Memorandum For: **Ms. Lee Ann Smith, Chair, POWER Action Group**
Protecting Our Water and Environmental Resources

From: FSA **Frank Anastasi, P.G., Community Technical Advisor**
(NC LG-2459; PA PG-2605; WY PG-2001;)

Date: **March 2, 2018**

Subject: **Status Update: Interim Remedial Action at TCE Source Areas**
CTS of Asheville Superfund Site
235 Mills Gap Rd., Asheville, Buncombe County, NC

Introduction

The U.S. Environmental Protection Agency (EPA) issued the Record of Decision (ROD) for the Interim Remedial Action at the CTS of Asheville Superfund Site on February 11, 2016. The remediation will attack the residual mass of contamination that is present beneath the former manufacturing plant and nearby. This work is focused on the non-aqueous phase liquid (NAPL) and dissolved-phase trichloroethylene (TCE) in the subsurface soil and ground water above the bedrock.

EPA published a fact sheet (https://semspub.epa.gov/work/04/11095198.pdf) about the interim remedial action that includes graphic depictions of the technologies and basic descriptions of how they will work. My March 25, 2016 memorandum reviewed the ROD and summarized site conditions, EPA's evaluation of potential clean-up options, and the technologies selected to accomplish the remediation.

The March 7, 2017 Consent Decree between EPA and CTS Corporation, Mills Gap Road Associates, and Northrup Grumman Systems Corporation set in motion the design and construction of the equipment and facilities for the interim remedial action. Soil and ground water sampling to obtain final design data commenced in May 2017; field work to prepare the site and install facilities and equipment for one remedial system began in October 2017 and is nearing completion. A treatability study (TS) is underway for another technology planned to be used at another portion of the site.

This memorandum gives additional details about the design and construction of the remediation systems, the current status of the work, and the schedule for implementation. It is based on my knowledge of the work to be done, my review of the available planning/design documents, and several interviews with Craig Zeller, EPA's Remedial Project Manager, over the past few months as the work has progressed.

Background

TCE was used in the former plant at the site as a cleaner and degreaser. Although the NAPL is primarily residual petroleum (weathered fuel oil released from boiler operations), TCE makes up as much as 35 percent of it. The heaviest contamination is present in the soil beneath part of the former manufacturing building foundation and nearby to the south, below an area of about 1.2 acres (known as the Source Area). Extremely high levels of TCE exist at the Source Area (e.g., 42,000 ug/L in ground water and 830,000 ug/kg in soil).

Significant residual contamination is present also beyond the Source Area to the north almost to Mills Gap Road, under an additional area of about 1.9 acres (referred to as the Northern Area). The Source Area will be treated using electrical resistance heating (ERH); the Northern Area will be treated with in-situ chemical oxidation (ISCO). Figure 1 from the ROD (attached) shows these two areas and the surrounding site.

ERH Remedial Design and ISCO Treatability Study Work Plan

AMEC Foster Wheeler (AMEC) recently prepared the following two documents that describe how the ERH will be implemented, and how the TS will be conducted to provide final design information for implementing the ISCO remediation:

- Final Remedial Design for Electrical Resistance Heating, November 27, 2017
- In-Situ Chemical Oxidation Treatability Study Work Plan, November 7, 2017

EPA has approved the ERH remedial design (RD) and the ISCO Treatability Study Work Plan (WP). The RD lays out design criteria and remedial approach; system layout and specifications; operation and maintenance information; monitoring and control measures to protect human health and the environment; construction quality assurance and control measures; performance monitoring objectives and procedures; and a revised remedial action schedule. Table 1 of the RD presents the main design parameters and system components; Figure Y-1 in Appendix C of the RD shows the site plan and ERH equipment layout. The table and figure are attached to this memorandum.

The WP explains how the ISCO treatability study will test performance of the process on a small scale, generating critical information to confirm that ISCO will work, and to develop the final design for full scale ISCO implementation. Figure 3 from the WP (attached) shows the ISCO area and layout of the injection and monitoring wells.

<u>ERH at the Source Area</u>

CTS retained TRS Group, Inc. to construct and implement the ERH. The remedial action objective (RAO) for the ERH project is to remove at least 95 percent of the TCE in soil, ground water, and NAPL in the subsurface treatment zone. Appendix C of the RD is TRS' Final Design, Execution, and Operation & Maintenance Plan, which contains all of the required specific plans and specifications for the ERH. Detailed design and construction specifications are included in the TRS document, including numerous diagrams that illustrate how the various facilities will be configured and how the processes will work.

