258.79	51.5	263.79	46.5
RR07	19	136.0	310.22	136.1	68.3	250.12	60.1	255.12	55.1	260.12	50.1	265.12	45.1
RR08	19	136.3	310.52	136.3	92.7	250.22	60.3	255.22	55.3	260.22	50.3	265.22	45.3
RR09	19	136.9	310.78	136.3	105.5	250.48	60.3	255.48	55.3	260.48	50.3	265.48	45.3
RR10	19	137.1	310.96	137.0	117.8	249.96	61.0	254.96	56.0	259.96	51.0	264.96	46.0
RR11	19	137.6	311.34	137.5	130.8	249.84	61.5	254.84	56.5	259.84	51.5	264.84	46.5
RR12	19	137.9	311.61	137.7	142.9	249.91	61.7	254.91	56.7	259.91	51.7	264.91	46.7
RR13	19	135.6	311.96	135.7	155.2	252.26	59.7	257.26	54.7	262.26	49.7	267.26	44.7
RR14	19	136.0	312.28	136.6	167.0	251.68	60.6	256.68	55.6	261.68	50.6	266.68	45.6
RR15	19	136.4	312.16	136.4	183.0	251.76	60.4	256.76	55.4	261.76	50.4	266.76	45.4
RR16	19	136.4	312.20	136.4	195.9	251.80	60.4	256.80	55.4	261.80	50.4	266.80	45.4
RR17	19	134.2	312.37	134.4	209.7	253.97	58.4	258.97	53.4	263.97	48.4	268.97	43.4
RR18	19	135.9	312.79 <sup>2</sup>	136.1	222.2	252.69	60.1	257.69	55.1	262.69	50.1	267.69	45.1
RR19	19	136.3	313.19	136.3	234.2	252.89	60.3	257.89	55.3	262.89	50.3	267.89	45.3
RR20	16	122.5	313.56	122.5	246.1	267.06	46.5						
RR21	16	122.9	314.02	123.5	258.6	266.52	47.5						
RR22	16	121.7	314.35	121.7	270.2	268.65	45.7						
RR23	16	122.0	314.65	121.9	282.5	268.75	45.9						

<sup>1</sup> Location along alignment is from Northernmost injection (PGF) well.

<sup>2</sup> RR18 surface elevation is an approximation.

Colors denote wire colors used for receivers.

amsl - above mean sea level

Table 5. ZVI Injection Quantities

Station ID		Panel Designation						Total ZVI Weight [lbs or US tons]	RADP Target Weight <sup>2</sup> [lbs or US tons]
Old ID	New ID	A	B	C	D	E	F		
F01	PGF001	11340	11340	11340	11340	11340	7005	63705	64800
F02	PGF002	11340	11340	15347	15402	11340	7005	71774	64800
F03	PGF003	11340	11340	15347	15347	11340	7005	71719	64800
F04	PGF004	11340	11340	15347	15347	11340	7005	71719	64800
F05	PGF005	11340	11340	15347	15347	11340	7005	71719	64800
F06	PGF006	11340	11340	15347	15347	11340	7005	71719	64800
F07	PGF007	11340	11340	15347	15347	11340	7005	71719	64800
F08	PGF008	11340	11340	15347	15347	11340	7005	71719	64800
F09	PGF009	11340	11340	15347	15347	11340	7005	71719	64800
F10	PGF010	11340	11340	15347	15347	15347	7005	75726	64800
F11	PGF011	11340	11340	15347	15347	15347	7005	75726	64800
F12	PGF012	11340	11340	15347	15347	15347	7005	75726	64800
F13	PGF013	11340	11342	15347	15347	15347	7005	75728	64800
F14	PGF014	11340	11340	15347	15347	15347	7005	75726	64800
F15	PGF015	11340	11340	15347	15347	15347	7005	75726	64800
F16	PGF016	11340	11340	15347	15399	15347	7005	75778	64800
F17	PGF017	11340	11340	11340	15347	15347	7005	71719	64800
F18	PGF018	11340	11340	11340	15347	15347	7005	71719	64800
F19	PGF019		11340	11340	15347	15347	7005	60379	54000
F20	PGF020		11340	11340	15347	15347	7005	60379	54000
F21	PGF021		11340	11340	20261	20261	7005	70207	54000
F22	PGF022		0	0	0	0	7005	7005	54000
Total ZVI Injected [lbs]		204120	238142	298245	323301	291138	154110	1431844	1274400
Total ZVI Injected [US tons]		102.1	119.1	149.1	161.7	145.6	77.1	715.9	637.2
Washout Weight [lbs]		6700	5580	6580	2960	4460	660	26940	-
Retained Weight [lbs]		197420	232562	291665	320341	286678	153450	1482116	-
Retained Weight [US tons]		98.7	116.3	145.8	160.2	143.3	76.7	741.1	-

<sup>1</sup> Quantities represent injected quantities. This does not account for ZVI losses due to washout.

<sup>2</sup> RADP target weights were determined based on a design thickness of 4 in. and a ZVI bulk density of 180 pcf. Actual ZVI bulk densities averaged 151 pcf. Highlighted weights indicate the "hot-spots" agreed on by the project team.

Table 6. In-Wall Monitoring Well Construction Details

Station ID	Ground Elevation [ft amsl]	Pad Elevation [ft amsl]	Total Depth [ft bgs]	Casing Diameter [in.]	Construction Material	Top of Screen [ft bgs]	Screened Interval [ft bgs]	Screen Length [ft]	Screen Size [in.]	Filter Pack/Depth [ft bgs]		Completion Date
PIW001D	310.268	310.599	106.6	1	PVC Schedule 40	86.6	86.6-106.6	20	0.010	#2 Sand/4.6-43.0	ZVI/43.0-106.6	12/17/2019
PIW002D	311.739	312.138	93.0	1	PVC Schedule 40	78.0	78.0-93.0	15	0.010	#2 Sand/3.0-44.5	ZVI/44.5-93.0	12/17/2019
PIW003D	312.987	313.134	92.1	1	PVC Schedule 40	72.1	72.1-92.1	20	0.010	#2 Sand/4.7-45.0	ZVI/45.0-92.1	12/18/2019
PIW004D	314.324	314.577	82.9	1	PVC Schedule 40	62.9	62.9-82.9	20	0.010	#2 Sand/4.0-43.7	ZVI/43.7-82.9	12/18/2019

amsl - above mean sea level

Table 7. Summary of Deviations

Item	Change	Reason
1	The injection well station IDs changed from F01-F22 to PGF001-PGF022.	This change was necessary as there are already wells within SRNS' database of wells with IDs F01-F22.
2	The locations and depths of the resistivity strings differed slightly from the design in the RADP. RR01 was moved slightly toward RR02. RR11, RR12, and RR13 were moved 1.2 m (4 ft) closer to the ZVI-PRB and RR14 was moved 0.9 m (3 ft) closer. The depths of all resistivity strings were slightly deeper than proposed in the RADP and are summarized in Table 4.	<p>Prior to the PAGW OU NTC RA construction, a gravel pad was constructed at the ZVI-PRB site to provide stability. This pad increased the ground surface elevation slightly in some areas. The total depths of the resistivity strings were increased to account for this change in elevation.</p> <p>During installation of RR01, the resistivity string was pulled up ~3.7 m (12 ft) while trying to extract the CPT rods and had to be abandoned in place. Therefore, RR01 was installed a second time and its location was moved less than 0.30 m (1 ft) toward RR02 in order to decrease with interference with the abandoned RR01. In addition, the locations of RR11-RR14 were moved due to drill rig access constraints from monitoring wells in close proximity. RR11-RR13 were moved 1.2 m (4 ft) closer to the ZVI-PRB and RR14 was moved 0.91 m (3 ft) closer to the ZVI-PRB. The remaining resistivity strings maintained a 7.3 m (24 ft) offset from the ZVI-PRB.</p> <p>The changes to resistivity string locations and depths did not hamper the ability to monitor, and therefore all associated performance objectives were met.</p>
3	Per the RADP, injection wells were to be installed with a total depth of 41.1 m (135 ft) bgs for PGF001-PGF018 and 36.6 m (120 ft) bgs for PGF019-PGF022. These depths were increased slightly and are summarized in Table 3.	Prior to the PAGW OU NTC RA construction, a gravel pad was constructed at the ZVI-PRB site to provide stability. This pad increased the ground surface elevation slightly in some areas. The total depths of the injection wells were increased to account for this change in elevation. In addition, injection well PGF006 was installed deeper than intended due to difficulties in reaching a stable bottom during drilling. At PGF006 the formation washed out to a depth of 44.2 m (145 ft) bgs. After adding 13 bags of #2 filter sand (22.7 kg [50 lb] bags) the driller attempted to install the injection well at target depth. The injection well assembly settled to a depth of 42.7 m (140 ft) bgs. The project team discussed this with the subcontractor and determined the slight difference in elevation would not cause an issue with ZVI-PRB construction, as the ZVI fracture would propagate toward the adjacent injection wells. The change is not anticipated to affect the ZVI-PRB performance, and therefore the performance objective is met.
4	ZVI was not injected in PGF022 for the depth interval 18.3-36.6 m (60-120 ft) (Panels B, C, D, and E).	During installation of the injection wells, the riser for PGF022 was damaged. GeoSierra excavated down 1.8 m (6 ft) around the riser, cut the riser, and welded on new riser piper to grade. During installation of the packer in PGW022 for injections, the packer ended up lodged in Panel E at 22.3 m (73 ft) bgs. Therefore, no ZVI could be injected in Panels B, C, D, and E of PGF022. The ZVI allocated for the four panels that could not be isolated was redistributed in a targeted approach, as described in item 5 below. During injections in PGF021, active resistance mapping images showed evidence of ZVI propagation toward PGF022 for Panels B-E. Considering that ZVI was propagating from PGF021 toward PGF022, and that the TCE concentrations in Panels B-E of PGF022 are relatively low, the project team agreed to not injecting in Panels B-E at PGF022. This deviation is not anticipated to reduce the overall performance of the ZVI-PRB and the final ZVI-PRB still addresses over 90% of the cVOC contaminant plume, therefore the performance objective is met.

Table 7. Summary of Deviations (Continued)

Item	Change	Reason
5	<p>The envisioned ZVI-PRB in the RADP had a 10.2 cm (4 in.) nominal thickness and required 627 metric tons (691 US tons) of ZVI with 10% additional ZVI allocated for waste (total of ~689 metric tons [760 US tons] of ZVI). The design intended the ZVI-PRB thickness to be consistent throughout. However, the constructed ZVI-PRB has varying thicknesses throughout the barrier due to changes in the target injection weight of ZVI made by the project team. The amount of ZVI injected in Panel C of PGF002-PGF016, Panel D of PGF002-PGF021, and Panel E of PGF010-PGF021 was increased. The amount of ZVI injected in Panel F of all injection wells was decreased.</p>	<p>For construction of a typical ZVI-PRB, GeoSierra orders an additional 10% of ZVI to account for potential losses in broken supersacks, bad batches, washout, etc. in order to ensure the correct amount of ZVI is retained in the subsurface per the design. For Panel A and B injections, GeoSierra injected 105% of the target weight of ZVI to account for washout losses and held 5% of the ZVI back as a buffer for unforeseen losses. After completing Panel A and B, it was determined that actual losses were much lower due to process efficiency and low washout returns. Therefore, 3% of the remaining 5% buffer was distributed to a list of 47 "hot-spots" determined by SRNS to be the expansion casings that transect the highest TCE concentrations in the cVOC plume.</p> <p>In addition to redistributing a portion of the buffer ZVI, the project team agreed that the top panel (Panel F) thickness could be reduced due to TCE concentrations being significantly lower than the remainder of the ZVI-PRB. The thickness in Panel F was reduced from 10.2 cm (4 in.) to 5.1 cm (2 in.). The reduction in ZVI thickness will not have an impact on ZVI-PRB effectiveness. The 'excess' ZVI was redistributed to the 47 "hot-spots" determined from analysis of soil boring plugs.</p> <p>Lastly, 'excess' ZVI was realized from Panels B-E of PGF022 due to no injections as described in item 4. ZVI allocated for Panel B and C of PGF022 was distributed to the "hot-spots." Half of the ZVI allocated for Panel D and E of PGF022 was distributed to the "hot-spots," and the other half was added to the weights for Panel D and E of PGF021 based on observations of propagation from PGF021 to PGF022 in the active resistance mapping images.</p> <p>The resulting ZVI-PRB thickness in Panels A-E is greater than the design thickness described in the RADP. The final thickness of Panel F is ~7.8 cm (3.1 in.) based on a bulk density of 151 pcf (See item 6). Panel F is the only panel that saw a reduced thickness from the RADP but is still anticipated to achieve at least 90% reduction in TCE mass flux due to lower influent concentrations. Therefore, the performance objective is met.</p> <p>This deviation is explained in detail in SDDR 7 (Appendix H)</p>
6	<p>The ZVI bulk density in the RADP was to be 2,883 kg/m<sup>3</sup> (180 pcf). The average bulk density of the delivered ZVI was 2,419 kg/m<sup>3</sup> (151 pcf).</p>	<p>The difference in bulk density was the result of an incorrect reference in the RADP. The design referenced the bulk density of ZVI used in the Treatability Study during the PDI. The bulk density of 151 pcf is within specifications for the ZVI selected for the PAGW OU NTC RA. This deviation is explained in SDDR 6 (Appendix I). The correction in the ZVI bulk density shows that the ZVI-PRB nominal thickness is greater than calculated with the higher value. Therefore, this deviation does not lead to a reduction in the ZVI-PRB performance, and the performance objective is met.</p>

Table 8. ZVI Gel Mixture Ingredient Quantities

Ingredient	Product per Gallon of Water [lbs]	Max Weight By UIC Permit <sup>1</sup> [lbs]	Total Amount Used <sup>2</sup> [lbs]
ZVI	8 - 10	1,600,000	1,520,000
HPG	0.05 - 0.06	13,000	11,202
Acetic Acid	0.001 - 0.002	500	237
HPG Cross-Linker	0.046 - 0.065	20,000	12,831 <sup>3</sup>
HPG Enzyme	0.001 - 0.002	500	395 <sup>3</sup>
Sodium Chloride	0.02 - 0.03	4,000	3,462

<sup>1</sup> Maximum weights set by UIC Permit Table 6C (SRNS 2019b).

<sup>2</sup> Totals are the amounts of each ingredient used. Therefore, the injected amount is slightly less than these values.

<sup>3</sup> Weight of cross-linker and enzyme was estimated based on the typical amounts used per gallon of water. Approximately 197,400 gal of water was used for gel mixtures.

Table 9. Gel Batch Testing Results

Date	Gel Batch No.	Temperature [°C]	Shear Rate [sec-1]			Gel pH	Gel Resistivity [ohms-cm]	Batch Size/Remarks
			1	10	100			
			Gel Viscosity [cP]					
8/7/2019	1	31.8	1400	690	195	5.74	250	1500 gal, 80 lbs HPG, 30 lbs salt, 800 mL acetic acid
8/8/2019	1	29	800	390	200	5.5	250	Test 2nd day
8/9/2019	2	31.3	1600	750	202	5.72	280	1500 gal, 80 lbs HPG, 25 lbs salt, 750 mL acetic acid
8/14/2019	3	33.1	975	495	145	5.88	295	3000 gal, 145 lbs HPG, 50 lbs salt, 1500 mL acetic acid; 2900 gal dumped for quality issues
8/15/2019	4	30.7	700	320	100	5.89	280	2000 gal, 95 lbs HPG, 50 lbs salt, 1000 mL acetic acid; dumped 1700 gal
8/19/2019	5	28.5	1000	520	168	6.2	265	500 gal, 27 lbs HPG, 8.5 lbs salt, 200 mL acetic acid
8/19/2019	6	32.4	1300	600	167	6.1	282	1500 gal, 80 lbs HPG, 25 lbs salt, 750 mL acetic acid
8/20/2019	7	28.5	1000	525	155	6.02	287	3000 gal, 162 lbs HPG, 50 lbs salt, 1500 mL acetic acid
8/21/2019	8	31.6	1500	660	188	6.12	280	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
8/22/2019	9	31.2	800	498	147	6.08	280	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
8/23/2019	10	32.9	1200	630	175	6.24	280	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid; dumped 2300 gal due to bad weather
8/27/2019	11	26.7	1500	657	186	6.12	280	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
8/28/2019	12	26.3	2000	700	201	6.16	310	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
8/29/2019	13	28	1600	740	185	6.27	310	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
9/4/2019	14	31.2	1700	760	190	6.24	310	3000 gal, 169 lbs HPG, 50 lbs salt, 1500 mL acetic acid
9/5/2019	14	28.2	1300	650	180	5.73	300	Test 2nd day
9/5/2019	15	31.6	1100	550	150	6.1	290	2500 gal, 131 lbs HPG, 40 lbs salt, 1250 mL acetic acid
9/6/2019	15	29.5	950	440	135	5.77	290	Test 2nd day
9/9/2019	16	30.8	2100	900	225	6.58	270	500 gal water, 35 lbs HPG, 8.5 lbs salt, 200 mL acetic acid
9/11/2019	17	29.2	1400	620	165	6.21	280	3000 gal water, 169 lbs guar, 50 lbs salt, 1500 mL acetic acid
9/12/2019	18	30.8	1400	600	160	6.13	280	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid
9/13/2019	19	29.6	1000	510	155	6.1	280	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid; dumped 1500 gal due to low viscosity
9/16/2019	20	31.2	1100	580	165	6.11	280	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid
9/17/2019	21	30.9	1300	600	175	6.09	280	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid
9/18/2019	22	28.1	1200	570	155	6.13	280	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid
9/19/2019	22	25.1	700	375	137	6.03	280	Test 2nd day

Table 9. Gel Batch Testing Results (Continued)

Date	Gel Batch No.	Temperature [°C]	Shear Rate [sec-1]			Gel pH	Gel Resistivity [ohms-cm]	Batch Size/Remarks
			1	10	100			
			Gel Viscosity [cP]					
9/19/2019	23	27.1	1100	550	155	6.08	350	3000 gal water, 174 lbs HPG, 50 lbs salt, 1550 mL acetic acid
9/20/2019	23	19.9	600	350	120	6.08	350	Test 2nd day
9/20/2019	24	27.4	1100	550	155	5.85	300	2500 gal water, 125 lbs HPG, 50 lbs salt, 1300 mL acetic acid
9/26/2019	25	31.2	1000	500	150	6.13	310	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
9/27/2019	25	27.8	500	320	120	5.95	-	Test 2nd day; dumped 300 gal due to broken cross-link pump
9/30/2019	26	30.1	1100	550	155	6.1	280	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/1/2019	26	27.1	300	240	97	5.72	-	Test 2nd day; dumped 1000 gal due to low viscosity
10/1/2019	27	29.5	1500	750	195	6.12	280	1500 gal water, 84 lbs HPG, 30 lbs salt, 775 mL acetic acid
10/2/2019	28	27.1	1100	580	160	5.93	270	1500 gal water, 84 lbs HPG, 30 lbs salt, 775 mL acetic acid
10/3/2019	29	28.9	1100	520	150	6.02	280	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/4/2019	29	26.8	500	310	120	6	280	Test 2nd day
10/4/2019	30	29.6	1600	770	195	5.96	310	2200 gal water, 128 lbs HPG, 30 lbs salt, 1130 mL acetic acid
10/7/2019	31	27.2	1100	580	165	6.14	320	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/8/2019	32	27.6	1200	610	165	6.15	320	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/9/2019	33	24.5	1300	620	170	6.26	330	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/10/2019	34	24.3	1200	580	165	6.13	340	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/11/2019	35	24	1400	620	165	6.16	360	3000 gal water, 175 lbs HPG, 60 lbs salt, 1550 mL acetic acid
10/15/2019	36	24	1500	650	170	6.14	380	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/16/2019	37	24	1400	650	170	6.15	370	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/17/2019	38	21.7	1700	740	180	6.15	340	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/18/2019	39	22.1	1400	610	165	6.05	350	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/21/2019	40	21.2	1800	750	185	6.22	350	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/23/2019	41	19.7	1400	700	370	6.04	350	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid
10/24/2019	41	19.7	700	370	130	6.04	350	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid; 2nd test
10/24/2019	42	21.7	1700	750	190	6.28	350	3000 gal water, 175 lbs HPG, 60 lbs salt, 1570 mL acetic acid; dumped 1500 gal due to broken chem grout pump
10/29/2019	43	23	1400	610	165	6.08	410	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
10/30/2019	44	23.2	1700	620	170	6.06	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid

Table 9. Gel Batch Testing Results (Continued)

Date	Gel Batch No.	Temperature [°C]	Shear Rate [sec-1]			Gel pH	Gel Resistivity [ohms-cm]	Batch Size/Remarks
			1	10	100			
			Gel Viscosity [cP]					
10/31/2019 DI	45	25.9	1300	555	150	5.96	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/1/2019 DL	46	16.5	1500	665	163	6.12	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/5/2019	47	19.2	1600	750	185	6.16	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/6/2019	48	21	1500	660	171	6.16	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/7/2019	48	19.3	850	390	122	6.31	370	Test 2nd day
11/7/2019	49	22.1	1200	570	162	6.09	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/8/2019	50	20.3	1200	530	135	6.11	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid; dumped 1000 gal due to broken blender
11/12/2019	51	18.9	1500	650	169	6.21	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/13/2019	51	8.9	1400	615	166	6.35	370	Test 2nd day; dumped 500 gal due to blown bypass line
11/13/2019	52	15.6	1700	690	175	6.22	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/14/2019	52	10.1	1400	600	165	6.39	370	Test 2nd day
11/14/2019	53	14.2	1700	740	184	6.22	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid; dumped 500 gal due to weather
11/18/2019	54	13.5	2800	1050	240	6.17	370	1500 gal water, 90 lbs HPG, 25 lbs salt, 800 mL acetic acid
11/19/2019	55	13.3	2000	840	205	6.18	370	3000 gal water, 175 lbs HPG, 50 lbs salt, 1570 mL acetic acid
11/20/2019	56	14.3	1600	720	180	5.99	370	2700 gal water, 135 lbs HPG, 25 lbs salt, 1500 mL acetic acid
11/21/2019	57	14.8	1500	700	200	6	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
11/22/2019	58	15.7	1500	700	201	6.16	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
11/25/2019	59	13	1700	730	186	6.15	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
11/26/2019	60	13	1200	670	190	6.06	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
11/26/2019	61	15.4	1100	640	183	6.1	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
11/26/2019	62	14.5	1000	420	150	6.15	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/2/2019	63	16.3	1200	570	150	6.15	370	1500 gal water, 75 lbs HPG, 25 lbs salt, 700 mL acetic acid
12/2/2019	64	17.3	1400	640	165	6.22	370	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/3/2019	64	12.6	800	420	139	6.14	275	Test 2nd day
12/3/2019	65	15.1	1700	710	178	6.04	280	1500 gal water, 75 lbs HPG, 25 lbs salt, 700 mL acetic acid
12/4/2019	65	7.8	700	275	95	6.39	245	Test 2nd day
12/5/2019	66	16.6	700	375	130	6	250	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid

Table 9. Gel Batch Testing Results (Continued)

Date	Gel Batch No.	Temperature [°C]	Shear Rate [sec-1]			Gel pH	Gel Resistivity [ohms-cm]	Batch Size/Remarks
			1	10	100			
			Gel Viscosity [cP]					
12/6/2019	67	13.1	1300	630	178	6.1	270	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/6/2019	68	16.7	700	370	111	5.92	300	1500 gal water, 65 lbs HPG, 25 lbs salt, 700 mL acetic acid
12/9/2019	69	17.5	1200	620	155	6.02	300	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/10/2019	70	20.1	1300	620	165	5.92	290	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/11/2019	71	16.3	1000	500	152	6.11	200	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid
12/11/2019	72	16.7	1500	700	183	6.05	200	3000 gal water, 170 lbs HPG, 50 lbs salt, 1600 mL acetic acid

Table 10. Comparison of Pre- and Post-Construction HPIT Data

Direction of Test	Source Well	Receiver Well	Distance Between Wells [ft]	Pre-Construction HPIT				Post-Construction HPIT			
				K [ft day <sup>-1</sup> ]	K [cm sec <sup>-1</sup> ]	S <sub>s</sub> [ft <sup>-1</sup> ]	Groundwater Flow Velocity <sup>1</sup> [ft day <sup>-1</sup> ]	K [ft day <sup>-1</sup> ]	K [cm sec <sup>-1</sup> ]	S <sub>s</sub> [ft <sup>-1</sup> ]	Groundwater Flow Velocity <sup>1</sup> [ft day <sup>-1</sup> ]
Upgradient to Downgradient	PRW001DU	PRW002DU	40.6	6.19E+01	2.18E-02	5.27E-05	2.17E+00	-	-	-	-
	PRW001DL	PRW002DL	40.1	3.40E-01	1.20E-04	1.78E-06	1.19E-02	2.03E+01	7.15E-03	3.14E-05	7.09E-01
	PRW003DU	PRW004DU	44.0	-	-	-	-	3.01E+00	1.06E-03	-	1.05E-01
	PRW003DL	PRW004DL	40.0	5.06E+01	1.78E-02	2.26E-06	1.77E+00	3.39E+00	1.20E-03	1.31E-09	1.19E-01
Downgradient to Upgradient	PRW002DU	PRW001DU	40.6	4.79E+02	1.69E-01	3.91E-05	1.68E+01	5.83E+01	2.06E-02	1.62E-05	2.04E+00
	PRW002DL	PRW001DL	40.1	2.36E+00	8.33E-04	7.50E-06	8.26E-02	8.89E+01	3.13E-02	1.19E-05	3.11E+00
	PRW004DU	PRW003DU	44.0	1.36E+02	4.81E-02	8.87E-06	4.77E+00	-	-	-	-
	PRW004DL	PRW003DL	40.0	-	-	-	-	-	-	-	-
			Average	1.22E+02	4.29E-02	1.87E-05	4.26E+00	4.26E+00	4.26E+00	4.26E+00	4.26E+00

<sup>1</sup> Groundwater flow velocity calculated using 0.007 ft/ft horizontal gradient and 20% effective porosity.

K - hydraulic conductivity

S<sub>s</sub> - specific storage

cm sec<sup>-1</sup> - centimeters per second

Table 11. SRNS QA Surveillance Findings and Responses

CQAPP Section	Page	Surveillance Request/Questions	Surveillance Notes	GeoSierra's Response
<b>2.2 Expansion Casings</b>				
2.2.3 Documentation	10	Where is documentation of the quality data as described in the bullets? Documentation of review and approval by QC Officer?	Per GeoSierra Quality Control Officer (QCO): <ul style="list-style-type: none"> <li>Bentonite data was provided with well installation information and 5%/95% bentonite/cement mixture QC information was documented in the Field Notes.</li> <li>Riser pipe certification was provided by vendor to GeoSierra and reviewed by GeoSierra. Some were returned because they were not straight.</li> </ul>	Addressed in field by QCO. GeoSierra provided steel riser documentation to SRNS for review.
<b>2.3 Resistivity Receiver Wells and Strings</b>				
2.3.2 & 2.3.3 Procedures and Documentation	11 & 12	Provide evidence of QC officer monitoring, documenting, and approving the installation of all resistivity strings?	Per QCO: <ul style="list-style-type: none"> <li>GeoSierra Site Manager was acting as the QC Officer for the installation of resistivity strings, due to his extensive field experience.</li> <li>Resistivity strings are usually installed by a "local" driller.</li> <li>Resistivity strings installed by CPT are preferable because they are in direct contact with the native soil vs. a sand packing if installed by roto sonic drilling.</li> </ul>	Addressed in field by QCO.
2.3.3 Documentation	11	Provide proof of manufacturer's QC test data for resistivity receivers.	Per QCO: <ul style="list-style-type: none"> <li>QCO received the manufacturer's component data, however the resistivity strings were fabricated by GeoSierra.</li> </ul>	QC data is provided from the manufacture for the stainless steel receivers. All connects and wires are checked for continuity by GeoSierra before installation. Resistivity Receiver data was provided to SRNS for review.
<b>3.0 Iron/Guar Mixture</b>				
3.1 Iron	14	Provide evidence of QC tests prior to shipment or at receipt.	Per QCO: <ul style="list-style-type: none"> <li>A certificate of analysis (COA) for each batch of iron is provided by the iron vendor (Peerless) and reviewed by QCO. COA includes sieve test and density.</li> <li>QCO provided the COAs to us during our breakout meeting in the control room.</li> </ul>	COA documentation will be provided per load and cross-checked by the QCO to ensure it is within acceptable range.
3.1.1 Supplier Quality Control	14	Provide evidence that suppliers certificates/analyses have been reviewed for conformance with Technical Specifications.	Copies of COAs were supplied during surveillance. No evidence of QC officer review. This will be resolved via SDDR #6. A subsequent review of this documentation identified a discrepancy with the design parameters. This discrepancy was discussed with GeoSierra and documented/resolved in SDDR #6.	SDDR-06 submitted and approved by SRNS on 10/3/2019.
3.1.1 Supplier Quality Control	14	Provide information of any site visits to iron supplier.	No site visits have been made by GeoSierra to the iron vendor. GeoSierra and Peerless (the iron vendor) have had communications as a result of the identified discrepancies. Communications captured in SDDR #6.	GeoSierra conducted a vendor visit in April 2018. Raw materials, processing, and sampling/testing were observed during the site visit. All communication with respect to the QA/QC were communicated with the vendor and captured in the SDDR-06.

Table 11. SRNS QA Surveillance Findings and Responses (Continued)

CQAPP Section	Page	Surveillance Request/Questions	Surveillance Notes	GeoSierra's Response
3.1.2.1 Delivery Evaluation (Iron Filings)	15	Provide evidence of iron delivery details and inspection.	Although the bags are inspected upon delivery as part of the unloading, there are no specific tests of the material performed by GeoSierra for conformance to the design specifications. <b>See next item for action</b>	See next item (3.1.2.2 for action).
3.1.2.2 Quality Control Testing (Iron Filings)	15	Provide evidence of testing per recommended frequency (for 1st 200 tons)	GeoSierra has not performed a QC test of the iron. <b>SDDR 0006 will address. ACTION ITEM: GeoSierra will perform at least one sample be analyzed for the items recommended in paragraph 2 of Section 3.1.2.2 of the CQAPP.</b>	SDDR-06 addressed 3rd party sampling of loads shipped 9/19/19-9/20/19. Samples will be analyzed for grain size, bulk density, pH, permeability, and chemical composition.
<b>3.2 Uncross-linked Gel Fluid</b>				
3.2.3 Documentation	16	Provide evidence that the weights, volumes, resistivity, viscosity and temperature of uncross-linked gel are being recorded.	QCO showed us the spreadsheet with this information in the control room which is recorded daily.	Addressed in field by QCO.
<b>3.3 Iron/Gel Mixture</b>				
3.3.1 Requirements	16	Provide evidence that volumetric flow rates are recorded in the field log book.	QCO described the process. ACTION ITEM: QCO will provide an example of a field log book entry for SRNS review.	A sample of the field book has been provided along with an example of calculations in our average flow rate & iron/gel density calculator. Log and Average Q & Iron-Gel Density Calculator were provided to SRNS for review.
3.3.2 Sampling and Testing Procedures	16	Provide evidence that the density of the iron/gel is being recorded in a field log book.	QCO described the process. ACTION ITEM: QCO will provide an example of a field log book entry for SRNS review.	A sample of the field book has been provided along with an example of calculations in our average flow rate & iron/gel density calculator. Injection Log and Average Q & Iron-Gel Density Calculator were provided to SRNS for review.
3.3.3 Documentation	17	Provide evidence of iron/gel volumes and/or weights by ingredient are being documented for QC Officer review.	During discussions with QCO, evidence was provided showing these requirements are being met. SMEs observed spreadsheets where data was recorded.	Addressed in field by QCO.
<b>4.1 Injection Pressures (Emplacement Requirements)</b>				
4.1.3 Documentation	18	Provide calibration records in accordance with manufacturer's recommendations for MSI pressure transducers.	Pressure transducers are a fail/operate device and don't have much drift. Failed transducers are replaced with new ones.	Addressed in field by QCO.

Table 11. SRNS QA Surveillance Findings and Responses (Continued)

CQAPP Section	Page	Surveillance Request/Questions	Surveillance Notes	GeoSierra's Response
4.1.3 Documentation	18	Provide evidence of continuous pressure monitoring and recording. What is impact of absent pressure data? Documentation of QC officer evaluations? How is pore pressure relief documented and evaluated?	Per QCO: <ul style="list-style-type: none"> <li>Pressure monitoring is performed continuously and is stopped if pressure transducers fail. In some rare cases if the last reading was good prior to transducer failure, the injection will continue so as not to disrupt the fracture/injection. Because there are several injections in each casing a few missed pressure readings would not be detrimental to the evaluation.</li> <li>QCO showed SMEs example files of the pressure data and described how he reviewed it each day.</li> <li>QCO also showed us the computer files that are used to document pore pressure relief.</li> </ul>	Addressed in field by QCO.
<b>4.2 Flow Rates (Emplacement Requirements)</b>				
4.2.3 Documentation	19	Provide calibration records in accordance with manufacturer's recommendations for flow instrumentation, if used.	A flow meter is not used for recording flow. Scales are used for the weight/mass of material and stop watches are used to calculate the flow rate.	Addressed in field by QCO.
4.2.3 Documentation	19	Provide evidence of continuous flow monitoring and recording.	Data used to calculate flow is recorded in the log book. ACTION ITEM: QCO will provide an example log book entry page to show that this is being done.	A sample of the field book has been provided along with an example of calculations in our average flow rate & iron/gel density calculator. Injection Log and Avg. Q and Iron-Gel Density Calculator provided to SRNS for review.
<b>4.3 Batch Feed Rate of Iron Filings (Emplacement Requirements)</b>				
4.3.2 Procedures for Determining Weight of Iron	20	Provide calibration data for Fairbanks Omnicell (or equivalent).	The scales are calibrated prior to every job. A certificate of calibration was provided to us during the visit to the control room.	Addressed in field by QCO.
4.3.3 Documentation	19	Provide evidence of batch feed weight documentation.	This data is recorded in the log book. ACTION ITEM: QCO will provide an example log book entry page to show that this is being done.	A sample of the field book and Injection Log were provided to SRNS for review.
<b>4.4 Emplacement Geometry of PRB</b>				
4.4.1 Requirements	20	Has the geometry of the PRB been determined for any intervals?	The geometry has been evaluated/determined for the "A" interval. This was shown to us in the control room. In addition to evaluation of the daily injection data, a high voltage was induced on one injection well to measure the in-place iron in the lower casing for all wells. This was done at each end of the PRB. QCO showed us the images. ACTION ITEM: QCO will provide PDF copies of these two images.	Both images produced on either side of the wall have been provided. PGF001 Panel A Post Baseline and PGF017 Panel A Post Baseline were provided to SRNS for review.

Table 11. SRNS QA Surveillance Findings and Responses (Continued)

CQAPP Section	Page	Surveillance Request/Questions	Surveillance Notes	GeoSierra Environmental's Response
<b>4.4 Emplacement Geometry of PRB (Continued)</b>				
4.4.2 Procedures for Determining Reactive Barrier Geometry	20	What is the implication of all receivers not functioning correctly? What is the receiver failure frequency in past projects?	Per QCO, he believes that there is only one resistivity point (out of >400) that is not functioning correctly. Other points may appear as "absent data" in the visualizations because if the data from that point is considered to be anomalous by the computer program, the data will not be used in analyses and is marked with a hashtag in the text file. QCO can remove the hashtag (or add one) if he thinks the data point is valid (or invalid). QCO thinks the percentage of functioning receivers is good and better than at other sites.	Addressed in field by QCO.
4.4.2 Procedures for Determining Reactive Barrier Geometry	20	Provide evidence that the injection signal is monitored and recorded continuously. (reference Section 1.3)	Text files of the induced voltages and output voltages were shown to us in the control room. This data is interrupted whenever a snapshot of the geometries is produced. This interruption only happens for a few intervals (seconds) during each injection.	Addressed in field by QCO.
4.4.2 Procedures for Determining Reactive Barrier Geometry	21	Provide evidence that the receivers signals and total volume are recorded and evidence that inclusion geometries are calculated. Provide an example of satisfactory conditions that meet the technical specifications.	A 2-D geometry was provided. The volumes injected are calculated based on the mass and injection times. The calculation and records of this data was shown to us in the control room.	Addressed in field by QCO.
<b>4.4 Emplacement Geometry of PRB (Continued)</b>				
4.4.3 Documentation	21	When control room is unmanned during injections, are receiver signals still being recorded continuously?	Per QCO, it is important the control room is manned at all time during injections. Based on field visits, it was observed that there were occasions where the control room was not manned during injections due to field conditions. QCO indicated he will remind the team that it is important not to miss the resistivity data while injecting.	Addressed in field by QCO.

Table 12. EMP Well Details

Station ID	Location	Ground Elevation [ft amsl]	Total Depth [ft bgs]	SRS Northing	SRS Easting	Screen Interval [ft bgs]
PRW001C	Upgradient	310.95	206.0	44430.09	64299.54	146 - 156
PRW001DL	Upgradient	310.8	122.5	44441.59	64301.86	109.9 - 119.9
PRW001DU	Upgradient	310.6	98.0	44451.96	64301.23	81.8 - 91.8
PRW002C	Downgradient	311.13	196.0	44439.09	64260.32	148.3 - 158.3
PRW002DL	Downgradient	311.36	119.7	44450.85	64261.83	107.3 - 117.3
PRW002DU	Downgradient	310.85	93.2	44461	64265.69	80.8 - 90.8
PRW003C	Upgradient	311.01	206.0	44363.47	64294.85	136.8 - 146.8
PRW003DL	Upgradient	311.53	107.5	44391.79	64291.73	95.0 - 105.0
PRW003DU	Upgradient	311.44	74.5	44350.37	64287.02	61.9 - 71.9
PRW004C	Downgradient	312.5	216.0	44385.39	64249.94	144.5 - 155.5
PRW004DL	Downgradient	312.31	124.5	44395.72	64252.8	111.6 - 121.6
PRW004DU	Downgradient	312.51	77.5	44369.91	64246.71	64.91 - 74.91
P002U	Downgradient	311.48	92.6	-81°35'2.19"	33°13'43.73"	87.5 - 92.5
P003U	Upgradient	310.72	89.4	-81°35'1.06"	33°13'44.13"	84.3 - 89.3
P003L	Upgradient	310.74	118.7	-81°35'1.08"	33°13'44.17"	113.6 - 118.6
PRW005DL	Downgradient	310.197	186.6	-81°35'2.13"	33°13'44.67"	114.34 - 124.31
PRW005DU	Downgradient	310.366	54.7	-81°35'2.19"	33°13'44.59"	37.4 - 52.37
PRW006C	Downgradient	327.361	185.12	-81°35'3.65"	33°13'43.84"	163.77 - 173.74
PRW006DL	Downgradient	327.423	152.25	-81°35'3.53"	33°13'43.86"	134.94 - 149.92
PRW006DU	Downgradient	327.547	95.58	-81°35'3.42"	33°13'43.90"	83.29 - 93.26
PRW007DL	Downgradient	314.258	186.0	-81°35'2.12"	33°13'42.59"	107.36 - 117.33
PRW007DU	Downgradient	313.886	80.13	-81°35'2.14"	33°13'42.68"	67.82 - 77.79
PIW001D	In-Wall	310.27	106.6	44462.51	64297.01	86.6 - 106.6
PIW002D	In-Wall	311.74	93.0	44401.71	64274.37	78.0 - 93.0
PIW003D	In-Wall	312.99	92.1	44346.28	64238.87	72.1 - 92.1
PIW004D	In-Wall	314.32	82.9	44301.46	64221.77	62.9 - 82.9

Table 13. NTC RA Cost Comparison Summary

Entity	Item	RSER/EE/CA Cost Estimate [\$]	Actual Cost [\$]	Delta Cost [%]
SRNS	DDAP	\$ -	\$ 464,640.00	-
	Design	\$ 156,842.00	\$ 129,765.00	-17%
	Construction	\$ 1,176,318.00	\$ 1,250,054.00	6%
Subcontractor	DDAP	\$ -	\$ 1,410,161.00	-
	Design	\$ 100,000.00	\$ 89,400.00	-11%
	Construction	\$ 1,468,423.00	\$ 6,005,436.00	309%
Total Capital Cost		\$ 2,901,583.00	\$ 9,349,456.00	222%
Total O&M Cost		\$ 1,709,506.00	TBD	TBD

<sup>1</sup> Actual O&M costs include costs associated with the EMP, which extends for 5 years. Therefore, the amount is TBD.