Electrodes will be placed into the ground over the 56,100 square-foot Source Area. An alternating-current voltage applied to the electrodes will induce an electric current into the ground. The moisture in the ground conducts electricity throughout the area, which heats up the ground and actually boils the water in the subsurface. TCE and other volatile compounds and petroleum hydrocarbons present in the soil and ground water will transition into the vapor phase and be collected by recovery wells. An estimated 20,000 lbs. of VOCs are expected to be removed from the subsurface treatment zone (having an estimated volume of 47,250 cubic yards) over 90 to 120 days of heating operations.

The recovered vapors will be treated above ground by a regenerative thermal oxidizer to destroy TCE and other VOCs. The treated airstream will then be discharged into the air. Liquid condensate collected with the vapors will be treated also, and the treated water recycled back into the ground at the electrodes to enhance performance of the ERH process. The system is designed to segregate any NAPL that potentially may be collected with the vapors so it can be stored and transported off-site for proper treatment/disposal. Contingent plans are included for treatment of the recovered vapors by granular activated carbon if VOC concentrations become low enough as the projects nears completion (instead of the thermal oxidizer).

The design called for 229 electrodes to be installed across the Source Area treatment zone (but recently this was modified to total 227). The electrodes will be installed through borings made into the soil to the top of the bedrock (up to about 50 feet). Some of the electrodes will be installed through angle borings so the contaminated area beneath a small parcel of adjacent, off-site property can be treated. Vent wells (used to collect the vapors created by the heating process) will be installed alongside each electrode. Temperature monitoring points (TPMs) will be installed in the ground at 18 locations to monitor the earth's response to the ERH.

Performance of the ERH will be monitored by sampling NAPL, ground water, saturated soil, and air during the project. Twenty-two wells will enable collection of shallow and deep ground water; approximately 45 soil samples will be collected from shallow, intermediate, and deep depths at 15 locations; and up to five samples of NAPL will be collected from wells where it is observed.

Baseline sampling will determine arithmetic averages of TCE in soil, NAPL and ground water before heating commences. Confirmation post-treatment samples will be collected when operational monitoring indicates that the goal has been reached. EPA must concur when TRS determines that the RAO appears to have been reached (and therefore when post-treatment samples should be collected). EPA will determine if the RAO has been successfully achieved based on the post-treatment sample analytical results; additional heating would be required if the RAO is not met.

Baseline ambient air samples will be collected before heating commences at four perimeter monitoring locations, and continuous air monitoring will be performed during heating. Additional air monitoring will be performed around the source area during construction and operation using hand-held devices. The airstream discharged from the thermal oxidizer will be monitored continuously during operation, and discreet air samples will be collected at frequent intervals during the heating process to document compliance with air-discharge limitations.

ISCO at the Northern Area

ISCO will be used to reduce dissolved-phase TCE concentrations in ground water above the bedrock at the 1.9-acre Northern Area. Potassium permanganate will be injected into the subsurface to provide a source of oxygen that will promote chemical breakdown of TCE in the ground water. The RAO is to reduce TCE concentrations in groundwater in the Northern Area by 95 percent.

The injected permanganate treats the ground water in two ways. First, the sand and permanganate forced into the soil should be more permeable that the surrounding natural soil. Ground water will flow through these higher-permeability zones, coming into contact with the permanganate, which will react with the TCE to break it down. Secondly, over time the solid permanganate will dissolve into the ground water, and the dissolved portion of the permanganate will also break down TCE in the ground water beyond the actual zones where the injected slurry penetrates.

This results in essentially a two-stage TCE-destruction process -- early treatment of TCE in the zones where permanganate slurry has been injected, and longer-term treatment throughout the aquifer, beyond the slurry injection zones, where the dissolved permanganate becomes distributed in the ground water.

EPA estimated in the ROD that about 161,000 cy of saturated soil in the Northern Area will be treated with ISCO. More than one phase of ISCO slurry injection will be required to treat the ground water in some parts of the Northern Area to achieve overall 95 percent reduction of TCE in the ground water. Follow-up injections would target zones where TCE was not reduced adequately, based on soil and ground water sampling.

The WP presents the following objectives of the ISCO TS:

- Evaluate the distribution of the injected/emplaced potassium permanganate;
- Evaluate the diffusive zone created from the potassium permanganate;
- Evaluate TCE concentrations downgradient of the emplacements; and
- Collect/interpret data for implementation of the full-scale ISCO remedial design.