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**APPENDIX A**

**ZVI-PRB Injection Well Construction Logs**

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F01 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 309.80 WATER DEPTH ~35.0 ft  
 WEATHER Partly Cloudy DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. High 80s / low 90s DRILL RIG(S) ProSonic PS150T DRILLER T. Ardito STARTED 0800/6-19-19 COMPLETED 1255/6-21-19  
 LOCATION/COORDINATES: NORTHING: 44481.28 EASTING: 64341.16 Long: -81°25'1.78" Lat: 33°13'44.79"

**MATERIALS INVENTORY**

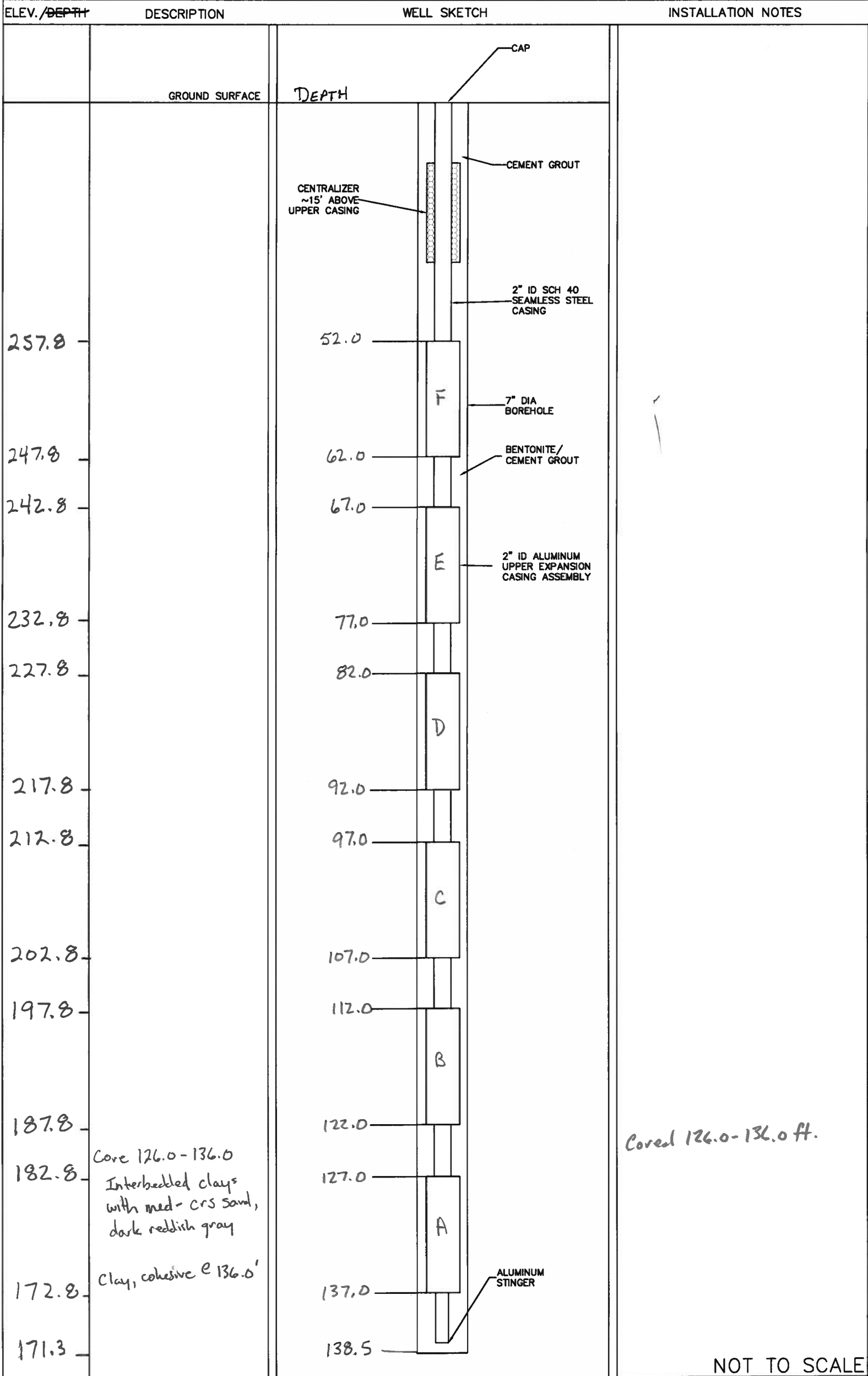
WELL CASING 2 in. dia. 77.0 I.F. EXPAN. CASING 2 in. dia. 60.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (50#) wt. = 12.2-12.8 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE 03020223M 2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
		<p>The well sketch shows a vertical borehole with several casing sections labeled A through F. Section A is at the bottom, followed by B, C, D, E, and F. A centralizer is located ~15' above the upper casing. Cement grout is shown around the casing. An aluminum stinger is at the very bottom. The ground surface is at the top. The depth scale on the left shows elevations from 171.3 to 257.8.</p>	
257.8		52.0	
247.8		62.0	
242.8		67.0	
232.8		77.0	
227.8		82.0	
217.8		92.0	
212.8		97.0	
202.8		107.0	
197.8		112.0	
187.8		122.0	
182.8		127.0	
172.8		137.0	
171.3		138.5	

NOT TO SCALE

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>F02</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinsey</u>	DRILLING METHOD <u>Rotasonic</u>	GROUND ELEV. <u>309.83</u>	WATER DEPTH <u>~35.0 ft</u>
WEATHER <u>Sunny</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>Mid 90's</u>	DRILL RIG(S) <u>ProSonic PS150T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>0740/5-30-19</u>
LOCATION/COORDINATES: NORTHING: <u>44476.74</u>		EASTING: <u>64330.11</u>	LONG: <u>-81°35'1.86"</u> LAT: <u>33°13'44.68"</u>
<b>MATERIALS INVENTORY</b>			
WELL CASING <u>2</u> in. dia. <u>77.0</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____ in. dia. _____ I.F.	
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE <u>STEEL</u>	
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4" OD X 4'</u>	WELL SECURITY <u>2" NPT PLUG</u>	
GROUT QUANTITY <u>36 Bags (50#) Wt: 12.1-12.8</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE <u>BENTONITE</u>	
SURFACE COMPLETION _____	WELL PERMIT #: <u>SCHE03020223M2</u>		

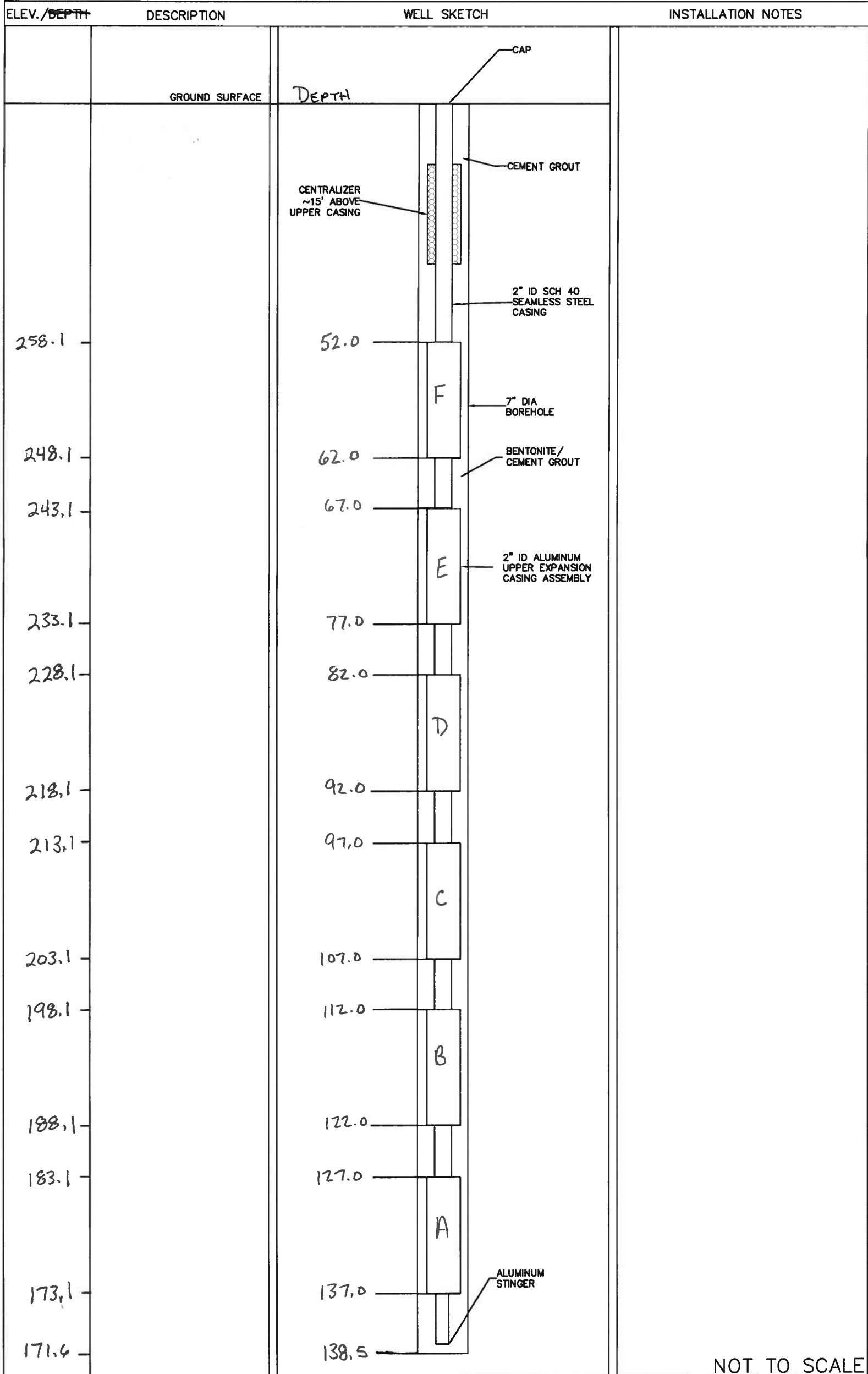


# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>Fp3</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinley</u>	DRILLING METHOD <u>Roto Sonic</u>	GROUND ELEV. <u>310.07</u>	WATER DEPTH <u>~35.0 ft</u>
WEATHER <u>Sunny</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>Mid 90's</u>	DRILL RIG(S) <u>ProSonic PS150T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>1400 / 5-31-19</u>
LOCATION/COORDINATES: NORTHING: <u>44471.98</u> EASTING: <u>64319.08</u>		LONG: <u>-81°35'1.93"</u>	LAT: <u>33°13'44.58"</u>

<b>MATERIALS INVENTORY</b>			
WELL CASING <u>2</u> in. dia. <u>27.0</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____	in. dia. _____
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE _____	STEEL
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4"OD X 4'</u>	WELL SECURITY _____	<u>2" NPT PLUG</u>
GROUT QUANTITY <u>30 Bags (50#) wt: 12.3-12.7</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE _____	<u>BENTONITE</u>
SURFACE COMPLETION _____	WELL PERMIT # <u>SCHE03020223M2</u>		

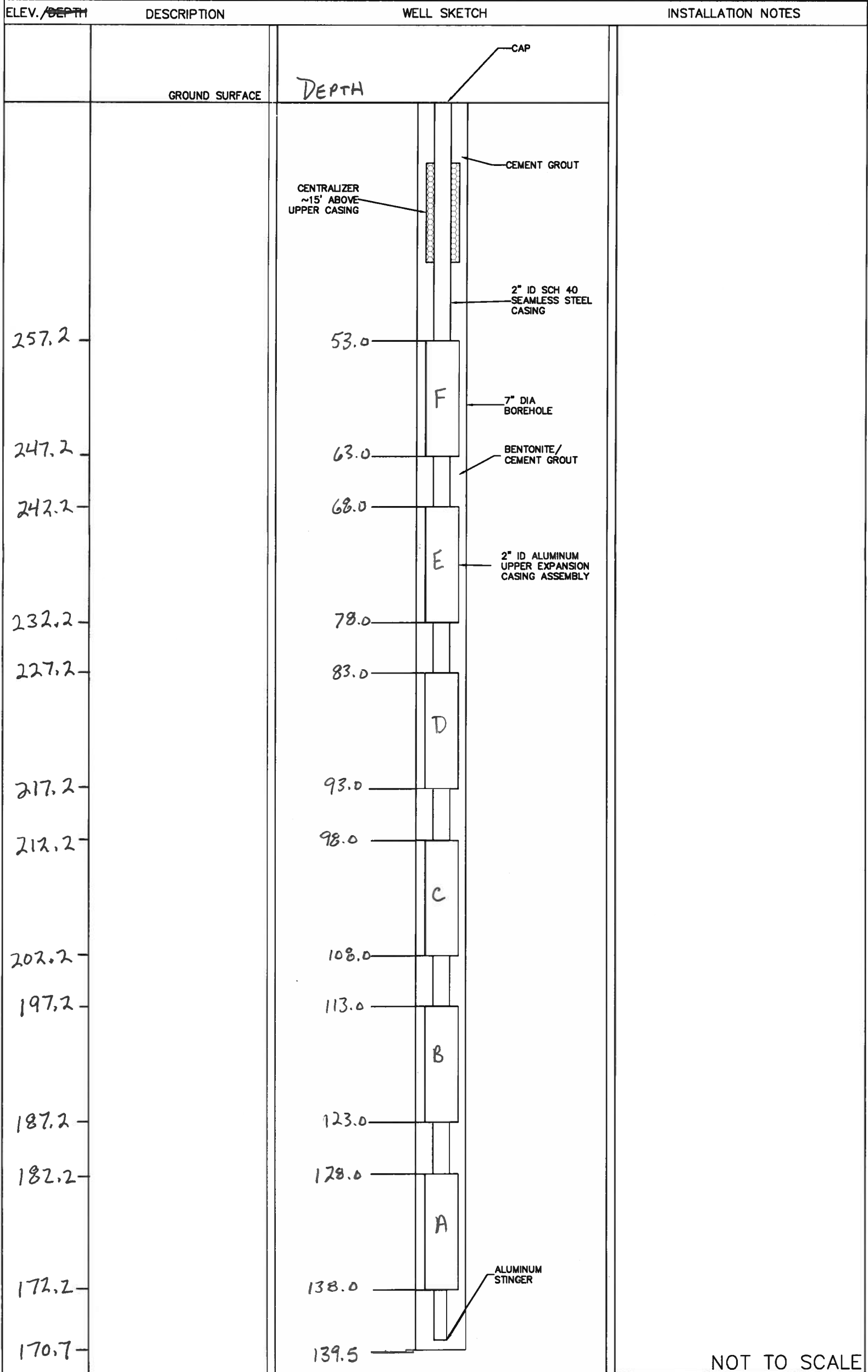


# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F04 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD RotoSonic GROUND ELEV. 310.17 WATER DEPTH ~35.0ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. Mild to upper 90's DRILL RIG(S) ProSonic PS150T DRILLER T. Ardito STARTED 1530/6-3-19 COMPLETED 0845/6-5-19  
 LOCATION/COORDINATES: NORTHING: 44467.15 EASTING: 64308.08 Long: -81°35'2.00" LAT: 33°13'44.48"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 78.0 I.F. EXPAN. CASING 2 in. dia. 60.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 308 bags (50#) WT=12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT # SCH E0302022JM2



NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F05 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 310.38 WATER DEPTH ~35.0ft  
 WEATHER Sunny w/ Storms DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. 90's DRILL RIG(S) ProSonic PS150T DRILLER T. Ardito STARTED 1035/6-5-19 COMPLETED 0910/6-6-19  
 LOCATION/COORDINATES: NORTHING: 44462.51 EASTING: 64297.01 Long: -81°35'2.07" LAT: 33°13'44.38"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 77.0 I.F. EXPAN. CASING 2 in. dia. 60.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags / 12.5-12.2 wt. GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE03026223M2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>258.4</p> <p>248.4</p> <p>243.4</p> <p>233.4</p> <p>228.4</p> <p>218.4</p> <p>213.4</p> <p>203.4</p> <p>198.4</p> <p>188.4</p> <p>183.4</p> <p>173.4</p> <p>171.9</p>		<p style="text-align: center;">CAP</p> <p style="text-align: center;">CENTRALIZER ~15' ABOVE UPPER CASING</p> <p style="text-align: center;">CEMENT GROUT</p> <p style="text-align: center;">2" ID SCH 40 SEAMLESS STEEL CASING</p> <p style="text-align: center;">7" DIA BOREHOLE</p> <p style="text-align: center;">BENTONITE/ CEMENT GROUT</p> <p style="text-align: center;">2" ID ALUMINUM UPPER EXPANSION CASING ASSEMBLY</p> <p style="text-align: center;">D</p> <p style="text-align: center;">C</p> <p style="text-align: center;">B</p> <p style="text-align: center;">A</p> <p style="text-align: center;">ALUMINUM STINGER</p>	<p>Lost circulation from 108 - 138.5 ft.</p> <p>NOT TO SCALE</p>

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>F06</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinsey</u>	DRILLING METHOD <u>RotoSonic</u>	GROUND ELEV. <u>310.80</u>	WATER DEPTH <u>~35.0 ft</u>
WEATHER <u>Sunny</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>90's</u>	DRILL RIG(S) <u>ProSonic PS150T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>11/5/6-6-19</u>
LOCATION/COORDINATES: NORTHING: <u>44457.83</u>		EASTING: <u>64285.96</u>	LONG: <u>-81° 35' 2.14"</u> LAT: <u>33° 13' 44.27"</u>
<b>MATERIALS INVENTORY</b>			
WELL CASING <u>2</u> in. dia. <u>80.6</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____	in. dia. _____ I.F.
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE <u>STEEL</u>	
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4" OD X 4'</u>	WELL SECURITY <u>2" NPT PLUG</u>	
GROUT QUANTITY <u>36 Bags (50#) Wt. = 12.2-12.5</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE <u>BENTONITE</u>	
SURFACE COMPLETION _____	WELL PERMIT # <u>SCHE03020223M2</u>		

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>255.2</p> <p>245.2</p> <p>240.2</p> <p>230.2</p> <p>225.2</p> <p>215.2</p> <p>210.2</p> <p>200.2</p> <p>195.2</p> <p>185.2</p> <p>180.2</p> <p>170.2</p> <p>168.7</p> <p>165.8</p>	<p>Core was not collected. The formation between 135-140 ft bgs was unstable.</p>		<p>Drilled to target depth and the formation washed out to a tagged depth of 145.0 ft.</p> <p>Added 13 bags of #2 filter sand (50 lb bags) to bring the casing to target depth.</p> <p>The formation continued to be unstable at the bottom depth.</p> <p>1-in PVC tremie pipe broke while grouting and ~130 ft of tremie was lost. It was determined that the tremie was positioned along the side of the wings and not obstructing the expansion casing. The PVC tremie was grouted in place.</p>
NOT TO SCALE			

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>F07</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinsey</u>	DRILLING METHOD <u>RotoSonic</u>	GROUND ELEV. <u>310.94</u>	WATER DEPTH <u>~35.0 ft</u>
WEATHER <u>Sunny</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>High 80s</u>	DRILL RIG(S) <u>ProSonic PS 50T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>1150/6-16-19</u>
LOCATION/COORDINATES: NORTHING: <u>44449.44</u>		EASTING: <u>64279.88</u>	COMPLETED <u>0850/6-11-19</u>
<b>MATERIALS INVENTORY</b>			
WELL CASING <u>2</u> in. dia. <u>78.6</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____	in. dia. _____ I.F.
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE <u>STEEL</u>	
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4" OD X 4'</u>	WELL SECURITY <u>2" NPT PLUG</u>	
GROUT QUANTITY <u>36 Bags (50#) wt = 12.4-13.9</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE <u>BENTONITE</u>	
SURFACE COMPLETION _____		WELL PERMIT # <u>SCH 03020223m 2</u>	

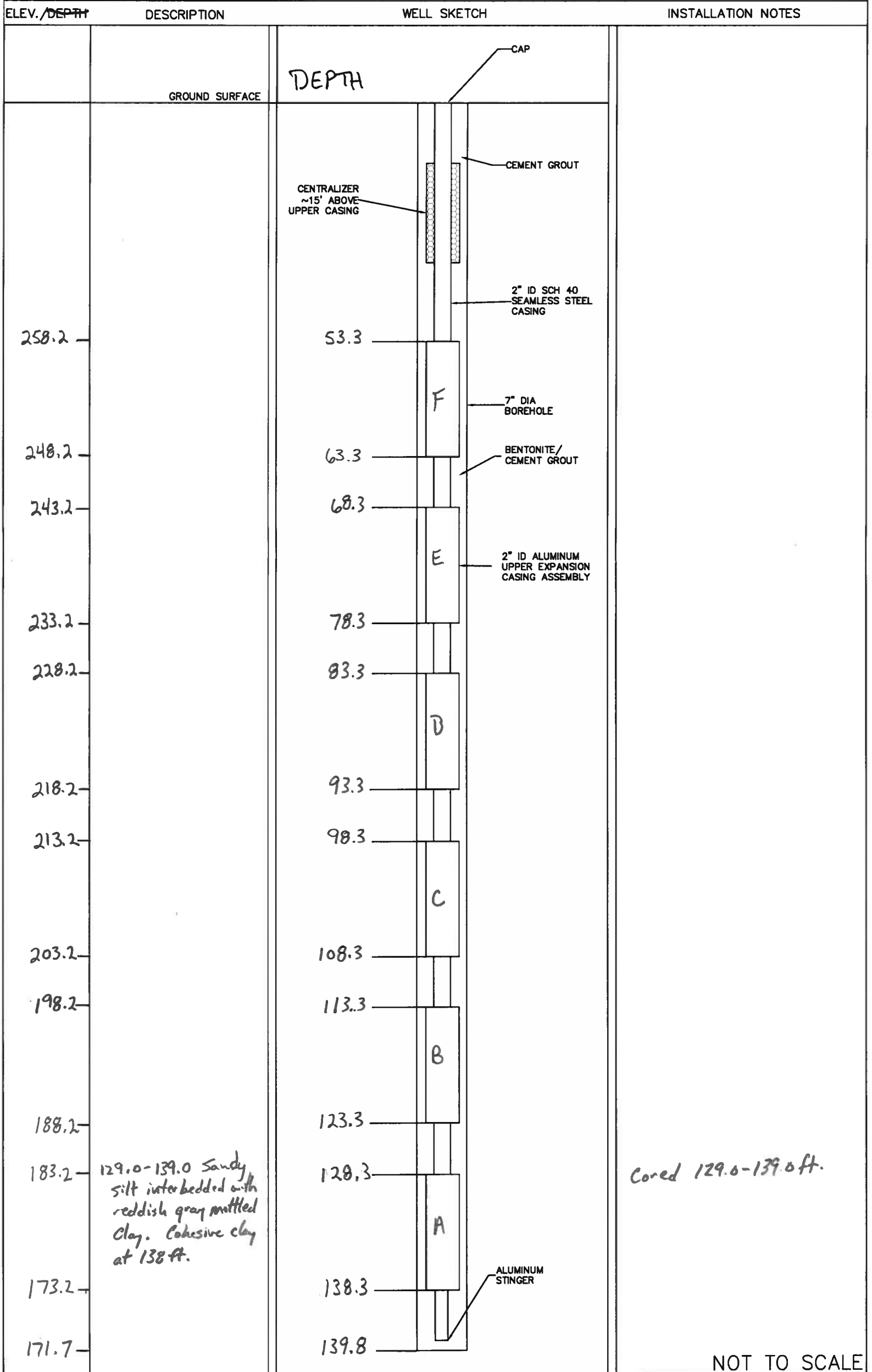
ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
257.3		<p style="font-size: small;">           CAP            CENTRALIZER ~15' ABOVE UPPER CASING            2" ID SCH 40 SEAMLESS STEEL CASING            7" DIA BOREHOLE            BENTONITE/CEMENT GROUT            2" ID ALUMINUM UPPER EXPANSION CASING ASSEMBLY            ALUMINUM STINGER         </p>	
247.3		F	
242.3		E	
232.3		D	
227.3		C	
217.2		B	
212.2		A	
202.2			
197.2			
187.2			
182.2	<u>128.0-138.0 Sandy Silt interbedded with reddish gray mottled clay layers.</u>		<u>Cored 128.0-138.0 ft.</u>
172.2			
170.7			

NOT TO SCALE



**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>F09</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinsey</u>	DRILLING METHOD <u>Roto Sonic</u>	GROUND ELEV. <u>311.46</u>	WATER DEPTH <u>~35.0ft</u>
WEATHER <u>Sunny</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>80s-90s</u>	DRILL RIG(S) <u>Pro Sonic PS150T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>1400/6-12-19</u>
LOCATION/COORDINATES: NORTHING: <u>44425.62</u>		EASTING: <u>64277.18</u>	LONG: <u>-81°35'2.00"</u> LAT: <u>33°13'43.97"</u>
<b>MATERIALS INVENTORY</b>			
WELL CASING <u>2</u> in. dia. <u>78.3</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____	in. dia. _____ I.F.
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE <u>STEEL</u>	
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4"OD X 4'</u>	WELL SECURITY <u>2" NPT PLUG</u>	
GROUT QUANTITY <u>30 Bags Wt=12.3-12.9</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE <u>BENTONITE</u>	
SURFACE COMPLETION _____		WELL PERMIT #: <u>SCHE03020223M2</u>	



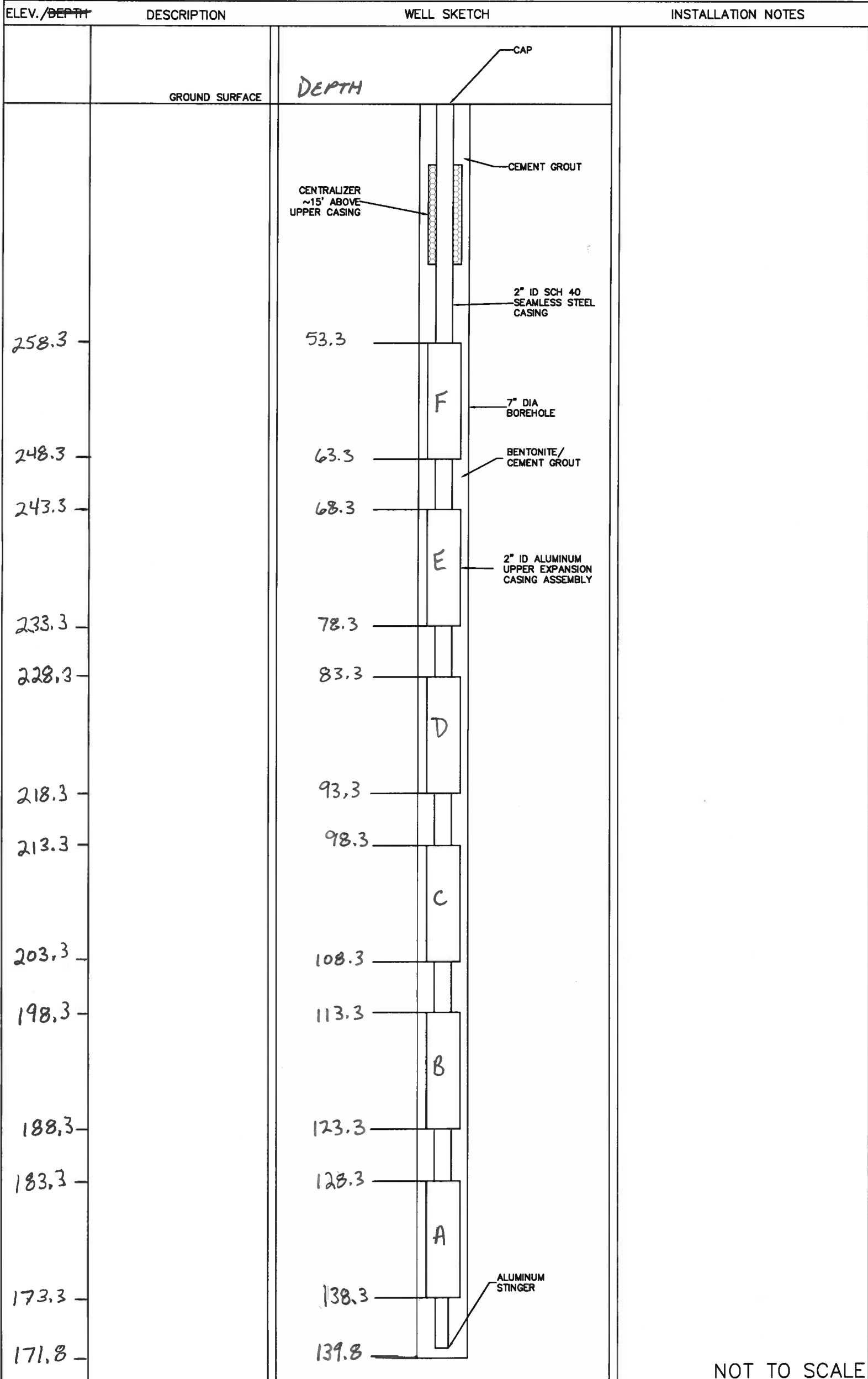
NOT TO SCALE

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F1φ SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 311.59 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. High 80s DRILL RIG(S) Pro Sonic PS150T DRILLER T. Ardito STARTED 1400/6-13-19 COMPLETED 1005/6-14-19  
 LOCATION/COORDINATES: NORTHING: 44413.71 EASTING: 64275.81 Long: -81°35'17.93" LAT: 33°13'43.86"

**MATERIALS INVENTORY**

WELL CASING 2 in. dia. 78.3 I.f. EXPAN. CASING 2 in. dia. 60.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (56\*) Wt = 12.5 \* 12.7 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE 03020 223M2



NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F11 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 311.81 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. 80s DRILL RIG(S) ProSonic P3150T DRILLER T. Ardito STARTED 1120/6-14-19 COMPLETED 0955/6-17-19  
 LOCATION/COORDINATES: NORTHING: 44401.71 EASTING: 64274.37 Long: -81° 35' 1.86" LAT: 33° 13' 43.76"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 77.0 I.f. EXPAN. CASING 2 in. dia. 60.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 36 Bags wt=12.2-12.9 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE 03020 223 M2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
259.8  249.8 244.8  234.8 229.8  219.8 214.8  204.8 199.8  189.8 184.8  174.8 173.3 170.3			Casing suspended inside drill casing over the weekend. When it was lowered to the bottom of the borehole it dropped 2.5 ft deeper. Added 5 bags of #2 filter sand to raise the well casing. Bottom of stinger set at 138.5 ft
		CENTRALIZER ~15' ABOVE UPPER CASING 2" ID ALUMINUM UPPER EXPANSION CASING ASSEMBLY ALUMINUM STINGER	NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F12 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 312.03 WATER DEPTH ~35.0ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. Mid 90's DRILL RIG(S) ProSonic PS 150T DRILLER T. Ardito STARTED 1200/6-17-19 COMPLETED 1300/6-18-19  
 LOCATION/COORDINATES: NORTHING: 44389.89 EASTING: 64273.15 LAT: 33°13'43.66" LONG: -81°35'1.79"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 78.0 I.F. EXPAN. CASING 2 in. dia. 60.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 35 Bags (#50) wt: 12.2-12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT # SCHE03020223m2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>259.0</p> <p>249.0</p> <p>244.0</p> <p>234.0</p> <p>229.0</p> <p>219.0</p> <p>214.0</p> <p>204.0</p> <p>199.0</p> <p>189.0</p> <p>184.0</p> <p>174.0</p>	<p>129'-138' Clay interbedded with fine to medium sand beds. Clay is cohesive and gray mottled with dark red.</p> <p>138'-139' Sand, med, dark yellowish orange.</p>	<p style="text-align: center;">CAP</p> <p style="text-align: center;">CEMENT GROUT</p> <p style="text-align: center;">CENTRALIZER ~15' ABOVE UPPER CASING</p> <p style="text-align: center;">2" ID SCH 40 SEAMLESS STEEL CASING</p> <p style="text-align: center;">7" DIA BOREHOLE</p> <p style="text-align: center;">BENTONITE/ CEMENT GROUT</p> <p style="text-align: center;">2" ID ALUMINUM UPPER EXPANSION CASING ASSEMBLY</p> <p style="text-align: center;">ALUMINUM STINGER</p>	<p>Added 11 bags of sand to fill in washout near bottom of the borehole.</p> <p>Cored 129'-139'</p> <p style="text-align: right;">NOT TO SCALE</p>

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. <u>801181002</u>	PROJECT <u>SAVANNAH RIVER SITE P-AREA</u>	WELL NO. <u>F-13</u>	SHEET <u>1/1</u>
INSP. <u>T. McKinsey</u>	DRILLING METHOD <u>Roto Sonic</u>	GROUND ELEV. <u>312.18</u>	WATER DEPTH <u>~35.0 ft</u>
WEATHER <u>Cloudy</u>	DRILLING COMPANY(S) <u>CASCADE DRILLING</u>	CAP ELEV. _____	DATE/TIME <u>NA</u>
TEMP. <u>High 80's</u>	DRILL RIG(S) <u>ProSonic PS 150T</u>	DRILLER <u>T. Ardito</u>	STARTED <u>0925/7-9-19</u>
LOCATION/COORDINATES: NORTHING: <u>44377.89</u>		EASTING: <u>64271.73</u>	LAT: <u>33° 13' 48.55" N</u>
		LONG: <u>-81° 35' 1.72" W</u>	COMPLETED <u>0915/7-10-19</u>

WELL CASING <u>2</u> in. dia. <u>78.0</u>	I.F. EXPAN. CASING <u>2</u> in. dia. <u>60.0</u>	I.F. TEMP. CASING _____ in. dia. _____ I.F.
CASING TYPE <u>SCH 40 SEAMLESS STEEL PIPE</u>	CASING TYPE <u>ALUMINUM EXPANSION CASING</u>	CASING TYPE <u>STEEL</u>
JOINT TYPE <u>STEEL COUPLING</u>	CENTRALIZERS <u>5 3/4" OD X 4'</u>	WELL SECURITY <u>2" NPT PLUG</u>
GROUT QUANTITY <u>35 Bags (#50) Wt: 12.2-12.5</u>	GROUT TYPE <u>5% BENTONITE/95% CEMENT</u>	DRILLING MUD TYPE <u>BENTONITE</u>
SURFACE COMPLETION _____	WELL PERMIT # <u>SCHE03020223M2</u>	

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE		
259.2		53.0	<p>During drilling of the borehole drilling mud flowed out of the annulus of resistivity test point RR-14 (installed with CPT). Approximately 30-40 gals of bentonite drilling mud flowed out onto the ground surface.</p>
249.2		63.0	
244.2		68.0	
234.2		78.0	
229.2		83.0	
219.2		93.0	
214.2		98.0	
204.2		108.0	
199.2		113.0	
189.2		123.0	
184.2		128.0	
174.2		138.0	
172.7		139.5	NOT TO SCALE

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. 801181002	PROJECT SAVANNAH RIVER SITE P-AREA	WELL NO. F14	SHEET 1/1
INSP. T. McKinsey	DRILLING METHOD RotoSonic	GROUND ELEV. 312.40	WATER DEPTH ~35.0 ft
WEATHER Partly Cloudy	DRILLING COMPANY(S) CASCADE DRILLING	CAP ELEV.	DATE/TIME NA
TEMP. High 80's/Low 90's	DRILL RIG(S) ProSonic PS 150T	DRILLER T. Ardito	STARTED 1030/7-8-19
LOCATION/COORDINATES: NORTHING: 44368.65		EASTING: 64266.24	LAT: 33°13'43.45" LONG: -81°35'1.71"

<b>MATERIALS INVENTORY</b>			
WELL CASING 2 in. dia. 77.9	I.f. EXPAN. CASING 2 in. dia. 60.0	I.f. TEMP. CASING	in. dia.
CASING TYPE SCH 40 SEAMLESS STEEL PIPE	CASING TYPE ALUMINUM EXPANSION CASING	CASING TYPE	STEEL
JOINT TYPE STEEL COUPLING	CENTRALIZERS 5 3/4"OD X 4'	WELL SECURITY	2" NPT PLUG
GROUT QUANTITY 35 Bags (#50) wt: 12.2-12.5	GROUT TYPE 5% BENTONITE/95% CEMENT	DRILLING MUD TYPE	BENTONITE
SURFACE COMPLETION	WELL PERMIT #: SCHE03020223 m2		

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
259.5		52.9	
249.5		62.9	
244.5		67.9	
234.5		77.9	
229.5		82.9	
219.5		92.9	
214.5		97.9	
204.5		107.9	
199.5		112.9	
189.5	Core from 120'-140' was disturbed and it was not possible to determine depth of formation material.	122.9	Lost circulation ~110ft. GROUT began flowing out of F15 (12ft away) annulus. Lower water pressure pumping drilling mud and run the core barrel from 120'-140' to remove formation material and drill without circulation. GROUT flow from F15 stopped.
184.5		127.9	
174.5	The core samples did include clay (gray and dark red mottled) at the bottom of the core barrel,	137.9	
173.0		139.4	

NOT TO SCALE

**GEOSIERRA ENVIRONMENTAL  
DEEP EXPANSION CASING LOG**

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F15 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 312.55 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. high 90's DRILL RIG(S) ProSonic PS 150T DRILLER T. Ardito STARTED 1015 / 7-3-19 COMPLETED 0920 / 7-8-19  
 LOCATION/COORDINATES: NORTHING: 44362.02 EASTING: 64256.17 LAT: 33°13' 43.34" LONG: -81°35' 1.76"

**MATERIALS INVENTORY**

WELL CASING 2 in. dia. 77.8 I.F. EXPAN. CASING 2 in. dia. 60.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE \_\_\_\_\_ STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 35 Bags (#50) w/ 12.2-12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCH E 03020223M2

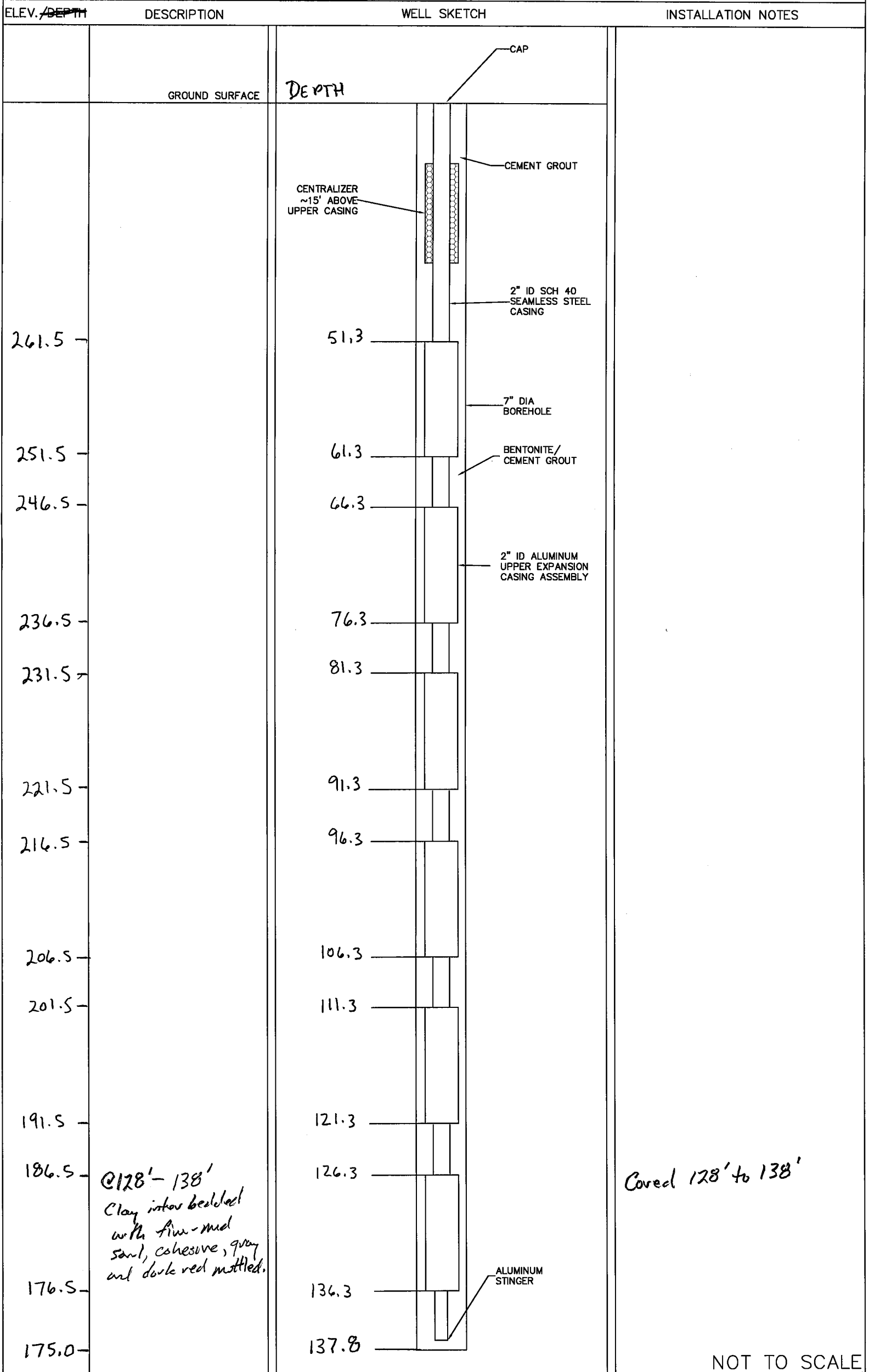
ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
259.8		52.8	<p>Drill casing was in place for 4 days. Required increased vibration to get it started when pulling after grouting. No rotation was required.</p> <p>When drilling the borehole for F14 circulation of drilling fluid was lost at ~110ft. Grout began flowing from the annulus of F15 and approximately 5-10 gals flowed to the surface.</p>
249.8		62.8	
244.8		67.8	
234.8		77.8	
229.8		82.8	
219.8		92.8	
214.8		97.8	
204.8		107.8	
199.8		112.8	
189.8		122.8	
184.8		127.8	
174.8		137.8	
173.3		139.3	NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F16 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD RotoSonic GROUND ELEV. 312.75 WATER DEPTH ~35.0ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. high 90's DRILL RIG(S) ProSonic PS150T DRILLER T. Ardito STARTED 1300/7-2-19 COMPLETED 0955/7-8-19  
 LOCATION/COORDINATES: NORTHING: 44355.42 EASTING: 64246.2 LAT: 33°13'43.23" Long: -81°35'1.80"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 76.3 I.f. EXPAN. CASING 2 in. dia. 60.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 35 Bags (#50) wt: 12.2-12.6 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE 03020223 M2



# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F17 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 312.87 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. high 90's DRILL RIG(S) ProSonic PS 150T DRILLER T. Ardito STARTED 1245/6-28-19 COMPLETED 1100/7-2-19  
 LOCATION/COORDINATES: NORTHING: 44346.28 EASTING: 64238.87 LAT: 33°13'43.21" Long: -81°35'1.81"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 76.4 I.f. EXPAN. CASING 2 in. dia. 60.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE \_\_\_\_\_ STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 35 Bags (#5) wt: 12.4 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCH E03020223M2

ELEV. / <del>DEPTH</del>	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
261.5		51.4	
251.5		61.4	
246.5		66.4	
236.5		76.4	
231.5		81.4	
221.5		91.4	
216.5		96.4	
206.5		106.4	
201.5		111.4	
191.5		121.4	
186.5		126.4	
176.5		136.4	
175.0		137.9	

NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL DEEP EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F18 SHEET 1/1  
 INSP. T. McKinsey DRILLING METHOD RotoSonic GROUND ELEV. 313.26 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. high 90's DRILL RIG(S) ProSonic PS 150T DRILLER T. Ardito STARTED 1545/6-27-19 COMPLETED 1200/6-28-19  
 LOCATION/COORDINATES: NORTHING: 44335.04 EASTING: 64234.54 LAT: 33° 13' 42.99" N LONG: -81° 35' 1.77" W

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 77.2 l.f. EXPAN. CASING 2 in. dia. 60.0 l.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ l.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4" OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 35 Bags (#50) wt: 12.2-12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE 03020 223 M 2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>261.1</p> <p>251.1</p> <p>246.1</p> <p>236.1</p> <p>231.1</p> <p>221.1</p> <p>216.1</p> <p>206.1</p> <p>201.1</p> <p>191.1</p> <p>186.1</p> <p>176.1</p> <p>174.6</p>			<p>NOT TO SCALE</p>

# GEOSIERRA ENVIRONMENTAL SHALLOW EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F19 SHEET 1 of 1  
 INSP. T. McKinsey DRILLING METHOD RotoSonic GROUND ELEV. 313.64 WATER DEPTH ~95.0ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. High 90's DRILL RIG(S) Prosonic PS150T DRILLER T. Ardito STARTED 0815/6-26-19 COMPLETED 1920/6-27-19  
 LOCATION/COORDINATES: NORTHING: 44323.84 EASTING: 64230.30 LAT: 33° 13' 42.88" LONG: -81° 35' 1.73"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 73.9 I.F. EXPAN. CASING 2 in. dia. 50.0 I.F. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.F.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE \_\_\_\_\_ STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (#50) WT: 12.2-12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCH E 03020223M2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>259.7</p> <p>249.7</p> <p>244.7</p> <p>234.7</p> <p>229.7</p> <p>219.7</p> <p>214.7</p> <p>204.7</p> <p>199.7</p> <p>189.7</p> <p>188.2</p>		<p style="text-align: center;">CAP</p> <p style="text-align: center;">CEMENT GROUT</p> <p style="text-align: center;">7" DIA BOREHOLE</p> <p style="text-align: center;">2" ID SCH 40 SEAMLESS STEEL CASING</p> <p style="text-align: center;">CENTRALIZER ~15' ABOVE UPPER CASING</p> <p style="text-align: center;">BENTONITE/ CEMENT GROUT</p> <p style="text-align: center;">2" ID ALUMINUM UPPER EXPANSION CASING ASSEMBLY</p> <p style="text-align: center;">ALUMINUM STINGER</p>	

NOT TO SCALE

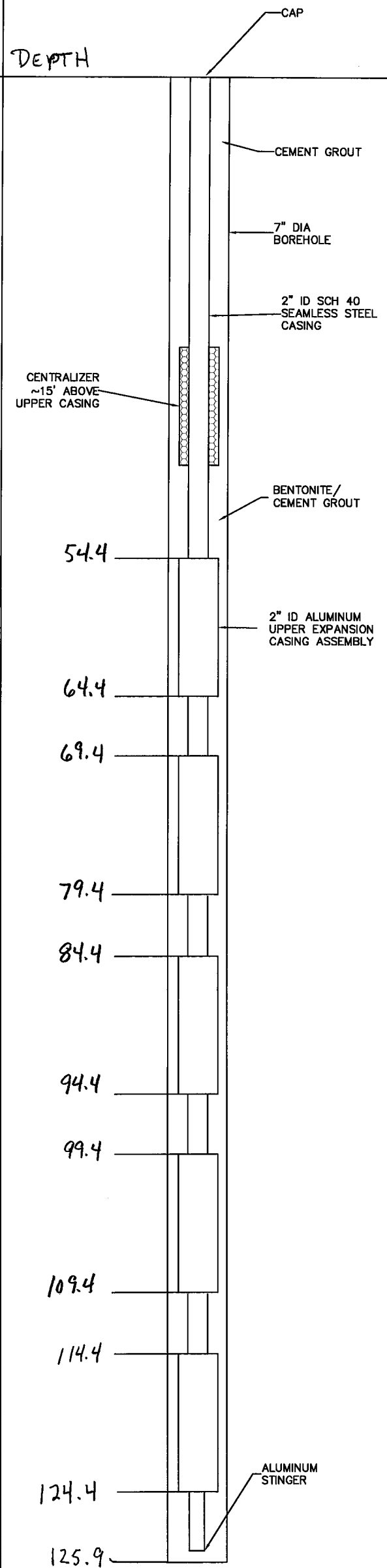
# GEOSIERRA ENVIRONMENTAL SHALLOW EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F2φ SHEET 1 of 1  
 INSP. T. McKinsey DRILLING METHOD RotoSonic GROUND ELEV. 314.02 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. Mid/High 90's DRILL RIG(S) ProSonic PS150T DRILLER J. Ardito STARTED 1125/6-25-19 COMPLETED 0800/6-26-19  
 LOCATION/COORDINATES: NORTHING: 44312.65 EASTING: 64226.04 LAT: 33° 13' 42.77" LONG: -81° 35' 1.70"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 74.4 I.f. EXPAN. CASING 2 in. dia. 50.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (#50) Wt: 12.2-12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE03020223M2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
259.6		54.4	
249.6		64.4	
244.6		69.4	
234.6		79.4	
229.6		84.4	
219.6		94.4	
214.6		99.4	
204.6		109.4	
199.6		114.4	
189.6		124.4	
188.1		125.9	



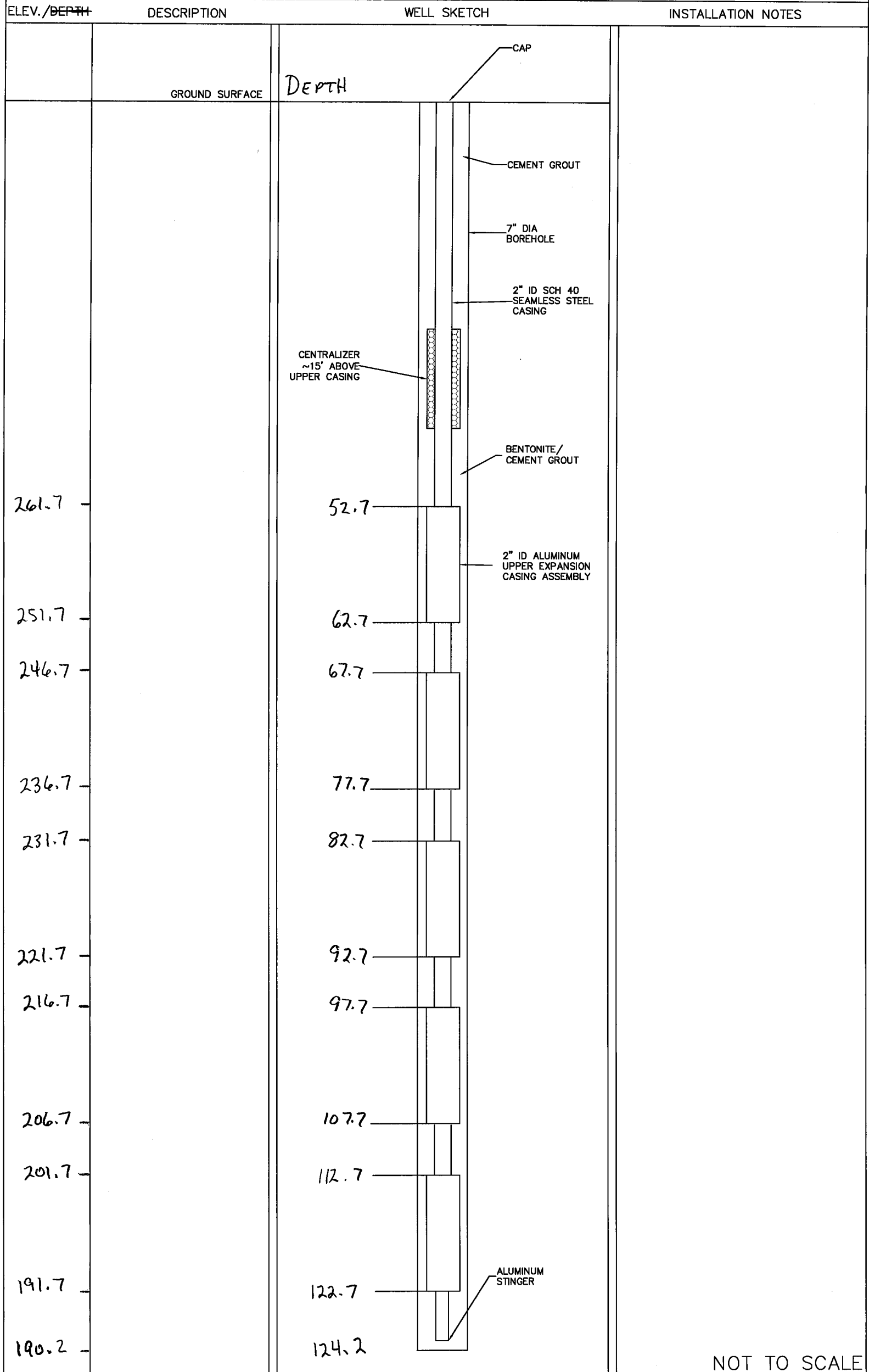
NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL SHALLOW EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F21 SHEET 1 of 1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 314.39 WATER DEPTH ~35.0 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. Mid to high 90's DRILL RIG(S) Pro Sonic PS 150 T DRILLER T. Ardito STARTED 1830/6-24-19 COMPLETED 0915/6-25-19  
 LOCATION/COORDINATES: NORTHING: 44301.46 EASTING: 64221.77 LAT: 33°13'42.65" LONG: -81°35'1.66"

## MATERIALS INVENTORY

WELL CASING 2 in. dia. 72.7 I.f. EXPAN. CASING 2 in. dia. 50.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (#50) Wt: 12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT #: SCHE03020228M2



NOT TO SCALE

# GEOSIERRA ENVIRONMENTAL SHALLOW EXPANSION CASING LOG

JOB NO. 801181002 PROJECT SAVANNAH RIVER SITE P-AREA WELL NO. F22 SHEET 1 of 1  
 INSP. T. McKinsey DRILLING METHOD Roto Sonic GROUND ELEV. 314.71 WATER DEPTH ~35 ft  
 WEATHER Sunny DRILLING COMPANY(S) CASCADE DRILLING CAP ELEV. \_\_\_\_\_ DATE/TIME NA  
 TEMP. Mid-high 90's DRILL RIG(S) \_\_\_\_\_ DRILLER T. Ardito STARTED 1430/6-21-19 COMPLETED 1200/6-24-19  
 LOCATION/COORDINATES: NORTHING: 44290.18 EASTING: 64217.44 LAT: 33°13'42.54" Long: -81°35'1.62"

### MATERIALS INVENTORY

WELL CASING 2 in. dia. 72.5 I.f. EXPAN. CASING 2 in. dia. 50.0 I.f. TEMP. CASING \_\_\_\_\_ in. dia. \_\_\_\_\_ I.f.  
 CASING TYPE SCH 40 SEAMLESS STEEL PIPE CASING TYPE ALUMINUM EXPANSION CASING CASING TYPE STEEL  
 JOINT TYPE STEEL COUPLING CENTRALIZERS 5 3/4"OD X 4' WELL SECURITY 2" NPT PLUG  
 GROUT QUANTITY 30 Bags (#50) wt: 12.2 to 12.5 GROUT TYPE 5% BENTONITE/95% CEMENT DRILLING MUD TYPE BENTONITE  
 SURFACE COMPLETION \_\_\_\_\_ WELL PERMIT # SCHE 03020223 M2

ELEV./DEPTH	DESCRIPTION	WELL SKETCH	INSTALLATION NOTES
	GROUND SURFACE	DEPTH	
<p>262.2</p> <p>252.2</p> <p>247.2</p> <p>237.2</p> <p>232.2</p> <p>222.2</p> <p>217.2</p> <p>207.2</p> <p>202.2</p> <p>192.2</p> <p>190.7</p>	<p>① 114' - Sand, med, clay matrix (40%), poorly sorted, alternating red and light gray bedding</p> <p>Clay thick laminae to thin beds interbedded cohesive, light gray with dark red mottling.</p>	<p style="text-align: right;">ALUMINUM STINGER</p>	<p style="text-align: center; font-size: 1.2em;">Core 114.0' - 124.0'</p> <p style="text-align: right; font-weight: bold;">NOT TO SCALE</p>

**APPENDIX B**

**ZVI-PRB Resistivity String Installation Reports**

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	01

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southern of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44505.79</i>	SRS East Grid Coordinate <i>64337.4</i>	Ground Elevation <i>309.56</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 44.96"</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 1.99"</i>

**Testing and Sampling**

Test Start Date <i>6/27/19</i>	Test Complete Date <i>6/27/19</i>	Total Penetration Depth <i>137.8</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>ConeTec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.3 ft to 137.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string was abandoned by excavating to a depth of 6m, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6m concrete pad.</i>	Actual Grout Volume
Report Prepared by <i>M3 Amidon</i>	Date Report Prepared <i>1/24/2020</i>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	φ2

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>	County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44501.01</i>	SRS East Grid Coordinate <i>64326.37</i>	Ground Elevation <i>309.76</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.06"</i>

**Testing and Sampling**

Test Start Date <i>6-27-19</i>	Test Complete Date <i>6-27-19</i>	Total Penetration Depth <i>137.8</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.3 ft to 137.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string used abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/c 1ft x 1ft x 6in concrete pad.</i>	Actual Grout Volume <i>1/24/2020</i>
Report Prepared by <i>MS Amidon</i>		Date Report Prepared	

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	ϕ3

**General**

Project Name <b>P-Area Groundwater Permeable Reactive Barrier</b>				
Project Manager (last name, first initial) <b>Miller, S.</b>			Department <b>ACP</b>	
Type of Cone Penetrometer Test <b>Installation of Resistivity Sensors</b>		County <b>Barnwell</b>	Location Description <b>Southeast of P-Reactor Building</b>	
SRS North Grid Coordinate <b>44496.46</b>	SRS East Grid Coordinate <b>64315.3</b>	Ground Elevation <b>309.83</b>	Latitude (degrees, minutes, seconds) <b>33° 13' 44.75"</b>	Longitude (degrees, minutes, seconds) <b>-81° 35' 2.13"</b>

**Testing and Sampling**

Test Start Date <b>6-27-19</b>	Test Complete Date <b>6-27-19</b>	Total Penetration Depth <b>137.8</b>	Interpreted Water Table Level <b>NA</b>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <b>Cone Tec</b>	Cone Operator <b>White, D.</b>	Oversight Company <b>Geo Sierra Environmental</b>	Oversight (last name, first initial) <b>McKinsey, T.</b>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
**Resistivity sensors installed in 5ft intervals from 42.3 ft to 137.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.**

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   **Installed Resistivity Sensor Strings**

**Abandonment**

Date Abandoned <b>1/14/2020</b>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <b>Sensor string was abandoned by excavator to a depth of 6-m, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</b>	Actual Grout Volume <b>excavator to a depth</b>
Report Prepared by <b>M3 Anidon</b>		Date Report Prepared <b>1/24/2020</b>	

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	ϕ4

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44491.68</i>	SRS East Grid Coordinate <i>64304.28</i>	Ground Elevation <i>309.99</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 44.65"</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.21"</i>

<b>Testing and Sampling</b>					
Test Start Date <i>6-26-19</i>	Test Complete Date <i>6-26-19</i>	Total Penetration Depth <i>137.8</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>
<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.3 ft to 137.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)  
  Tip (psi)  
  Ratio (%)  
  Pressure (psi)  
  Resistivity

Other Logs (list)    *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume <i> </i>
Report Prepared by <i>M3 Amidon</i>	Date Report Prepared <i>1/24/2020</i>		<i> </i>

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	ϕ5

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44486.94</i>	SRS East Grid Coordinate <i>64293.26</i>	Ground Elevation <i>310.07</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 44.55"</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.28"</i>

**Testing and Sampling**

Test Start Date <i>6-26-19</i>	Test Complete Date <i>6-26-19</i>	Total Penetration Depth <i>137.5</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<del>Cone Penetrometer Test Type</del>	<del>Depth to Sample</del>	<del>Cone Penetrometer Test Type</del>	<del>Depth to Sample</del>	<del>Cone Penetrometer Test Type</del>	<del>Depth to Sample</del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.0 ft to 137.0 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad.</i>	Actual Grout Volume <i>excavating to a depth</i>
Report Prepared by <i>MS Amidon</i>			Date Report Prepared <i>1/24/2020</i>

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	06

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44482.29</i>	SRS East Grid Coordinate <i>64282.17</i>	Ground Elevation <i>310.29</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 44.45"</i>	Longitude (degrees, minutes, seconds) <i>-81° 55' 2.35"</i>

**Testing and Sampling**

Test Start Date <i>6-25-19</i>	Test Complete Date <i>6-25-19</i>	Total Penetration Depth <i>138.0</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.5 ft to 137.5 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2000</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a concrete pad.</i>	Actual Grout Volume
Report Prepared by <i>M3 Amidon</i>	Date Report Prepared <i>1/24/2000</i>		

## Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR 07

## General

Project Name P-Area Groundwater Permeable Reactive Barrier

Project Manager (last name, first initial) Miller, S.

Department ACP

Type of Cone Penetrometer Test  
Installation of Resistivity SensorsCounty  
BarnwellLocation Description  
Southwest of P-Reactor BuildingSRS North Grid Coordinate  
44477.57SRS East Grid Coordinate  
64271.15Ground Elevation  
310.22Latitude (degrees, minutes, seconds)  
33° 13' 44.35"Longitude (degrees, minutes, seconds)  
-81° 35' 2.42"

## Testing and Sampling

Test Start Date  
6-25-19Test Complete Date  
6-25-19Total Penetration Depth  
136.6Interpreted Water Table Level  
NAGround Water Samples?  
 Yes  NoSoil Samples?  
 Yes  No

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Company  
Cone TecCone Operator  
White, D.Oversight Company  
Geo Sierra EnvironmentalOversight (last name, first initial)  
McKinsey, T.

Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)

Resistivity sensors installed in 5ft intervals from 46.1 ft to 136.1 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.

## Logging

Log Type

 Sleeve (psi)  Tip (psi)  Ratio (%)  Pressure (psi)  Resistivity

Other Logs (list) Installed Resistivity Sensor Strings

## Abandonment

Date Abandoned

1/14/2020

Method of Abandonment

 Tremie Pipe  CP Rod-Grouting Method

Theoretical Grout Volume

Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete cap

Actual Grout Volume

Date Report Prepared

1/24/2020

Report Prepared by

M3 Amidon

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)		
RR	08	

**General**

Project Name <b>P-Area Groundwater Permeable Reactive Barrier</b>				
Project Manager (last name, first initial) <b>Miller, S.</b>			Department <b>ACP</b>	
Type of Cone Penetrometer Test <b>Installation of Resistivity Sensors</b>		County <b>Barnwell</b>	Location Description <b>Southeast of P-Reactor Building</b>	
SRS North Grid Coordinate <b>44458.08</b>	SRS East Grid Coordinate <b>64256.59</b>	Ground Elevation <b>310.52</b>	Latitude (degrees, minutes, seconds) <b>33° 13' 44.10"</b>	Longitude (degrees, minutes, seconds) <b>-81° 35' 2.42"</b>

**Testing and Sampling**

Test Start Date <b>6-28-19</b>	Test Complete Date <b>6-28-19</b>	Total Penetration Depth <b>136.8</b>	Interpreted Water Table Level <b>NA</b>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>
<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <b>ConeTec</b>	Cone Operator <b>White, D.</b>	Oversight Company <b>Geo Sierra Environmental</b>	Oversight (last name, first initial) <b>McKinsey, T.</b>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
**Resistivity sensors installed in 5ft intervals from 41.3 ft to 136.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.**

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   **Installed Resistivity Sensor Strings**

**Abandonment**

Date Abandoned <b>1/14/2020</b>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <b>Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</b>	Actual Grout Volume <b> </b>
Report Prepared by <b>M3 Amidon</b>	Date Report Prepared <b>1/24/2020</b>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	49

**General**

Project Name P-Area Groundwater Permeable Reactive Barrier				
Project Manager (last name, first initial) Miller, S.			Department ACP	
Type of Cone Penetrometer Test Installation of Resistivity Sensors		County Barnwell	Location Description Southwest of P-Reactor Building	
SRS North Grid Coordinate 44446.13	SRS East Grid Coordinate 64255.3	Ground Elevation 310.78	Latitude (degrees, minutes, seconds) 33° 13' 44.00"	Longitude (degrees, minutes, seconds) -81° 35' 2.35"

**Testing and Sampling**

Test Start Date 6-29-19	Test Complete Date 6-29-19	Total Penetration Depth 136.8	Interpreted Water Table Level NA	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company Cone Tec	Cone Operator White, D.	Oversight Company Geo Sierra Environmental	Oversight (last name, first initial) McKinsey, T.
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
 Resistivity sensors installed in 5ft intervals from 41.3 ft to 136.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   Installed Resistivity Sensor Strings

**Abandonment**

Date Abandoned 1/14/2020	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, & capping w/ a 1ft x 1ft x 6in concrete pad.	Actual Grout Volume excavating to a depth of
Report Prepared by MS Amidon			Date Report Prepared 1/24/2020

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RK	10

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>
SRS North Grid Coordinate <i>44434.22</i>	SRS East Grid Coordinate <i>64253.85</i>	Ground Elevation <i>310.96</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.28"</i>

**Testing and Sampling**

Test Start Date <i>6-24-19</i>	Test Complete Date <i>6-24-19</i>	Total Penetration Depth <i>137.5</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.0 ft to 137.0 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string was abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ 1ft x 1ft x 2in concrete pad!</i>	Actual Grout Volume <i>excavating to a depth of</i>
Report Prepared by <i>M. Amidon</i>			Date Report Prepared <i>1/24/2020</i>

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	11

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>	County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44422.29</i>	SRS East Grid Coordinate <i>64252.59</i>	Ground Elevation <i>311.34</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.21"</i>

**Testing and Sampling**

Test Start Date <i>6-24-19</i>	Test Complete Date <i>6-24-19</i>	Total Penetration Depth <i>138.0</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<i>(This section is crossed out with a large X)</i>					

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>GeoSierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 42.5 ft to 137.5 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/19/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavation to a depth of 6 in, cutting the wires, &amp; capping w/c 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume
Report Prepared by <i>MJ Anderson</i>	Date Report Prepared <i>1/24/2020</i>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	12

**General**

Project Name P-Area Groundwater Permeable Reactive Barrier			
Project Manager (last name, first initial) Miller, S.		Department ACP	
Type of Cone Penetrometer Test Installation of Resistivity Sensors	County Barnwell	Location Description Southwest of P-Reactor Building	
SRS North Grid Coordinate 44410.37	SRS East Grid Coordinate 64251.24	Ground Elevation 311.61	Longitude (degrees, minutes, seconds) -81° 35' 2.14"

**Testing and Sampling**

Test Start Date 6-21-19	Test Complete Date 6-24-19	Total Penetration Depth 130.2	Interpreted Water Table Level NA	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample

Cone Penetrometer Company ConeTec	Cone Operator White, D.	Oversight Company GeoSierra Environmental	Oversight (last name, first initial) McKinsey, T.
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
Resistivity sensors installed in 5ft intervals from 42.7 ft to 137.7 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.

**Logging**

Log Type

Sleeve (psi)  Tip (psi)  Ratio (%)  Pressure (psi)  Resistivity

Other Logs (list) Installed Resistivity Sensor Strings

**Abandonment**

Date Abandoned 1/14/2020	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume Sensor string abandoned by excavator to a depth of 6m, cutting the wires, & capping w/ a 1ft x 1ft x 6in concrete pad	Actual Grout Volume
Report Prepared by MB Amidon			Date Report Prepared 1/24/2020

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR

13

## General

Project Name *P-Area Groundwater Permeable Reactive Barrier*

Project Manager (last name, first initial) *Miller, S.*

Department *ACP*

Type of Cone Penetrometer Test  
*Installation of Resistivity Sensors*

County *Barnwell*

Location Description  
*Southeast of P-Reactor Building*

SRS North Grid Coordinate  
*44398.46*

SRS East Grid Coordinate  
*64249.92*

Ground Elevation  
*311.96*

Latitude (degrees, minutes, seconds)  
*33° 13' 43.59"*

Longitude (degrees, minutes, seconds)  
*-81° 35' 2.07"*

## Testing and Sampling

Test Start Date  
*6-20-19*

Test Complete Date  
*6-20-19*

Total Penetration Depth  
*136.2*

Interpreted Water Table Level  
*NA*

Ground Water Samples?  
 Yes  No

Soil Samples?  
 Yes  No

Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company  
*ConeTec*

Cone Operator  
*White, D.*

Oversight Company  
*Geo Sierra Environmental*

Oversight (last name, first initial)  
*McKinsey, T.*

Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)

*Resistivity sensors installed in 5ft intervals from 40.7 ft to 135.7 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

## Logging

Log Type

Sleeve (psi)  Tip (psi)  Ratio (%)  Pressure (psi)  Resistivity

Other Logs (list) *Installed Resistivity Sensor Strings*

## Abandonment

Date Abandoned  
*1/14/2020*

Method of Abandonment  
 Tremie Pipe  CP Rod-Grouting Method

Theoretical Grout Volume  
*Sensor string abandoned by excavating to a depth of 6-in, cutting the wires, & capping with 1ft x 1ft x 6in concrete pad*

Actual Grout Volume

Date Report Prepared

Report Prepared by  
*M3 Amidon*

*1/24/2020*

# Cone Penetrometer Field Report

Test Hole Number (AAA.NNN.AA)	
RR	14

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>	County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44385.88</i>	SRS East Grid Coordinate <i>64248.3</i>	Ground Elevation <i>312.28</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.00"</i>

**Testing and Sampling**

Test Start Date <i>6-20-19</i>	Test Complete Date <i>6-20-19</i>	Total Penetration Depth <i>137.1</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>ConeTec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>GeoSierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 41.6 ft to 136.6 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type  
 Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavation to a depth of 6 in, cutting the wires, &amp; capping w/ 2 1/2" x 1/2" x 6 in concrete pad</i>	Actual Grout Volume <i> </i>
Report Prepared by <i>MB Anderson</i>	Date Report Prepared <i>1/24/2020</i>		<i> </i>

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)		
RR	15	

**General**

Project Name <b>P-Area Groundwater Permeable Reactive Barrier</b>				
Project Manager (last name, first initial) <b>Miller, S.</b>			Department <b>ACP</b>	
Type of Cone Penetrometer Test <b>Installation of Resistivity Sensors</b>		County <b>Barnwell</b>	Location Description <b>Southwest of P-Reactor Building</b>	
SRS North Grid Coordinate <b>44379.00</b>	SRS East Grid Coordinate <b>64238.29</b>	Ground Elevation <b>312.16</b>	Latitude (degrees, minutes, seconds) <b>33° 13' 43.37"</b>	Longitude (degrees, minutes, seconds) <b>-81° 35' 2.04"</b>

<b>Testing and Sampling</b>					
Test Start Date <b>6-19-19</b>	Test Complete Date <b>6-19-19</b>	Total Penetration Depth <b>136.9</b>	Interpreted Water Table Level <b>NA</b>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <b>Cone Tec</b>	Cone Operator <b>White, D.</b>	Oversight Company <b>Geo Sierra Environmental</b>	Oversight (last name, first initial) <b>McKinsey, T.</b>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
**Resistivity sensors installed in 5ft intervals from 41.4 ft to 136.4 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.**

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   **Installed Resistivity Sensor Strings**

<b>Abandonment</b>			
Date Abandoned <b>1/14/2020</b>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <b>Sensor string abandoned by excavating to a depth of 6in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</b>	Actual Grout Volume <b> </b>
Report Prepared by <b>M3 Amidon</b>	Date Report Prepared <b>1/24/2020</b>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR 16

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44372.06</i>	SRS East Grid Coordinate <i>64227.73</i>	Ground Elevation <i>312.20</i>	Latitude (degrees, minutes, seconds) <i>33°13'43.25"</i>	Longitude (degrees, minutes, seconds) <i>-81°35'2.10"</i>

**Testing and Sampling**

Test Start Date <i>6-19-19</i>	Test Complete Date <i>6-19-19</i>	Total Penetration Depth <i>136.4</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 41.4 ft to 136.4 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavating to a depth of 6-m, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume <i> </i>
Report Prepared by <i>M3 Amidan</i>	Date Report Prepared <i>1/24/2020</i>		<i> </i>

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR 17

**General**

Project Name *P-Area Groundwater Permeable Reactive Barrier*

Project Manager (last name, first initial) *Miller, S.*

Department *ACP*

Type of Cone Penetrometer Test  
*Installation of Resistivity Sensors*

County  
*Barnwell*

Location Description  
*Southeast of P-Reactor Building*

SRS North Grid Coordinate  
*44360.96*

SRS East Grid Coordinate  
*64210.74*

Ground Elevation  
*312.37*

Latitude (degrees, minutes, seconds)  
*33° 13' 43.11"*

Longitude (degrees, minutes, seconds)  
*-81° 35' 2.10"*

**Testing and Sampling**

Test Start Date  
*6-18-19*

Test Complete Date  
*6-18-19*

Total Penetration Depth  
*134.9*

Interpreted Water Table Level  
*NA*

Ground Water Samples?  
 Yes  No

Soil Samples?  
 Yes  No

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Test Type

Depth to Sample

Cone Penetrometer Company  
*ConeTec*

Cone Operator  
*White, D.*

Oversight Company  
*GeoSierra Environmental*

Oversight (last name, first initial)  
*McKinsey, T.*

Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)

*Resistivity sensors installed in 5ft intervals from 39.4 ft to 134.4 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)  Tip (psi)  Ratio (%)  Pressure (psi)  Resistivity

Other Logs (list)  
*Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned

*1/14/2020*

Method of Abandonment

Tremie Pipe  CP Rod-Grouting Method

Theoretical Grout Volume

*Sensor string abandoned by excavator, to a depth of 6-m, cutting the wires, & capping w/ 1ft x 1ft x 6-m concrete pad*

Actual Grout Volume

Date Report Prepared

*1/24/2020*

Report Prepared by

*M3 Amidon*

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	18

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>	County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44349.88</i>	SRS East Grid Coordinate <i>64214.57</i>	Ground Elevation <i>312.79</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 2.07"</i>

**Testing and Sampling**

Test Start Date <i>6-18-19</i>	Test Complete Date <i>6-18-19</i>	Total Penetration Depth <i>136.6</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>GeoSierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 41.1 ft to 136.1 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type  
 Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavating to a depth of 6-in, cutting the wires, &amp; capping w/ a 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume <i> </i>
Report Prepared by <i>M3 Amidon</i>	Date Report Prepared <i>1/24/2020</i>		

## Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR

19

## General

Project Name P-Area Groundwater Permeable Reactive Barrier					
Project Manager (last name, first initial) Miller, S.			Department ACP		
Type of Cone Penetrometer Test Installation of Resistivity Sensors		County Barnwell	Location Description Southwest of P-Reactor Building		
SRS North Grid Coordinate 44338.66	SRS East Grid Coordinate 64210.34	Ground Elevation 313.19	Latitude (degrees, minutes, seconds) 33° 13' 42.88"	Longitude (degrees, minutes, seconds) -81° 35' 2.03"	
Testing and Sampling					
Test Start Date 6-17-19	Test Complete Date 6-17-19	Total Penetration Depth 136.8	Interpreted Water Table Level NA	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
Cone Penetrometer Company ConeTec	Cone Operator White, D.	Oversight Company Geo Sierra Environmental	Oversight (last name, first initial) McKinsey, T.		
Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.) Resistivity sensors installed in 5ft intervals from 41.3 ft to 136.3 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.					
Logging					
Log Type <input type="checkbox"/> Sleeve (psi) <input type="checkbox"/> Tip (psi) <input type="checkbox"/> Ratio (%) <input type="checkbox"/> Pressure (psi) <input type="checkbox"/> Resistivity					
Other Logs (list) Installed Resistivity Sensor Strings					
Abandonment					
Date Abandoned 1/14/2020	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume Sensor string abandoned by excavating to a depth of 6in, cutting the wires, capping w/ 1ft x 1ft x 6in concrete pad		Actual Grout Volume	Date Report Prepared 1/24/2020
Report Prepared by M3 Amidon					

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)	
RR	2φ

**General**

Project Name <b>P-Area Groundwater Permeable Reactive Barrier</b>				
Project Manager (last name, first initial) <b>Miller, S.</b>			Department <b>ACP</b>	
Type of Cone Penetrometer Test <b>Installation of Resistivity Sensors</b>		County <b>Barnwell</b>	Location Description <b>Southeast of P-Reactor Building</b>	
SRS North Grid Coordinate <b>44327.37</b>	SRS East Grid Coordinate <b>64205.96</b>	Ground Elevation <b>313.56</b>	Latitude (degrees, minutes, seconds) <b>33°13'42.77"</b>	Longitude (degrees, minutes, seconds) <b>-81°35'1.99"</b>

**Testing and Sampling**

Test Start Date <b>6-21-19</b>	Test Complete Date <b>6-21-19</b>	Total Penetration Depth <b>123.0</b>	Interpreted Water Table Level <b>NA</b>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <b>ConeTec</b>	Cone Operator <b>White, D.</b>	Oversight Company <b>GeoSierra Environmental</b>	Oversight (last name, first initial) <b>McKinsey, T.</b>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
**Resistivity sensors installed in 5ft intervals from 37.5 ft to 122.5 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.**

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   **Installed Resistivity Sensor Strings**

**Abandonment**

Date Abandoned <b>1/14/2020</b>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <b>Sensor string abandoned by excavating to a depth of 6m, cutting the wires, &amp; capping with 1ft x 1ft x 6m concrete pad</b>	Actual Grout Volume <b> </b>
Report Prepared by <b>M. J. Amidon</b>	Date Report Prepared <b>1/24/2020</b>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)		
RR	21	

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>					
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>		
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>		
SRS North Grid Coordinate <i>44316.75</i>	SRS East Grid Coordinate <i>64201.71</i>	Ground Elevation <i>314.02</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 42.65"</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 1.95"</i>	

**Testing and Sampling**

Test Start Date <i>6-21-19</i>	Test Complete Date <i>6-21-19</i>	Total Penetration Depth <i>124.0</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 38.5 ft to 123.5 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavation to a depth of 6in, cutting the wires, &amp; capping w/ 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume
Report Prepared by <i>M3 Andon</i>	Date Report Prepared <i>1/24/2020</i>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)

RR 22

**General**

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>			
Project Manager (last name, first initial) <i>Miller, S.</i>		Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>	County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44304.95</i>	SRS East Grid Coordinate <i>64197.44</i>	Ground Elevation <i>314.35</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 1.91"</i>

**Testing and Sampling**

Test Start Date <i>6-14-19</i>	Test Complete Date <i>6-14-19</i>	Total Penetration Depth <i>122.2</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>Geo Sierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 36.7ft to 121.7ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

**Logging**

Log Type

Sleeve (psi)  Tip (psi)  Ratio (%)  Pressure (psi)  Resistivity

Other Logs (list) *Installed Resistivity Sensor Strings*

**Abandonment**

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavating to a depth of 6m cutting the wires, &amp; capping w/ 1ft x 1ft x 6m concrete pad</i>	Actual Grout Volume <i>6m</i>
Report Prepared by <i>MJ Anderson</i>	Date Report Prepared <i>1/24/2020</i>		

# Cone Penetrometer Field Report

Test Hole Number (AAA,NNN,AA)		
RR	23	

## General

Project Name <i>P-Area Groundwater Permeable Reactive Barrier</i>				
Project Manager (last name, first initial) <i>Miller, S.</i>			Department <i>ACP</i>	
Type of Cone Penetrometer Test <i>Installation of Resistivity Sensors</i>		County <i>Barnwell</i>	Location Description <i>Southeast of P-Reactor Building</i>	
SRS North Grid Coordinate <i>44293.68</i>	SRS East Grid Coordinate <i>64193.1</i>	Ground Elevation <i>314.65</i>	Latitude (degrees, minutes, seconds) <i>33° 13' 42.42"</i>	Longitude (degrees, minutes, seconds) <i>-81° 35' 1.88"</i>

## Testing and Sampling

Test Start Date <i>6-14-19</i>	Test Complete Date <i>6-14-19</i>	Total Penetration Depth <i>122.4</i>	Interpreted Water Table Level <i>NA</i>	Ground Water Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Soil Samples? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample
<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>

Cone Penetrometer Company <i>Cone Tec</i>	Cone Operator <i>White, D.</i>	Oversight Company <i>GeoSierra Environmental</i>	Oversight (last name, first initial) <i>McKinsey, T.</i>
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Drilling and Sampling Comments (drilling muds used, source of water, lost circulation zones, etc.)  
*Resistivity sensors installed in 5ft intervals from 36.9 ft to 121.9 ft. Purpose is to monitor injection of ZVI during construction of the Permeable Reactive Barrier.*

## Logging

Log Type

Sleeve (psi)    Tip (psi)    Ratio (%)    Pressure (psi)    Resistivity

Other Logs (list)   *Installed Resistivity Sensor Strings*

## Abandonment

Date Abandoned <i>1/14/2020</i>	Method of Abandonment <input type="checkbox"/> Tremie Pipe <input type="checkbox"/> CP Rod-Grouting Method	Theoretical Grout Volume <i>Sensor string abandoned by excavation to a depth of 6in cutting the wires, &amp; capping w/ 1ft x 1ft x 6in concrete pad</i>	Actual Grout Volume
Report Prepared by <i>MS Amidon</i>	Date Report Prepared <i>1/24/2020</i>		

**APPENDIX C**

**ZVI Injection Quantity Records**

Table 3. A Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Aug-19													Sep-19				Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 5% (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in A Panel (lbs)																		
	7	8	9	14	15	19	20	21	22	23	27	28	29	4	5	6	9																								
<b>A PANEL 10-FT (APPROX. 125' - 135' BGS)</b>																																									
F01	200	1000	0	200	1000	0	0	1500	2000	0	2000	0	2640	0	0	800		11,340	0	10,800	11,340	372	10,968																		
F02	0	2000	2000	0	0	0	1000	1000	0	2000	0	2000	0	1340				11,340	0	10,800	11,340	372	10,968																		
F03	0	1000	1000	0	0	0	0	2000	2000	0	2000	0	3340					11,340	0	10,800	11,340	372	10,968																		
F04	0	1000	1500	0	0	0	1000	2000	0	0	2000	2000	0	1840				11,340	0	10,800	11,340	372	10,968																		
F05	0	1000	2000	0	0	0	0	2000	2000	0	2000	0	2340					11,340	0	10,800	11,340	372	10,968																		
F06	0	0	2000	0	0	0	1005	2500	0	0	2000	0	1500	2335				11,340	0	10,800	11,340	372	10,968																		
F07	0	1000	2000	0	0	0	0	2000	2000	0	2000	0	2340					11,340	0	10,800	11,340	372	10,968																		
F08	0	0	0	0	0	1000	2000	0	2500	0	2000	2000	0	1840				11,340	0	10,800	11,340	372	10,968																		
F09	0	0	0	0	0	2767	1500	2000	2000	0	750	0	2323					11,340	0	10,800	11,340	372	10,968																		
F10	0	0	0	0	0	1000	2005	0	2000	0	2000	2000	0	2335				11,340	0	10,800	11,340	372	10,968																		
F11	0	0	0	0	0	2000	1000	2000	3000	0	0	2250	1090					11,340	0	10,800	11,340	372	10,968																		
F12	0	0	0	0	0	1000	2000	0	2000	0	2000	2000	0	2340				11,340	0	10,800	11,340	372	10,968																		
F13	0	0	0	0	0	2000	1000	2000	0	2000	0	2000	2340					11,340	0	10,800	11,340	372	10,968																		
F14	0	0	0	0	0	500	2000	0	2000	0	2000	0	0	0	4840			11,340	0	10,800	11,340	372	10,968																		
F15	0	0	0	0	0	1000	2000	1000	0	2000	0	3005	0	0	2335			11,340	0	10,800	11,340	372	10,968																		
F16	0	0	0	0	200	1000	2000	0	2000	0	2000	0	0	0	4140			11,340	0	10,800	11,340	372	10,968																		
F17	0	0	0	0	0	0	0	0	0	0	0	3000	0	0	3000	5000	340	11,340	0	10,800	11,340	372	10,968																		
F18	0	0	0	0	0	0	0	0	0	0	0	0	2087	0	3000	3885	2368	11,340	0	10,800	11,340	372	10,968																		
F19																		NA	NA	NA	NA	NA	NA																		
F20																		NA	NA	NA	NA	NA	NA																		
F21																		NA	NA	NA	NA	NA	NA																		
F22																		NA	NA	NA	NA	NA	NA																		
ZVI Subtotal	200	7,000	10,500	200	1,200	12,267	18,510	20,000	23,500	6,000	22,750	20,255	20,000	12,030	17,315	9,685	2,708	204,120	0	194,400	204,120	6,700	197,420																		
Total ZVI (tons)	0.10	3.50	5.25	0.10	0.60	6.13	9.26	10.00	11.75	3.00	11.38	10.13	10.00	6.02	8.66	4.84	1.35	102.06	0.0	97.2	102.1	3.4	98.7																		

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

Table 4. B Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Sep-19											Oct-19		Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 5% (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in B Panel (lbs)
	11	12	13	16	17	18	19	20	26	27	30	1	2						
<b>B PANEL 10-FT (APPROX. 110' - 120' BGS)</b>																			
F01	2000	3000	0	0	3000	0	2000	0	0	0	1340			11,340	0	10,800	11,340	266	11,074
F02	2000	0	0	3000	0	3000	0	0	0	0	0	2000	1340	11,340	0	10,800	11,340	266	11,074
F03	2292	3500	0	0	2000	0	500	0	0	0	3048			11,340	0	10,800	11,340	266	11,074
F04	3000	0	0	2000	0	3000	0	0	0	0	0	3340		11,340	0	10,800	11,340	266	11,074
F05	2000	0	2500	0	2000	0	2500	0	0	0	0	2340		11,340	0	10,800	11,340	266	11,074
F06	1000	0	0	2000	0	3000	0	0	0	2660	0	0	2680	11,340	0	10,800	11,340	266	11,074
F07	2000	0	3000	0	3000	0	3000	0	0	340				11,340	0	10,800	11,340	266	11,074
F08	0	3000	0	2000	0	3000	0	0	3340					11,340	0	10,800	11,340	266	11,074
F09	0	0	1000	0	3000	0	0	3000	0	2000	0	1000	1340	11,340	0	10,800	11,340	266	11,074
F10	0	3000	0	3000	0	0	2000	0	2160	0	0	0	1180	11,340	0	10,800	11,340	266	11,074
F11	2000	0	2000	0	3000	0	0	3000	0	1340				11,340	0	10,800	11,340	266	11,074
F12	0	3000	0	2000	0	0	2500	1000	0	0	0	2840		11,340	0	10,800	11,340	266	11,074
F13	2000	0	2000	0	3000	0	0	3000	0	1342				11,342	2	10,800	11,340	266	11,076
F14	0	3000	0	3000	0	0	3500	0	1840					11,340	0	10,800	11,340	266	11,074
F15	2000	0	1500	0	2000	0	0	2000	0	0	2000	1840		11,340	0	10,800	11,340	266	11,074
F16	0	3000	0	2000	0	0	2000	0	3000	0	0	0	1340	11,340	0	10,800	11,340	266	11,074
F17	0	0	0	0	3000	3000	0	3000	0	0	2340			11,340	0	10,800	11,340	266	11,074
F18	0	3000	0	0	0	0	3000	0	3660	0	0	0	1680	11,340	0	10,800	11,340	266	11,074
F19	2000	0	0	2000	0	3000	0	3000	0	0	1340			11,340	0	10,800	11,340	266	11,074
F20	0	3000	0	0	3000	0	2000	0	3340					11,340	0	10,800	11,340	266	11,074
F21	0	0	0	3000	0	2000	0	2000	0	0	2340	2000		11,340	0	10,800	11,340	266	11,074
F22 <sup>a</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,800	0	NA	NA
ZVI Subtotal	22,292	27,500	12,000	24,000	27,000	20,000	23,000	20,000	17,340	7,682	12,408	15,360	9,560	238,142	2	237,600	238,140	5,580	232,562
Total ZVI (tons)	11.15	13.75	6.00	12.00	13.50	10.00	11.50	10.00	8.67	3.84	6.20	7.68	4.78	119.07	0.0	118.8	119.1	2.8	116.3

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

<sup>a</sup> - F22 B Panel could not be isolated. The target plus 5% was distributed to "hot spot" areas in above panels.

Table 5. C Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Oct-19												Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 5% & Hot Spots (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in C Panel (lbs)
	3	4	7	8	9	10	11	15	16	17	18	21						
<b>C PANEL 10-FT (APPROX. 95' - 105' BGS)</b>																		
F01	2000	0	0	3000	0	2000	0	3000	0	1340	<del> </del>	<del> </del>	11,340	0	10,800	11,340	313	11,027
F02	1672	0	3000	0	2000	0	3000	0	2320	0	3355	<del> </del>	15,347	0	10,800	15,347	313	15,034
F03	3000	0	0	3000	0	3000	0	3000	0	3347	<del> </del>	<del> </del>	15,347	0	10,800	15,347	313	15,034
F04	1000	0	3000	0	3000	0	3000	0	3000	0	2347	<del> </del>	15,347	0	10,800	15,347	313	15,034
F05	2000	0	0	3000	0	3000	0	2000	0	3133	0	2214	15,347	0	10,800	15,347	313	15,034
F06	1000	0	2000	0	2000	0	3000	0	2000	0	2978	2369	15,347	0	10,800	15,347	313	15,034
F07	1000	0	0	3000	0	2000	0	2000	0	3000	2000	2347	15,347	0	10,800	15,347	313	15,034
F08	1000	0	3000	0	3000	0	3000	0	3000	0	2347	<del> </del>	15,347	0	10,800	15,347	313	15,034
F09	0	2000	0	3000	0	500	0	3000	0	3000	2000	1847	15,347	0	10,800	15,347	313	15,034
F10	1000	0	2000	0	2000	0	3000	0	3000	0	2653	1694	15,347	0	10,800	15,347	313	15,034
F11	0	3000	0	3000	0	2500	0	2000	0	2000	0	2847	15,347	0	10,800	15,347	313	15,034
F12	1000	0	3000	0	3000	0	3000	0	3000	0	2347	<del> </del>	15,347	0	10,800	15,347	313	15,034
F13	0	3000	0	3000	0	2000	0	2000	0	3000	0	2347	15,347	0	10,800	15,347	313	15,034
F14	1000	0	2000	0	2000	0	3000	0	3000	0	2653	1694	15,347	0	10,800	15,347	313	15,034
F15	0	3000	0	3000	0	2000	0	2000	0	2000	0	3347	15,347	0	10,800	15,347	313	15,034
F16	1000	0	3000	0	2000	0	1500	0	3000	0	3000	1847	15,347	0	10,800	15,347	313	15,034
F17	0	3000	0	2000	0	3000	0	2000	0	0	1340	<del> </del>	11,340	0	10,800	11,340	313	11,027
F18	1000	0	3000	0	1500	0	0	2500	0	3340	<del> </del>	<del> </del>	11,340	0	10,800	11,340	313	11,027
F19	0	3000	0	1000	2000	3000	0	0	2340	<del> </del>	<del> </del>	<del> </del>	11,340	0	10,800	11,340	313	11,027
F20	1000	0	3000	0	0	2500	0	2000	0	2840	<del> </del>	<del> </del>	11,340	0	10,800	11,340	313	11,027
F21	0	3000	0	0	3000	0	3000	0	2340	<del> </del>	<del> </del>	<del> </del>	11,340	0	10,800	11,340	313	11,027
F22 <sup>a</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,800	0	NA	NA
ZVI Subtotal	18,672	20,000	27,000	27,000	25,500	25,500	25,500	25,500	27,000	27,000	27,020	22,553	298,245	0	237,600	298,245	6,580	291,665
Total ZVI (tons)	9.34	10.00	13.50	13.50	12.75	12.75	12.75	12.75	13.50	13.50	13.51	11.28	149.12	0.0	118.8	149.1	3.3	145.8

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

<sup>a</sup> - F22 C Panel could not be isolated. The target plus 5% was distributed to "hot spot" areas in this and above panels.

Yellow highlighted areas represent hotspots.

Table 6. D Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Oct-19				Nov-19									Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 5% & Hot Spots (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in D Panel (lbs)
	24	29	30	31	1	5	6	7	8	12	13	14	15						
<b>D PANEL 10-FT (APPROX. 80' - 90' BGS)</b>																			
F01	1447	3000	0	2000	0	2000	0	0	2893	<del>0</del>	<del>3000</del>	<del>2402</del>	<del>0</del>	11,340	0	10,800	11,340	141	11,199
F02	2000	0	3000	0	3000	0	0	2000	0	0	3000	2402	<del>0</del>	15,402	55	10,800	15,347	141	15,261
F03	2000	3000	0	3000	0	3000	0	2000	2347	<del>0</del>	<del>3000</del>	<del>347</del>	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F04	3000	0	3000	0	3000	0	0	3000	0	0	3000	347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F05	2000	3000	0	3000	0	1000	0	0	1830	0	0	4517	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F06	2000	0	3000	0	3000	0	0	3000	0	0	3000	1347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F07	2000	3000	0	3000	0	0	2000	0	3000	0	0	2347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F08	3000	0	3000	0	0	3000	0	3000	0	0	3347	<del>0</del>	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F09	2000	3000	0	3000	0	0	2000	0	3000	0	0	2347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F10	2000	0	3000	0	0	3000	0	3000	0	0	2653	1694	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F11	2000	3000	0	2500	0	0	3000	0	3000	0	0	1847	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F12	2000	0	2500	0	0	3000	0	3000	0	0	3000	1847	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F13	2000	2000	0	0	3500	0	3000	0	2000	0	0	2000	847	15,347	0	10,800	15,347	141	15,206
F14	2000	0	0	3000	0	3000	0	3000	0	0	3000	1347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F15	2000	0	2000	0	2000	0	3000	0	0	3000	0	3347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F16	0	2000	0	3000	0	3000	0	3000	0	0	1347	0	3052	15,399	52	10,800	15,347	141	15,258
F17	2000	0	3000	0	3000	0	3000	0	0	3000	0	1347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F18	0	2000	0	3000	0	3000	0	2000	0	0	2653	0	2694	15,347	0	10,800	15,347	141	15,206
F19	2000	0	2000	0	3000	0	3000	0	0	3000	0	2347	<del>0</del>	15,347	0	10,800	15,347	141	15,206
F20	0	2000	0	3000	0	3000	0	3000	0	0	2000	0	2347	15,347	0	10,800	15,347	141	15,206
F21	2000	0	3000	1000	4000	1000	0	3000	0	3000	0	3261	<del>0</del>	20,261	0	10,800	20,261	141	20,120
F22 <sup>a</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,800	0	NA	NA
ZVI Subtotal	37,447	26,000	27,500	29,500	24,500	28,000	19,000	33,000	18,070	12,000	27,000	32,344	8,940	323,301	107	237,600	323,194	2,960	320,341
Total ZVI (tons)	18.72	13.00	13.75	14.75	12.25	14.00	9.50	16.50	9.04	6.00	13.50	16.17	4.47	161.65	0.1	118.8	161.6	1.5	160.2

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

<sup>a</sup> - F22 D Panel could not be isolated. The target plus 5% was distributed to "hot spot" areas in this and above panels.

Yellow highlighted areas represent hotspots.

Table 7. E Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Nov-19						Dec-19				Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 5% & Hot Spots (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in E Panel (lbs)
	19	20	21	22	25	26	27	2	3	4						
<b>E PANEL 10-FT (APPROX. 75' - 85' BGS)</b>																
F01	1959	0	3000	3000	0	3381	<del>3000</del>	<del>3340</del>	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F02	2000	0	2000	0	1000	0	3000	3340	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F03	2000	0	3000	3000	0	3340	<del>3000</del>	<del>3340</del>	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F04	0	800	0	3000	3000	0	3000	1540	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F05	2000	0	3000	3000	0	3340	<del>3000</del>	<del>3340</del>	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F06	0	3000	0	3000	2000	0	3340	<del>3000</del>	<del>3340</del>	<del>3000</del>	11,340	0	10,800	11,340	212	11,128
F07	2000	0	3000	0	3000	3340	<del>3000</del>	<del>3340</del>	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F08	0	3000	0	3000	0	3000	2340	<del>3000</del>	<del>3340</del>	<del>3000</del>	11,340	0	10,800	11,340	212	11,128
F09	2000	0	3000	0	3000	3340	<del>3000</del>	<del>3340</del>	<del>3000</del>	<del>3340</del>	11,340	0	10,800	11,340	212	11,128
F10	0	3000	0	3000	0	3000	3320	3027	<del>3000</del>	<del>3340</del>	15,347	0	10,800	15,347	212	15,135
F11	2000	0	3000	0	3000	2259	0	3000	2088	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F12	0	3000	0	3000	0	3000	3000	3347	<del>3000</del>	<del>3340</del>	15,347	0	10,800	15,347	212	15,135
F13	2000	0	3000	0	3000	2000	0	3000	2347	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F14	0	3000	0	3000	0	3000	3000	3347	<del>3000</del>	<del>3340</del>	15,347	0	10,800	15,347	212	15,135
F15	2000	2000	3000	0	3000	0	0	3000	2347	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F16	0	0	3000	0	0	3000	3000	3381	2966	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F17	2000	3000	3000	0	3000	0	0	3000	1347	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F18	0	0	3000	3000	0	3000	0	0	3000	3347	15,347	0	10,800	15,347	212	15,135
F19	0	0	0	0	3000	4000	2000	3000	3347	<del>3000</del>	15,347	0	10,800	15,347	212	15,135
F20	0	0	3000	3000	0	3000	0	0	3000	3347	15,347	0	10,800	15,347	212	15,135
F21	2000	0	4000	3000	3000	0	3000	3000	2261	<del>3000</del>	20,261	0	10,800	20,261	212	20,049
F22 <sup>a</sup>	0	0	0	0	0	0	0	0	0	0	0	0	10,800	0	NA	NA
ZVI Subtotal	21,959	20,800	42,000	36,000	30,000	46,000	29,000	35,982	22,703	6,694	291,138	0	237,600	291,138	4,460	286,678
Total ZVI (tons)	10.98	10.40	21.00	18.00	15.00	23.00	14.50	17.99	11.35	3.35	145.57	0.0	118.8	145.6	2.2	143.3

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

<sup>a</sup> - F22 E Panel could not be isolated. The target plus 5% was distributed to "hot spot" areas in this and above panels.

Yellow highlighted areas represent hotspots.