CTS contracted with FRx, Inc., an environmental injection contractor, to perform the TS. Field work began in late January 2018. The TS is being conducted in the north-central area of the Site within the Northern Area, beyond and downgradient of the ERH Source Area, in the vicinity of the ground water divide (where ground water flow diverges and flows to the east and to the west). Existing monitoring wells MW-7 and MW-7A are located in the TS area. Three new injection wells and eight new monitoring wells have been installed in and around the area.

VOC concentrations in ground water samples and geochemical parameters of the subsurface materials were determined in pre-treatment baseline sampling. Monitoring wells were installed in pairs, with one shallow and one deep well at each location. Based on the baseline sampling data that was collected, the treatment zone will extend from approximately 30 feet below ground surface (bgs) to the top of bedrock. At MW-7A, the top of bedrock was encountered at 72 feet bgs.

Seven emplacement zones were constructed in each injection well, in the saturated soil and highly-weathered bedrock, separated by approximately 6-foot vertical intervals. A high velocity water jet cut the PVC well casings and grout and created a void in the surrounding soil at each depth interval. The potassium permanganate slurry was injected through these perforations and into the voids. The injected slurry is expected to have penetrated about 15 to 20 feet radially out from the well into the surrounding soil. The table on page 16 of the WP details design criteria for each of the permanganate emplacements.

Ground water and soil samples will be collected and analyzed over the next nine months to determine how well the permanganate was distributed in the subsurface, and how effective it has been in reducing TCE. Precautions are being taken to ensure that the process does not cause unacceptable adverse consequences. Monitoring wells will be installed between the Northern Area and the eastern and western springs to look out for ground water with permanganate migrating towards the springs. If migration is observed, actions would be taken to reduce the oxidizing potential of the ground water to normal levels. Air and liquids will be monitored during the action to ensure unacceptable levels of contaminants are not released into surface waters or the air.

Current Status and Schedule of ERH and ISCO Activities

A copy of the schedule for the interim remedial action is included in the RD and attached to this memorandum. CTS posts weekly status updates online at http://www.ctsofasheville.com/news/

So far, the ERH work has progressed as planned. As of the end of February, approximately 185 electrodes had been installed (out of the total 227); 15 of the planned 18 temperature monitoring points had been installed; and new monitoring wells had been installed. Electrode installation work will be paused in early March to enable the power company to install equipment to bring electricity to the site.

Treatment system equipment and components are being shipped to the site for assembly and installation. Once the complete system is constructed and tested, the active heating of the subsurface will commence (by May 2018). Heating/treatment is scheduled to continue for about five months, and be completed in September 2018.

The ISCO TS permanganate injections/emplacements were conducted in January 2017, with follow-up work conducted through early February 2018. The planned amounts of permanganate slurry were successfully injected into the subsurface at all intervals in each of the three emplacement wells.

The first of three quarterly ground water sampling events for the TS will occur soon (anticipated in April 2018), to monitor the reduction of TCE in ground water and distribution of permanganate in the subsurface. Soil samples will be collected around each injection well about five months after injection to examine the extent of residual permanganate in the soil.

An ISCO TS report will be submitted to EPA after results of testing on the third round of ground water samples become available (around the end of 2018/early 2019). The report will present all of the data generated in the TS and provide recommendations for design of the full-scale ISCO remediation.

EPA estimated in the ROD that full-scale ISCO will require about 59 injection wells, with each cut at up to seven depths to create the emplacement zones. The wells will be spaced about 30 to 40 feet apart across the 1.9-acre treatment area. Implementation of the ISCO is projected to take about 10 months; it will take 2 to 3 additional years before TCE levels in ground water in the treatment zone reach the desired 95 percent reduction.

Air Monitoring

EPA published a fact sheet in December 2017 to address citizen's concerns about potential releases of VOCs into air that might be caused by the ERH work, and possible migration to off-site areas. The fact sheet details precautions that will be taken, safeguards built into the ERH system, and air monitoring that will be conducted to document ambient air quality along the perimeter of the site and detect potential VOC migration. CTS agreed to enhance the planned air monitoring program to include perimeter monitoring with hand-held sensors in addition to four fixed perimeter monitoring stations.