Table 8. F Panel ZVI-PRB Well Construction Summary. SRNS; Savannah River Site P-Area ZVI PRB. Aiken, SC

Frac Casing No.	Dec-19					Quantity of ZVI Injected (lbs)	Delta (lbs)	Target (lbs)	Target Plus 3% (lbs)	Washout from Skid Pan (lbs)	Quantity of ZVI in F Panel (lbs)
	5	6	9	10	11						
<b>F PANEL 10-FT (APPROX. 50' - 60' BGS)</b>											
F01	2000	3000	0	0	2005	7,005	0	10,800	7,005	30	6,975
F02	4000	0	0	3005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F03	1603	1500	0	0	3902	7,005	0	10,800	7,005	30	6,975
F04	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F05	2000	0	3000	0	2005	7,005	0	10,800	7,005	30	6,975
F06	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F07	2000	0	3000	0	2005	7,005	0	10,800	7,005	30	6,975
F08	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F09	2000	0	3000	0	2005	7,005	0	10,800	7,005	30	6,975
F10	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F11	1000	0	4000	0	2005	7,005	0	10,800	7,005	30	6,975
F12	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F13	2000	0	0	3000	2005	7,005	0	10,800	7,005	30	6,975
F14	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F15	2000	0	0	3000	2005	7,005	0	10,800	7,005	30	6,975
F16	0	3000	0	4005	<del>2005</del>	7,005	0	10,800	7,005	30	6,975
F17	2000	0	0	3000	2005	7,005	0	10,800	7,005	30	6,975
F18	0	3000	0	1960	2045	7,005	0	10,800	7,005	30	6,975
F19	2000	0	0	3000	2005	7,005	0	10,800	7,005	30	6,975
F20	0	3000	0	0	4005	7,005	0	10,800	7,005	30	6,975
F21	2000	0	0	3000	2005	7,005	0	10,800	7,005	30	6,975
F22	0	3000	0	0	4005	7,005	0	10,800	7,005	30	6,975
ZVI Subtotal	24,603	34,500	13,000	48,000	34,007	154,110	0	237,600	154,110	660	153,450
Total ZVI (tons)	12.30	17.25	6.50	24.00	17.00	77.06	0.0	118.8	77.1	0.3	76.7

Notes: All ZVI calculations assume 180 pcf for bulk density. Average density of all ZVI loads was 151 pcf.

F Panel was adjusted to 2-inch thickness, resulting in a target ZVI of 5,400 lbs per casing.

The original target (i.e., 4-inch thickness) was distributed to "hot spot" areas below this panel.

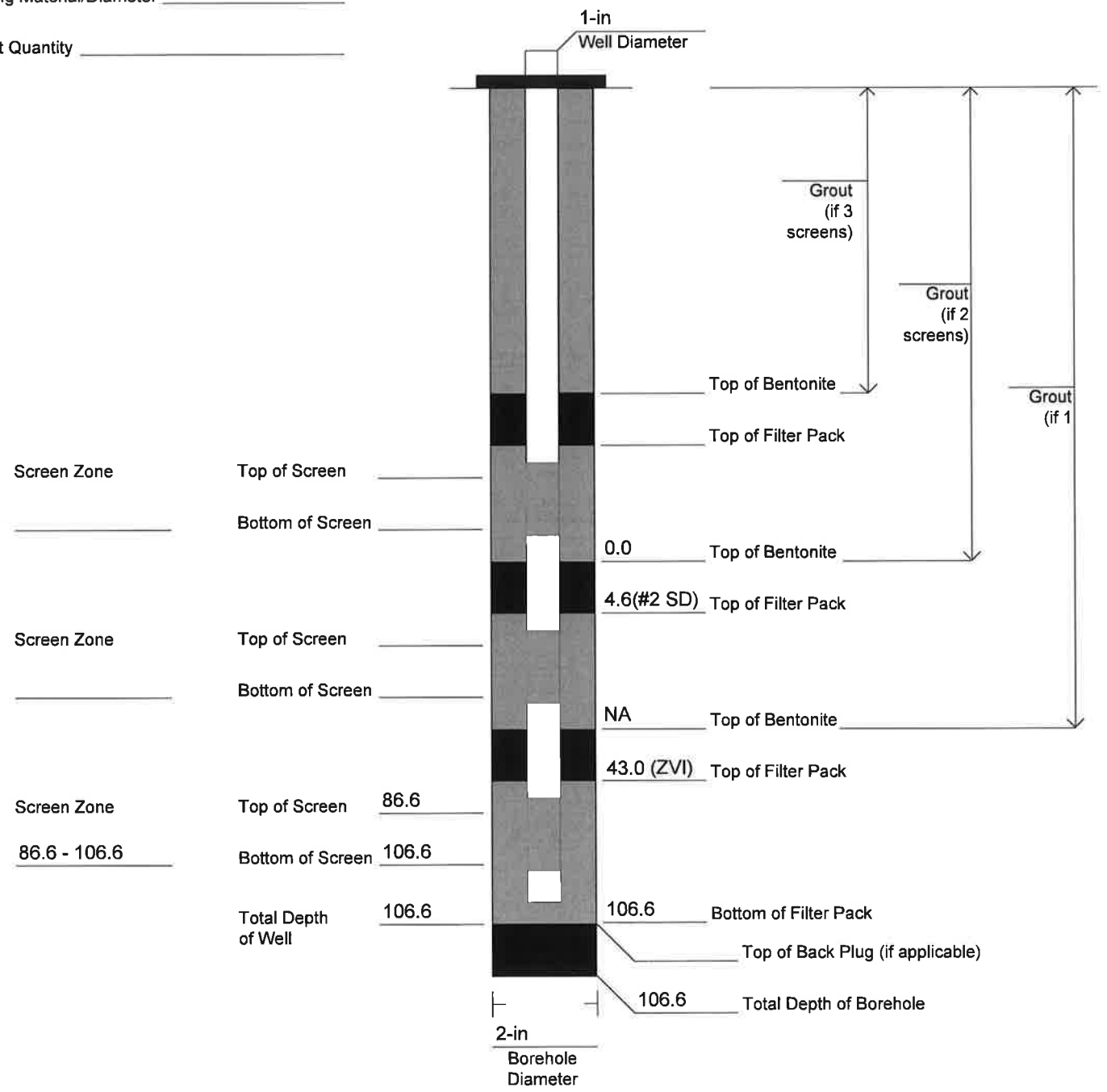
**APPENDIX D**

**ZVI-PRB In-Wall Monitoring Well Construction Reports**

# Monitoring Well Installation Report

Driller Name/Company T. Ardito/Cascade		Driller Cert. No. 2225	Tech Oversight Name/Company T. McKinsey/GeoSierra	Well Number PIW001D
Well Installation Date 12/17/2019	SC DHEC Well Approval Number MW-11995		Drilling Method (Auger Mud Rotary, Rotosonic, etc) Wash casing to depth inside existing injection well casing.	
SRS North Grid Coordinate (as built) 44462.51	SRS East Grid Coordinate (as built) 64297.01	Latitude (deg/min/sec - as built) (NAD 27) 33 13' 44.38"	Longitude (deg/min/sec - as built) (NAD 27) -81 35' 2.07"	
Top of Pad Elevation (as built) (310.38 GE)	Water Level Reference Point Elevation (as built) 36.0	Survey Point <input type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input checked="" type="checkbox"/> Ground Surface		
Surface Casing (if installed) _____ Depths measured from ground surface to nearest 0.1 ft				

Total Depth of Installed Casing \_\_\_\_\_  
Casing Material/Diameter \_\_\_\_\_  
Grout Quantity \_\_\_\_\_





# Monitoring Well Installation Report (Continued)

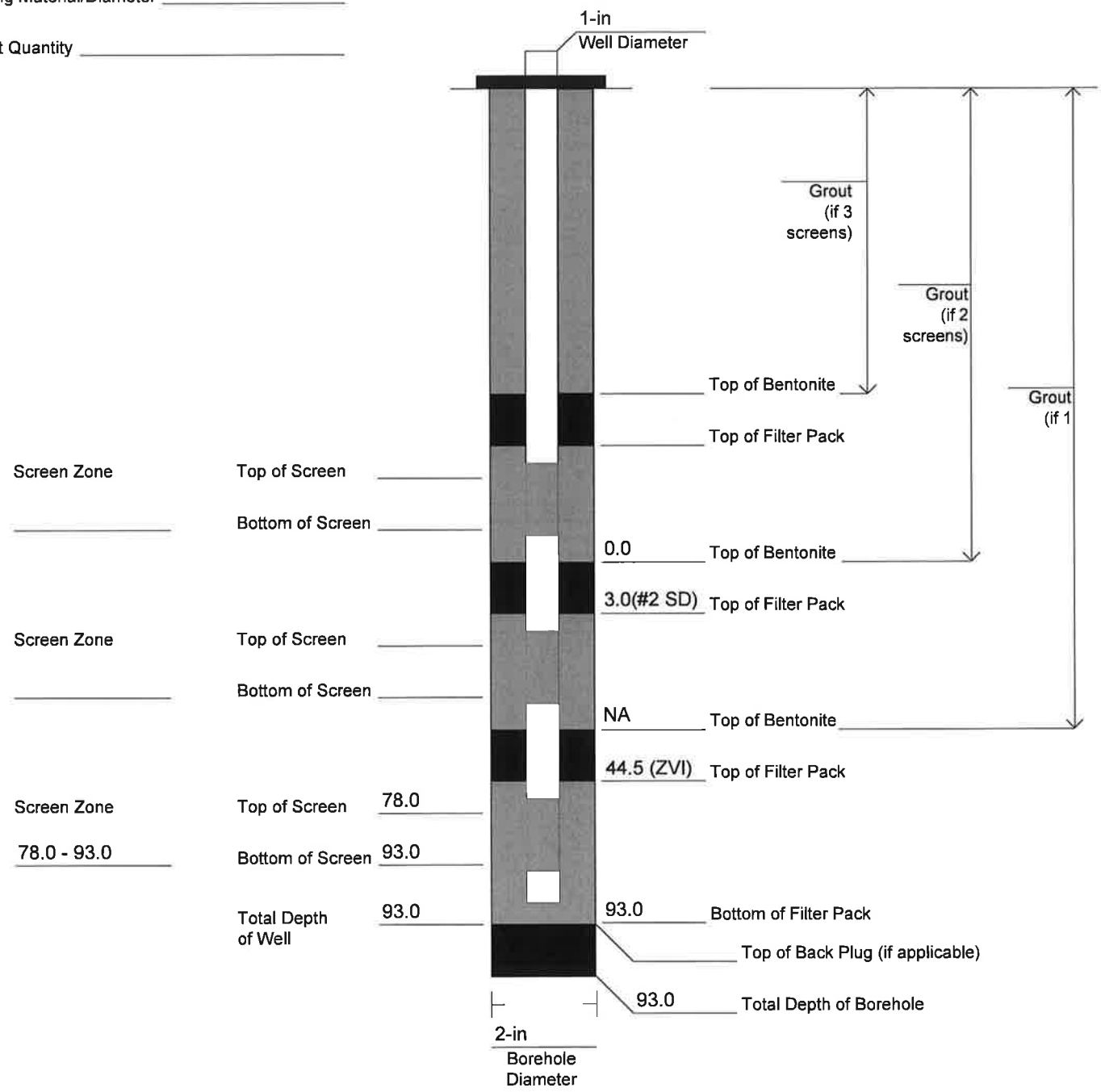
					Well Number PIW001D	
<b>Casing</b>	<b>Top Depth</b>	<b>Bottom Depth</b>	<b>Material/Schedule</b>	<b>Diameter</b>	<b>Slot Size</b>	<b>Slot Type</b>
	0.0	86.6	PVC/Sch 40	1-in		
<b>Screen</b>	86.6	106.6	PVC/Sch 40	1-in	0.010	
<b>Sump</b>						
<b>Sump Cap</b>	106.6	106.6	PVC/Sch 40	1-in		
<b>Filter Pack</b>	<b>Top Depth</b>	<b>Bottom Depth</b>	<b>Amount (sacks and size)</b>	<b>Trade Name</b>		
	43.0	106.6		ZVI from the PRB		
	4.6	43.0		# 2 filter sand		
<b>Bentonite Seal</b>	<b>Top Depth</b>	<b>Bottom Depth</b>	<b>Amount/Size (sack, bucket, etc.)</b>			
	0.0	4.6	Bentonite HolePlug chips			
<b>Grout</b>	<b>Top Depth</b>	<b>Bottom Depth</b>	<b>Amount (sacks and size)</b>	<b>Grout Date</b>	<b>Grout Weight</b>	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input type="checkbox"/> High Solids Bentonite						
<b>Well Installation Comments</b> PRB In-Wall installation inside of PGF005 injection well casing.						
<b>Pump Installation Information</b>						
<input checked="" type="checkbox"/> Pump Not Installed						
<b>Installation Date</b>		<b>Installer/Company</b>		<b>Model/Manufacturer</b>		<b>Diameter</b>
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed			<b>Depth from Top of Casing to Top of Pump</b>			
<b>Report Prepared By</b> T. McKinsey						<b>Date</b> 12/17/2019

Depths measured from ground surface to nearest 0.1 ft.

# Monitoring Well Installation Report

Driller Name/Company T. Ardito/Cascade		Driller Cert. No. 2225	Tech Oversight Name/Company T. McKinsey/GeoSierra	Well Number PIW002D
Well Installation Date 12/17/2019	SC DHEC Well Approval Number MW-11995		Drilling Method (Auger Mud Rotary, Rotosonic, etc) Wash casing to depth inside existing injection well casing.	
SRS North Grid Coordinate (as built) 44401.71	SRS East Grid Coordinate (as built) 64274.37	Latitude (deg/min/sec - as built) (NAD 27) 33 13' 43.76"	Longitude (deg/min/sec - as built) (NAD 27) -81 35' 1.86"	
Top of Pad Elevation (as built) (311.81 GE)	Water Level Reference Point Elevation (as built) 37.6	Survey Point <input type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input checked="" type="checkbox"/> Ground Surface		
Surface Casing (if installed) _____ Depths measured from ground surface to nearest 0.1 ft				

Total Depth of Installed Casing \_\_\_\_\_  
Casing Material/Diameter \_\_\_\_\_  
Grout Quantity \_\_\_\_\_



# Monitoring Well Installation Report (Continued)

Well Number PIW002D
------------------------

Program Plan Name PAGW Wells and Soil Borings	Location Description SRS P-Area	Site ID PRB Groundwater	Project Manager Seth Miller
--	------------------------------------	----------------------------	--------------------------------

Station Type (Monitoring Well, Piezometer, etc.)  
Monitoring Well

Drilling and Sampling			
Drilling Start Date	Drilling Completion Date	Total Drilled Depth	
12/16/2019	12/17/2019	93.0	
Drilling Sampling Method	Top Depth	Bottom Depth	Diameter

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)  
PIW002D constructed as a PRB "in-wall" monitoring point inside of PGF011 injection well casing.

Geophysical Logging				
Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

Caliper     
  Natural Gamma     
  Neutron Density     
  Resistivity     
  Single Pt. Resistivity     
  L & S Normal Resistivity     
  Spontaneous Potential

Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)

Depths measured from ground surface to nearest 0.1 ft.

# Monitoring Well Installation Report (Continued)

					Well Number PIW002D	
	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
<b>Casing</b>	0.0	78.0	PVC/Sch 40	1-in		
<b>Screen</b>	78.0	93.0	PVC/Sch 40	1-in	0.010	
<b>Sump</b>						
<b>Sump Cap</b>	93.0	93.0	PVC/Sch 40	1-in		
<b>Filter Pack</b>	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	44.5	93.0		ZVI from the PRB		
	3.0	44.5		# 2 filter sand		
<b>Bentonite Seal</b>	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	0.0	3.0	Bentonite HolePlug chips			
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input type="checkbox"/> High Solids Bentonite	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
<b>Well Installation Comments</b> PRB In-Wall installation inside of PGF011 injection well casing.						
<b>Pump Installation Information</b>						
<input checked="" type="checkbox"/> Pump Not Installed						
Installation Date		Installer/Company		Model/Manufacturer		Diameter
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed			Depth from Top of Casing to Top of Pump			
Report Prepared By T. McKinsey						Date 12/17/2019

Depths measured from ground surface to nearest 0.1 ft.

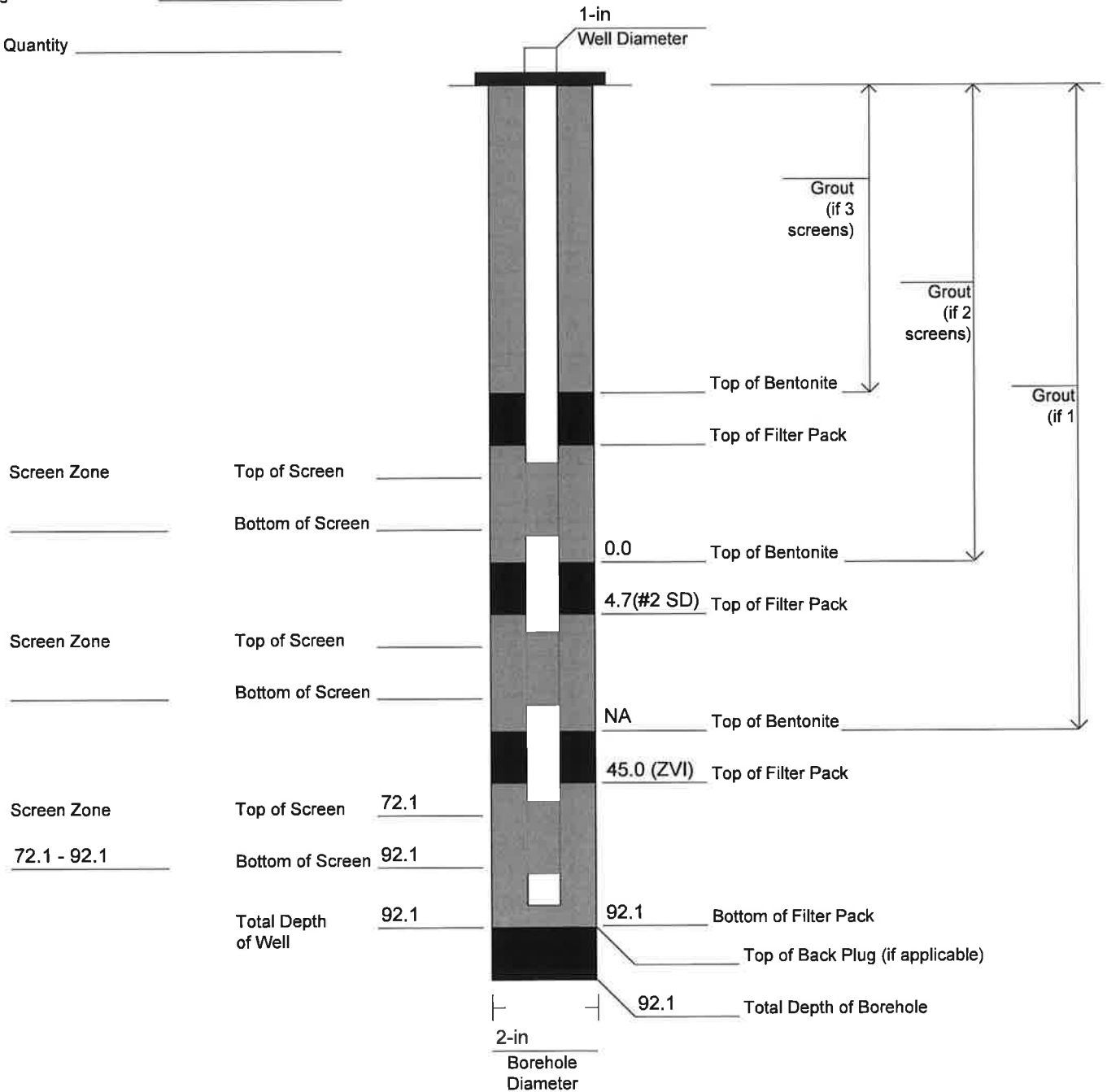
# Monitoring Well Installation Report

Driller Name/Company T. Ardito/Cascade		Driller Cert. No. 2225	Tech Oversight Name/Company T. McKinsey/GeoSierra		Well Number PIW003D
Well Installation Date 12/18/2019	SC DHEC Well Approval Number MW-11995		Drilling Method (Auger Mud Rotary, Rotosonic, etc) Wash casing to depth inside existing injection well casing.		
SRS North Grid Coordinate (as built) 44346.28	SRS East Grid Coordinate (as built) 64238.87	Latitude (deg/min/sec - as built) (NAD 27) 33 13' 43.11"		Longitude (deg/min/sec - as built) (NAD 27) -81 35' 1.81"	
Top of Pad Elevation (as built) (312.87 GE)	Water Level Reference Point Elevation (as built) 38.3		Survey Point <input type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input checked="" type="checkbox"/> Ground Surface		
Surface Casing (if installed) _____ Depths measured from ground surface to nearest 0.1 ft					

Total Depth of Installed Casing \_\_\_\_\_

Casing Material/Diameter \_\_\_\_\_

Grout Quantity \_\_\_\_\_



# Monitoring Well Installation Report (Continued)

Well Number PIW003D
------------------------

Program Plan Name PAGW Wells and Soil Borings	Location Description SRS P-Area	Site ID PRB Groundwater	Project Manager Seth Miller
--	------------------------------------	----------------------------	--------------------------------

Station Type (Monitoring Well, Piezometer, etc.)  
Monitoring Well

Drilling and Sampling			
Drilling Start Date	Drilling Completion Date	Total Drilled Depth	
12/17/2019	12/18/2019	92.1	
Drilling Sampling Method	Top Depth	Bottom Depth	Diameter

Drilling and Sampling Comments (lost circulation zones, drilling problems, etc.)  
PIW003D constructed as a PRB "in-wall" monitoring point inside of PGF017 injection well casing.

Geophysical Logging				
Date Logged	Logging Top Depth	Logging Bottom Depth	Logging Contractor	Logging Truck Operator

Geophysical Logs

Caliper     
  Natural Gamma     
  Neutron Density     
  Resistivity     
  Single Pt. Resistivity     
  L & S Normal Resistivity     
  Spontaneous Potential

Other (List)

Backfill Top Depth	Backfill Bottom Depth	Backfill Material (Include Type, Quantity)
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Depths measured from ground surface to nearest 0.1 ft.

# Monitoring Well Installation Report (Continued)

Well Number  
PIW003D

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	0.0	92.1	PVC/Sch 40	1-in		
Screen	72.1	92.1	PVC/Sch 40	1-in	0.010	
Sump						
Sump Cap	92.1	92.1	PVC/Sch 40	1-in		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	45.0	92.1		ZVI from the PRB		
	4.7	45.0		# 2 filter sand		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	0.0	4.7	Bentonite HolePlug chips			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	

- Neat Cement
- Bentonite Cement
- High Solids Bentonite

Well Installation Comments  
PRB In-Wall installation inside of PGF017 injection well casing.

Pump Installation Information  Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump	

Report Prepared By  
T. McKinsey

Date  
12/18/2019

Depths measured from ground surface to nearest 0.1 ft.

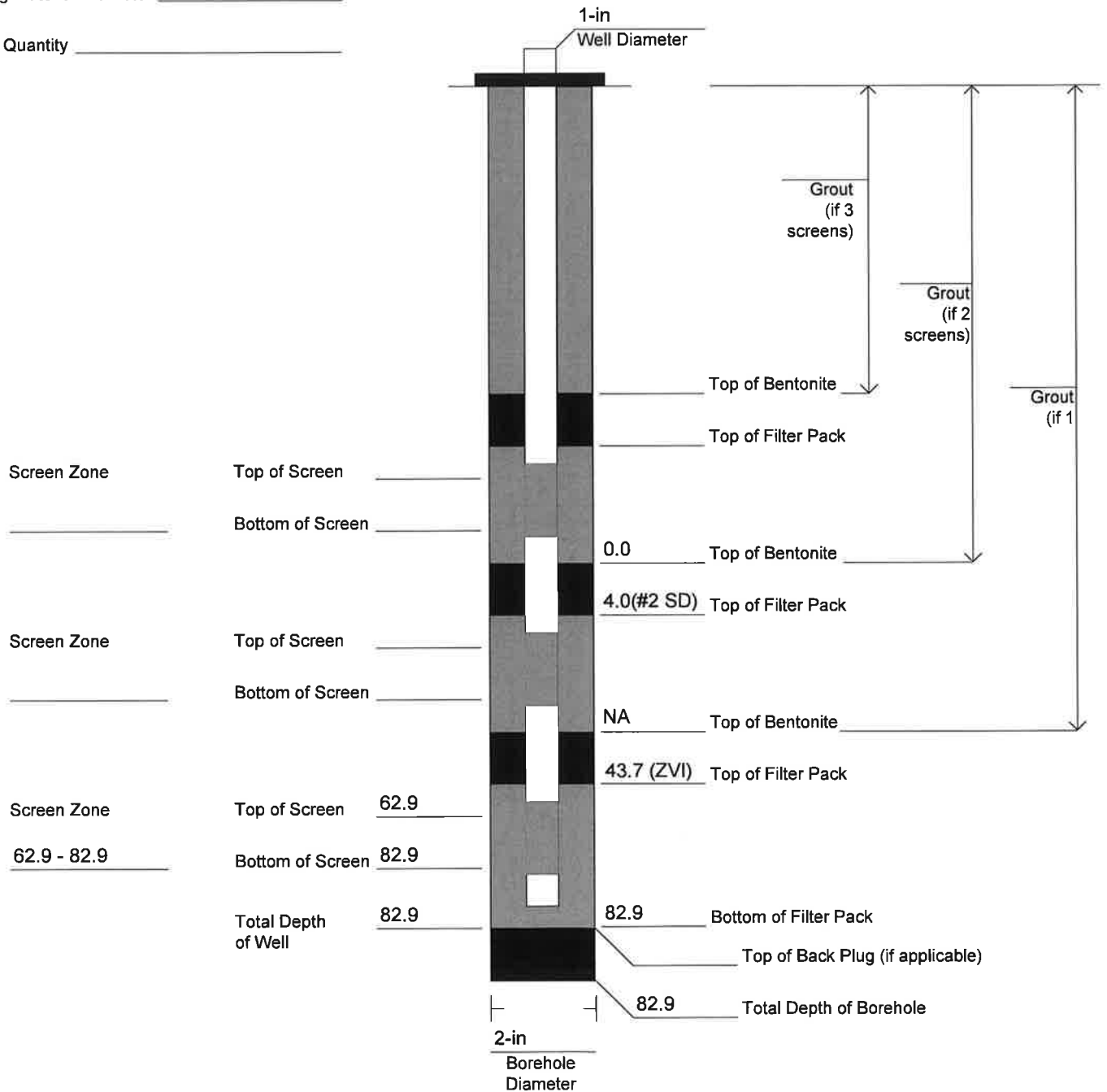
# Monitoring Well Installation Report

Driller Name/Company T. Ardito/Cascade		Driller Cert. No. 2225	Tech Oversight Name/Company T. McKinsey/GeoSierra		Well Number PIW004D
Well Installation Date 12/18/2019	SC DHEC Well Approval Number MW-11995		Drilling Method (Auger Mud Rotary, Rotosonic, etc) Wash casing to depth inside existing injection well casing.		
SRS North Grid Coordinate (as built) 44301.46	SRS East Grid Coordinate (as built) 64221.77	Latitude (deg/min/sec - as built) (NAD 27) 33 13' 42.65"		Longitude (deg/min/sec - as built) (NAD 27) -81 35' 1.66"	
Top of Pad Elevation (as built) (314.39 GE)	Water Level Reference Point Elevation (as built) 39.5		Survey Point <input type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input checked="" type="checkbox"/> Ground Surface		
Surface Casing (if installed) _____ Depths measured from ground surface to nearest 0.1 ft					

Total Depth of Installed Casing \_\_\_\_\_

Casing Material/Diameter \_\_\_\_\_

Grout Quantity \_\_\_\_\_





# Monitoring Well Installation Report (Continued)

Well Number  
PIW004D

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
<b>Casing</b>	0.0	62.9	PVC/Sch 40	1-in		
<b>Screen</b>	62.9	82.9	PVC/Sch 40	1-in	0.010	
<b>Sump</b>						
<b>Sump Cap</b>	82.9	82.9	PVC/Sch 40	1-in		
<b>Filter Pack</b>	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	43.7	82.9		ZVI from the PRB		
	4.0	43.7		# 2 filter sand		
<b>Bentonite Seal</b>	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	0.0	4.0	Bentonite HolePlug chips			
<b>Grout</b>	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	

- Neat Cement
- Bentonite Cement
- High Solids Bentonite

Well Installation Comments  
PRB In-Wall installation inside of PGF021 injection well casing.

Pump Installation Information  Pump Not Installed

Installation Date	Installer/Company	Model/Manufacturer	Diameter
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump	

Report Prepared By  
T. McKinsey

Date  
12/18/2019

Depths measured from ground surface to nearest 0.1 ft.

**APPENDIX E**

**ZVI-PRB Construction Supplier Deviation Disposition Request #6**

# Supplier Deviation Disposition Request

**NOTE**

<p>1. Completion instructions attached. 2. Items 1-19 and 35 below to be completed by Supplier. 3. *Items SRS entries only.</p>	<p>4. Attach additional information whenever necessary. 5. SRS shall be notified within 5 days after detection of deviation. 6. A copy of the completed SDDR form shall be included by the Supplier in the Quality Verification Data Package for each item to which this SDDR applies.</p>
---	--

	For Supplier Use	For SRS Use
	Supplier SDDR No. 6	Date Submitted 9/27/2019
	SRS SDDR No. 14018	Project No. Date Received
Supplier Completed	1. Supplier Name GeoSierra Environmental, Inc.	Address 220 Rte 70, Suite D
	City/State/Zip Medford, NJ 08055	2. Supplier's Order No.
	2.1 SRS Document Q-SOW-P-0013-Rev 2	3. Supplier's Part No.
	4. Supplier's Part Name	5. Deviation Detected (Date) 09/23/2019
	Method Check	
	6. All Previous SDDRS (No./Date) 1-8/30/18,2&3-10/8/18,4-10/11/18,5-10/16/18	7. SRS PO No./Change Notice No. 371219
	8. SRS Buyer Andrew Murphy	9. SRS Part No.
	10. SRS Part Name	11. SRS SSR Notified (Date) Method
	12. SRS Eng Notified (Date) Method	
	13. Deviation Description (attach extra sheets, photographs, sketches, etc., as necessary and identify quantity and Serial Nos. as applicable) 3.1.3.1.D. Product specifications in PRB Design & Implementation Plan - GeoSierra is installing a PRB in P-Area at SRS comprised of 760 tons of Peerless ZVI with grain size distribution of -8/+100 as documented in App. H. Sect. 1.0 of March 2019 ZVI-PRB Design Report. During a recent SRNS' QA 9/23/19 site visit, a review of Certificate of Analysis from shipments showed a bulk density range (145-165.5 pcf), which is below the range included in the Design Report (165-215 pcf). GeoSierra incorrectly referenced the TS ZVI density (14D) rather than the design density provided in letter from Peerless.	
14. Supplier's Proposed Disposition <input checked="" type="radio"/> Use As-Is <input type="radio"/> Repair <input type="radio"/> Modify SRS Requirement		
15. Cost Impact None	16. Schedule Impact None	
17. Proposed Disposition and Technical (plus cost/schedule if applicable) Justification (attach extra sheets, sketches, etc., as necessary).  See attached technical discussion and Peerless letter.		
18. Associated Supplier Document Change(s) None		
19. Supplier's Authorized Representative (Print Name/Signature) Deborah L. Schnell	Title Senior Project Manager	
Date 09/27/2018		

SRS	20. SRS Disposition							
	<input checked="" type="radio"/> Accepted	Item Description <u>ZVI Iron</u> Responsible Division <u>EC&amp;ACP</u>						
	<input type="radio"/> Rejected	End Use <u>Reactive media for PRB</u> Functional Class <u>GS</u>						
	21. USQ/TSQ/DATR Document No. N/A	For Prior Use USQ/TSQ/DATR Application (Print Name/Signature) CTF1 <u>Monique Rabin</u> CTF2 <u>N/A</u>						
	22. SRS Action Justification and Statement of Verification/Re-examination Method (attach extra sheets, sketches, etc., as necessary) (See "Table A" on page 2 of 2) EC&ACP Engineering has reviewed the revised product sheet from the subcontractor's supplier (Peerless). Based on a review of the bulk density range for the specialty blend of iron and the certificates of analysis for iron shipments to date, the values fall within the range of the specification. EC&ACP Engineering agrees that the lower bulk density of the specialty blend of iron exceeds the design requirements for the permeable reactive barrier (PRB) as described in the technical justification provided by the subcontractor in Section 17 of this SDDR. This SDDR will provide the necessary documentation for the technical specification change with respect to bulk density of the iron. The subcontractor's design report will not be revised. The change in bulk density will be documented in the subcontractor's post verification document.							
	23. SRS Disposition Acceptance/Printed Name/Signature							
	<table border="0" style="width: 100%;"> <tr> <td style="width: 33%;"><u>Monique Rabin</u> Monique Rabin CTF/Disposition Originator</td> <td style="width: 33%;"><u>Stan Pruitt</u> Stan Pruitt CQF</td> <td style="width: 33%;"><u>10/3/19</u> Date</td> </tr> <tr> <td><small>Digitally signed by Monique Rabin Date: 2019.10.02 09:02:19 -0400</small></td> <td><small>Digitally signed by Stan Pruitt Date: 2019.10.03 05:58:23 -0400</small></td> <td></td> </tr> </table>	<u>Monique Rabin</u> Monique Rabin CTF/Disposition Originator	<u>Stan Pruitt</u> Stan Pruitt CQF	<u>10/3/19</u> Date	<small>Digitally signed by Monique Rabin Date: 2019.10.02 09:02:19 -0400</small>	<small>Digitally signed by Stan Pruitt Date: 2019.10.03 05:58:23 -0400</small>		
<u>Monique Rabin</u> Monique Rabin CTF/Disposition Originator	<u>Stan Pruitt</u> Stan Pruitt CQF	<u>10/3/19</u> Date						
<small>Digitally signed by Monique Rabin Date: 2019.10.02 09:02:19 -0400</small>	<small>Digitally signed by Stan Pruitt Date: 2019.10.03 05:58:23 -0400</small>							
	<table border="0" style="width: 100%;"> <tr> <td style="width: 33%;"><u>Adam Willey</u> Adam Willey VER/CHK</td> <td style="width: 33%;"><u>Andrew Murphy</u> ANDREW MURPHY (Affiliate) Buyer</td> <td style="width: 33%;"><u>10/3/19</u> Date</td> </tr> <tr> <td><small>Digitally signed by Adam Willey Date: 2019.10.02 09:02:19 -0400</small></td> <td><small>Digitally signed by ANDREW MURPHY (Affiliate) Date: 2019.10.03 09:30:32 -0400</small></td> <td></td> </tr> </table>	<u>Adam Willey</u> Adam Willey VER/CHK	<u>Andrew Murphy</u> ANDREW MURPHY (Affiliate) Buyer	<u>10/3/19</u> Date	<small>Digitally signed by Adam Willey Date: 2019.10.02 09:02:19 -0400</small>	<small>Digitally signed by ANDREW MURPHY (Affiliate) Date: 2019.10.03 09:30:32 -0400</small>		
<u>Adam Willey</u> Adam Willey VER/CHK	<u>Andrew Murphy</u> ANDREW MURPHY (Affiliate) Buyer	<u>10/3/19</u> Date						
<small>Digitally signed by Adam Willey Date: 2019.10.02 09:02:19 -0400</small>	<small>Digitally signed by ANDREW MURPHY (Affiliate) Date: 2019.10.03 09:30:32 -0400</small>							
	<table border="0" style="width: 100%;"> <tr> <td style="width: 33%;"><u>Manuel I. Terronez</u> MANUEL TERRONEZ (Affiliate) MGR</td> <td style="width: 33%;"></td> <td style="width: 33%;"><u>10/2/19</u> Date</td> </tr> <tr> <td><small>Digitally signed by MANUEL TERRONEZ (Affiliate) Date: 2019.10.02 15:04:42 -0400</small></td> <td><u>Other</u></td> <td><u>                    </u> Date</td> </tr> </table>	<u>Manuel I. Terronez</u> MANUEL TERRONEZ (Affiliate) MGR		<u>10/2/19</u> Date	<small>Digitally signed by MANUEL TERRONEZ (Affiliate) Date: 2019.10.02 15:04:42 -0400</small>	<u>Other</u>	<u>                    </u> Date	
<u>Manuel I. Terronez</u> MANUEL TERRONEZ (Affiliate) MGR		<u>10/2/19</u> Date						
<small>Digitally signed by MANUEL TERRONEZ (Affiliate) Date: 2019.10.02 15:04:42 -0400</small>	<u>Other</u>	<u>                    </u> Date						

# Supplier Deviation Disposition Request (Con't)

Table A - Documents Requiring Action		
Identify all change docs and Check <b>Yes</b> or <b>No</b> for each		
24. <b>SRS Document Change</b>	Incorporation Required <input type="radio"/> Yes <input checked="" type="radio"/> No	Document Number _____
25. <b>SRS Specification Change</b>	Incorporation Required <input type="radio"/> Yes <input checked="" type="radio"/> No	Document Number _____
26. <b>Baseline Change</b>	Incorporation Required <input type="radio"/> Yes <input checked="" type="radio"/> No	Document Number _____
27. <b>Supplier Document Change</b>	Incorporation Required <input type="radio"/> Yes <input checked="" type="radio"/> No	Document Number _____
28. <b>Other Document Change</b>	Incorporation Required <input type="radio"/> Yes <input checked="" type="radio"/> No	Document Number _____
29. <b>Nonconformance Report (NCR)</b>  <i>Supplier Issued</i>  If YES, SDDR/DCF cannot be invalidated or modified without CQF approval or reissue of an NCR <input type="radio"/> Yes <input checked="" type="radio"/> No NCR No. _____	30. Methods of Verification (Choose <b>All</b> that apply)  <input type="checkbox"/> <b>RI</b> Verify Inspection Attributes cover changes  <input type="checkbox"/> <b>SSR</b> Verify Inspection Plan/Surveillance Report includes/inspects NCR item  <input type="checkbox"/> <b>Document Submittal</b> Document Number _____  <input checked="" type="checkbox"/> <b>Other</b> <u>Review of COAs for iron shipments and revised supplier data sheet.</u>	
31. Related Docs SRNS-OS-2019-00170 SRNS Surveillance: 2019-SUV-21-00001	32. Additional Reviewers N/A	
33. FOSC N/A	34. DC/RO N/A	
35. SDDR Disposition Supplier/Subcontractor Field Implementation  <input checked="" type="radio"/> SDDR Disposition Implemented and Incorporated into Supplier/Subcontractor Submittals  <input type="radio"/> SDDR Disposition Implementation and Incorporation not Required (Disapproved or No Change)		
_____ Deborah L. Schnell Supplier Quality Manager (Print Name)	_____ Deborah L. Schnell Supplier Quality Manager (Signature)	_____ 10/3/19 Date

Digitally signed by Deborah L. Schnell  
DN: cn=Deborah L. Schnell, o=Deborah Environmental, Inc., ou=Senior Project Manager,  
email=dschnell@germanym.com, c=US  
Date: 2019.10.03 10:44:19 -0400

# Supplier Deviation Disposition Request

## *(Always include Instruction Sheet with Form)*

This form is to be used by a supplier or subtier supplier after Purchase Order Award to:

- a) Notify SRS when manufactured product or service does not meet established contract requirements and to document the supplier's proposed disposition, with their technical proposed disposition, with their technical (and where appropriate, Cost/Schedule) justification.
- b) Notify SRS when the supplier wants to propose changes to the contract documents unanticipated at time of award.
- c) Record SRS disposition of the SDDR.

A deviation is any departure from the requirements of the procuring documents, which the supplier has incorporated or proposes to incorporate in the completed item or service provided. Deviation disposition can be classified as "Use As-Is" or "Repair."

Repair is defined as the process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still may not conform to the original requirement. Repair includes alterations to the properties to the material through heat-treating, welding, metal deposition, chemical processing, etc. The SDDR form is not required for cases where SRS has previously provided authorization to proceed, using an accepted repair method for a specific type of repair. Records must be maintained for each specific repair.

A SRS Engineering action and disposition statement does not relieve the supplier from responsibility for the accuracy, adequacy, or suitability of the item or service being provided as defined in the procurement documents, nor does it constitute waiver of the right to renegotiate the terms of the procurement documents.

### **Block No.**                      **Entry Information**

1. Supplier's name and address, city, state and zip code. List same information for subtier suppliers if applicable.
2. Supplier's order number if one has been assigned.
- 2.1 SRS specification or drawing number against which a deviation is being proposed.
3. Supplier's Part Number as applicable from the drawings, catalog, internal specification, etc.
4. Supplier's Part Name.
5. Date deviation detected and method used to detect deviation (NDE, dimensional, check, visual, etc.).
6. List all previous SDDRs and their dates that have been submitted for similar deviations requested on this purchase order.
7. SRS Purchase Order Number and Revision Number.
8. SRS Buyer Name.
9. SRS Purchase Requisition (item, part, tag or code) Number(s).
10. SRS Part Name, if one has been assigned.
11. Date and method (fax, letter, etc.) used to notify the SRS Supplier Surveillance Representative (SSR) whenever SRS Quality Surveillance is applicable. If the Purchase Requisition identified no requirements for Supplier Surveillance, enter "Not Required."
12. Date and method (fax, letter, etc.) used to notify SRS Engineering.
13. Describe the deviating characteristics and define the extent of the out-of specification condition for each identified piece affected. Identify the location of the deviation characteristic by print coordinates or specific location, as applicable. Attach reproducible quality extra sheets, sketches, photographs, etc., as necessary. When proposing a change in either supplier or SRS documents; describe the change; identify the documents completely including title or subject, date and revision; and where appropriate, attach a copy of areas in question.
14. State proposed disposition.
15. Enter cost impact that would result from proposed changes and which will be reflected in appropriate Procurement documents.
16. Enter delivery schedule impact that would result from proposed changes.
17. Describe the proposed disposition and provide technical (and where appropriate cost/schedule) justification for SRS evaluation. Attach reproducible quality copies whenever required. If the deviation is correctable by repair, submit a detailed repair procedure or reference

the procedure previously submitted and approved by SRS for use in similar situations. Provide supplier control number and procedure title. For documents, provide suggested corrective wording, procedures, documents, etc. Provide a copy of each SDDR attachment to the SRS SSR at the supplier's location.

18. Identify the nature of changes that may be needed on associated supplier documents (drawings, specifications, procedures, installation instructions, etc.).
19. Enter the name (typed or printed) and title of the supplier's representative authorizing the disposition request and have appropriate signature and date signed.
20. Check SRS Engineering disposition accepted or rejected. Provide justification for the acceptance or rejection in Block 22. Include the appropriate item description, end use, responsible division and functional classification.
21. When a disposition of "Use As-Is," "Repair," or "Modify SRS Requirement" is accepted for parts used in nuclear and nuclear support facilities, enter USQ/TSQ Document No. This may be a USQ Screening, USQ Evaluation, or Categorical Exclusion Document No. If the designated USQS or USQE was created prior to this SDDR and is being reused, then two USQ qualified engineers must sign approving this application. Reference 11Q, 1.05. TSQ screenings are performed in accordance with Manual 19Q, 4.05.
22. Provide appropriate justification for the SRS action(s) indicated in Block 20. When changes to drawings, specification, requisitions, or other SRS documents are involved, each document should be identified and the associated change briefly described. If other suppliers are affected, indicate who they are and the documents that initiated resolution of that involvement. "Other" follow-up action (e.g., the need for additional SRS calculations, additional drawings or sketches, inspection by SRS Engineering representative, etc.) should also be identified here. If SRS action is required, so indicate. State the verification/re-examination method to assure supplier action(s) were performed. This method is defined by the CTF and may be performed as defined by the process; for example, they may be performed by RI or the SSR. They may also be performed by document review or other method(s) defined by the CTF. Refer to baseline change procedures for baseline changes.
23. Originator - Signature of Responsible Engineer.  
Verifier/Checker - Signature of the Verifier/Checker reviewing the engineering action and the date signed.  
MGR - Signature of the SRS Department Manager and the date signed.  
CQF - Signature of the Cognizant Quality Function representative and the date signed.  
Buyer - Signature of the SRS Procurement and Materials Management Department representative acknowledging the SDDR.
24. Identify if an SRS Document Change requires incorporation. If "Yes" then identify the documents(s) requiring change.
25. Identify if an SRS Specification Change requires incorporation. If "Yes" then identify the SRS Specification requiring change.
26. Identify if a Baseline Change is required. If "Yes" then identify the Trend Number requesting the Baseline Change.
27. Identify if a Supplier Document Change requires incorporation. If "Yes" then identify the Supplier Document(s) requiring change.
28. Identify if any Other Document Change requires incorporation. If "Yes" then identify the Other Document(s) requiring change.
29. Identify if a Nonconformance Report is associated with this SDDR. If "Yes" then identify the NCR no.
30. Identify the Methods of Verification.
31. Identify any other Related Docs. If none, enter "N/A"
32. Identify any Additional Reviewer(s) required. If none, enter "N/A".
33. Identify if a Facility Operations Safety Committee (FOSC) review is required. If not required, enter "N/A".
34. Obtain DC/RO review if required. If not required, enter "N/A".
35. Upon completion of work, complete the "SDDR Disposition Supplier/Subcontractor Field Implementation" part of the SDDR including the name and signature of the Supplier Quality Manager and date. Include the completed SDDR with the Receipt Inspection Documentation or Subcontract close-out documentation.

**APPENDIX F**

**ZVI-PRB Construction Field Observation Notes**

Frac Well No.	Aug-19															Sep-19				
	7	8	9	14	15	19	20	21	22	23	26	27	28	29	30	4	5	6	9	10
Panel	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
F01				A (2)	A (2)							A (2)								
F02							A (1,5)													
F03								A (2,4)												
F04												A (5)	A (5)							
F05								A (6)				D (450 psi)								
F06												A (7)	D							
F07									A (6)			D (400 psi)								
F08							A (6)						A (9)							
F09								A (8, 10)												
F10							A (9)		A (7,9,11, 12)			A (9)								
F11								A (11, 12, 13)					A (10)	B (12)						
F12							A (10, 11)		A (13)			A (11, 13)								
F13																				
F14							A (13, 15)		A (16)			A (16)								
F15								A (16)		A (16)			A (16)							
F16									A (15)			A (15)								
F17																				
F18														A (16)				A (16, 17)		
F19																				
F20																			E	
F21																				
F22																				

A = Active PPR at >=1 Location  
 B = Active PPR w/ZVI

C = Heavy Pore Pressure Relief  
 D = High Pressure / Sanded Off

E = Abandoned packer

( ) = F Well #

 = Panel Completed

Frac Well No.	Sep-19											Oct-19									
	11	12	13	16	17	18	19	20	26	27	30	1	2	3	3	4	7	8	9	10	
Panel	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	
F01	A (2)																		A (2)		
F02				A (3)																A (1)	
F03					A (4)		D												A (4)	A (2,4)	
F04				A (5)		A (3)														A (3)	
F05																					
F06				A (7)																A (5,7)	
F07					A (6,8)										D						
F08		A (9)															A (5,9)		A (9)		
F09			E													A (10)				D	
F10																					
F11	A (13)		A (12)													A (12)					
F12		A (13)																			
F13			A (14)																		
F14				A (15)													A (15)		A (13)		
F15					A (14)			A (16)								A (14)					
F16		A (17, 18)						A (17)	A (15)												
F17				D	A (16, 18)	A (16)		A (18)			A (16, 18)								A (18)	A (18)	
F18		A (15)						A (19)		A (16, 17)							A (17, 19)		A (19, 21)		
F19				A (18)		A (18, 20)		A (20)			A (20)								A (20)	A (18, 20)	
F20		A (19)			A (19, 21)		A (21)		A (19)						A (21)		A (21)				
F21				A (20)												A (20)					
F22	WELL UNUSABLE										E	WELL UNUSABLE									

A = Active PPR at >=1 Location      C = Heavy Pore Pressure Relief      E = Abandoned packer      ( ) = F Well #  
 B = Active PPR w/ZVI      D = High Pressure / Sanded Off      = Panel Completed

Frac Well No.	Oct-19											Nov-19									
	11	15	16	17	18	21	22-23	24	29	30	31	1	5	6	7	8	12	13	14	15	
Panel	C	C	C	C	C	C	C	D	D	D	D	D	D	D	D	D	D	D	D	D	
F01		A (2)					E														
F02	A (1)		A (1,3)		B (3)																
F03		A (4)		A (2)						A (2)					A (2)						
F04	A (3)											A (5)						A (5)			
F05				A (4)							A (4,6)								A (4)		
F06	A (5,7)		A (5)		A (7)										C (7)						
F07				A (6) B (8)		A (6)															
F08	A (9)		A (7)																		
F09		A (8)		A (10)		A (8)					A (8, 10)					A (10)					
F10			A (9, 11)		A (9)	A (9)															
F11		A (10)		A (12)											A (10)						
F12					A (11)						A (13) D			A (13)							
F13		A (12, 14)		A (14)									A (14)		A (12)						
F14																					
F15				A (16)							C (16)							A (14)			
F16					A (15)				A (15)												
F17													A (16)								
F18				A (19)									A (17)			A (17)					
F19											A (20)										
F20		A (21)																			
F21	A (20)		A (20)																A (20)		
F22	WELL UNUSABLE																				

A = Active PPR at >=1 Location  
 B = Active PPR w/ZVI


C = Heavy Pore Pressure Relief  
 D = High Pressure / Sanded Off

E = Abandoned packer

( ) = F Well #

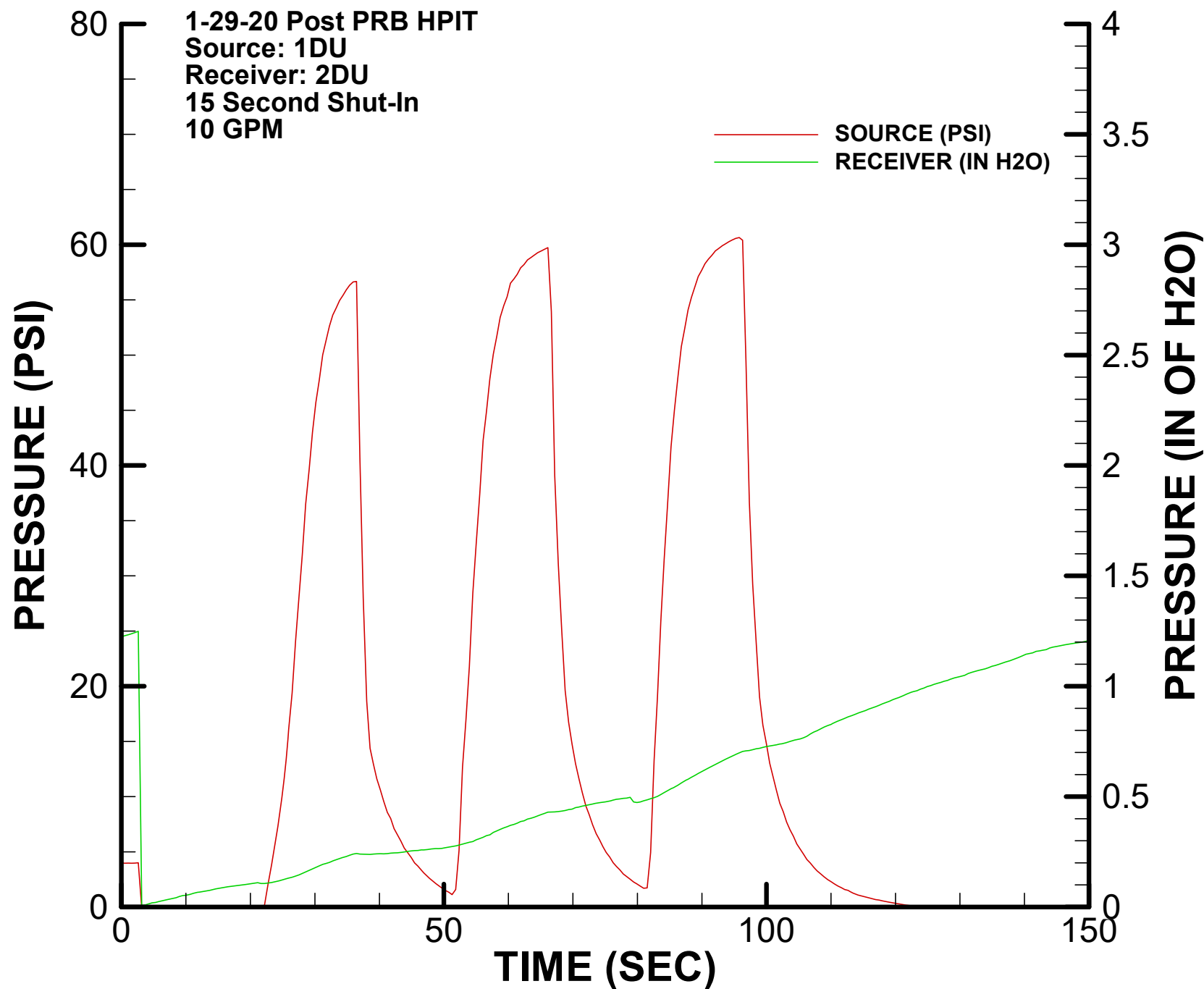
 = Panel Completed

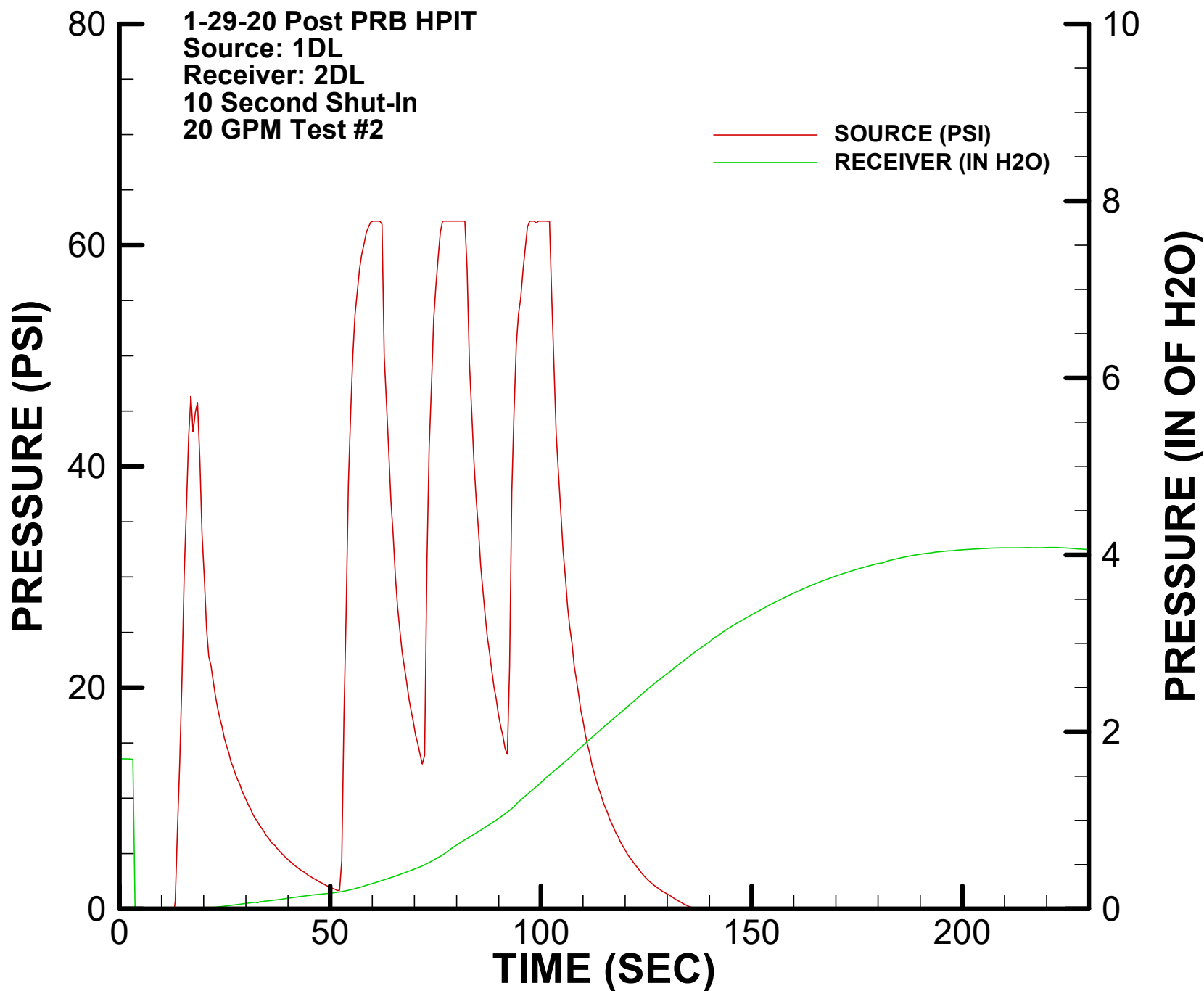
Frac Well No.	Nov-19								Dec-19									
	18	19	20	21	22	25	26	27	2	3	4	5	5	6	9	10	11	11
Panel	D	E	E	E	E	E	E	E	E	E	E	E	F	F	F	F	F	F
F01	X						A (2)	X	X	X	X	X						X
F02	X					A (1)				X	X	X					X	X
F03	X						A (4,5)	X	X	X	X	X						X
F04	X		A (5)			A (3,5)		A (3,5)		X	X	X		A (12)			X	X
F05	X							X	X	X	X	X						X
F06	X		C (7)					A (7)		X	X	X					X	X
F07	X					A (10)		X	X	X	X	X						X
F08	X						A (6,7,10)			X	X	X		A (9)		A (9)		X
F09	X							X	X	X	X	X						X
F10	X							A (11)		X	X	X						X
F11	X		D	A (12)		A (12)				X	X	X			A (10)		A (12)	X
F12	X						A (13)		A (14)	X	X	X				A (11)		X
F13	X								A (14)		X	X						X
F14	X				A (15,16)		A (15)			X	X	X				A (15)		X
F15	X									X	X	X						X
F16	X									X	X	X				A (17)		X
F17	X	A (16)				A (18)				X	X	X						X
F18	X			A (17)						X	A (19)	X						A (17)
F19	X									X	X	X						A (21)
F20	X						A (21)			A (19)	A (21)	X		A (19)				A (19,21)
F21	X									X	X	X						X
F22	WELL UNUSABLE																	

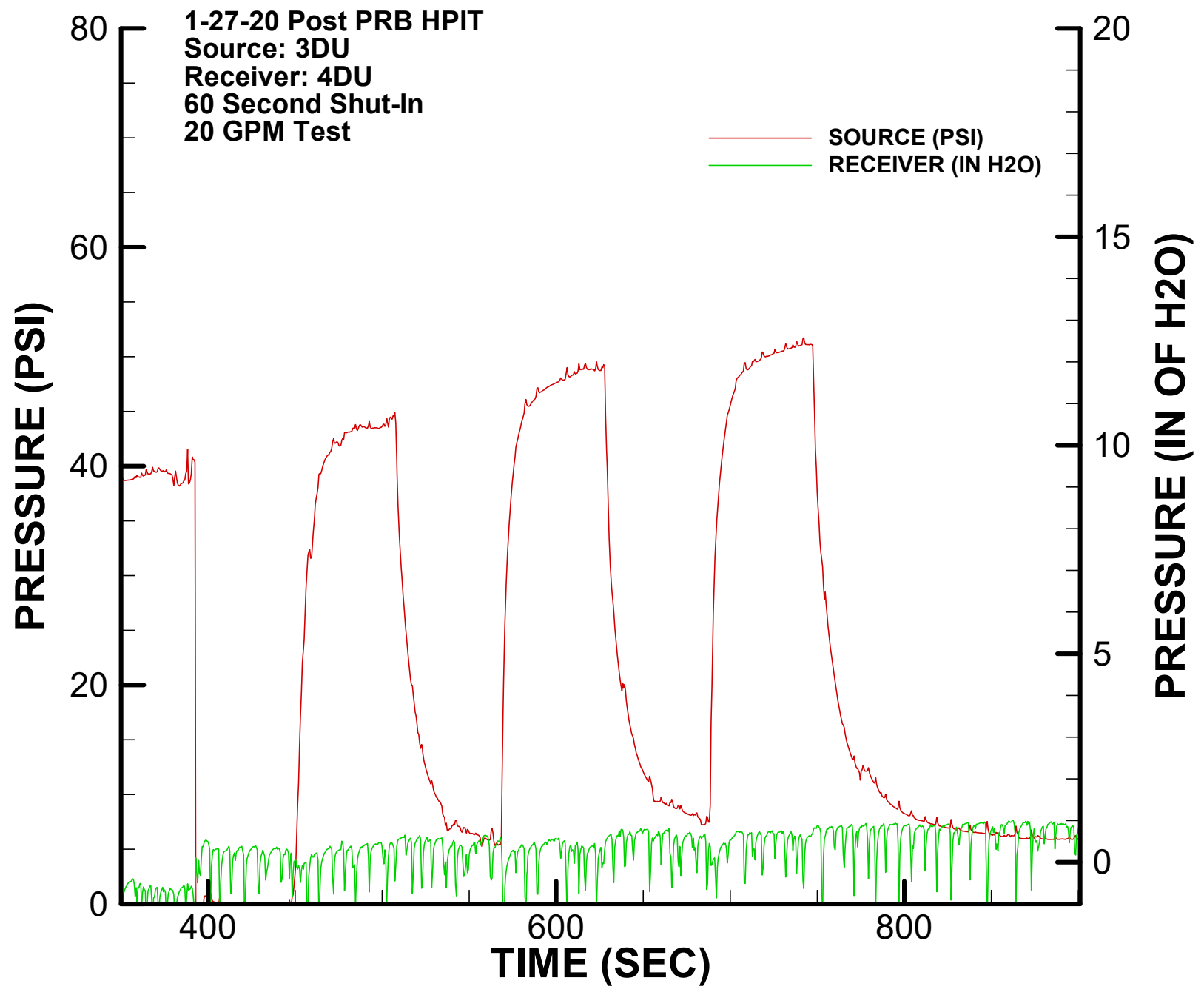
A = Active PPR at >=1 Location      C = Heavy Pore Pressure Relief      E = Abandoned packer      ( ) = F Well #  
 B = Active PPR w/ZVI      D = High Pressure / Sanded Off       = Panel Completed

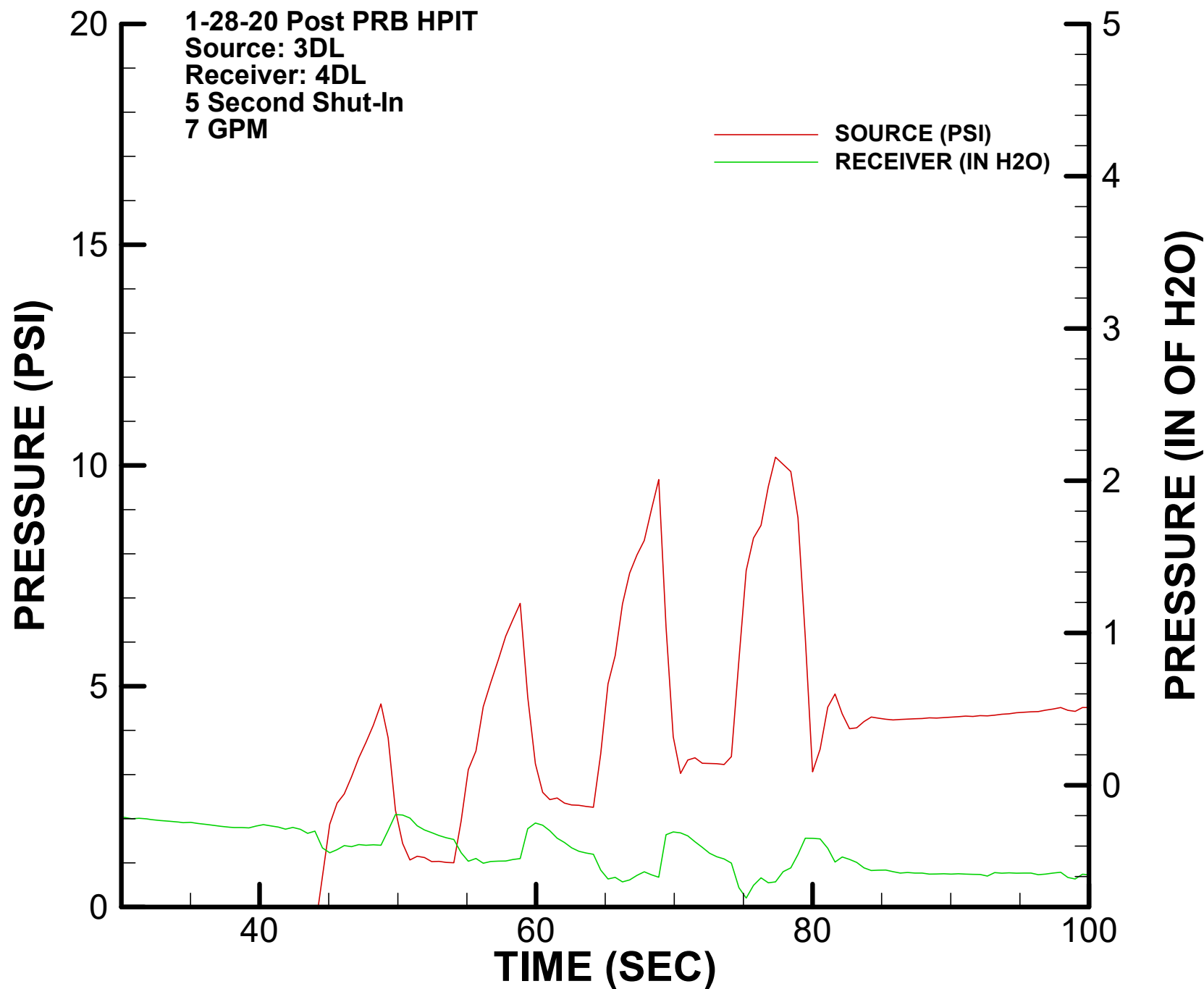
**APPENDIX G**

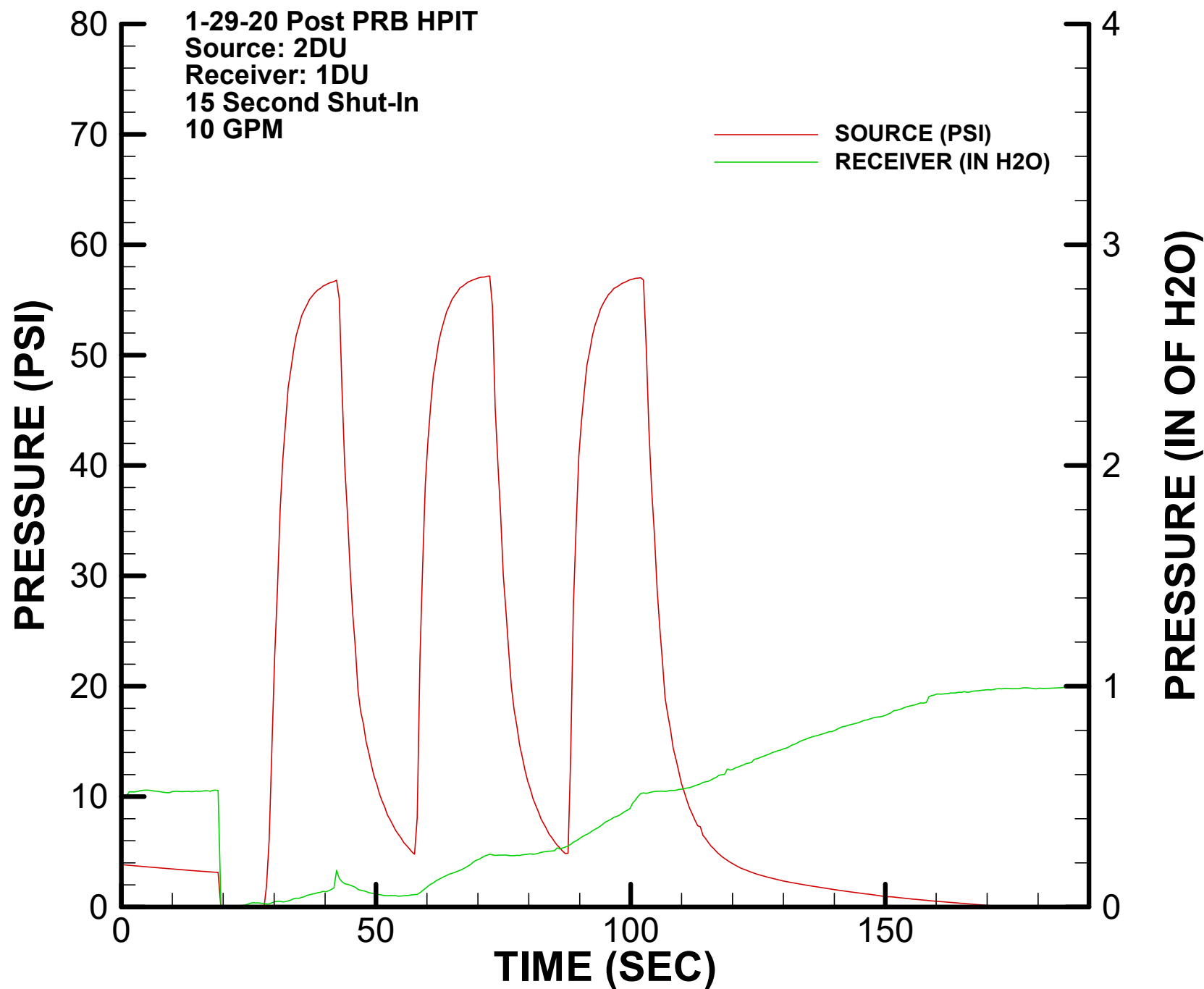
**Hydraulic Pulse Interference Testing Data**

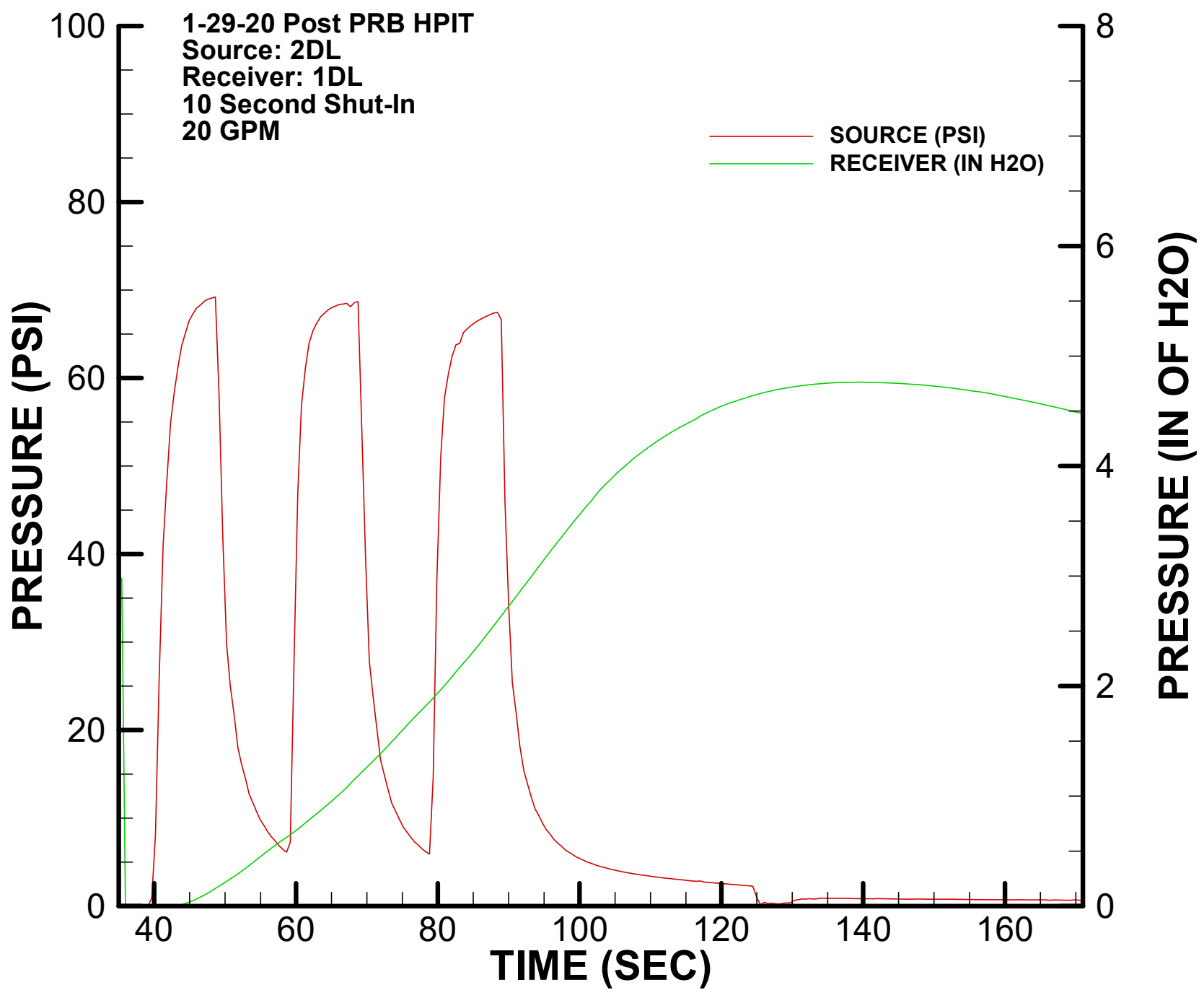


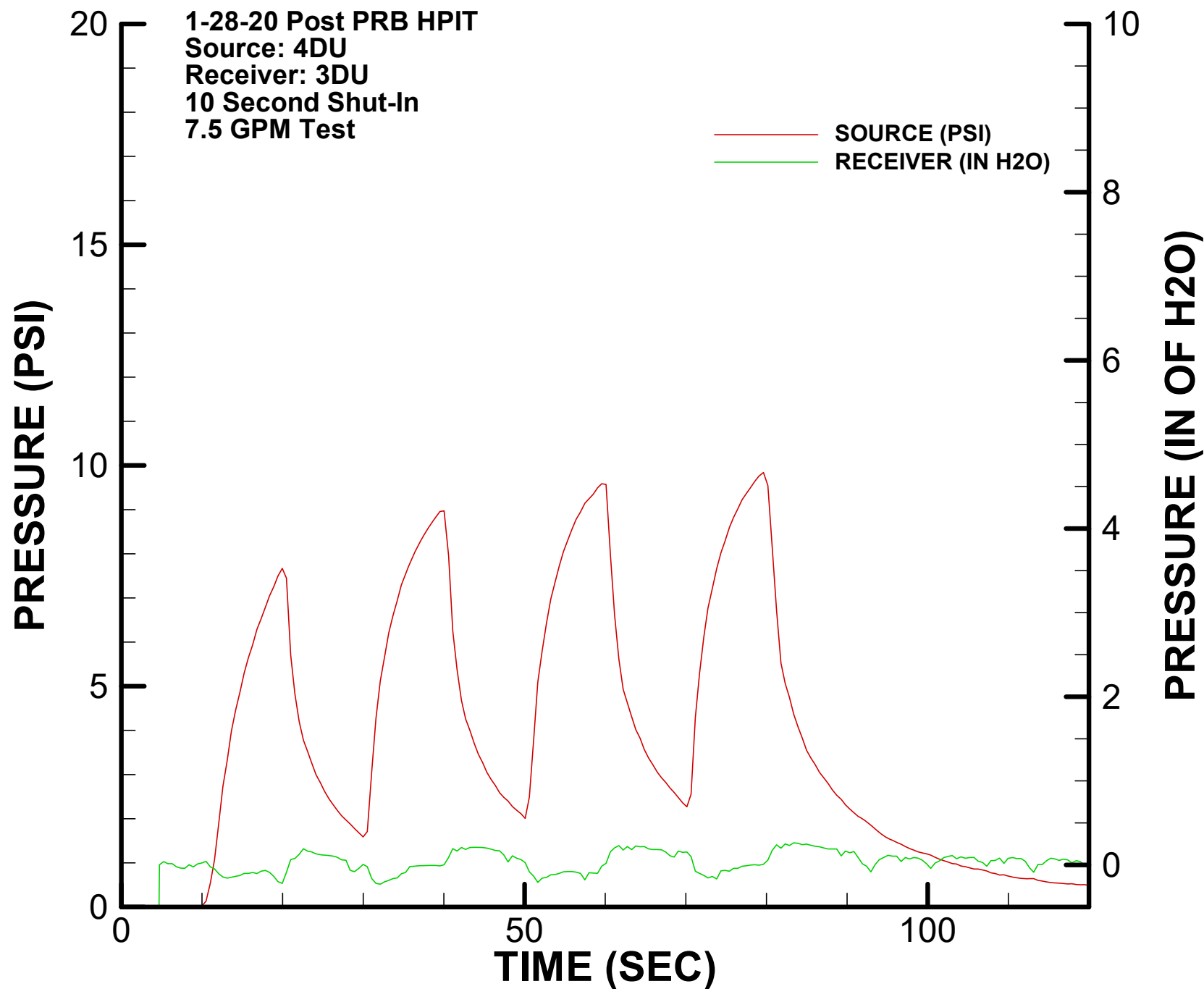


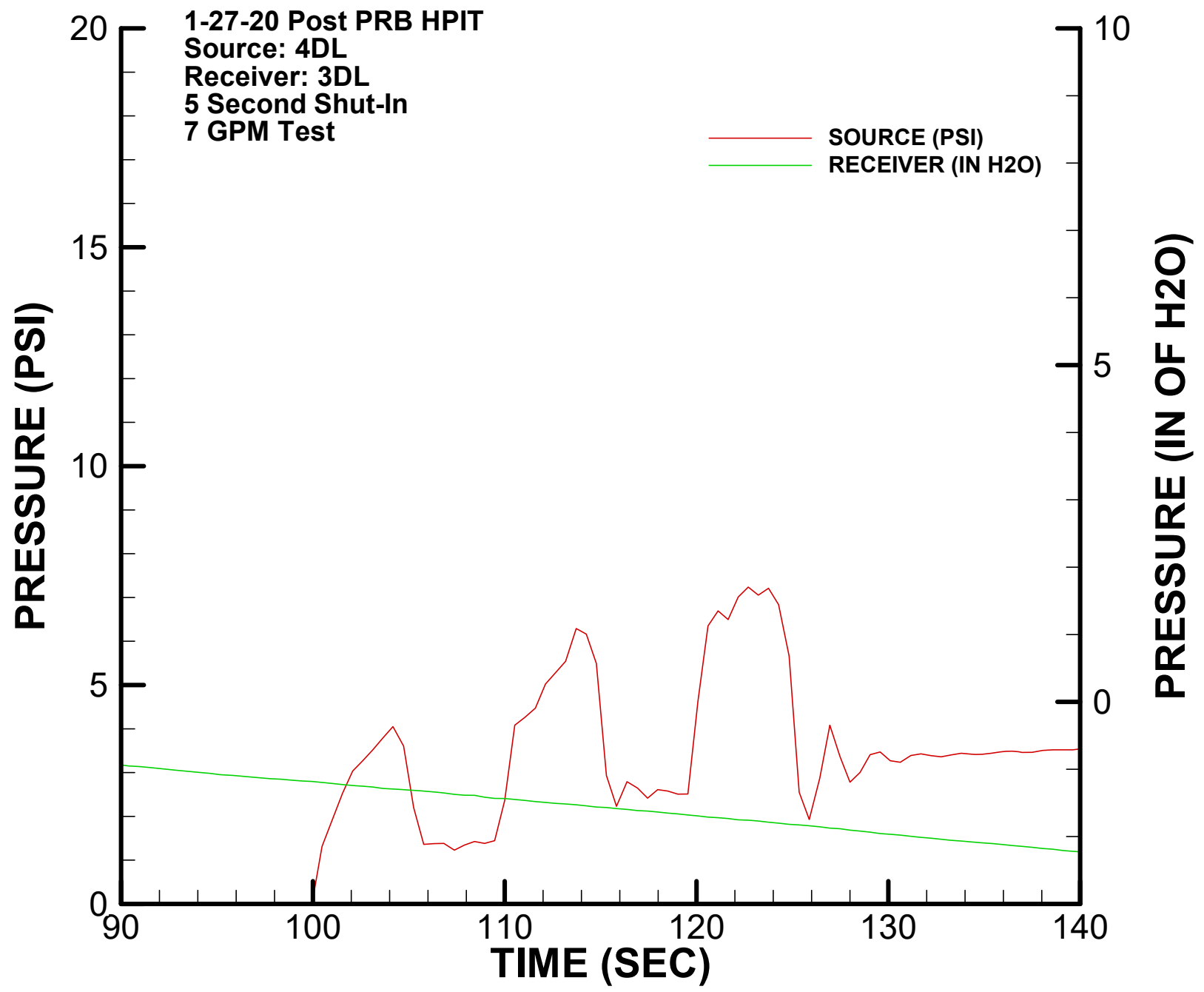












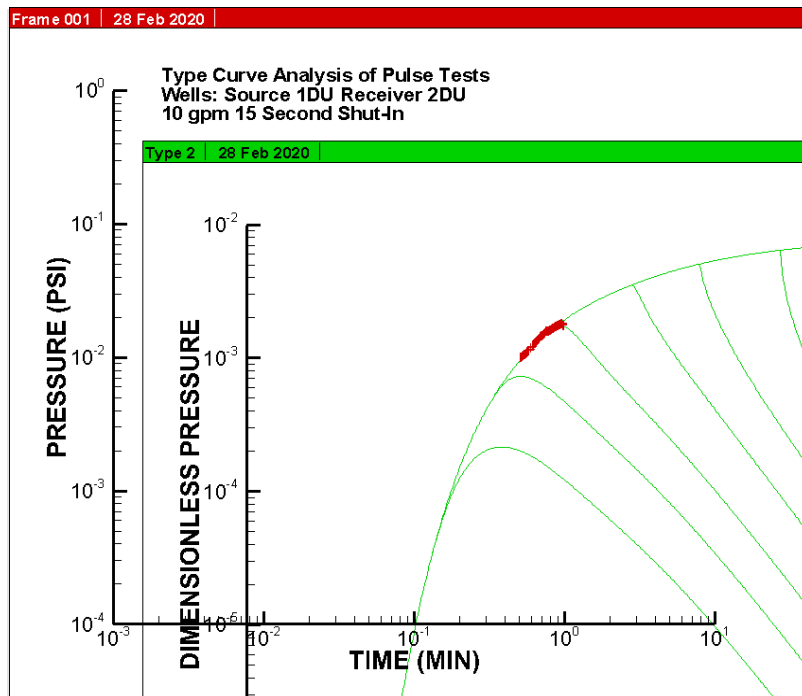
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 1DU RECEIVER: 2DU**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	$K$ = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	$S_s$ = formation specific storage

where:

- $q$  = flow rate
- $p_D$  = dimensionless pressure
- $r_w$  = well bore radius of source well
- $\Delta p$  = pressure
- $t$  = time
- $t_D$  = dimensionless time

PULSE TEST DATA	RESULTS				
$q = 10.00$ gpm	<table border="1" style="margin: auto;"> <tr> <td><math>K = 6.19E+01</math></td> <td>ft/day</td> </tr> <tr> <td><math>S_s = 5.27E-05</math></td> <td>1/ft</td> </tr> </table>	$K = 6.19E+01$	ft/day	$S_s = 5.27E-05$	1/ft
$K = 6.19E+01$		ft/day			
$S_s = 5.27E-05$		1/ft			
$r_w = 0.25$ ft					
<b>TYPE CURVE MATCH PARAMETERS</b>					
$\Delta p = 0.0163$ ft. of H <sub>2</sub> O					
$p_D = 1.64E-03$					
$t = 0.82$ mins					
$t_D = 10704.30$					



Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/29/2020

Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

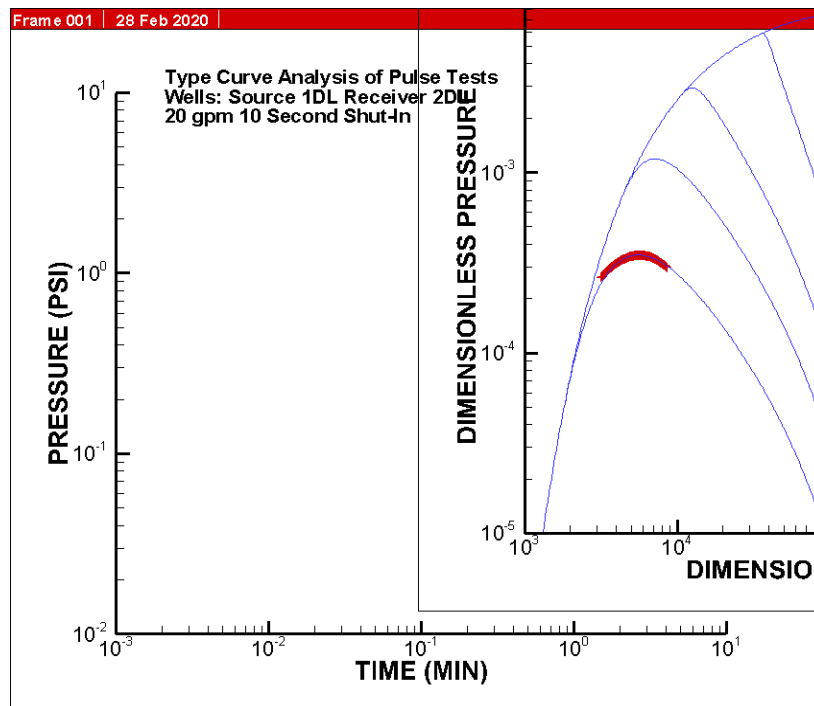
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 1DL RECEIVER: 2DL**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	$K$ = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	$S_s$ = formation specific storage

where:

- $q$  = flow rate
- $p_D$  = dimensionless pressure
- $r_w$  = well bore radius of source well
- $\Delta p$  = pressure
- $t$  = time
- $t_D$  = dimensionless time

PULSE TEST DATA	RESULTS				
$q = 20.00$ gpm	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;"><math>K = 3.39E-01</math></td> <td style="padding: 5px;">ft/day</td> </tr> <tr> <td style="padding: 5px;"><math>S_s = 1.78E-06</math></td> <td style="padding: 5px;">1/ft</td> </tr> </table>	$K = 3.39E-01$	ft/day	$S_s = 1.78E-06$	1/ft
$K = 3.39E-01$		ft/day			
$S_s = 1.78E-06$		1/ft			
$r_w = 0.25$ ft					
<b>TYPE CURVE MATCH PARAMETERS</b>					
$\Delta p = 1.2551$ ft. of H <sub>2</sub> O					
$p_D = 3.47E-04$					
$t = 2.61$ mins					
$t_D = 5523.64$					



Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/29/2020

Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

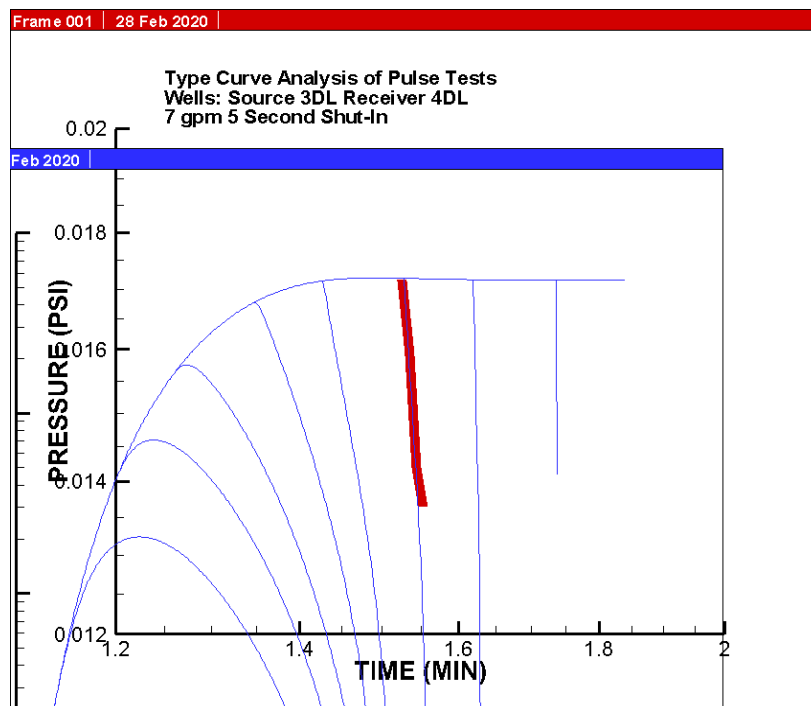
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 3DL RECEIVER: 4DL**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	$K$ = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	$S_s$ = formation specific storage

where:

- $q$  = flow rate
- $p_D$  = dimensionless pressure
- $r_w$  = well bore radius of source well
- $\Delta p$  = pressure
- $t$  = time
- $t_D$  = dimensionless time

PULSE TEST DATA	RESULTS				
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$K = 5.05E+01$		ft/day			
$S_s = 2.26E-06$		1/ft			
$r_w = 0.25$ ft					
<b>TYPE CURVE MATCH PARAMETERS</b>					
$\Delta p = 0.0158$ ft. of H <sub>2</sub> O					
$p_D = 1.86E-03$					
$t = 1.54$ mins					
$t_D = 382052.51$					



Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/28/2020

Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

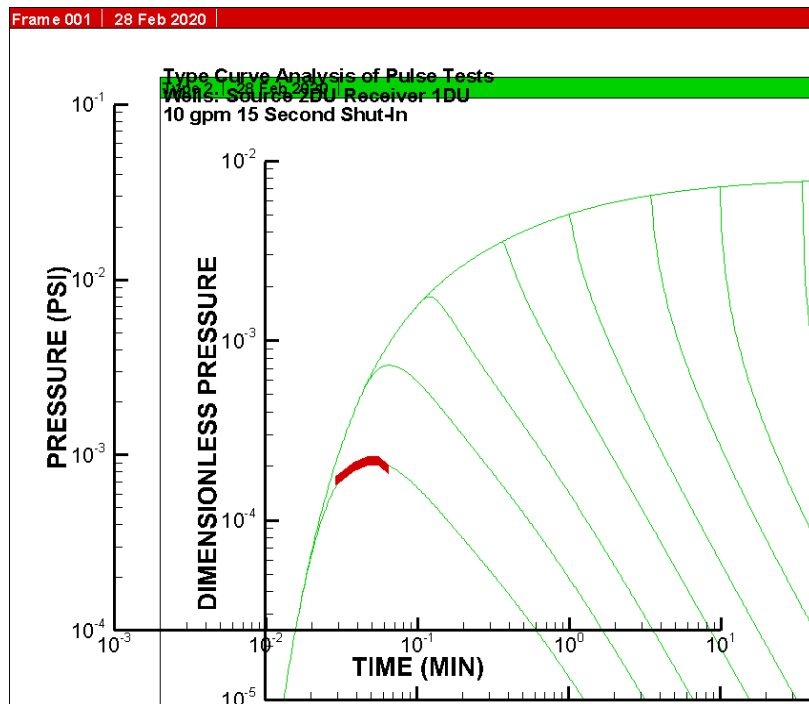
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 2DU RECEIVER: 1DU**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	$K$ = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	$S_s$ = formation specific storage

where:

- $q$  = flow rate
- $p_D$  = dimensionless pressure
- $r_w$  = well bore radius of source well
- $\Delta p$  = pressure
- $t$  = time
- $t_D$  = dimensionless time

PULSE TEST DATA	RESULTS		
$q = 10.00$ gpm	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;"><math>K = 4.79E+02</math> ft/day</td> </tr> <tr> <td style="padding: 5px;"><math>S_s = 3.91E-05</math> 1/ft</td> </tr> </table>	$K = 4.79E+02$ ft/day	$S_s = 3.91E-05$ 1/ft
$K = 4.79E+02$ ft/day			
$S_s = 3.91E-05$ 1/ft			
$r_w = 0.25$ ft			
<b>TYPE CURVE MATCH PARAMETERS</b>			
$\Delta p = 0.0009$ ft. of H <sub>2</sub> O			
$p_D = 7.26E-04$			
$t = 0.05$ mins			
$t_D = 7072.38$			



Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/29/2020

Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

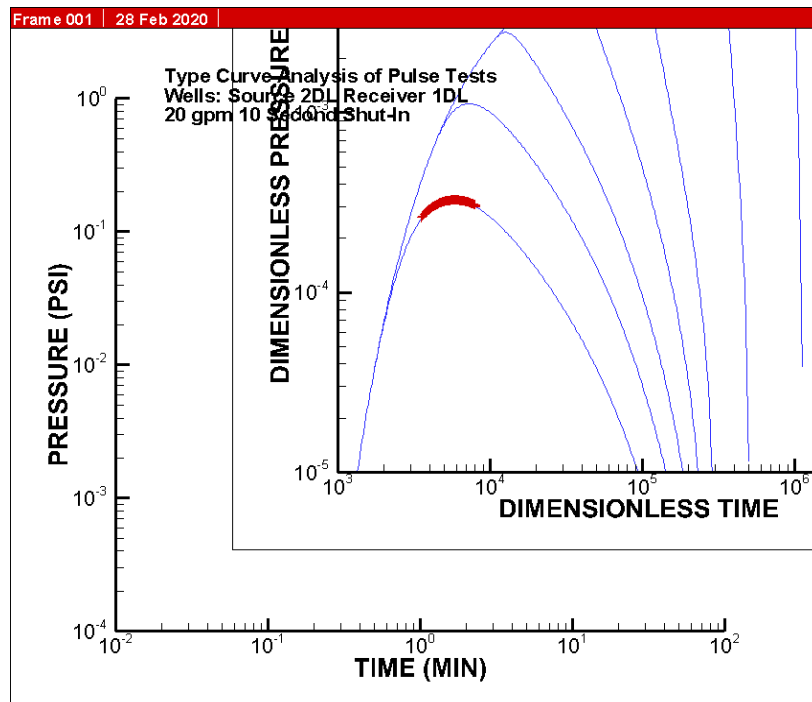
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 2DL RECEIVER: 1DL**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	K = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	S <sub>s</sub> = formation specific storage

where:

- q = flow rate
- p<sub>D</sub> = dimensionless pressure
- r<sub>w</sub> = well bore radius of source well
- Δp = pressure
- t = time
- t<sub>D</sub> = dimensionless time

PULSE TEST DATA	RESULTS						
q = 20.00 gpm	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px;">K =</td> <td style="padding: 2px;">2.36E+00</td> <td style="padding: 2px;">ft/day</td> </tr> <tr> <td style="padding: 2px;">S<sub>s</sub> =</td> <td style="padding: 2px;">7.51E-06</td> <td style="padding: 2px;">1/ft</td> </tr> </table>	K =	2.36E+00	ft/day	S <sub>s</sub> =	7.51E-06	1/ft
K =		2.36E+00	ft/day				
S <sub>s</sub> =		7.51E-06	1/ft				
r <sub>w</sub> = 0.25 ft							
<b>TYPE CURVE MATCH PARAMETERS</b>							
Δp = 0.1677 ft. of H <sub>2</sub> O							
p <sub>D</sub> = 3.23E-04							
t = 1.51 mins							
t <sub>D</sub> = 5288.83							



Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/29/2020

Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

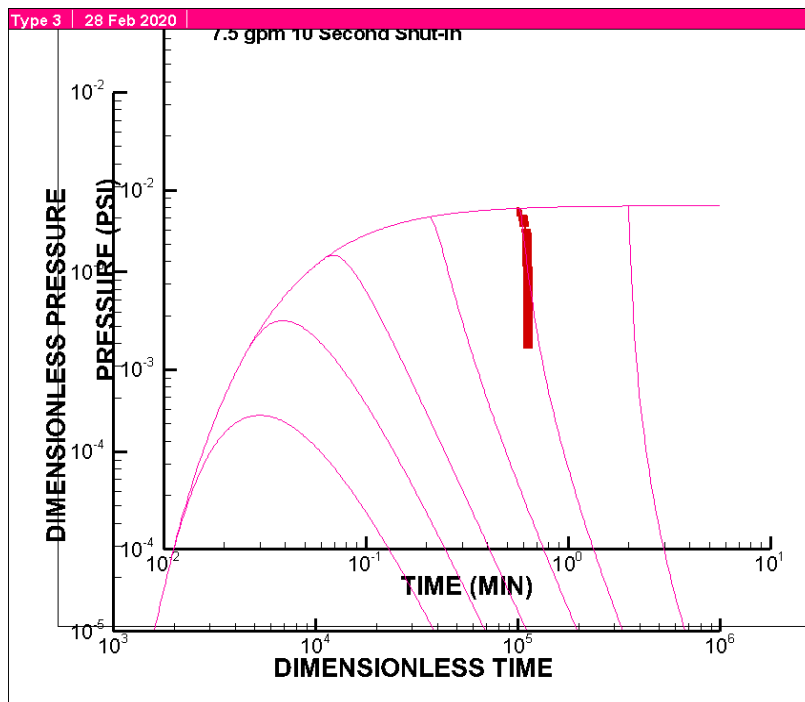
**HYDRAULIC PULSE INTERFERENCE TEST  
POST-PRB TEST SAVANNAH RIVER SITE SOURCE: 4DU RECEIVER: 3DU**

$K = \frac{qp_D}{4\pi r_w \Delta p}$	$K$ = formation hydraulic conductivity
$S_s = \frac{Kt}{r_w^2 t_D}$	$S_s$ = formation specific storage

where:

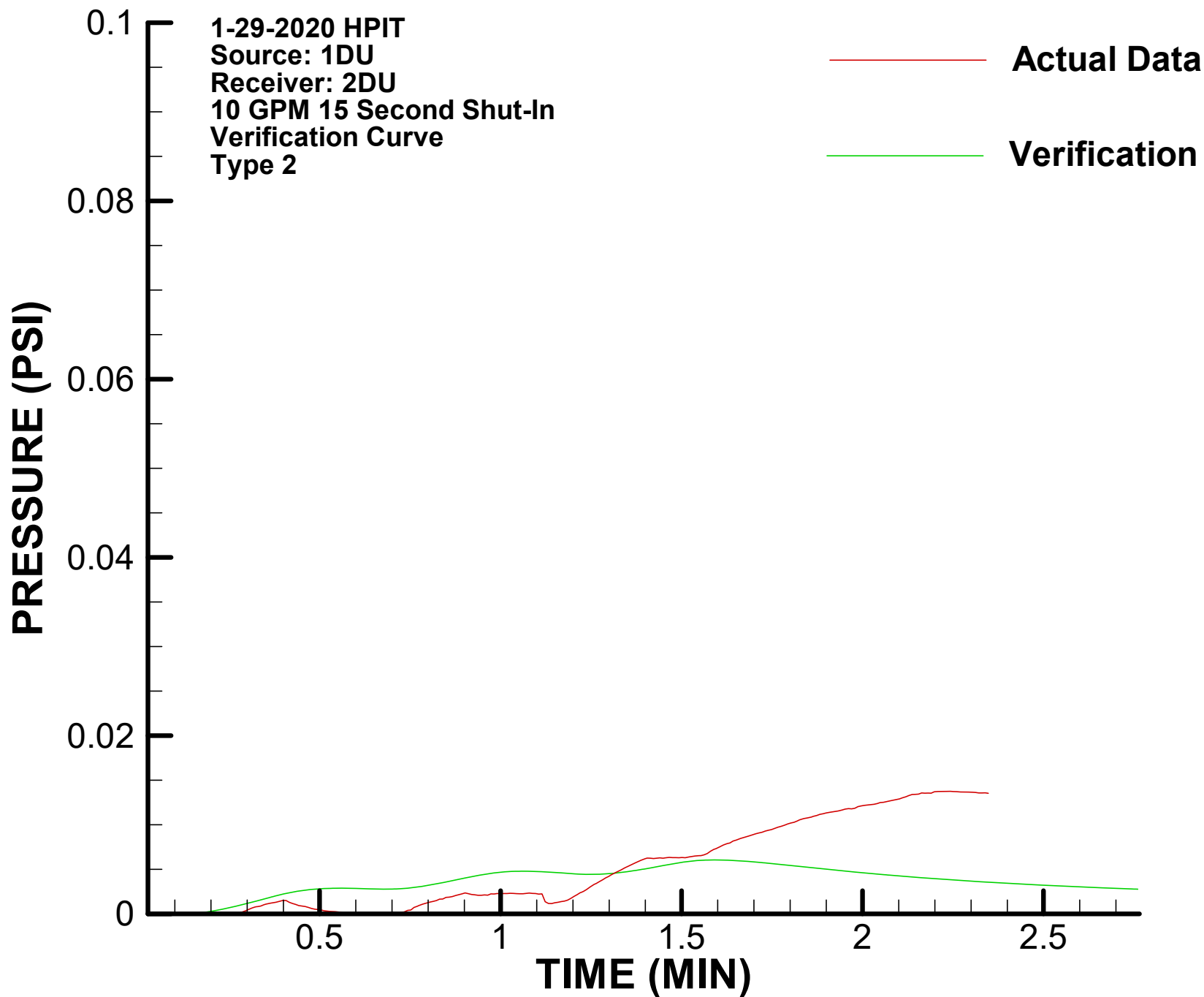
- $q$  = flow rate
- $p_D$  = dimensionless pressure
- $r_w$  = well bore radius of source well
- $\Delta p$  = pressure
- $t$  = time
- $t_D$  = dimensionless time

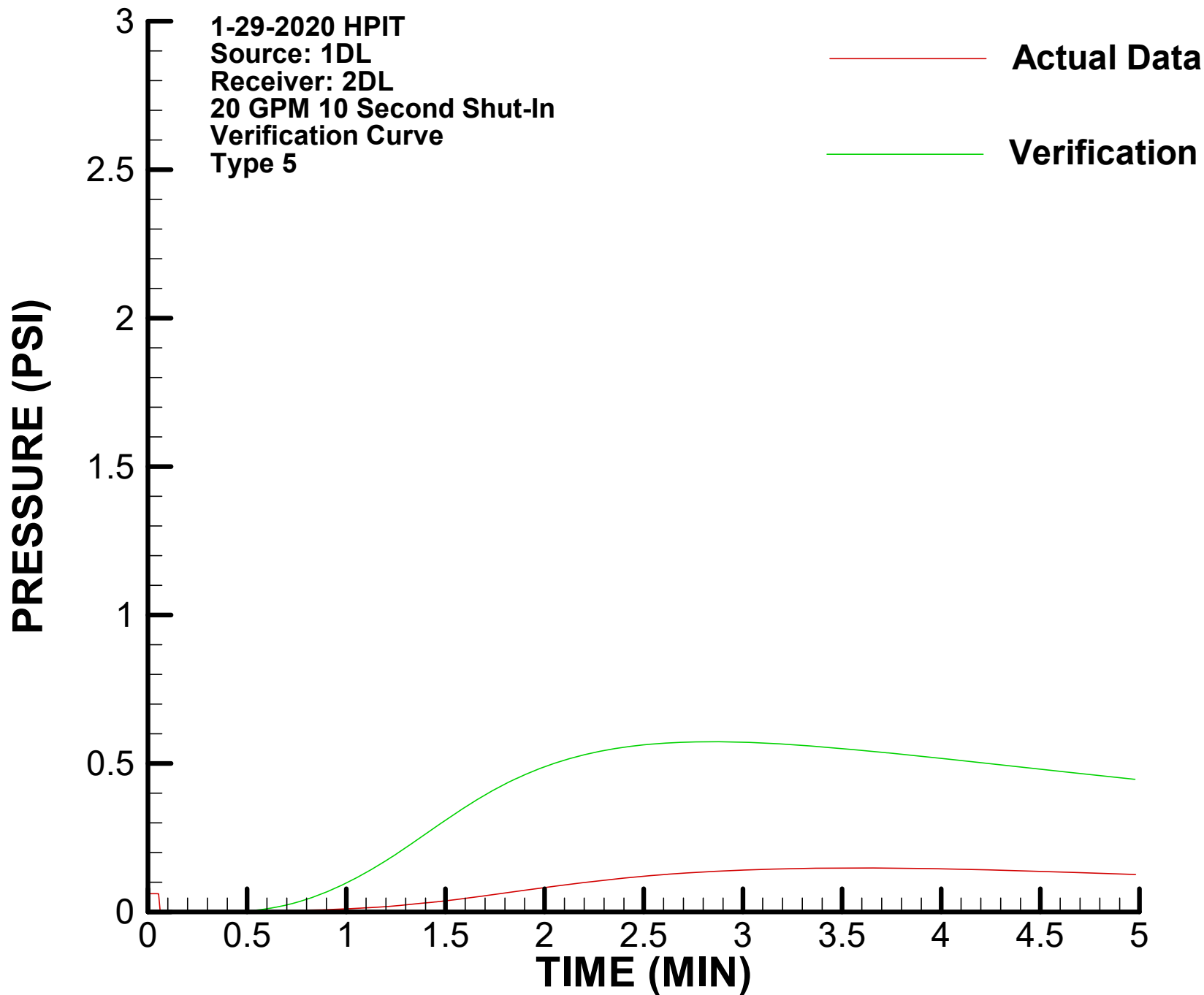
PULSE TEST DATA	RESULTS				
$q = 7.50$ gpm	<table border="1" style="margin: auto;"> <tr> <td><math>K = 1.36E+02</math></td> <td>ft/day</td> </tr> <tr> <td><math>S_s = 8.87E-06</math></td> <td>1/ft</td> </tr> </table>	$K = 1.36E+02$	ft/day	$S_s = 8.87E-06$	1/ft
$K = 1.36E+02$		ft/day			
$S_s = 8.87E-06$		1/ft			
$r_w = 0.25$ ft					
<b>TYPE CURVE MATCH PARAMETERS</b>					
$\Delta p = 0.0059$ ft. of H <sub>2</sub> O					
$p_D = 1.74E-03$					
$t = 0.62$ mins					
$t_D = 105526.86$					

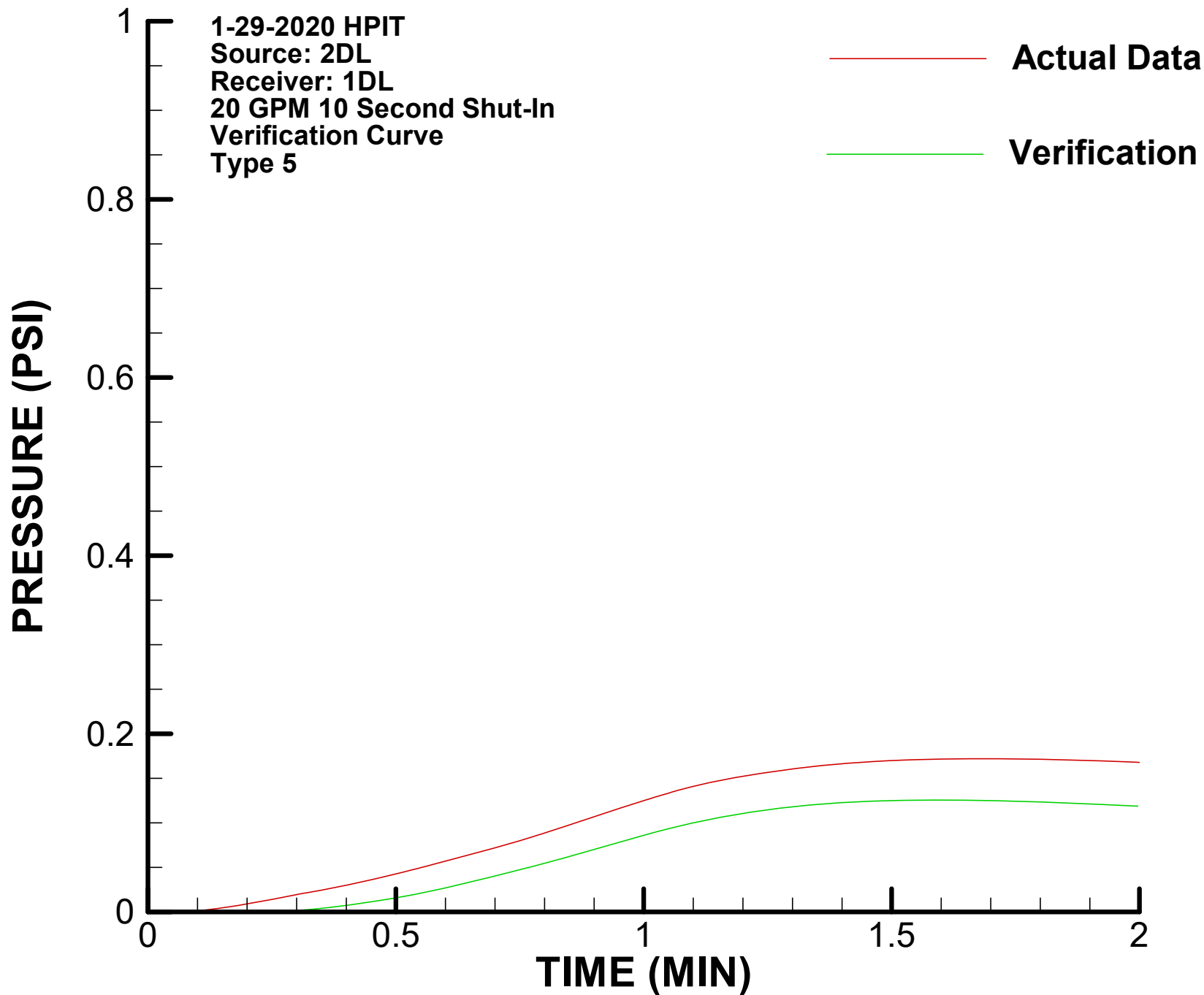


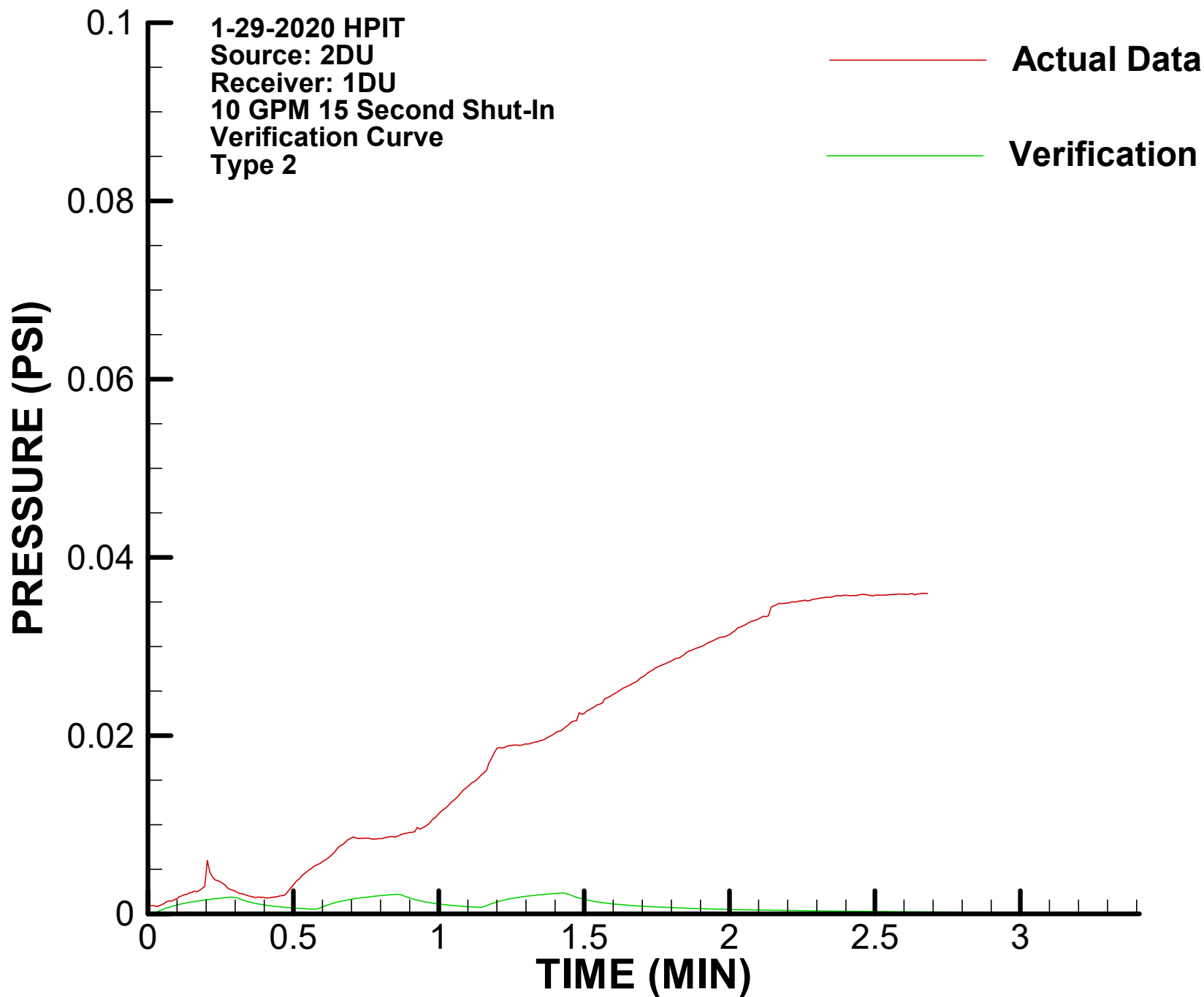
Project Name: Savannah River Site, Aiken, SC  
 Project No.: G801181002  
 Test Date: 1/28/2020

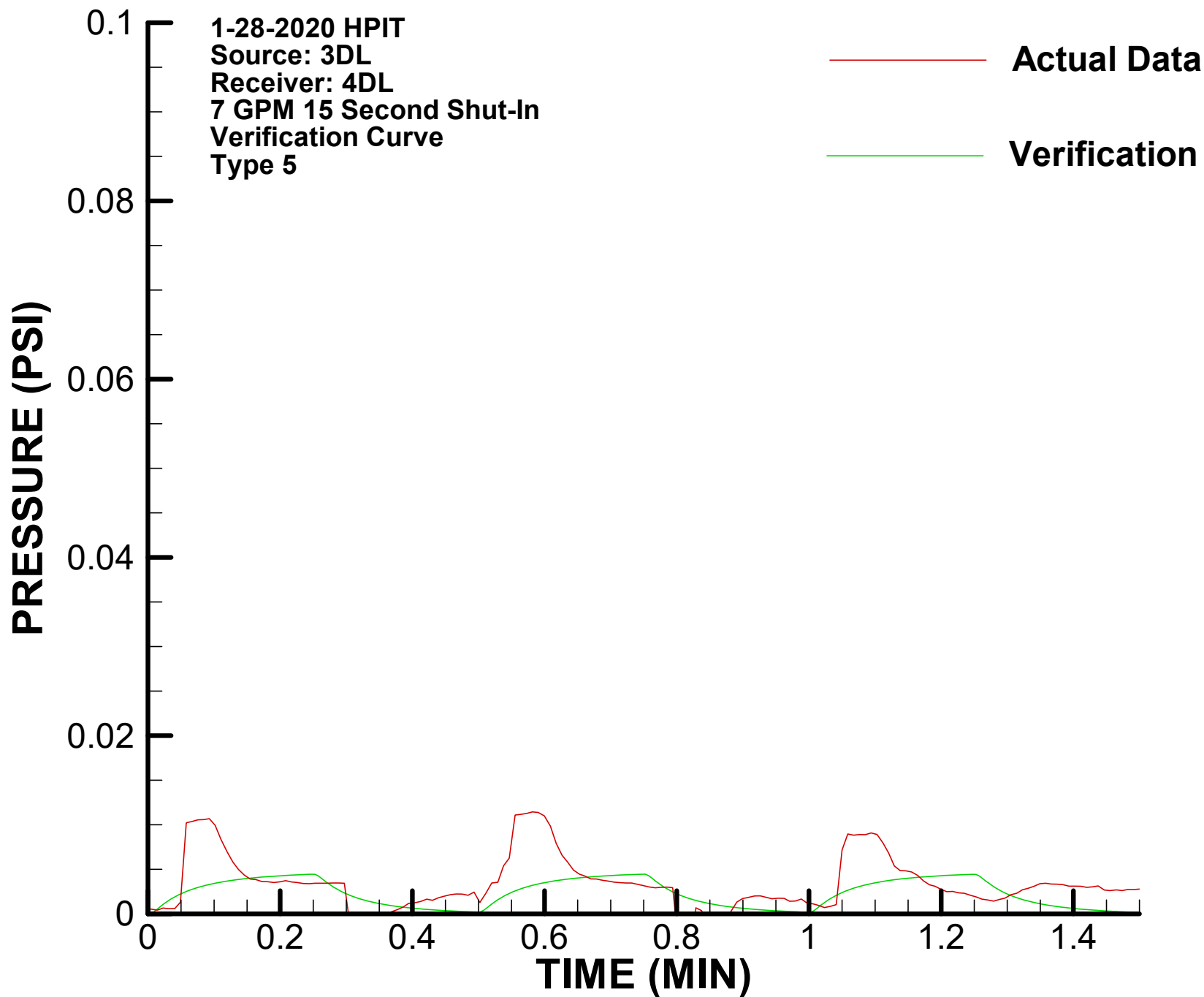
Analysis By: GSF  
 Checked By: DLS  
 Reference: Hocking (2001)

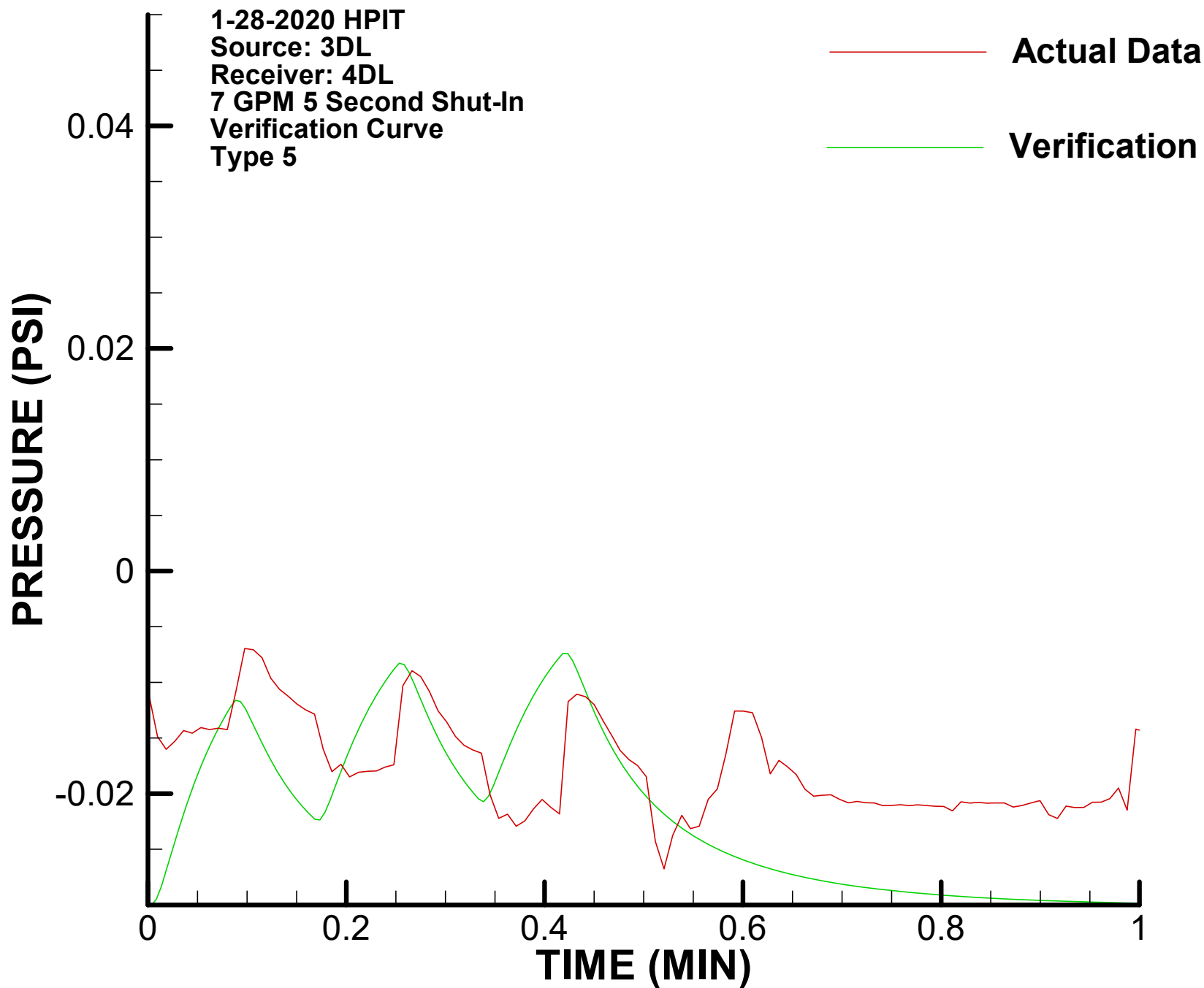


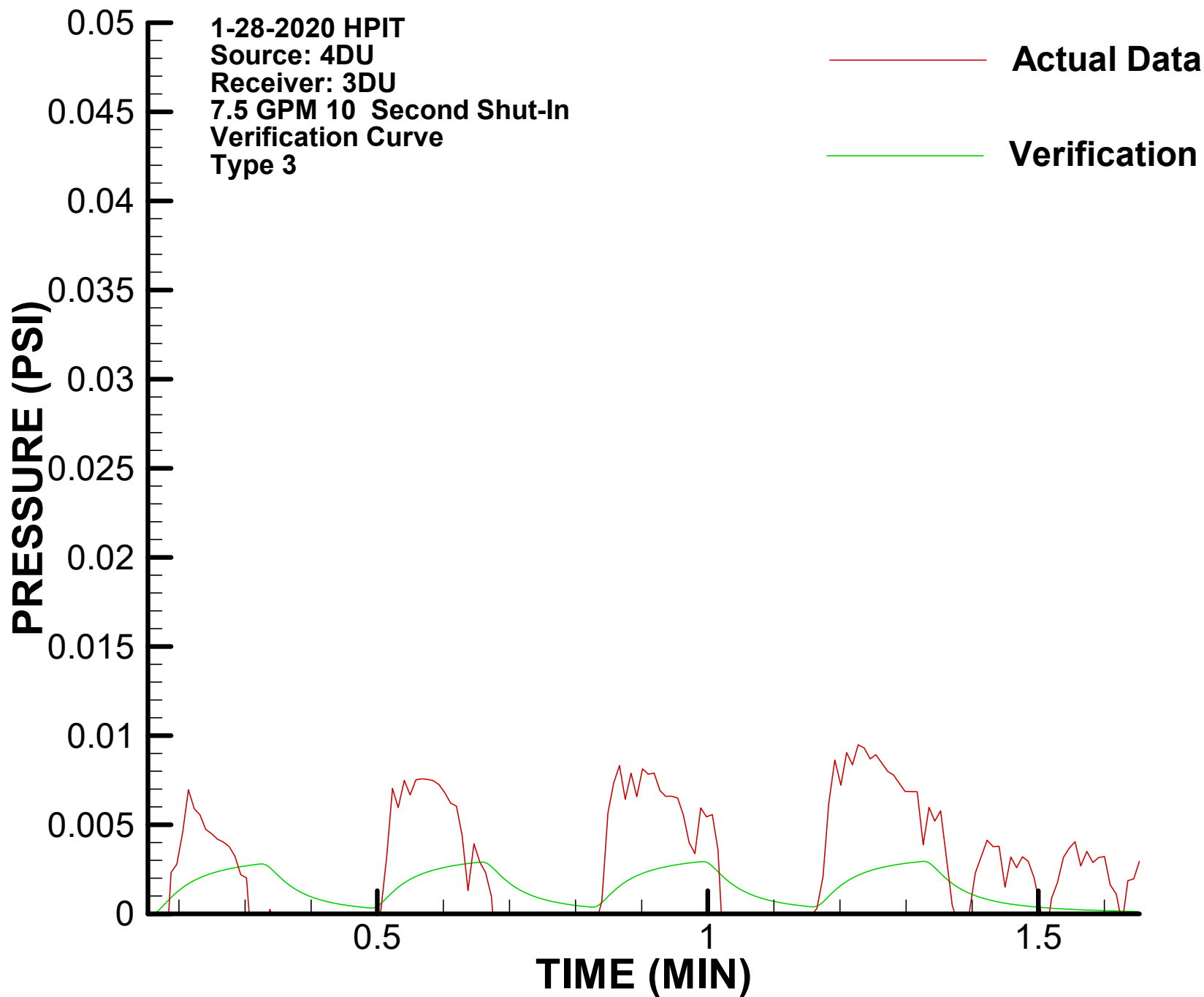












**APPENDIX H**

**Installation Reports for Newly Installed EMP Monitoring Wells**

# Monitoring Well Installation Report

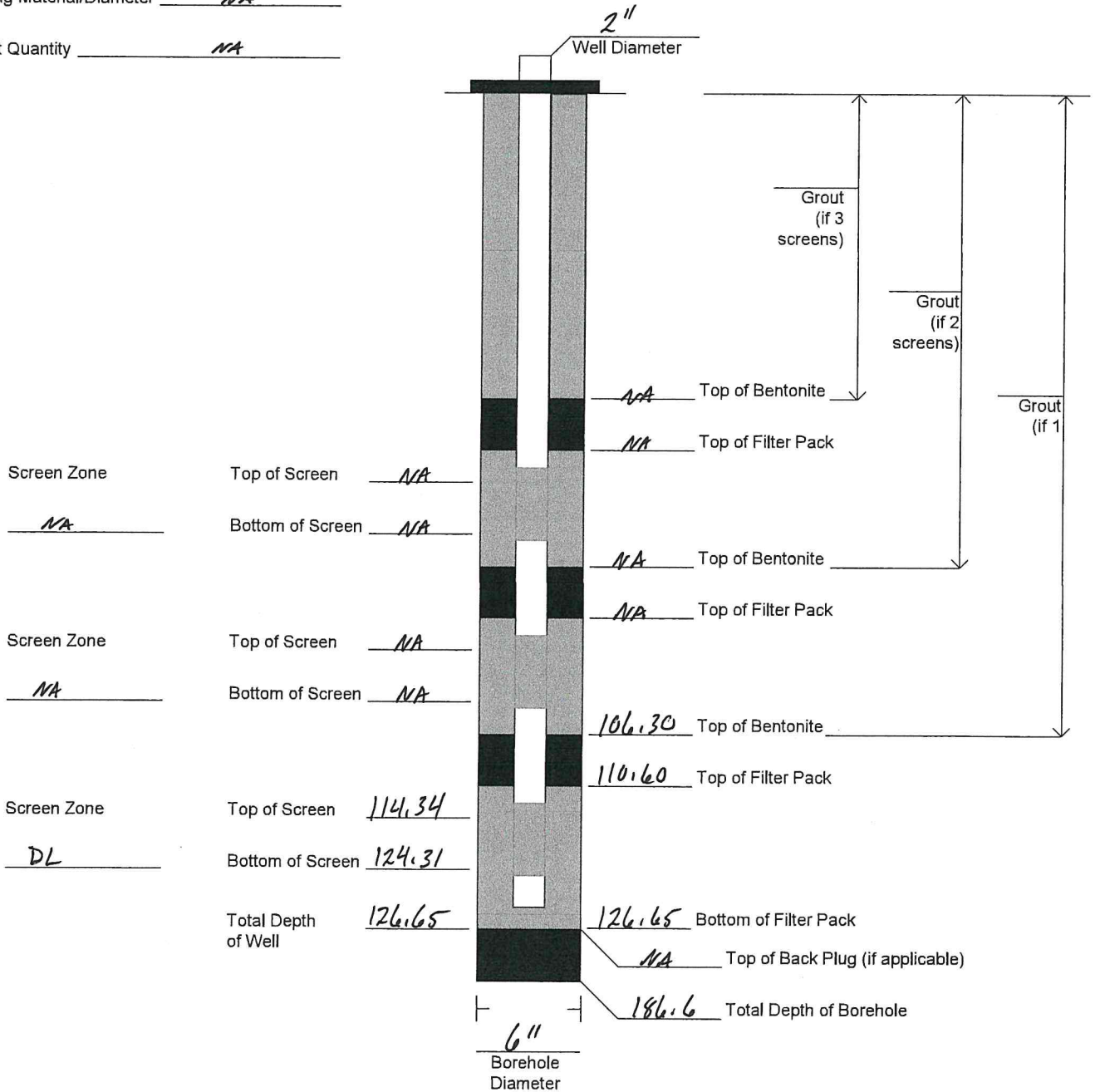
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW005DL</b>
Well Installation Date <b>3/17/2020</b>		SC DHEC Well Approval Number <b>MW-12192</b>	Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676642.7153</b>	SRS East Grid Coordinate (as built) <b>445592.0388</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'44.67"</b>	Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'2.13"</b>		
Top of Pad Elevation (as built) <b>310.197</b>	Water Level Reference Point Elevation (as built) <b>312.71</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA



Screen Zone NA  
Top of Screen NA  
Bottom of Screen NA

Screen Zone NA  
Top of Screen NA  
Bottom of Screen NA

Screen Zone DL  
Top of Screen 114.34  
Bottom of Screen 124.31  
Total Depth of Well 126.65



# Monitoring Well Installation Report (Continued)

Well Number  
PRW005DL

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	+2.71	114.34	PVC/SCH 40	2"		
Screen	114.34	124.31	PVC/SCH 40	2"	0.010	slotted
Sump	124.31	126.32	PVC/SCH 40	2"		
Sump Cap	126.32	126.65	PVC/SCH 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	110.60	126.65	9-50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	106.30	110.60	1-bucket 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	106.30	6-50lb bags	3/17/2020	Aquaguard	
	0.0	110.60	2-50lb bags	3/19/2020	Aquaguard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						

Well Installation Comments

Pump Installation Information  Pump Not Installed

Installation Date NA	Installer/Company NA	Model/Manufacturer NA	Diameter NA
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<input type="checkbox"/> Single Speed	<input type="checkbox"/> Variable Speed	Depth from Top of Casing to Top of Pump NA
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Report Prepared By <i>Scott D...</i>	Date 6/4/2020
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Depths measured from ground surface to nearest 0.1 ft.

WELL ID: RELW05D1

PUMP TYPE: Submersible

DATE: 4/2/2020

SAMPLERS:

DEPTH TO WATER: 33.10 ft bTOS  
TOS: top of standpipe

Depth - 124.71 ft bTOS  
 Scrn Bot 57.07

CALCULATED 2 WELL VOLUMES: 29.86 gals

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 408 gals

PURGE RATE: ~1.25 gpm

Time (Start): 4/2/2020 12:10 hrs

YSI Model:

Time (End): 5/13/2020 1333 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1210									0	Start pump
1.0 gpm	1215	203	6.36	24.7	2.52	7.9	1000+	21.20	5	5	WL = 41.05 Tac
	1255	137	6.00	40.2	3.33	32.1	109	21.26	40	45	
	1320	114	5.90	36.7	3.26	39.7	765	21.28	25	70	Surge w/ pump, WL = 41.90 Tac
1.0 gpm	1355	109	5.82	36.1	3.34	47.9	76.6	21.33	35	105	WL = 43.05 Tac
	1405										Stop pump; Surb + Surge
	1420										Start pump
1.0 gpm	1425	128	6.00	33.5	2.88	48.1	1000+	21.28	5	110	WL = 37.70 Tac
	1515	108	5.84	34.2	3.08	47.9	88.3	21.36	50	160	WL = 37.90 Tac
	1525								10	170	Stop pump
	1545										Start pump
1.0 gpm	1555	104	5.76	24.7	2.79	59.3	450	21.35	10	180	
	1635	85	5.59	28.6	2.61	61.9	44.0	21.28	40	220	
	1640								5	225	Stop pump

WELL ID: PR2605DL PUMP TYPE: Submersible  
 DATE: 5/12/2020 SAMPLERS: SEH Day

DEPTH TO WATER: 34.65 ft bTOS 124.71 ft bTOS  
TOS: top of standpipe

CALCULATED 2 WELL VOLUMES: 29.55 gals  
 ACTUAL PURGE AMOUNT: 408 gals  
 PURGE RATE: ~1.25 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 4/12/2020 1216 hrs YSI Model: \_\_\_\_\_  
 Time (End): 5/13/2020 1333 hrs YSI S/N: \_\_\_\_\_

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1420								0	0	Start pump
0.6gpm	1425	105	5.05	63.1	5.59	49.0	403	21.28	3.0	3.0	
0.8gpm	1440	111	5.16	60.3	5.33	20.0	23.0	21.28	12.0	15.0	WL = 36.60 TOC
0.8gpm	1455								0	27.0	Stop pump, surge + surge
1.0gpm	1505	112	5.19	59.6	5.28	54.2	725	21.28	4.0	31.0	Start pump
1.0gpm	1510	106	5.15	58.3	5.16	58.8	26.8	21.32	4.0	35.0	WL = 36.05 TOC
	1525	109	5.03	72.0	6.38	65.5	429	21.30	1.5	50.0	WL = 36.21 TOC
	1555	99	5.11	60.9	5.38	62.9	6.40	21.36	30	80.0	Surge with pump on, WL = 36.90 TOC
1.0gpm	1615	94	5.21	63.4	5.60	53.6	307	21.35	20	100.0	WL = 37.05 TOC
1.0gpm	1630	99	5.19	60.3	5.34	56.8	5169	21.37	1.5	115.0	Surge with pump on
	1655	97	5.29	58.1	5.13	44.0	3.45	21.35	25	140.0	WL = 36.78
	1700								5	145.0	Stop pump
5/13/2020	0805								0	145.0	Start pump, WL = 33.50 TOC
	0815	98	6.24	51.0	4.57	-13.9	180	21.12	10	155.0	WL = 36.30
1.0gpm	0820	94	6.24	53.6	4.73	-17.2	6.86	21.13	5	160.0	WL = 36.30
	0825	90	6.24	56.2	4.93	-14.3	189	21.16	5	165.0	Surge w/ pump on
1.0gpm	0850	93	6.21	60.4	5.35	-20.8	3.27	21.31	25	190.0	WL = 37.25

WELL ID: PR2605DL PUMP TYPE: Submersible  
 DATE: 5/13/2020 SAMPLERS: \_\_\_\_\_

DEPTH TO WATER: 34.05 ft bTOS  
 Depth - Screen Bot 124.71 ft bTOS

CALCULATED 2 WELL VOLUMES: 29.55 gals  
 Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft  
 ACTUAL PURGE AMOUNT: 408 gals  
 PURGE RATE: ~1.28 gpm

Time (Start): 4/12/2020 1210 hrs YSI Model: \_\_\_\_\_  
 Time (End): 5/13/2020 1333 hrs YSI S/N: \_\_\_\_\_

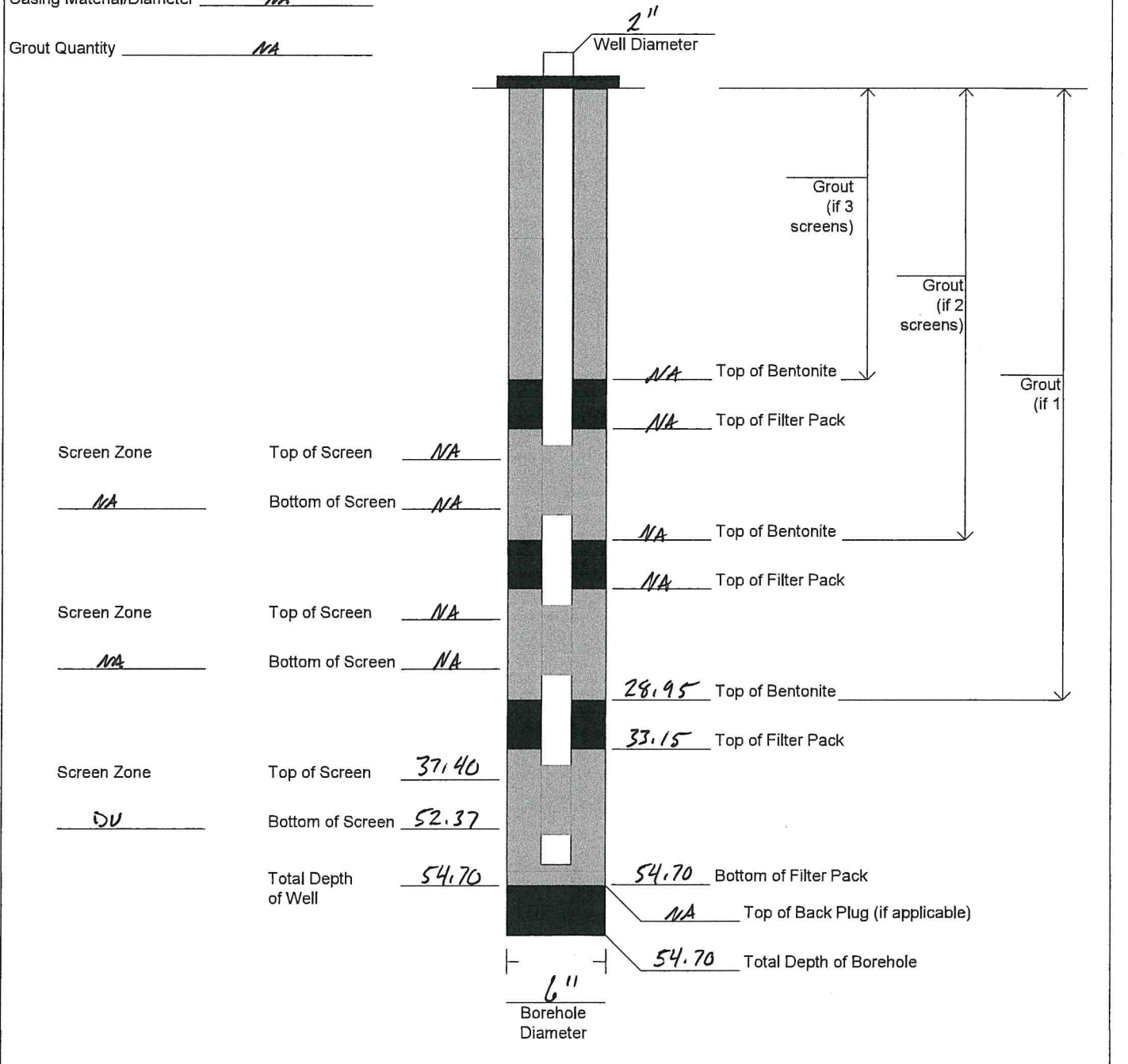
Calc. Flow	TIME	Sp. Cond. (uS/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
1.0 gpm	0916	88	6.21	63.2	5.60	-23.8	2.49	21.35	20	210.0	WL = 37.20 TOC
	0930	87	6.24	63.5	5.64	-26.0	2.32	21.33	20	230.0	WL = 37.33 TOC
	0940	87	6.24	64.0	5.70	-25.1	2.20	21.28	10	240.0	stop pump, surge + swirl
1.9 gpm	0947								0	240.0	Stop pump, WL = 34.30 TOC
	0950	91	6.23	76.8	6.91	-14.0	38.0	21.46	5.7	245.7	WL = 34.20 TOC
1.9 gpm	1005	86	6.22	74.6	6.54	-21.8	2.77	21.57	28.5	274.2	WL = 39.80 TOC
1.6 gpm	1025								52	306.2	stop pump
	1223								0	306.2	start pump
1.5 gpm	1225	80	6.16			19.7	43.7	21.32	2	308.2	WL = 36.80
	1245	84	6.08	90.5	8.01	-1.7	1.83	21.40	30	336.2	
1.5 gpm	1300	81	6.12	88.6	7.84	2.0	2.80	21.37	22.5	358.7	
	1315	83	6.12	86.8	7.64	1.0	2.88	21.39	22.5	381.2	WL = 37.40
1.5 gpm	1320	80	6.11	86.6	7.65	0.6	3.05	21.39	7.5	388.7	WL = 37.45
	1325	80	6.11	86.3	7.65	-0.8	3.01	21.38	7.5	396.2	WL = 37.50, Sample Time: 1325-
	1333								12	408	stop pump