Mr. Zeller informed me that to date, air monitoring on the site and around its perimeter has not detected any VOCs at levels of concern. Mr. Zeller also reported that air monitoring at on-site drilling locations for personnel health-and-safety has not detected VOCs at levels that would have required workers to don air-purifying respirators. He also informed me that the most recent routine, ambient air monitoring at the off-site springs areas to the east and to the west found lower levels of VOCs than in the previous monitoring event (unrelated to the site work, this is due to natural phenomena such as fluctuations in precipitation infiltration and ground water recharge, flow, and discharge conditions).

Observations and Conclusions

CTS and its contractors appear to be fulfilling all of their responsibilities to implement the ERH and ISCO remediation work. Both of these projects are proceeding as planned and on-schedule. Mr. Zeller reports that he is very pleased with the knowledge, experience, and productivity of the contractors performing the work so far.

It is important to note that air monitoring is confirming that the site work is not causing any significant release of VOCs from the site into the air, not only around the site perimeter but on-site as well. Although not currently included in the weekly updates posted by CTS on its project website, I suggested to Mr. Zeller that a succinct summary of the results of air monitoring (e.g., "No VOCs were detected at any perimeter monitoring point this week.") would add value to the status updates. I believe such reporting would be welcomed by interested members of the community.

As the ERH construction activities are approaching completion, Mr. Zeller and I discussed the idea of a site visit/meeting that could take place just before the ERH system is activated. This would likely be in mid-late April, and I will follow-up with POWER and EPA to explore opportunities for leveraging such a meeting to further inform the community about the actual start of remedial action.

I trust that this memorandum helps POWER and the community to understand what is happening at the site now, what the ERH and ISCO remedial actions will entail and their current status, and what should be expected over the next few years as they are implemented. I will continue to monitor progress and will bring any new developments to your attention.

Feel free to contact me if you have any questions or to discuss this matter further.

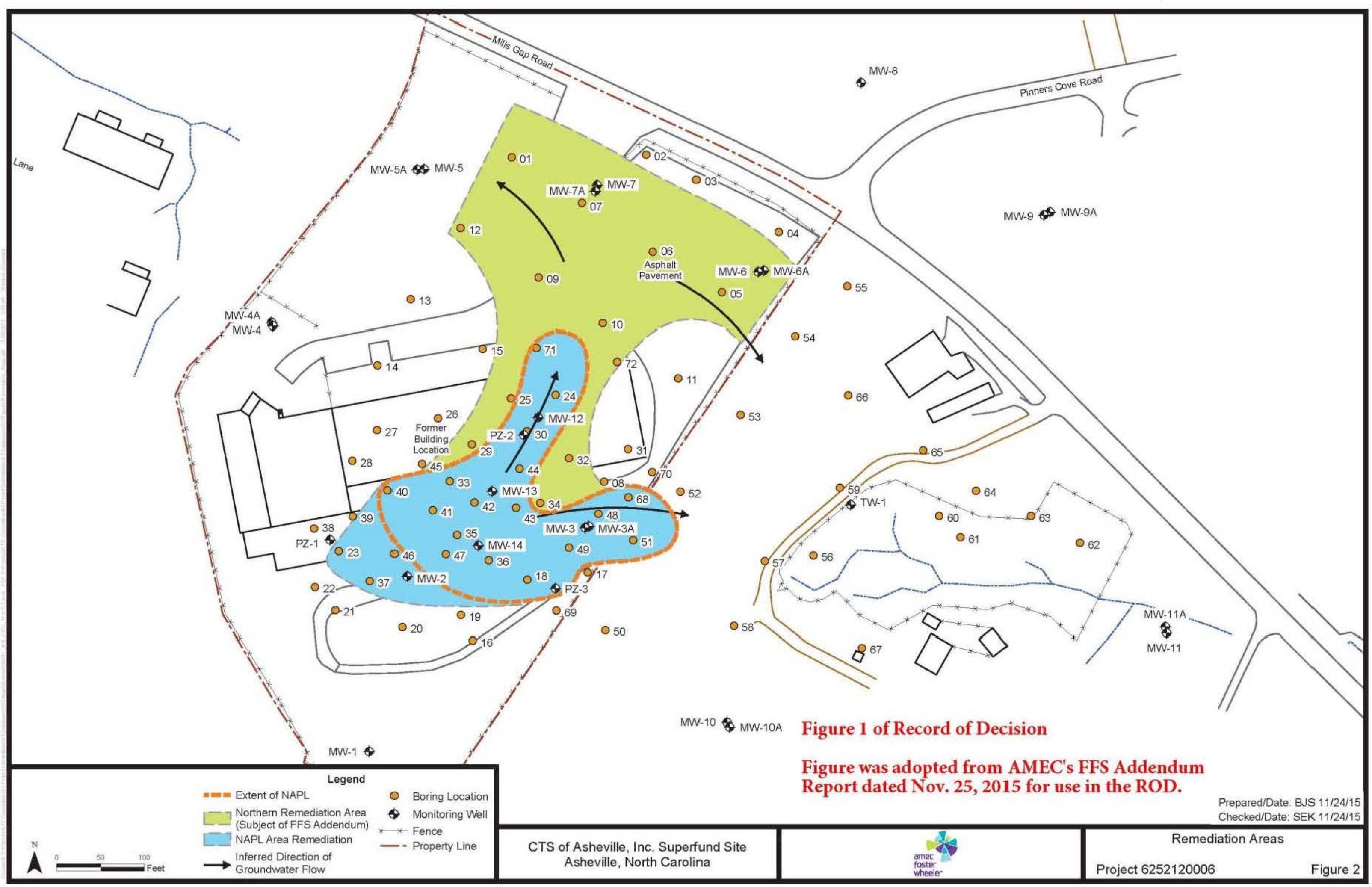

Mills Gap Road
Pinners Cove Road
Lane
Asphalt Pavement
Former Building Location
MW-1
MW-2
MW-3 MW-3A
MW-4A MW-4
MW-5A MW-5
MW-6 MW-6A
MW-7A MW-7
MW-8
MW-9 MW-9A
MW-10 MW-10A
MW-11A MW-11
MW-12
MW-13
MW-14
PZ-1
PZ-2
PZ-3
TW-1
Figure 1 of Record of Decision
Figure was adopted from AMEC's FFS Addendum Report dated Nov. 25, 2015 for use in the ROD.
Legend
Extent of NAPL
Northern Remediation Area (Subject of FFS Addendum)
NAPL Area Remediation
Inferred Direction of Groundwater Flow
Boring Location
Monitoring Well
Fence
Property Line
N
0 50 100 Feet
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Prepared/Date: BJS 11/24/15
Checked/Date: SEK 11/24/15
Remediation Areas
Project 6252120006
Figure 2

Table 1: ERH Design Parameters and System Components

Treatment area	56,100 sf
Treatment volume	47,250 cy
Anticipated depth to groundwater	14 to 26 feet bgs
Anticipated depth to auger refusal	28 to 47 feet bgs
Estimated VOC mass	20,000 pounds
Estimated soil moisture	17 percent
Estimated soil resistivity	110 Ω-m
Electrode spacing	17 feet
Electrodes	229
Vapor recovery wells	229 (co-located with electrodes); 2 vapor-only recovery wells
Temperature monitoring points	18 locations
Total energy, incl. treatment equipment	8,510,000 kWhr
Average energy density	175 kWhr/cy
Vapor treatment	Regenerative thermal oxidizer (or potentially, granular activated carbon near the end of the expected treatment period)
Condensate treatment	Liquid granular activated carbon
Days of operation	90 to 120

sf – square feet; cy – cubic yards;
bgs – below ground surface
Ω-m – ohm-meters; kWhr – kilowatt-hours

A Final Design, Execution, and Operation & Maintenance Plan (Final Execution Plan) has been prepared by TRS (Appendix C). The Final Execution Plan describes the components of the ERH heating and vapor/water treatment systems. The Final Execution Plan also contains drawings, descriptions of operation and maintenance (O&M) activities, and safety procedures.