# Monitoring Well Installation Report

Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW005DU</b>
Well Installation Date <b>3/18/2020</b>	SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676640.2451</b>	SRS East Grid Coordinate (as built) <b>445590.4653</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'44.59"</b>	Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'2.19"</b>		
Top of Pad Elevation (as built) <b>310.366</b>	Water Level Reference Point Elevation (as built) <b>312.90</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA  
 Casing Material/Diameter NA  
 Grout Quantity NA





# Monitoring Well Installation Report (Continued)

Well Number  
PRW005DU

	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
	Casing	+ 2.91	37.40	PVC/sch 40	2"	
Screen	37.40	52.37	PVC/sch 40	2"	0.010	slotted
Sump	52.37	54.38	PVC/sch 40	2"		
Sump Cap	54.38	54.70	PVC/sch 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	33.15	54.70	7-50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	28.95	33.15	1- bucket 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	28.95	2-50lb bags	3/18/2020	Aquagard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						

Well Installation Comments

Pump Installation Information  Pump Not Installed

Installation Date: NA  
 Installer/Company: NA  
 Model/Manufacturer: NA  
 Diameter: NA

Single Speed  Variable Speed  
 Depth from Top of Casing to Top of Pump: NA

Report Prepared By: *[Signature]*  
 Date: 6/14/2020

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: 7RLW005DU

PUMP TYPE: Submersible

DATE: 4/2/2020

SAMPLERS:

DEPTH TO WATER: 51.95 ft bTOS  
TOS: top of standpipe

Depth - Scrm Bot 51.07 ft bTOS

CALCULATED 2 WELL VOLUMES: 6.39 gals

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 282.8 gals

PURGE RATE: ~ 0.7 gpm

Time (Start): 4/2/2020 1220 hrs

YSI Model:

Time (End): 5/13/2020 1306 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mv)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1220									0	Start pump
1.25gpm	1230	144	5.62	15.2	10.22	77.0	1000+	20.97	2.5	2.5	WL = 37.90 TOL
	1255	138	5.72	79.9	7.08	63.7	161	21.23	6.25	8.75	WL = 39.20 TOL
	1320	138	5.88	75.7	6.71	54.4	495	21.17	6.25	15	Surge w/pump, WL = <del>38.65</del> 39.20
1.25gpm	1355	136	5.83	74.5	6.61	54.2	148	21.28	8.75	23.75	WL = 39.25
	1400								1.25	25	Stop pump
	1405			81.0							Start pump
1.25gpm	1410	182	6.20	75.9	7.59	40.4	1000+	21.40	1.25	26.25	WL = 37.55
	1425	142	5.95	70.7	6.24	48.6	740	21.38	3.75	30	WL = 37.95
	1510	136	5.96	72.1	6.37	47.6	69.6	21.41	11.25	41.25	WL = 38.40
	1517								1.75	43	Stop pump
	1525										Start pump
	1540	140	6.07	70.7	6.20	44.9	1000+	21.43	3.75	46.75	
	1635	119	5.86	55.4	4.92	48.7	29.3	21.11	13.75	60.5	
	1640								1.25	61.75	Stop pump

WELL ID: PR200520

PUMP TYPE: Submersible

DATE: 5/12/2020

SAMPLERS:

DEPTH TO WATER: 31.36 ft bTOS

Depth -  
Scrn Bot

51.07 ft bTOS

TOS: top of standpipe

CALCULATED 2 WELL VOLUMES: 6.39 gals

Rule of Thumb  
3/4-in: 0.023 gal/ft  
1-in: 0.041 gal/ft  
2-in: 0.163 gal/ft  
4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 282.8 gals

PURGE RATE: ~0.7 gpm

Time (Start): 4/2/2020 1220 hrs

YSI Model:

Time (End): 5/13/2020 1306 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1200									0	
0.3gpm	1205	621	5.66	39.6	3.44	-100.4	436	21.24	1.5	1.5	Start pump WL = 38.40 TDC
0.3gpm	1230	610	5.86	44.1	3.90	-174.3	105	21.32	7.5	9.0	WL = 39.05 TDC
0.3gpm	1240	624	5.93	33.0	2.92	-213.2	16.6	21.34	3.0	12.0	Surge with Pump
0.3gpm	1245	617	5.91	42.4	3.67	-214.0	995	21.41	1.5	13.5	
0.3gpm	1315	608	5.98	31.6	2.78	-218.1	97.6	21.56	9.0	22.5	WL = 39.10 TDC
0.3gpm	1325	607	5.99	34.0	2.98	-218.9	74.8	21.52	3.0	25.5	WL = 39.21 TDC
	1330								1.5	27.0	Stop pump, surge + surge
	1335								0	27.0	Start pump
0.3gpm	1340	597	5.95	32.9	2.90	-211.6	854	21.45	1.5	28.5	WL = 38.90 TDC
	1400	597	5.98	34.1	3.00	-201.6	101	21.52	6.0	34.5	WL = 39.20 TDC
	1410	609	5.96	34.0	3.01	-199.5	27.1	21.53	3.0	37.5	WL = 39.38 TDC
0.3gpm	1415	605	5.97	32.3	2.91	-199.1	6.08	21.51	1.5	39.0	* noticed from fillings in water
0.3gpm	1440	604	5.95	31.8	2.82	-198.5	6.08	21.50	7.5	46.5	WL = 39.81 TDC
	1445								1.5	48.0	Stop pump, surge + surge
	1450								0	48.0	Start pump
0.3gpm	1455	574	5.83	44.3	3.85	-169.5	6.76	21.55	1.5	49.5	WL = 37.50 TDC
	1510	563	5.83	36.1	3.17	-154.1	222	21.77	4.5	54.0	WL = 37.90 TDC

WELL ID: PRW050500 PUMP TYPE: Submersible  
 DATE: 5/12/2020 SAMPLERS: Settling Tray  
 DEPTH TO WATER: 31.36 ft bTOS Depth - 51.07 ft bTOS  
TOS: top of standpipe  
 CALCULATED 2 WELL VOLUMES: 6.42 gals  
 ACTUAL PURGE AMOUNT: 282.8 gals  
 PURGE RATE: ~0.7 gpm  
 Time (Start): 4/27/2020 1220 hrs YSI Model:  
 Time (End): 5/13/2020 1306 hrs YSI S/N:

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
0.3 gpm	1555	579	5.78	34.6	3.03	-135.2	9.41	21.74	13.5	67.5	WL = 38.50
0.3 gpm	1605								1.5	69.0	Stop pump, surge + swirls
0.3 gpm	1608								0	69.0	Start pump
0.3 gpm	1610	573	5.76	35.1	3.05	-136.2	5.25	21.78	0.6	69.6	
0.3 gpm	1630	590	5.75	22.6	2.86	-136.2	7.50	21.82	6	75.6	WL = 37.30 TOL
0.3 gpm	1655	590	5.76	31.3	2.78	-136.5	14.5	21.80	7.5	83.1	WL = 37.25 TOL
0.3 gpm	1700								1.5	84.6	Stop pump
0.3 gpm	0840	577	7.29	59.9	5.32	-21.1	9.67	21.04	0	84.6	Start pump WL = 31.38 TOL
0.3 gpm	0850	650	6.95	48.3	4.36	-27.3	2.23	21.08	2.15	85.85	WL = 35.20 TOL
0.3 gpm	0910	656	6.48	47.5	4.19	-13.7	18.5	21.21	5	88.35	WL = 36.40 TOL
0.3 gpm	0915								1.25	93.35	WL = 36.30 TOL
1.4 gpm	0920	541	6.35	52.5	4.67	-8.1	2.69	21.09	0	94.60	Stop pump, surge + swirls
1.4 gpm	0925	619	6.28	43.4	3.84	-11.4	70.9	21.11	14	94.60	Start pump WL = 33.20 TOL
1.0 gpm	0935	615	5.95	66.4	5.93	-3.8	4.33	21.13	5	101.60	WL = 44.40 TOL
1.0 gpm	1000	614	5.96	55.7	4.95	-7.0	9.83	21.24	10.5	115.6	Stop pump, WL = 49.50 TOL
0.70 gpm	1015									120.6	Start pump, WL = 31.70 TOL
										131.10	WL = 42.78 TOL

WELL ID: PR2005DU

PUMP TYPE: Submersible

DATE: 5/13/2020

SAMPLERS:

DEPTH TO WATER: 31.45 ft bTOS  
TOS: top of standpipe  
 Depth - 51.07 ft bTOS  
 Screen Bot

CALCULATED 2 WELL VOLUMES: 6.39 gals  
 ACTUAL PURGE AMOUNT: 282.9 gals  
 PURGE RATE: ~0.7 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 4/2/2020 1220 hrs  
 Time (End): 5/13/2020 1306 hrs  
 YSI Model:  
 YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
0.60 gpm	1035	604	5.85	54.0	4.77	-5.6	3.24	21.14	12.0	143.10	WL = 43.10 TDC
0.60 gpm	1050	597	5.84	55.1	4.86	-5.6	2.22	21.23	9.0	152.10	WL = 43.28 TDC
	1100	593	5.81	54.9	4.86	-3.3	1.84	21.25	6.0	158.10	Stop pump, Swab & Surge
	1105								0	158.10	Start pump, WL = 35.80 TDC
1.7 gpm	1110	590	5.71	61.5	5.45	3.1	146	21.20	3.5	201.60	WL = 41.35 TDC
	1135	593	5.60	56.8	5.03	3.0	10.3	21.24	17.5	219.10	WL = 42.50 TDC
	1205	583	5.50	56.0	4.94	4.5	2.24	21.28	21.0	240.10	WL = 42.70 TDC
1.7 gpm	1220	581	5.44	56.3	5.00	7.3	3.87	21.28	10.5	250.60	WL = 42.70 TDC
	1230	584	5.36	56.1	4.99	5.7	1.16	21.30	7.0	257.60	WL = 42.70 TDC
1.7 gpm	1245	580	5.34	56.8	5.02	5.4	1.83	21.22	10.5	268.10	WL = 42.50 TDC
	1250	579	5.33	58.4	5.20	6.0	1.17	21.31	3.5	271.60	WL = 42.85 TDC
1.7 gpm	1255	581	5.31	58.2	5.15	5.8	1.23	21.30	3.5	275.10	WL = 42.87 TDC, Sample Time: 1255
	1306								7.7	282.90	Stop pump

# Monitoring Well Installation Report

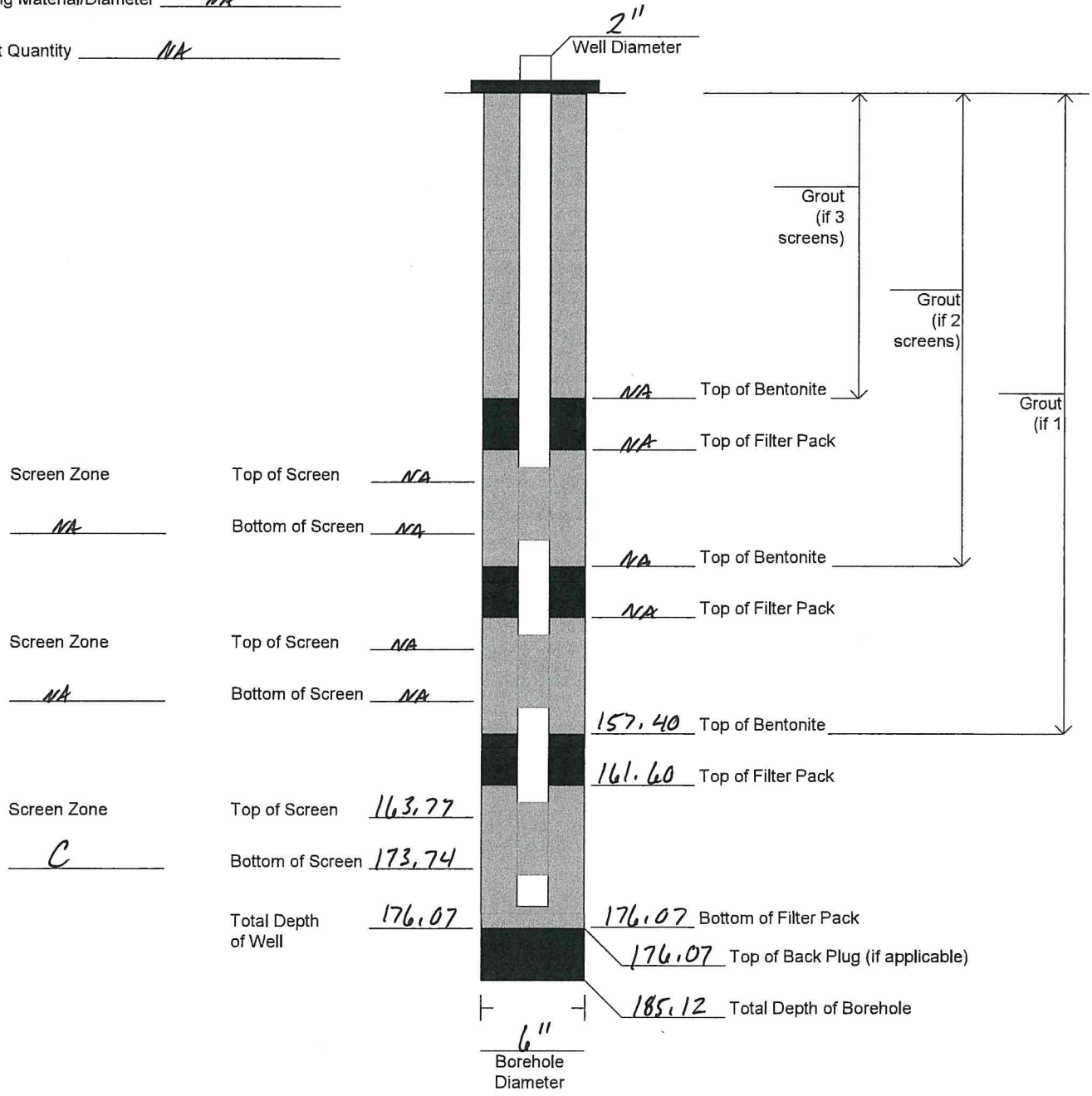
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW006C</b>
Well Installation Date <b>3/23/2020</b>		SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>	
SRS North Grid Coordinate (as built) <b>3676617.4201</b>	SRS East Grid Coordinate (as built) <b>445552.5490</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'43.84"</b>		Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'3.65"</b>	
Top of Pad Elevation (as built) <b>327.361</b>	Water Level Reference Point Elevation (as built) <b>330.08</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA



Screen Zone	Top of Screen	<u>NA</u>	Bottom of Screen	<u>NA</u>
<u>NA</u>				
Screen Zone	Top of Screen	<u>NA</u>	Bottom of Screen	<u>NA</u>
<u>NA</u>				
Screen Zone	Top of Screen	<u>163.77</u>	Bottom of Screen	<u>173.74</u>
<u>C</u>				
	Total Depth of Well	<u>176.07</u>		

**2"**  
Well Diameter

Grout (if 3 screens)

Grout (if 2 screens)

Grout (if 1)

NA Top of Bentonite

NA Top of Filter Pack

NA Top of Bentonite

NA Top of Filter Pack

157.40 Top of Bentonite

161.60 Top of Filter Pack

176.07 Bottom of Filter Pack

176.07 Top of Back Plug (if applicable)

185.12 Total Depth of Borehole

**6"**  
Borehole Diameter



# Monitoring Well Installation Report (Continued)

					Well Number PRW006C	
	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	+ 3.08	163.77	PVC/SCH 40	2"		
Screen	163.77	173.74	PVC/SCH 40	2"	0.010	Slotted
Sump	173.74	175.74	PVC/SCH 40	2"		
Sump Cap	175.74	176.07	PVC/SCH 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	161.60	176.07	5-50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	157.40	161.60	1-bucket + 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	157.4	10-50lb bags	3/23/2020	Aquaguard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						
Well Installation Comments						
Pump Installation Information <input type="checkbox"/> Pump Not Installed						
Installation Date NA		Installer/Company NA		Model/Manufacturer NA		Diameter NA
<input type="checkbox"/> Single Speed		<input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump NA		
Report Prepared By Scott D... <i>Scott D...</i>					Date 6/4/2020	

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: PR1006C

PUMP TYPE: Submersible

DATE: 5/19/2020

SAMPLERS:

DEPTH TO WATER: 59.65 ft bTOS

Depth -  
Screen Bot

173.87 ft bTOS

CALCULATED 2 WELL VOLUMES: 37.20 gals

Rule of Thumb  
3/4-in: 0.023 gal/ft  
1-in: 0.041 gal/ft  
2-in: 0.163 gal/ft  
4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 821 gals

PURGE RATE: 110 gpm

Time (Start): 5/19/2020 1140 hrs

YSI Model:

Time (End): 5/21/2020 1105 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
1.5gpm	1140								0	0	WL = 59.65 TOC, Start pump
1.5gpm	1145	35	6.16	60.0	5.36	26.4	760	20.82	7.5	7.5	WL = 65.20 TOC
1.5gpm	1205	41	6.31	47.3	4.22	12.4	25.3	20.94	45.30	22.5	WL = 65.80 TOC, Surge with pump
1.5gpm	1210	54	6.42	46.7	4.17	-16.8	1000+	20.93	7.5	45	
1.5gpm	1240	41	6.46	58.2	5.18	7.2	35.4	21.02	45	90	WL = 66.20 TOC
1.5gpm	1300	40	6.50	58.1	5.16	3.2	27.4	21.17	30	120	WL = 66.30 TOC
1.5gpm	1305								7.5	127.5	Stop pump, Surge & Surfs
1.5gpm	1310								0	127.5	Start pump, WL = 62.00 TOC
1.5gpm	1313	39	6.54	66.2	5.88	3.2	27.1	21.12	41.5	132.0	WL = 67.90 TOC
1.5gpm	1340	37	6.52	65.3	5.80	5.0	40.1	21.13	40.5	172.5	
1.5gpm	1400	37	6.52	68.1	6.06	5.1	37.6	21.08	30	202.5	Surged with pump on, WL = 69.01
1.5gpm	1445	34	6.49	67.1	5.98	5.3	80.1	21.34	67.5	270	Surge w/ pump on
1.5gpm	1450	34	6.48	71.6	6.36	7.3	31.2	21.21	7.5	277.5	WL = 70.15
1.5gpm	1545	31	6.43	74.4	6.60	12.4	14.6	21.21	82.5	360	
1.5gpm	1605	32	6.34	82.9	7.57	18.9	12.1	21.55	30	390	Surge with pump on, WL = 70.20 TOC
1.5gpm	1610	30	6.39	77.6	6.90	14.6	11.6	21.18	7.5	397.5	
1.5gpm	1635	30	6.31	86.0	7.62	14.7	18.9	21.29	37.5	435.0	WL = 71.6 TOC
1.5gpm	1650	29	6.32	85.4	45.4	15.1	15.1	21.36	22.5	457.5	STOP pump

7.58

WELL ID: P210066

PUMP TYPE: Submersible

DATE: 5/20/2020

SAMPLERS: Seth Gray

DEPTH TO WATER: 60.60 ft bTOS

Depth -  
Screen Bot

173.87 ft bTOS

CALCULATED 2 WELL VOLUMES: 37.20 gals

Rule of Thumb

- 3/4-in: 0.023 gal/ft
- 1-in: 0.041 gal/ft
- 2-in: 0.163 gal/ft
- 4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 821 gals

PURGE RATE: 110 gpm

Time (Start): 5/20/2020 5:19:20

YSI Model:

Time (End): 5/21/2020 11:05 hrs

YSIS/N:

Calc. Flow	TIME	Sp. Cond. (ns/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
1.5 gpm	0925								0	457.5	Start pump, WL = 60.60 TOS
	0935	33	5.07	67.0	5.97	57.5	396	21.01	15	46472.5	
1.5 gpm	0950	32	5.18	78.7	7.00	53.5	25.6	21.04	22.5	495	WL = 69.70 TOS, Surge with pump
	0955	29	5.18	74.9	6.68	59.4	20.9	21.00	7.5	502.5	
	1040	29	5.20	73.1	6.55	54.1	20.3	21.03	67.5	570	Stop pump
1.0 gpm	1445								0	570	Start pump, WL = 60.19 TOS
	1450	40	5.52	79.1	7.09	13.7	327	20.74	5	575	WL = 65.10 TOS
	1500	38	5.47	72.3	6.46	15.7	24.6	20.86	10	585	WL = 65.90 TOS
1.0 gpm	1525	38	5.47	80.1	7.15	15.0	15.7	20.90	25	610	WL = 66.10 TOS, Surge with pump
	1527	42	5.80	73.0	6.48	-4.0	51.4	20.96	2	612	
	1540	36	5.41	79.5	7.10	18.8	25.4	20.91	13	625	WL = 66.51 TOS
1.0 gpm	1600	37	5.40	79.8	7.13	17.6	20.7	20.90	20	645	
	1625	37	5.41	81.5	7.28	16.9	16.3	20.92	25	670	WL = 66.85 TOS
1.0 gpm	1646	36	5.42	81.7	7.29	16.2	13.3	20.93	15	685	
	1645								5	690	Stop pump
1.5 gpm	0917								0	690	Start pump, WL = 60.75 TOS
	0925	42	4.97	73.5	6.54	30.1	39.2	21.10	4	694	WL = 63.00
1.5 gpm	0940	39	4.94	63.2	5.61	27.4	56.1	21.15	7.5	701.5	

WELL ID: PR1006C PUMP TYPE: Submersible  
 DATE: 5/21/2020 SAMPLERS: Seal Dray

DEPTH TO WATER: 60.60 ft bTOS 173.87 ft bTOS  
TOS: top of standpipe

CALCULATED 2 WELL VOLUMES: 37 gals  
 ACTUAL PURGE AMOUNT: 821 gals  
 PURGE RATE: 1.0 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): ~~5/21/2020~~ 5/19/2020 hrs  
 Time (End): ~~5/21/2020~~ 5/21/2020 1105 hrs  
 YSI Model: \_\_\_\_\_ YSI S/N: \_\_\_\_\_

Calc. Flow	TIME	Sp. Cond. (uS/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
0.5 gpm	0945								2.5	704	stop pump; Pump toned off
0.5 gpm	0957								0	704	Start pump
0.5 gpm	1005	40	5.05	60.4	5.36	19.3	6.43	21.19	2.5	706.5	
0.5 gpm	1040	37	5.03	63.9	5.68	19.4	6.63	21.44	17.5	724.5	WL = 62.10 TOS
0.5 gpm	1110	38	5.06	67.7	5.96	18.6	25.8	22.78	15	739.5	WL = 62.15 TOS
0.5 gpm	1135								5	744.5	Stop pump
0.5 gpm	1137								0	744.5	Restart pump
0.5 gpm	1147	38	4.90	71.7	6.26	31.0	19.2	22.00	5	749.5	
0.5 gpm	1205								9	749.5	Stop pump
0.5 gpm	1225								0	749.5	Start pump
0.5 gpm	1230								2.5	751	Stop pump
0.5 gpm	0955								0	751	Start pump
1.0	1010	32	5.65	63.4	5.66	126.3	45.1	20.81	15	766	WL = 67.25 TOS
1.0 gpm	1030	28	5.66	64.7	5.79	125.7	3.97	20.87	20	786	
1.0 gpm	1035	28	5.74	67.0	5.98	121.5	3.30	20.88	5	791	WL = 67.95 TOS
1.0 gpm	1040	28	5.76	68.9	6.05	120.9	3.82	20.88	5	796	
1.0 gpm	1050	28	5.75	69.0	6.08	120.8	3.57	20.88	5	801	Sample Time = 1045
1.0 gpm	1105								20	821	Stop pump

# Monitoring Well Installation Report

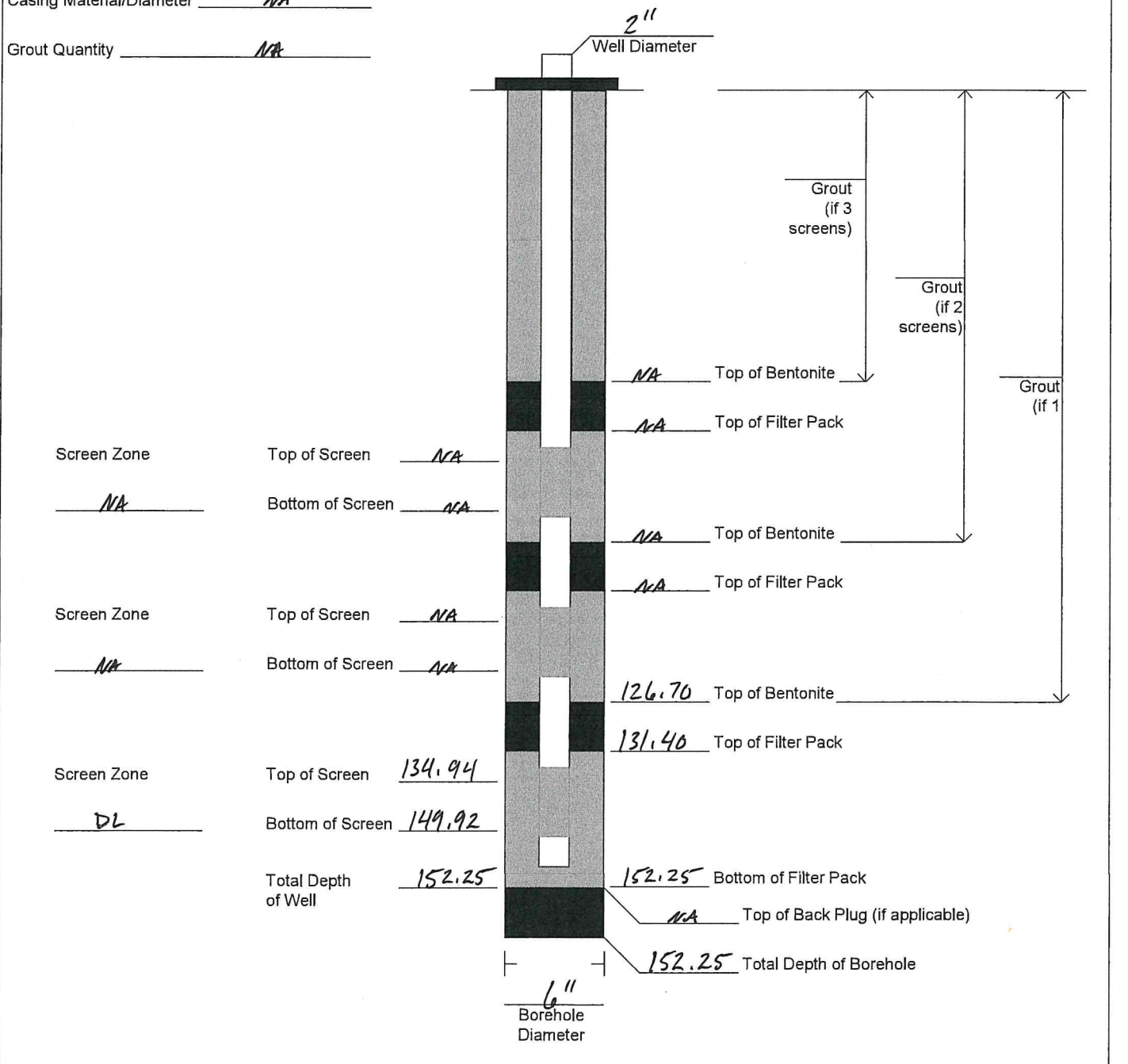
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW006DL</b>
Well Installation Date <b>3/24/2020</b>	SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676617.9803</b>	SRS East Grid Coordinate (as built) <b>445555.5770</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'43.86"</b>		Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'3.53"</b>	
Top of Pad Elevation (as built) <b>327.423</b>	Water Level Reference Point Elevation (as built) <b>330.25</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA





# Monitoring Well Installation Report (Continued)

					Well Number PRW006DL	
	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	43.0	134.94	PVC/SCH 40	2"		
Screen	134.94	149.92	PVC/SCH 40	2"	0.010	slotted
Sump	149.92	151.92	PVC/SCH 40	2"		
Sump Cap	151.92	152.25	PVC/SCH 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	131.40	152.25	7-50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	126.70	131.40	1- bucket 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	126.70	10-50lb bags	3/24/2020	Aquaguard	
	0.0	40.0	2-50lb bags	3/26/2020	Aquaguard	
	0.0	15.0	5-60lb bags	5/21/2020	Quickcrete	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						
Well Installation Comments						
Pump Installation Information <input type="checkbox"/> Pump Not Installed						
Installation Date NA		Installer/Company NA		Model/Manufacturer NA		Diameter NA
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed			Depth from Top of Casing to Top of Pump NA			
Report Prepared By JHA Day					Date 6/4/2020	

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: PR1006DL PUMP TYPE: Submersible  
 DATE: 5/21/2020 SAMPLERS: Seth Drey  
 DEPTH TO WATER: 47.60 ft bTOS Depth - 149.17 ft bTOS  
TOS: top of standpipe  
 CALCULATED 2 WELL VOLUMES: 33 gals  
 ACTUAL PURGE AMOUNT: 407.5 gals  
 PURGE RATE: 0.15 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 5/21/2020 09:05 hrs YSI Model: \_\_\_\_\_  
 Time (End): 6/1/2020 13:25 hrs YSI S/N: \_\_\_\_\_

Calc. Flow	TIME	Sp. Cond. (uS/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
0.04gpm	0905								0	0	Start pump, vol = 47.60 TOS
0.04gpm	0935								18	18	Stop pump
1.04gpm	1000						1000+		0	18	Start pump, vol = 85.10 TOS
1.04gpm	1016						1000+		16	34	Stop pump
1.04gpm	1040						1000+		0	34	Start pump, vol = 91.50 TOS
1.04gpm	1055						1000+		15	49	Stop pump, vol = 136.20 TOS
2.04gpm	1120						1000+		0	49	Start pump
1.04gpm	1126						1000+		12	61	Stop pump
1.04gpm	1155						1000+		0	61	Start pump
1.04gpm	1200						1000+		7.5	68.5	Stop pump, Pump malfunction
1.04gpm	1005						1000+		0	68.5	Start pump, vol = 50.15 TOS
1.04gpm	1015						1000+		10	78.5	Stop pump, Surge
1.04gpm	1025						1000+		0	78.5	Start pump
1.04gpm	1035						1000+		10	88.5	Stop pump
1.04gpm	1050						1000+		0	88.5	Start pump
1.04gpm	1120						1000+		30	108.5	Stop pump
1.04gpm	1140						1000+		0	108.5	Start pump,
1.04gpm	1200						1000+		20	128.5	Stop pump

WELL ID: PR1006.D2 PUMP TYPE: Submersible  
 DATE: 5/27/2020 SAMPLERS: \_\_\_\_\_

DEPTH TO WATER: 47.60 ft bTOS 149.17 ft bTOS  
TOS: top of standpipe

CALCULATED 2 WELL VOLUMES: 33 gals  
 ACTUAL PURGE AMOUNT: 407.5 gals  
 PURGE RATE: 0.5 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 5/21/2020 0905 hrs YSI Model: \_\_\_\_\_  
 Time (End): 6/1/2020 1325 hrs YSI S/N: \_\_\_\_\_

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1555								0	0	
0.5gpm	1615	52	5.50	91.7	8.02	188.1	1000+	22.07	10	10	Start pump, WL = 90.0 TOL
	1616										WL = 125.6 TOL
	1635								0.5	10.5	Stop pump
									0	10	Start pump, WL = 109.0 TOL
1.5gpm	1640	47	4.35	102.9	9.10	253.6	1000+	21.65	2.5	142.5	
	1655	36	4.47	85.9	7.52	246.7	1000+	21.98	7.5	150	WL = 132.6 TOL
	1656								1.5	150.5	Stop pump
1.75gpm	1730								0	150.5	Start pump, WL = 53.80 TOL
	1740										
1.5gpm	0845	42	5.01	60.6	5.42	213.4	1000+	21.31	3.75	154.25	
	0850	43	4.92	64.2	5.65	227.1	75	21.53	2.5	156.75	WL = 88.1 TOL
	0905	44	4.39	71.1	6.19	231.3	45	22.28	7.5	164.25	WL = 93.70 TOL
	0930	44	4.56	67.8	5.80	222.9	84	22.88	12.5	176.75	WL = 113.70 TOL
	1000	51	4.76	67.2	5.75	212.1	58	23.07	15	191.75	WL = 122.30 TOL
	1005								2.5	194.25	Stop pump, surge + swirl w/ pump
	1045								0	194.25	Start pump, WL = 81.20 TOL
1.0gpm	1048	44	5.20	73.1	6.47	182.6	1000+	21.29	2	196.25	
	1055	53	4.49	67.0	5.87	227.5	114	21.97	7	203.25	WL = 106.20 TOL
0.5gpm	1125								15	218.25	Stop pump

WELL ID: PR100651

PUMP TYPE: Submersible

DATE: 5/28/2020

SAMPLERS:

DEPTH TO WATER: 47.60 ft bTOS

Depth -  
Screen Bot

149.17 ft bTOS

CALCULATED 2 WELL VOLUMES: 33 gals

Rule of Thumb

3/4-in: 0.023 gal/ft  
1-in: 0.041 gal/ft  
2-in: 0.163 gal/ft  
4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 407.5 gals

PURGE RATE: 0.5 gpm

Time (Start): 5/21/2020 0905 hrs

YSI Model:

Time (End): 6/1/2020 1325 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (uS/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1230								0	218.25	Start pump, WL = 81.10 TAC
1.5 gpm	1235	51	4.87	70.2	70.57	166.01	1000+	22.20	2.5	220.75	
1.5 gpm	1245	49	4.59	66.1	85.71	165.79	186	22.94	5	225.75	
	1310								12.5	238.25	Stop pump
1.5 gpm	1335								0	238.25	Start pump, WL = 86.20 TAC
1.5 gpm	1338	42	5.34	64.3	5.56	171.5	272	22.58	1	239.25	
	1350	41	4.61	62.1	5.41	222.1	80	23.57	6	245.25	
	1355								2.5	247.75	Stop pump
1.0 gpm	1500								0	247.75	Start pump, WL = 71.20 TAC
	1505								5	242.75	Stop pump
1.0 gpm	1535								0	242.75	Start pump, WL = 72.30 TAC
1.5 gpm	1545	53	4.89	66.4	5.65	191.0	286	23.43	10	252.75	WL = 96.10 TAC
1.5 gpm	1600	52	4.83	64.5	5.43	171.9	59	23.94	7.5	259.25	WL = 101.20 TAC
1.5 gpm	1635	50	4.89	65.7	5.52	153.0	74	23.96	17.5	276.75	WL = 111.70 TAC
1.5 gpm	1650	42	4.81	63.9	5.35	154.4	4	24.22	7.5	284.25	Stop pump
	1655								2.5	286.75	Stop pump
1.25 gpm	01/2020 0935								0	286.75	Start pump, WL = 53.80 TAC
	0938	53	5.35	54.5	4.86	151.6	224	20.94	2.25	289.0	



# Monitoring Well Installation Report

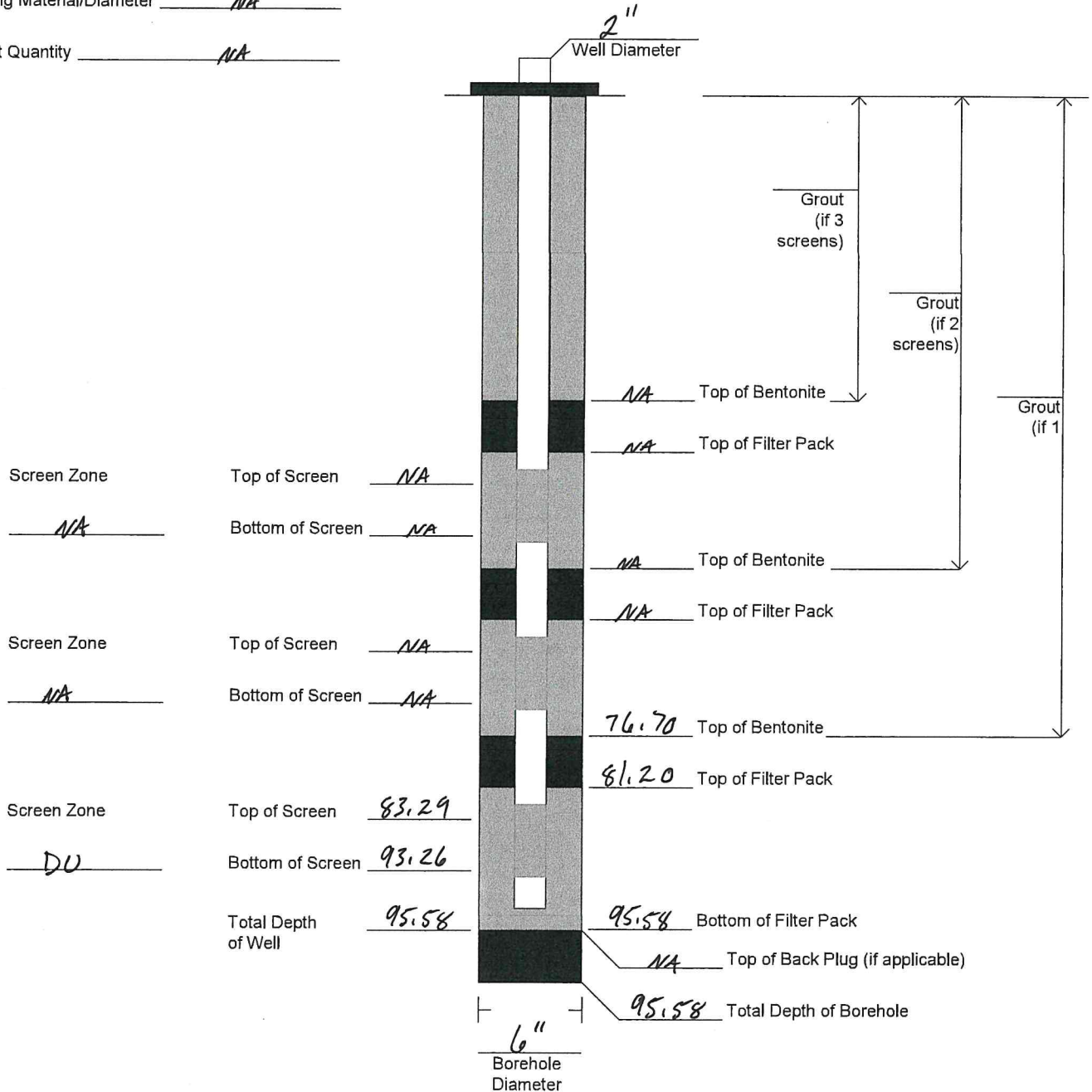
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW006DU</b>
Well Installation Date <b>3/25/2020</b>	SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676619.1591</b>	SRS East Grid Coordinate (as built) <b>445558.5662</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'43.90"</b>		Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'3.42"</b>	
Top of Pad Elevation (as built) <b>327.547</b>	Water Level Reference Point Elevation (as built) <b>330.32</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA





# Monitoring Well Installation Report (Continued)

					Well Number PRW006DU	
	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	73.05	83.29	PVC/SCH 40	2"		
Screen	83.29	93.26	PVC/SCH 40	2"	0.010	Slotted
Sump	93.26	95.24	PVC/SCH 40	2"		
Sump Cap	95.24	95.58	PVC/SCH 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	81.20	95.58	5 1/2 50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	76.7	81.20	2 - buckets 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	76.7	6 - 50lb bags	3/25/2020	Aquaguard	
	0.0	20.0	1 - 50lb bag	3/26/2020	Aquaguard	
	0.0	10.0	1 - 50lb bag	5/21/2020	Aquaguard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						
Well Installation Comments						
Pump Installation Information <input type="checkbox"/> Pump Not Installed <i>NA</i>						
Installation Date	Installer/Company	Model/Manufacturer	Diameter			
<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>			
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump				
		<i>NA</i>				
Report Prepared By					Date	
<i>Beth D...</i>					6/4/2020	

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: PRW006DU PUMP TYPE: Submersible  
 DATE: 5/19/2020 SAMPLERS: Seth Gray

DEPTH TO WATER: 45.80 ft bTOS  
 Depth - 93.50 ft bTOS  
 Scrn Bot

CALCULATED 2 WELL VOLUMES: 15.5 gals  
 Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft  
 ACTUAL PURGE AMOUNT: 245.5 gals  
 PURGE RATE: 0.4 gpm

Time (Start): 5/19/2020 1130 hrs YSI Model:  
 Time (End): 5/20/2020 1420 hrs YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
1.0 gpm	1130								0	0	WL = 45.80 TOL; Start pump
	1140	169	7.05	30.8	2.75	-10.3	449	20.88	2	2	
0.5 gpm	1150	130	6.95	29.8	2.62	-8.1	34.8	21.23	3	5	WL = 57.30 TOL, Surge w/ pump on
0.5 gpm	1200	139	6.96	31.7	2.82	-7.3	794	21.16	3	8	WL = 59.20 TOL
0.5 gpm	1220	115	6.91	38.0	3.33	-6.1	49.3	21.48	10	18	WL = 76.40 TOL
0.5 gpm	1240	134	6.93	31.9	2.81	-5.6	16.8	21.68	10	28	WL = 79.30 TOL
	1241								0.5	28.5	Stop pump, surge + swirls
0.5 gpm	1257								0	28.5	Start pump, WL = 60.90 TOL
	1300	128	6.94	83.3	7.22	-4.4	1000+	21.19	1.5	30	WL = 65.10 TOL
0.5 gpm	1315	111	6.87	32.1	2.81	-2.0	21.5	21.82	7.5	37.5	WL = 73.20 TOL
0.5 gpm	1340	110	6.87	29.6	2.60	-1.9	27.47	21.67	12.5	50	WL = 73.20 TOL
	1342								110	51	Stop pump, surge + swirls
0.5 gpm	1345									51	Start pump
	1347	102	6.86	42.6	3.56	-1.0	1000+	21.18	1.0	52	WL = 71.40 TOL
0.5 gpm	1400	116	6.87	31.9	2.82	-1.2	101	21.48	6.5	58.5	WL = 75.80 TOL
	1445	108	6.76	32.2	2.84	3.9	12.1	21.59	22.5	81	Stop pump, surge + swirls
	1450								0	81	Start pump WL = 71.0 TOL
	1455	100	6.76	34.0	2.99	5.0	753	21.35	2.5	83.5	WL = 78.70 TOL

WELL ID: PR100606 PUMP TYPE: Submersible  
 DATE: 5/19/2020, 5/20/2020 SAMPLERS: Self Draw

DEPTH TO WATER: 45.50 ft bTOS  
 Depth - 93.50 ft bTOS  
 Screen Bot

CALCULATED 2 WELL VOLUMES: 151.5 gals  
 ACTUAL PURGE AMOUNT: 245.5 gals  
 PURGE RATE: 0.14 gpm

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 5/19/2020 11:20 hrs YSI Model:  
 Time (End): 5/20/2020 14:20 hrs YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
.5 gpm	1545	99	6.73	48.9	4.06	6.6	25.9	21.70	25	1081.5	
	1557								6	1141.5	Stop pump, surge + scans
	1605								0	1141.5	Start pump, WL = 71.50 TAC
.5 gpm	1607	88	6.76	36.8	3.23	4.6	6.73	21.70	1	1151.5	WL = 73.95 TAC
	1427	91	6.70	35.5	3.11	6.5	60.9	21.88	10	1251.5	
.5 gpm	1650	127	6.73	40.6	3.54	7.6	35.6	21.57	11.5	137	WL = 74.1 TAC
	1657								.5	137.5	Stop pump
	0920								0	137.5	Start pump, WL = 47.65 TAC
.5 gpm	0925	123	5.37	21.8	1.98	38.8	26.2	20.41	2.5	140	WL = 58.50 TAC
	0945	116	5.25	33.0	2.95	44.5	56.5	20.78	18	150	WL = 72.90 TAC, surge with pump
.5 gpm	1005	110	5.28	33.6	2.97	41.3	160.4	21.21	10	160	
	1040	110	5.27	32.1	2.89	40.5	80.1	21.31	17.5	177.5	Stop pump, WL = 83.10 TAC
.5 gpm	1115								0	177.5	Start pump, WL = 61.50 TAC
	1120	96	5.23	44.5	3.98	37.8	66.8	20.86	2.5	180	WL = 69.80 TAC
	1135	99	5.25	34.3	3.05	36.0	50.1	21.10	7.5	187.5	WL = 73.80 TAC
	1200	82	5.19	30.1	2.66	35.1	17.1	21.40	12.5	200	WL = 79.80 TAC
	1205								2.5	202.5	Stop pump, surge in pump
	1210								0	202.5	Start pump, WL = 72.50 TAC