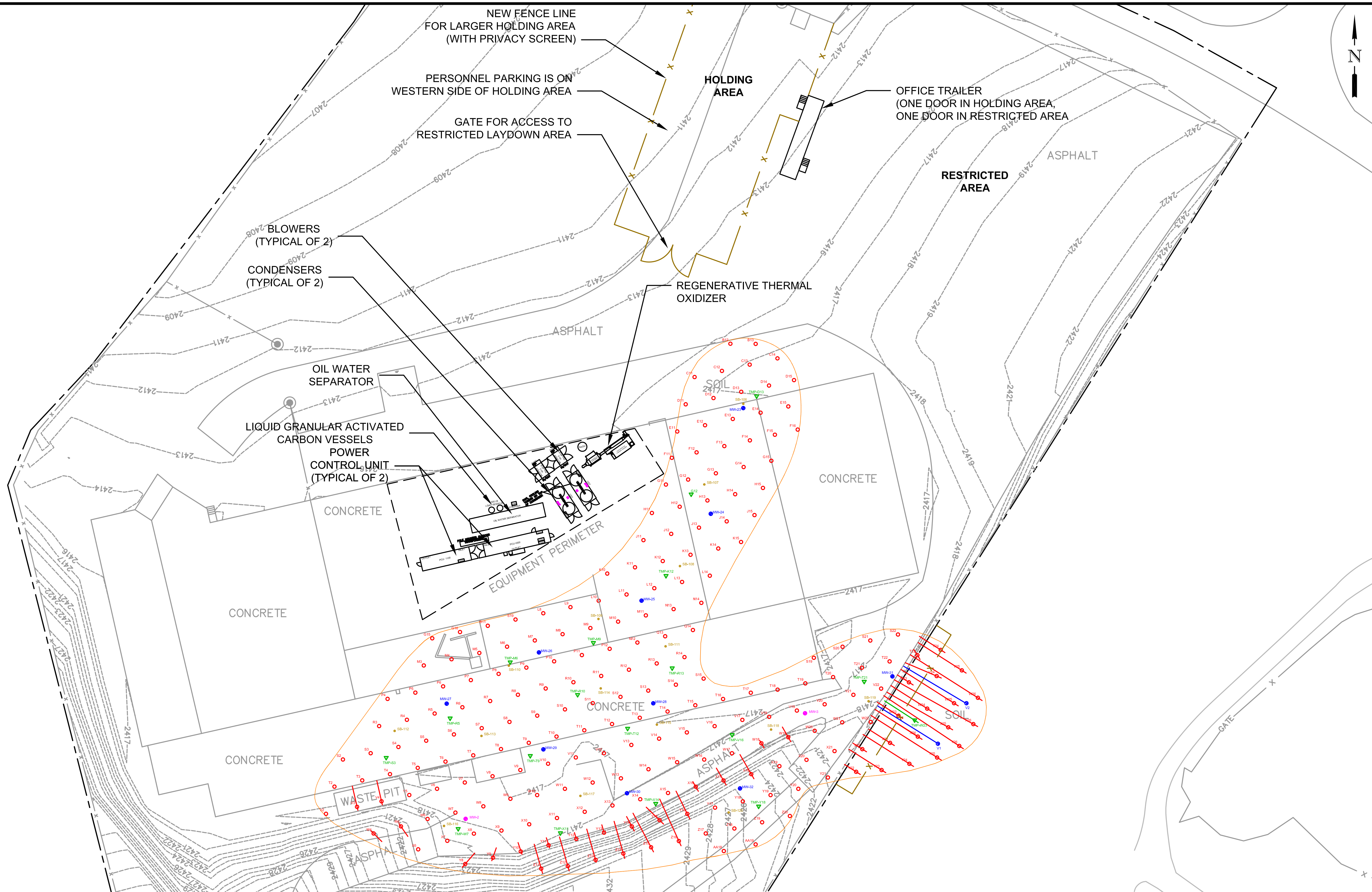
A Construction Quality Assurance/Quality Control Plan was also developed to evaluate and confirm that overall project management is maintained, production and quality are in compliance with project requirements, and construction deficiencies are identified and corrected in a timely manner. The ERH Construction Quality Assurance/Quality Control Plan is included in Appendix D.

APPROVED

For Construction

NORTH CAROLINA PROFESSIONAL SEAL 041303 ENGINEER DANIEL OBERLE

Daniel Oberle 11/27/17
ENGINEER SIGNATURE / DATE



LEGEND

- ○ VERTICAL ELECTRODE (QTY. 186)
- ANGLED ELECTRODE (QTY. 43)
- ▽ TEMPERATURE MONITORING POINT (18)
- SB-1 ● SOIL BORING (15)
- MW-1 MONITORING WELL CLUSTER (10)
- MW-2 EXISTING MONITORING WELLS (2)
- V1 ANGLED VAPOR RECOVERY WELL (2)