# Monitoring Well Installation Report

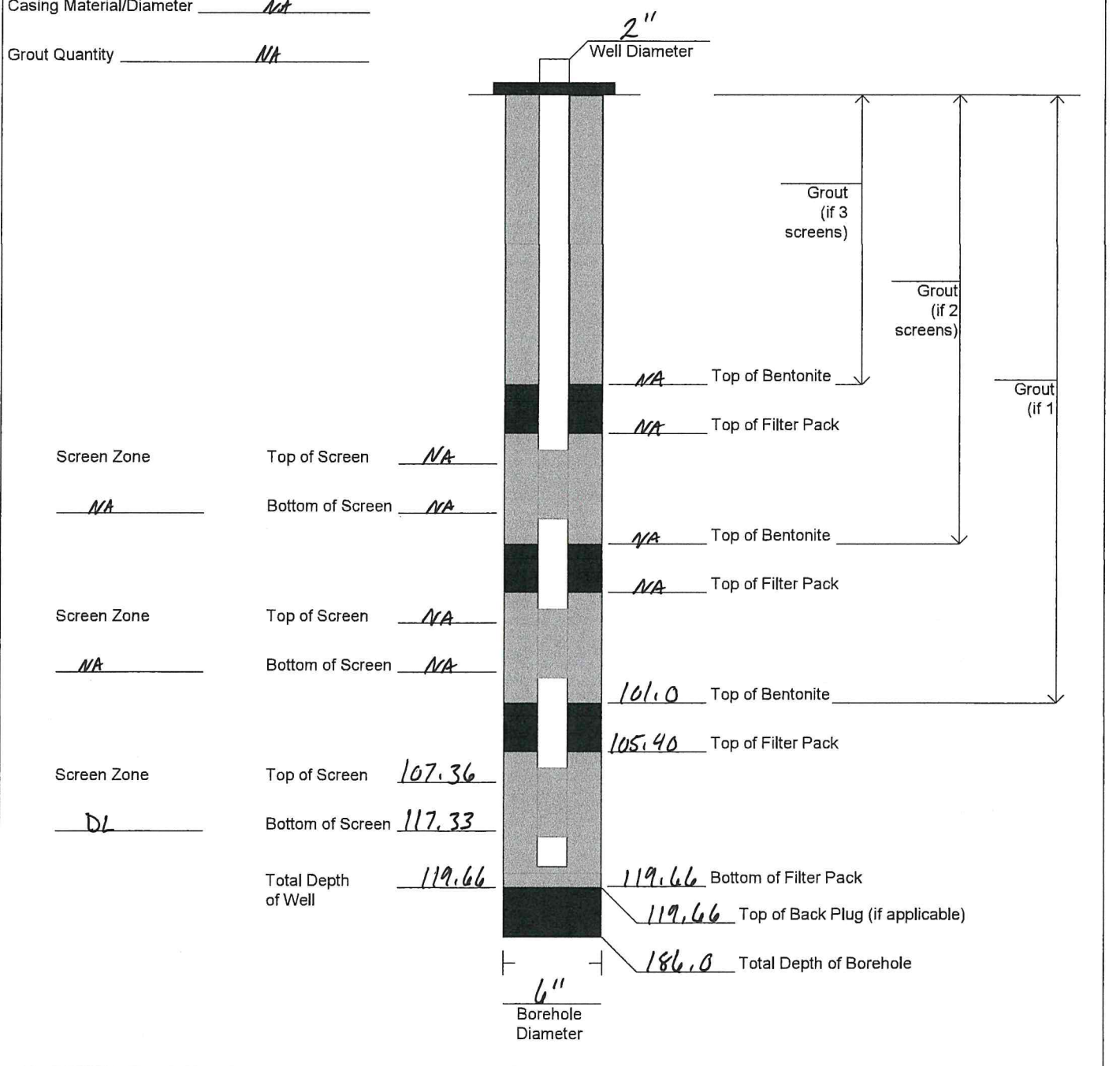
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW007DL</b>
Well Installation Date <b>3/16/2020</b>	SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676578.5192</b>	SRS East Grid Coordinate (as built) <b>445591.9135</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'42.59"</b>		Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'2.12"</b>	
Top of Pad Elevation (as built) <b>314.258</b>	Water Level Reference Point Elevation (as built) <b>316.78</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

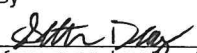
Grout Quantity NA





# Monitoring Well Installation Report (Continued)

Well Number  
PRW007DL

Casing	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
		+2.97	107.36	PVC/SCH 40	2"	
Screen	107.36	117.33	PVC/SCH 40	2"	0.010	slotted
Sump	117.33	119.32	PVC/SCH 40	2"		
Sump Cap	119.32	119.66	PVC/SCH 40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	105.40	119.66	5-50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	101.0	105.40	1 1/4 - bucket + 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	105.40	6-50lb bags	3/17/2020	AquaGuard	
	0.0	40.0	2-50lb bags	3/19/2020	AquaGuard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						
Well Installation Comments						
Pump Installation Information <input type="checkbox"/> Pump Not Installed						
Installation Date	Installer/Company	Model/Manufacturer	Diameter			
NA	NA	NA	NA			
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump				
Report Prepared By					Date	
					6/4/2020	

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: FRW007DL

PUMP TYPE: Submersible

DATE: 3/31/2020 4/1/2020

SAMPLERS:

DEPTH TO WATER: 38.78 ft bTOS  
TOS: top of standpipe

Depth -  
 Screen Bot 120.5 ft bTOS

CALCULATED 2 WELL VOLUMES: 26.6 gals

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 7.5 gals

PURGE RATE: 1.0 gpm

Time (Start): 3/31/2020 1110 hrs YSI Model:

Time (End): 4/2/2020 1120 hrs YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
2.25gpm	1110	160	6.57	-	-	-	1000+	20.0	0	0	WL=58.0TOL, Start pump
	1123								29.25	29.25	Stop pump, WL=118.7TOL, Surges + surge
	1248								0.0	29.25	Start pump, WL=38.9TOL
1.04gpm	1308	100	6.14	-	-	-	1000+	20.3	20	49.25	WL=56.30TOL
.5gpm	1330	100	6.02	-	-	-	525	20.4	11	60.25	WL=62.50TOL
.5gpm	1405	70	5.74	-	-	-	284	20.0	17.5	77.75	WL=62.90TOL
	1410								2.5	80.25	Stop pump, Surges + surge
	1440	90	6.02	-	-	-	1000+	19.6	0	80.25	Start pump, WL=38.80TOL
.5gpm	1455	60	5.63	-	-	-	468	19.8	7.5	87.75	
	1505	60	5.67	-	-	-	302	19.7	5	92.75	
	1550	50	5.41	-	-	-	146	19.2	22.5	115.25	
	1620	60	5.40	-	-	-	268	19.4	20	135.25	Surged with pump
.5gpm	1655	60	5.45	-	-	-	174	19.2	12.5	147.75	WL=54.05
	1700								2.5	150.25	Stop pump
	0835	150	6.52	-	-	-	1000+	19.65	0	150.25	Start pump, WL=38.45TOL
.7gpm	0850	77	5.84	-	-	-	219	19.90	10.5	160.75	
.7gpm	0915	68	5.58	-	8.43	83.5	87.9	20.01	17.5	178.25	WL=56.40TOL
	0945	52	5.46	-	9.15	100.1	941	20.11	21	199.25	Surge with pump

WELL ID: PR1007 DL

PUMP TYPE: Submersible

DATE: 4/10/20

SAMPLERS:

DEPTH TO WATER: 38.78 ft bTOS

Depth -  
Sern Bot

120.15 ft bTOS

CALCULATED 2 WELL VOLUMES: 26.6 gals

Rule of Thumb

3/4-in: 0.023 gal/ft

1-in: 0.041 gal/ft

2-in: 0.163 gal/ft

4-in: 0.653 gal/ft

ACTUAL PURGE AMOUNT: 7.15 gals

PURGE RATE: 1.0 gpm

Time (Start): 3/11/2020 110 hrs

YSI Model:

Time (End): 4/2/2020 1120 hrs

YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
.9 gpm	1000	56	5.39	-	9.05	100.4	116	20.11	13.5	212.75	WL = 58.90 TOL
	1030	56	5.43	-	9.43	105.5	181	20.14	27	239.75	WL = 59.50 TOL
	1055	54	5.35	-	9.36	110.4	442	20.12	22.5	262.25	WL = 59.65 TOL
	1056								1	263.25	Stop pump
	1108								0	263.25	Start pump
.9 gpm	1110	61	5.55	-	8.59	83.1	1000	19.87	1.8	265.05	
	1120	64	5.56	-	8.96	85.2	199	20.11	9	274.05	
.9 gpm	1140	56	5.38	-	9.33	108.5	61.3	20.09	18	292.05	WL = 60.1 TOL
	1215	55	5.34	-	9.67	111.5	36.4	20.08	31.5	323.55	
	1245	52	5.33	-	9.83	116.8	29.7	20.21	27	350.55	
1.0 gpm	1315	48	5.38	-	9.80	115.2	19.1	20.20	30	380.55	WL = 60.65 TOL
	1335	50	5.34	-	9.71	110.1	411	20.11	20	400.55	Surged with pump
	1345	50	5.24	-	10.24	123.8	80.3	20.22	10	410.55	
1.0 gpm	1420	48	5.17	-	-	-	21.5	20.23	35	445.55	WL = 61.20 TOL
	1500	48	5.19	-	10.60	133.1	11.6	20.18	40	485.55	
	1520	48	5.21	-	-	-	10.2	20.18	20	505.55	WL = 62.70 TOL
	1525	54	5.61	-	-	-	879	20.15	5	510.55	Surge with pump
	1530	44	5.04	-	10.45	144.0	143	20.16	5	515.55	

WELL ID: PR6007DL PUMP TYPE: Submersible  
 DATE: 4/1/2020, 4/2/2020 SAMPLERS: Set-Dray

DEPTH TO WATER: 38.78 ft bTOS 120.5 ft bTOS  
TOE: top of standpipe

CALCULATED 2 WELL VOLUMES: 26.6 gals  
 ACTUAL PURGE AMOUNT: 715 gals  
 PURGE RATE: 80 gpm 1.0 hrs

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Time (Start): 3/31/2020 1110 hrs YSI Model:  
 Time (End): 4/2/2020 1120 hrs YSI S/N:

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mv)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
1.0 gpm	1545	45	5.10	-	-	-	45.7	20.19	15	530.55	
	1615	47	5.15	-	10.46	142.9	32.5	20.15	30	560.55	
1.0 gpm	1640	47	5.14	-	-	-	14.0	20.18	25	585.55	WL = 62.15 TOL
	1650								10	595.55	Stop pump
	0830	62	5.164	-	-	-	1000+	19.95	0	595.55	Start pump, WL = 38.75 TOL
1.0 gpm	0850	53	5.34	-	10.34	127.0	25.0	19.94	20	615.55	WL = 58.30 TOL
1.0 gpm	0915	51	5.28	-	10.74	132.3	23.9	20.02	25	640.55	WL = 60.65 TOL
1.0 gpm	0935	50	5.27	-	10.25	142.4	14.0	20.14	20	660.55	WL = 60.50 TOL
1.0 gpm	0945	47	5.18	-	9.50	141.2	438	20.04	10	670	surge with pump
1.0 gpm	0955	49	5.24	-	9.71	145.6	48.4	20.08	10	680	WL = 60.95 TOL
1.0 gpm	1050	50	5.23	-	9.54	148.2	8.92	20.12	5	685	WL = 61.20 TOL
	1055	52	5.30	-	9.67	142.0	9.59	20.18	5	690	WL = 61.35 TOL
	1100	47	5.13	-	9.52	152.6	6.63	20.13	5	695	WL = 61.65 TOL
1.0 gpm	1105	48	5.16	-	9.48	149.2	7.90	20.11	5	700	
	1110	49	5.19	-	9.42	149.0	7.05	20.15	5	705	Sample Time = 1110
	1120								10	715	Stop pump

11/20/20

# Monitoring Well Installation Report

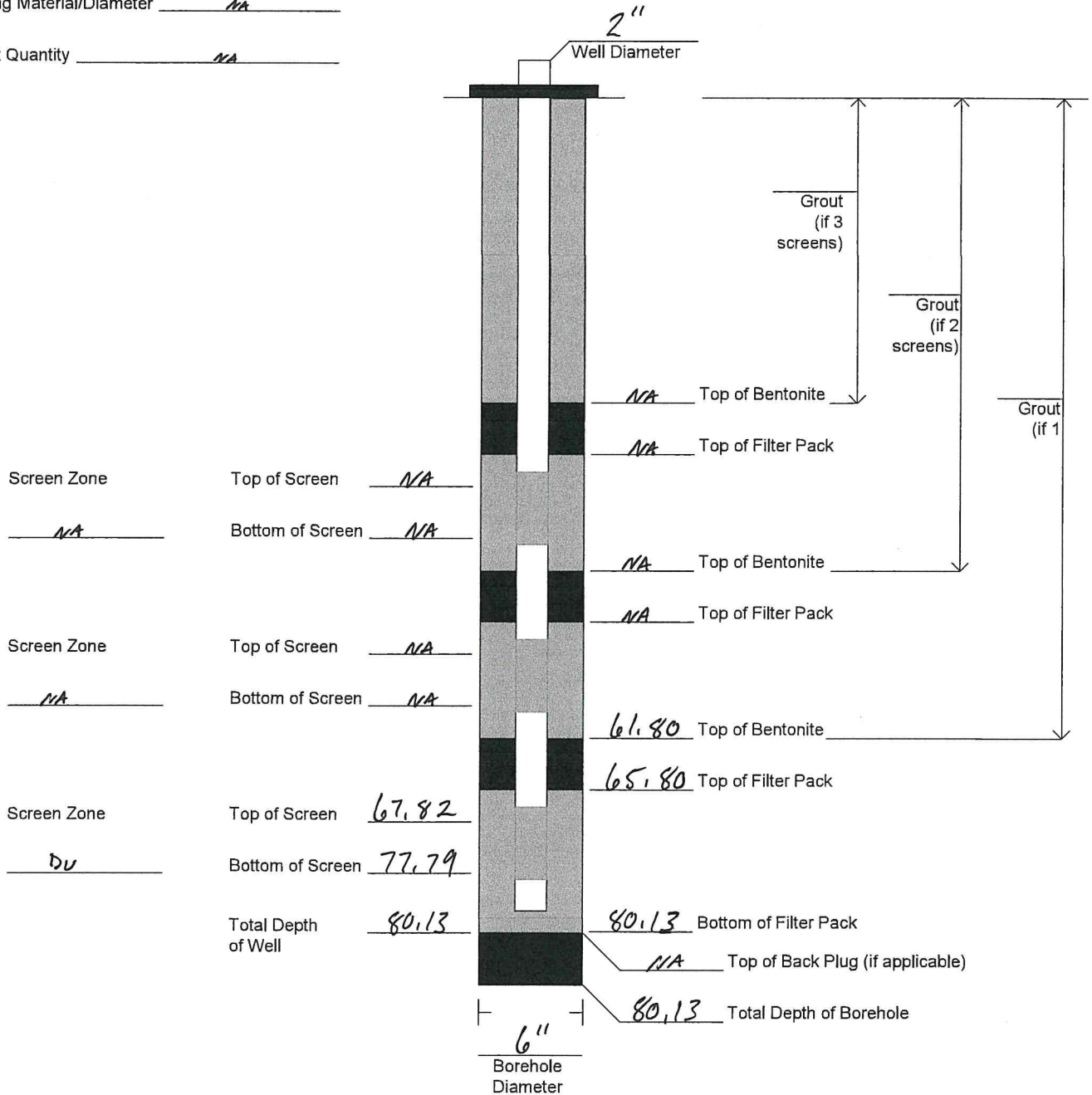
Driller Name/Company <b>Donald Myles/ Cascade</b>		Driller Cert. No. <b>2232</b>	Tech Oversight Name/Company <b>Seth Dray/ North Wind</b>		Well Number <b>PRW007DU</b>
Well Installation Date <b>3/18/2020</b>	SC DHEC Well Approval Number <b>MW-12192</b>		Drilling Method (Auger Mud Rotary, Rotosonic, etc) <b>Rotosonic</b>		
SRS North Grid Coordinate (as built) <b>3676581.4745</b>	SRS East Grid Coordinate (as built) <b>445591.4021</b>	Latitude (deg/min/sec - as built) (NAD 27) <b>33°13'42.68"</b>	Longitude (deg/min/sec - as built) (NAD 27) <b>-81°35'2.14"</b>		
Top of Pad Elevation (as built) <b>313.886</b>	Water Level Reference Point Elevation (as built) <b>316.43</b>		Survey Point <input checked="" type="checkbox"/> Top of Casing <input type="checkbox"/> Top of Stand Pipe <input type="checkbox"/> Ground Surface		

Surface Casing (if installed) \_\_\_\_\_ Depths measured from ground surface to nearest 0.1 ft

Total Depth of Installed Casing NA

Casing Material/Diameter NA

Grout Quantity NA





# Monitoring Well Installation Report (Continued)

					Well Number PRW007DU	
	Top Depth	Bottom Depth	Material/Schedule	Diameter	Slot Size	Slot Type
Casing	+ 2.96	67.82	PVC/SCH40	2"		
Screen	67.82	77.79	PVC/SCH40	2"	0.010	Slotted
Sump	77.79	79.80	PVC/SCH40	2"		
Sump Cap	79.80	80.13	PVC/SCH40	2"		
Filter Pack	Top Depth	Bottom Depth	Amount (sacks and size)	Trade Name		
	65.80	80.13	6 3/4 - 50lb bags	1A		
Bentonite Seal	Top Depth	Bottom Depth	Amount/Size (sack, bucket, etc.)			
	61.80	65.80	1 - bucket 3/8" non-coated pellets			
Grout	Top Depth	Bottom Depth	Amount (sacks and size)	Grout Date	Grout Weight	
	0.0	61.8	4 - 50lb bags	3/19/2020	AquaGuard	
<input type="checkbox"/> Neat Cement <input type="checkbox"/> Bentonite Cement <input checked="" type="checkbox"/> High Solids Bentonite						
Well Installation Comments						
Pump Installation Information <input type="checkbox"/> Pump Not Installed						
Installation Date	Installer/Company	Model/Manufacturer		Diameter		
NA	NA	NA		NA		
<input type="checkbox"/> Single Speed <input type="checkbox"/> Variable Speed		Depth from Top of Casing to Top of Pump				
Report Prepared By				Date		
				6/4/2020		

Depths measured from ground surface to nearest 0.1 ft.

WELL ID: PRW07DU PUMP TYPE: Submersible  
 DATE: 3/31/2020 SAMPLERS: SEA DRY

DEPTH TO WATER: 36.08 ft bTOS 83 ft bTOS  
TOS: top of standpipe

CALCULATED 2 WELL VOLUMES: 15.13 gals  
Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft  
 ACTUAL PURGE AMOUNT: 484.5 gals  
 PURGE RATE: 175 gpm

Time (Start): 1230 hrs YSI Model: \_\_\_\_\_  
 Time (End): 1412/2020 hrs YSI S/N: \_\_\_\_\_

Calc. Flow	TIME	Sp. Cond. (uS/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	1230								0	0	Start pump
1.0 gpm	1231	80	5.74	-	-	-	524	20.2	1	1	
	1241	80	5.75	-	-	-	546	20.5	10	11	WL = 49.80 TOL
.75 gpm	1305	60	5.57	-	-	-	200	20.4	24	35	WL = 50.80 TOL
.8 gpm	1325	60	5.62	-	-	-	405	20.5	18.75	53.75	WL = 52.30 TOL
	1335									53.75	Stop pump, Surges + Surge
	1348										RESISTANT PUMP, WL = 36.08 TOL
.75 gpm	1400	40	5.42	-	-	-	14.0	20.0	9	62.75	WL = 47.30 TOL
	1425	50	5.36	-	-	-	53.8	19.8	18.75	81.50	WL = 48.30 TOL
.75 gpm	1445	50	5.35	-	-	-	45.2	19.6	15	96.50	
	1448									96.50	Stop pump, Surge + Surges
	1456										Start pump
.75 gpm	1458	110	5.92	-	-	-	1000+	19.2	1.5	98	WL = 47.50 TOL
	1510	50	5.41	-	-	-	162	19.5	9	107	
	1555	50	5.35	-	-	-	21.8	19.2	33.75	140.75	
	1625	50	5.38	-	-	-	327	19.0	22.5	163.25	Surged with pump
.75 gpm	1655	40	5.32	-	-	-	20.0	19.3	22.5	185.75	Stop pump
	1700										

WELL ID: PR1007D PUMP TYPE: Submersible  
 DATE: 4/1/2020 SAMPLERS: Seth Day  
 DEPTH TO WATER: 35.90 ft bTOS 83 ft bTOS  
36.08 Depth -  
SD 4/1/2020 Scrn Bot

CALCULATED 2 WELL VOLUMES: 15.35 gals  
493  
 ACTUAL PURGE AMOUNT: 493 gals  
SD  
 PURGE RATE: 1.75 gpm

Time (Start): 3/31/2020 hrs  
1230  
 YSI Model:  
 Time (End): 4/2/2020 hrs  
1000 YSI S/N:

Rule of Thumb  
 3/4-in: 0.023 gal/ft  
 1-in: 0.041 gal/ft  
 2-in: 0.163 gal/ft  
 4-in: 0.653 gal/ft

Calc. Flow	TIME	Sp. Cond. (us/cm)	pH	DO (%)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	Temp (°C)	Purge (gal)	Total Purge (gal)	Comments
	0835								0	185.75	Start pump
0.5 gpm	0850	80	5.76	-	-	-	276	18.3	7.5	193.25	WL = 56.90 TOL
0.5 gpm	0915	50	5.52	-	-	-	14.5	18.6	12.5	205.75	Surge with pump
	0940	40	5.35	-	-	-	152	20.3	12.5	218.25	WL = 54.70 TOL
0.75 gpm	0955	40	5.40	-	-	-	33.9	19.8	11.25	229.50	WL = 54.85 TOL
0.75 gpm	1025	40	5.41	-	-	-	14.7	19.7	22.5	252	Stop pump, surge + surge
	1045								15	267	Start pump
0.75 gpm	1055	40	5.24	-	-	-	1000+	20.4	0	267	Start pump
0.75 gpm	1105	40	5.37	-	-	-	189	19.9	7.5	274.5	WL = 49.80 TOL
0.75 gpm	1135	40	5.30	-	-	-	10.2	19.3	22.5	297	WL = 50.45 TOL
	1215	40	5.23	-	-	-	9.10	19.9	30	227	WL = 49.95 TOL
0.75 gpm	1230	30	5.15	-	-	-	7.13	20.0	11.25	238.25	
	1235	30	5.14	-	-	-	5.57	20.0	3.75	242	
	1240	40	5.18	-	1.41	-	4.34	19.9	3.75	245.75	Sample Time = 1240
	1305	40	5.06	-	0.93	103.8	3.31	20.19	18.75	264.5	
0.75 gpm	1315	43	5.10	-	0.91	98.5	4.27	20.23	7.5	272	
	1330	42	5.06	-	0.91	95.5	4.11	20.27	11.25	283.25	
	1340	40	5.28	-	-	-	166	20.1	7.5	290.75	Surge with pump



**APPENDIX I**

**ZVI-PRB Construction Supplier Deviation Disposition Request #7**



# Supplier Deviation Disposition Request (Con't)

Table A - Documents Requiring Action		
Identify all change docs and Check <b>Yes</b> or <b>No</b> for each		
24. <b>SRS Document Change</b>	Incorporation Required <input type="radio"/> Yes <input type="radio"/> No	Document Number _____
25. <b>SRS Specification Change</b>	Incorporation Required <input type="radio"/> Yes <input type="radio"/> No	Document Number _____
26. <b>Baseline Change</b>	Incorporation Required <input type="radio"/> Yes <input type="radio"/> No	Document Number _____
27. <b>Supplier Document Change</b>	Incorporation Required <input type="radio"/> Yes <input type="radio"/> No	Document Number _____
28. <b>Other Document Change</b>	Incorporation Required <input type="radio"/> Yes <input type="radio"/> No	Document Number _____
29. <b>Nonconformance Report (NCR)</b>  <i>Supplier Issued</i>  If YES, SDDR/DCF cannot be invalidated or modified without CQF approval or reissue of an NCR <input type="radio"/> Yes <input type="radio"/> No NCR No. _____	30. Methods of Verification (Choose <b>All</b> that apply)  <input type="checkbox"/> <b>RI</b> Verify Inspection Attributes cover changes  <input type="checkbox"/> <b>SSR</b> Verify Inspection Plan/Surveillance Report includes/inspects NCR item  <input type="checkbox"/> <b>Document Submittal</b> Document Number _____  <input type="checkbox"/> <b>Other</b> _____	
31. Related Docs	32. Additional Reviewers	
33. FOSC		34. DC/RO
35. SDDR Disposition Supplier/Subcontractor Field Implementation  <input type="radio"/> SDDR Disposition Implemented and Incorporated into Supplier/Subcontractor Submittals  <input type="radio"/> SDDR Disposition Implementation and Incorporation not Required (Disapproved or No Change)  _____ Supplier Quality Manager (Print Name)                      Supplier Quality Manager (Signature)                      Date		

# Supplier Deviation Disposition Request

## *(Always include Instruction Sheet with Form)*

This form is to be used by a supplier or subtier supplier after Purchase Order Award to:

- a) Notify SRS when manufactured product or service does not meet established contract requirements and to document the supplier's proposed disposition, with their technical proposed disposition, with their technical (and where appropriate, Cost/Schedule) justification.
- b) Notify SRS when the supplier wants to propose changes to the contract documents unanticipated at time of award.
- c) Record SRS disposition of the SDDR.

A deviation is any departure from the requirements of the procuring documents, which the supplier has incorporated or proposes to incorporate in the completed item or service provided. Deviation disposition can be classified as "Use As-Is" or "Repair."

Repair is defined as the process of restoring a nonconforming characteristic to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still may not conform to the original requirement. Repair includes alterations to the properties to the material through heat-treating, welding, metal deposition, chemical processing, etc. The SDDR form is not required for cases where SRS has previously provided authorization to proceed, using an accepted repair method for a specific type of repair. Records must be maintained for each specific repair.

A SRS Engineering action and disposition statement does not relieve the supplier from responsibility for the accuracy, adequacy, or suitability of the item or service being provided as defined in the procurement documents, nor does it constitute waiver of the right to renegotiate the terms of the procurement documents.

### Block No.                      Entry Information

1. Supplier's name and address, city, state and zip code. List same information for subtier suppliers if applicable.
2. Supplier's order number if one has been assigned.
- 2.1 SRS specification or drawing number against which a deviation is being proposed.
3. Supplier's Part Number as applicable from the drawings, catalog, internal specification, etc.
4. Supplier's Part Name.
5. Date deviation detected and method used to detect deviation (NDE, dimensional, check, visual, etc.).
6. List all previous SDDRs and their dates that have been submitted for similar deviations requested on this purchase order.
7. SRS Purchase Order Number and Revision Number.
8. SRS Buyer Name.
9. SRS Purchase Requisition (item, part, tag or code) Number(s).
10. SRS Part Name, if one has been assigned.
11. Date and method (fax, letter, etc.) used to notify the SRS Supplier Surveillance Representative (SSR) whenever SRS Quality Surveillance is applicable. If the Purchase Requisition identified no requirements for Supplier Surveillance, enter "Not Required."
12. Date and method (fax, letter, etc.) used to notify SRS Engineering.
13. Describe the deviating characteristics and define the extent of the out-of specification condition for each identified piece affected. Identify the location of the deviation characteristic by print coordinates or specific location, as applicable. Attach reproducible quality extra sheets, sketches, photographs, etc., as necessary. When proposing a change in either supplier or SRS documents; describe the change; identify the documents completely including title or subject, date and revision; and where appropriate, attach a copy of areas in question.
14. State proposed disposition.
15. Enter cost impact that would result from proposed changes and which will be reflected in appropriate Procurement documents.
16. Enter delivery schedule impact that would result from proposed changes.
17. Describe the proposed disposition and provide technical (and where appropriate cost/schedule) justification for SRS evaluation. Attach reproducible quality copies whenever required. If the deviation is correctable by repair, submit a detailed repair procedure or reference

the procedure previously submitted and approved by SRS for use in similar situations. Provide supplier control number and procedure title. For documents, provide suggested corrective wording, procedures, documents, etc. Provide a copy of each SDDR attachment to the SRS SSR at the supplier's location.

18. Identify the nature of changes that may be needed on associated supplier documents (drawings, specifications, procedures, installation instructions, etc.).
19. Enter the name (typed or printed) and title of the supplier's representative authorizing the disposition request and have appropriate signature and date signed.
20. Check SRS Engineering disposition accepted or rejected. Provide justification for the acceptance or rejection in Block 22. Include the appropriate item description, end use, responsible division and functional classification.
21. When a disposition of "Use As-Is," "Repair," or "Modify SRS Requirement" is accepted for parts used in nuclear and nuclear support facilities, enter USQ/TSQ Document No. This may be a USQ Screening, USQ Evaluation, or Categorical Exclusion Document No. If the designated USQS or USQE was created prior to this SDDR and is being reused, then two USQ qualified engineers must sign approving this application. Reference 11Q, 1.05. TSQ screenings are performed in accordance with Manual 19Q, 4.05.
22. Provide appropriate justification for the SRS action(s) indicated in Block 20. When changes to drawings, specification, requisitions, or other SRS documents are involved, each document should be identified and the associated change briefly described. If other suppliers are affected, indicate who they are and the documents that initiated resolution of that involvement. "Other" follow-up action (e.g., the need for additional SRS calculations, additional drawings or sketches, inspection by SRS Engineering representative, etc.) should also be identified here. If SRS action is required, so indicate. State the verification/re-examination method to assure supplier action(s) were performed. This method is defined by the CTF and may be performed as defined by the process; for example, they may be performed by RI or the SSR. They may also be performed by document review or other method(s) defined by the CTF. Refer to baseline change procedures for baseline changes.
23. Originator - Signature of Responsible Engineer.  
Verifier/Checker - Signature of the Verifier/Checker reviewing the engineering action and the date signed.  
MGR - Signature of the SRS Department Manager and the date signed.  
CQF - Signature of the Cognizant Quality Function representative and the date signed.  
Buyer - Signature of the SRS Procurement and Materials Management Department representative acknowledging the SDDR.
24. Identify if an SRS Document Change requires incorporation. If "Yes" then identify the documents(s) requiring change.
25. Identify if an SRS Specification Change requires incorporation. If "Yes" then identify the SRS Specification requiring change.
26. Identify if a Baseline Change is required. If "Yes" then identify the Trend Number requesting the Baseline Change.
27. Identify if a Supplier Document Change requires incorporation. If "Yes" then identify the Supplier Document(s) requiring change.
28. Identify if any Other Document Change requires incorporation. If "Yes" then identify the Other Document(s) requiring change.
29. Identify if a Nonconformance Report is associated with this SDDR. If "Yes" then identify the NCR no.
30. Identify the Methods of Verification.
31. Identify any other Related Docs. If none, enter "N/A"
32. Identify any Additional Reviewer(s) required. If none, enter "N/A".
33. Identify if a Facility Operations Safety Committee (FOSC) review is required. If not required, enter "N/A".
34. Obtain DC/RO review if required. If not required, enter "N/A".
35. Upon completion of work, complete the "SDDR Disposition Supplier/Subcontractor Field Implementation" part of the SDDR including the name and signature of the Supplier Quality Manager and date. Include the completed SDDR with the Receipt Inspection Documentation or Subcontract close-out documentation.

**SUPPLIER DEVIATION DISPOSTION REQUEST #7 (10/17/19)**  
**SRNS PO 371219 - GEOSIERRA ENVIRONMENTAL, INC.**

17. Proposed Disposition and Technical Justification

ZVI-PRB Design Report – Section 6.1 presents the dimensions of the Iron PRB System, which is comprised of four segments with a total length of 264-LF and nominal 4-inch thickness. The northern section is 216-LF targeting 45 to 135 feet bgs and the southern section is 48-LF targeting 45 to 120-feet bgs. The PRB is constructed using eighteen injection well locations (F1 through F18) for the 90-foot high PRB and four injection well locations (F19 through F22) for the 75-foot high PRB. Section 5.3.1 discusses the vertical construction as panels A through F, where A targets 135 to 120 feet bgs; B targets 120 to 105 feet bgs; C targets 105 to 90 feet bgs; D targets 90 to 75 feet bgs; E targets 75 to 60 feet bgs; and F targets 60 to 45 feet bgs. F1 through F18 have six panels each (A through F) and F19 through F22 have five panels each (B through F).

Based on the above dimensions, approximately 692 tons of ZVI using a density of 180 lbs/cf is required to achieve a target effective iron thickness of 4-inches. As part of every PRB installation, GeoSierra orders the minimum ZVI required plus an additional 10% to account for potential broken supersacks during deliveries, potential bad gel batches where the ZVI is discarded; and the washout of the injection wells. For the SRNS P-Area PRB installation, 760 tons were assumed.

Prior to initiation of injection activities, GeoSierra allocated 5% (~34.5 tons) of the additional 10% ordered throughout the 128 casings comprising the PRB to account for washout of the injection wells, leaving 5% buffer remaining. Upon initiation of injections for all PRB projects, GeoSierra evaluates the installation by examining injection pressures and washout quantities. For A panel injections, minimal washout was being produced (approximately 3.3%). Hence, GeoSierra presented to SRNS the option to distribute ~3% of the remaining 5% buffer into higher TCE concentration areas (i.e., hot spots). SRNS produced a list of preferred areas designated as List 1 and List 2 in an email dated October 1, 2019 targeting 47 casings (email attached). SRNS also requested a reduction in the effective thickness of the uppermost F panel to 2-inches due to the minimal TCE concentrations. Hence, F panel will be injected with a volume achieving a 2-inch nominal thickness plus 3% ZVI of the remaining 5% buffer. The attached table depicts the reallocation of the ZVI to hot spots.

Additionally, during drilling activities CDS damaged the riser at F22. It was checked in the field, however, when placing the packer to depth for B panel injections, it wedged in the casing approximately 3-feet bgs. CDS attempted to repair the well by digging around F22, cutting the pipe and rewelding another riser. GeoSierra attempted to install the packer, and it wedged at approximately 62-feet bgs. After examining the packer with the camera, it was noted the bolts were sheared so the packer could not be removed. CDS mobilized a Geoprobe rig to the site to hammer the packer deeper but could only move it an additional 10-feet. After examining F22 with a camera, it is currently wedged at 73-feet bgs within the E casing.

As a result, F22 cannot be injected using casings B through E since a packer cannot be installed below the wedged packer to isolate the lower zones. GeoSierra reviewed resistivity images from F21 injections as well as field observations of pore pressure relief and has observed distribution towards F22. The below summarizes the redistribution of ZVI allocated originally for F22.

- B and C panel volumes redistributed to remaining 45 hot spots since F21 B and C were complete and TCE concentrations at F22 are lower
- D panel – half volume added to F21 D panel/half volume redistributed among remaining 45 hot spots
- E panel – half volume added to F21 E panel / half volume redistributed among remaining 45 hot spots
- F22 will be attempted to be filled with ZVI to bottom of F panel through wedged packer
- F panel volume will be injected

## Deborah Schnell GeoSierra

---

**From:** John.Harrie@srs.gov  
**Sent:** Tuesday, October 01, 2019 10:14 AM  
**To:** Deborah Schnell GeoSierra; Greg Filbey Geo Sierra  
**Cc:** seth.miller@srs.gov; Andrew.Murphy@srs.gov  
**Subject:** FW: ZVI Redistribution Direction

Hi Deborah and Greg,

Provided below is an injection scheme prepared by Mark and reviewed by the technical team for your review and consideration. The plan would basically redistribute ZVI to those wells where TCE levels are higher potentially using the 5% designated as waste and a reduction of the wall thickness in Panel F. This scheme would allow a more focused use of all the iron while leaving an end of injection contingency. If GeoSierra finds this approach to be acceptable, an SDDR would be needed to document acceptance. We can discuss this during our next weekly meeting this Thursday (10/3/19) or at your convenience.

Thanks,  
John

Per the teleconference on September 26, 2019, it is SRS's understanding that GeoSierra would like to use the remaining 5% of the 10% considered "waste" and redistribute it amongst those Frac wells that are installed within the zones of higher TCE contamination. SRS agrees with the approach and would like to recommend the following list of wells to be considered for additional injections of iron. The following list provides a hierarchy of wells to be considered for additional injections. The first list (List 1) should be considered the primary wells and if additional ZVI is available then the second list (List 2) of wells could also receive injections.

List 1: F12E to F19E  
F05D to F12D, F15D to F20D  
F05C to F15C

List 2: F10E, F11E, F20E, F21E  
F02D to F04D, F13D, F14D,  
F21D  
F02C-F04C, F16C

In addition to the 5%, SRNS would also like to propose for GeoSierra's consideration reducing the PRB thickness in Panel F from 4-in to no less than 2-in in wells F01-F22 and re-distribute that iron in amongst those wells in Lists 1 and 2. This would allow GeoSierra the ability to manage more iron for injection into those higher TCE contaminated zones without having to worry about whether or not there would be sufficient iron for the remainder of the wall as part of the 10% waste. If elected to do this, a SDDR must be completed and approved to account for the design change in the F panel wells. The technical team feels that based on the current contamination levels present at this Panel, reducing the wall thickness will not affect the wall performance or overall effectiveness of the wall in managing the TCE contamination. Additionally water level fluctuations should not affect the TCE concentrations within Panel F since the majority of the TCE is exhibited in low permeability sediments at depth.

If you have any questions or want further clarification, please don't hesitate to call or send an email.

MB Amidon  
SRNL-ERTS/Geosciences  
Sent via mobile device  
o: 803.725.8251 c: 803.645.0878

Table 6. PRB Construction Quantity Panel Summary. SRNS; Savannah River Site P-Area. Aiken, SC

Frac Casing No.	Panel Targets						To Date Quantity of Iron Injected (Pounds)	Quantity Iron Remaining for Injection (pounds)	Target Plus Adjusted F Panel and Hot spots (Pounds)	To Date Percent Complete
	A	B	C	D	E	F				
<b>ALL PANELS (Approx. 45' - 135' BGS)</b>										
F-1	11,340	11,340	11,340	11,340	11,340	7,473	27,680	36,493	64,173	46.60%
F-2	11,340	11,340	15,347	15,347	11,340	7,473	29,352	42,835	72,187	49.41%
F-3	11,340	11,340	15,347	15,347	11,340	7,473	28,680	43,507	72,187	48.28%
F-4	11,340	11,340	15,347	15,347	11,340	7,473	29,680	42,507	72,187	49.97%
F-5	11,340	11,340	15,347	15,347	11,340	7,473	27,680	44,507	72,187	46.60%
F-6	11,340	11,340	15,347	15,347	11,340	7,473	27,680	44,507	72,187	46.60%
F-7	11,340	11,340	15,347	15,347	11,340	7,473	26,680	45,507	72,187	44.92%
F-8	11,340	11,340	15,347	15,347	11,340	7,473	29,680	42,507	72,187	49.97%
F-9	11,340	11,340	15,347	15,347	11,340	7,473	27,680	44,507	72,187	46.60%
F-10	11,340	11,340	15,347	15,347	15,347	7,473	27,680	48,514	76,194	46.60%
F-11	11,340	11,340	15,347	15,347	15,347	7,473	28,680	47,514	76,194	48.28%
F-12	11,340	11,340	15,347	15,347	15,347	7,473	29,680	46,514	76,194	49.97%
F-13	11,340	11,340	15,347	15,347	15,347	7,473	28,682	47,512	76,194	48.29%
F-14	11,340	11,340	15,347	15,347	15,347	7,473	27,680	48,514	76,194	46.60%
F-15	11,340	11,340	15,347	15,347	15,347	7,473	28,680	47,514	76,194	48.28%
F-16	11,340	11,340	15,347	15,347	15,347	7,473	28,680	47,514	76,194	48.28%
F-17	11,340	11,340	11,340	15,347	15,347	7,473	27,680	44,507	72,187	46.60%
F-18	11,340	11,340	11,340	15,347	15,347	7,473	28,180	44,007	72,187	47.44%
F-19		11,340	11,340	15,347	15,347	7,473	17,340	43,507	60,847	35.68%
F-20		11,340	11,340	15,347	15,347	7,473	15,340	45,507	60,847	31.56%
F-21		11,340	11,340	20,261	20,261	7,473	17,340	53,335	70,675	35.68%
F-22		0	0	0	0	7,473	0	7,473	7,473	0.00%
Iron Subtotal	204,120	238,140	298,245	323,194	291,138	164,406	560,434	958,809	1,519,243	45.92%
Total Iron Tons	102.06	119.07	149.12	161.60	145.57	82.20	280	479.4	760	

\*Note: Yellow highlighted areas represent hotspots.

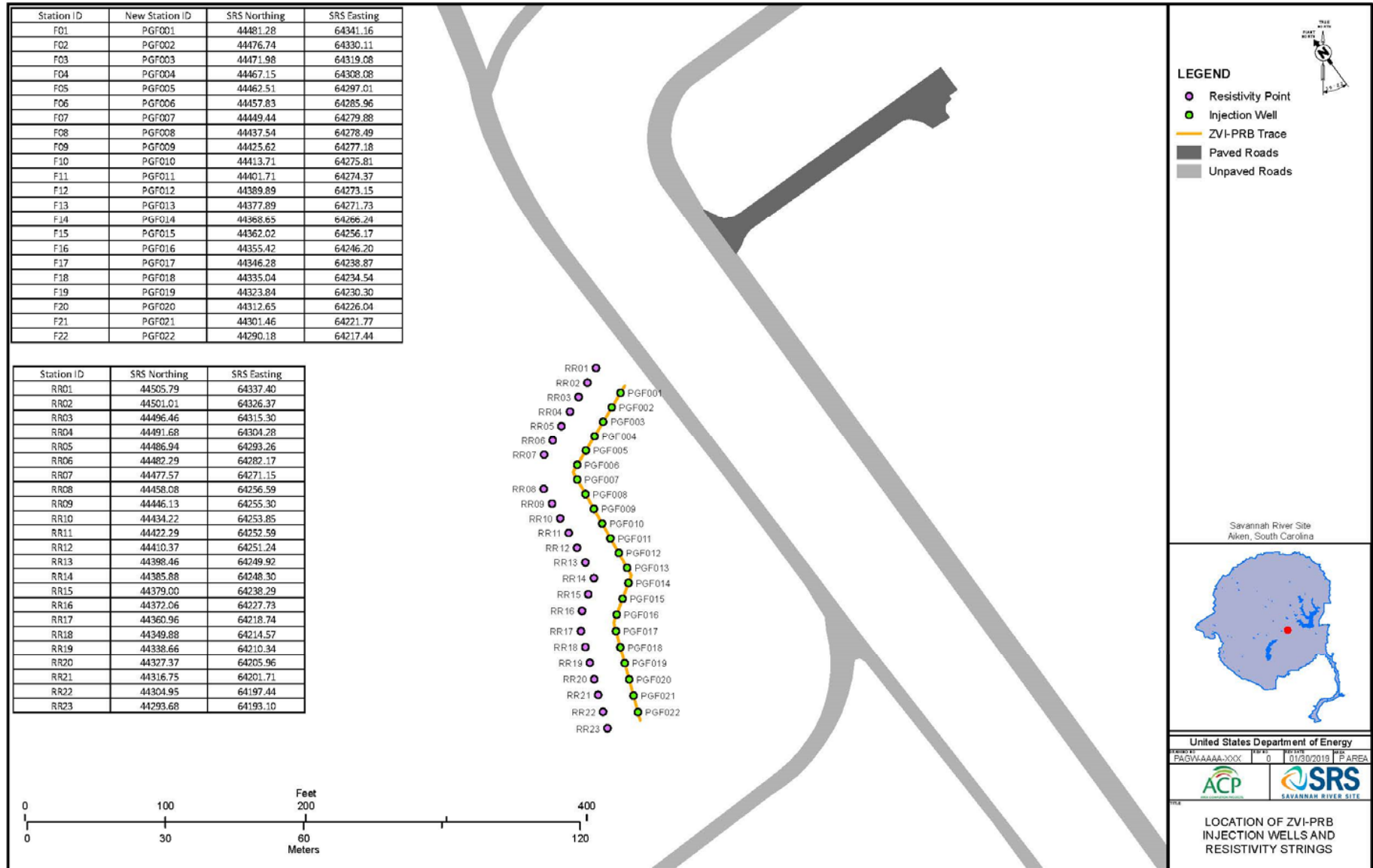
PRB Design Changes/Notable Events
8/7/19 - Increase 4" target per panel (10,800 lb) to include 5% to account for washout
10/8/19 - Adjust 3% remaining ZVI in select hot spots in B-F
10/10/19 - F Panel - 2" target & 3% overall waste + 2% distributed over SRNS hot spots
10/10/19 - All of F22 Panels B/C and half of F22 Panels D/E distributed over SRNS hot spots. Half of F22 Panels D/E added to F21 Panels D/E.

**APPENDIX J**

**ZVI-PRB As-Built Layout Drawings**

**APPENDIX J.1**

**PAGW OU NTC RA As-Built of Resistivity Strings and Injection Wells, Plan View**



**APPENDIX J.2**

**PAGW OU NTC RA As-Built of Monitoring Wells in Support of the EMP, Plan View**

Station ID	SRS Northing	SRS Easting
PRW001C	44429.78	64299.36
PRW001DL	44441.75	64301.85
PRW001DU	44452.30	64301.18
PRW002C	44439.74	64260.28
PRW002DL	44450.90	64262.17
PRW002DU	44461.05	64265.43
PRW003C	44363.87	64295.12
PRW003DL	44391.73	64291.38
PRW003DU	44349.84	64286.90
PRW004C	44385.76	64250.06
PRW004DL	44395.91	64253.32
PRW004DU	44369.52	64246.54
PRW005DL	44489.34	64310.53
PRW005DU	44486.36	64300.94
PRW006C	44498.37	64156.82
PRW006DL	44494.46	64165.54
PRW006DU	44492.17	64175.46
PRW007DL	44319.58	64186.54
PRW007DU	44328.41	64189.89
P002U	44415.87	64250.08
P003U	44391.50	64351.34
P003L	44395.76	64352.37
PIW001D	44462.51	64297.01
PIW002D	44401.71	64274.37
PIW003D	44346.28	64238.87
PIW004D	44301.46	64221.77



**LEGEND**

- ZVI-PRB Trace
- EMP Monitoring Wells
- Paved Roads
- Unpaved Roads

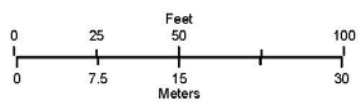
Savannah River Site  
 Aiken, South Carolina

United States Department of Energy

PROJECT	NO. 0	DATE	01/30/2019	AREA
PAGW/AAAAA-000				

ACP  
 SAVANNAH RIVER SITE

EMP MONITORING  
 WELL LOCATIONS



**APPENDIX J.3**

**PAGW OU NTC RA As-Built of the ZVI-PRB Trace, Plan View**