0 30 60 120
SCALE IN FEET

TRS Accelerating Value

TRS GROUP, INC. 338 COMMERCE AVE., SUITE 304, LONGVIEW, WA 98632

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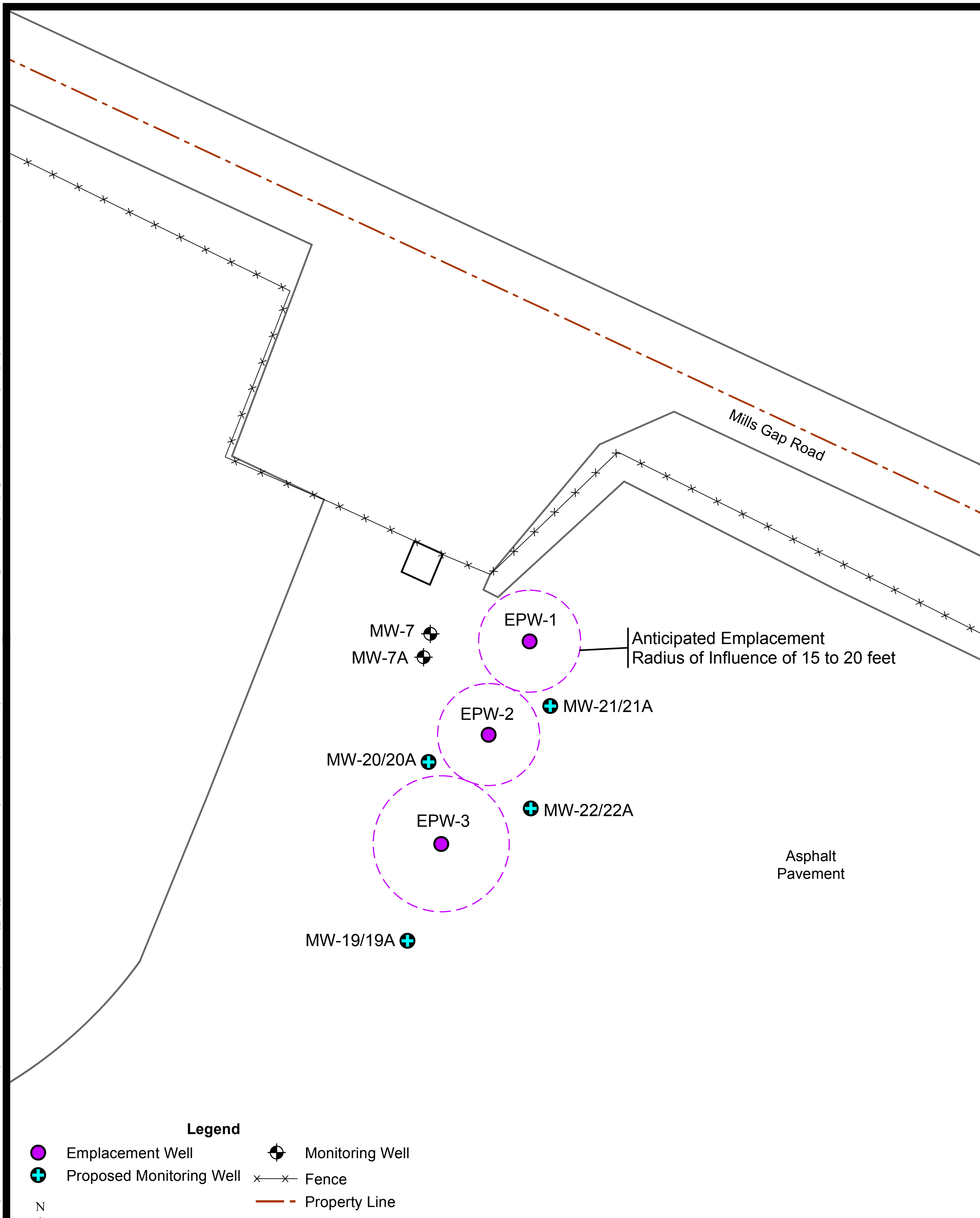
DESIGNED BY	E. CROWNOVER
DRAWN BY	A. PEABODY
CHECKED BY	D. OBERLE
PROJECT MANAGER	C. BLUNDY
QSAT REVIEW	2017.NOV.27

SITE	CTS OF ASHEVILLE SUPERFUND SITE
LOCATION	ASHEVILLE, NORTH CAROLINA
CLIENT	CTS CORPORATION

SITE PLAN WITH ELECTRODE LAYOUT

APPROVED FOR CONSTRUCTION
BY ______
DATE ______

DATE 2017.NOV.20 | PROJECT NC.ASH.1821
SHEET Y-1



Prepared/Date: BRP 11/02/17
Checked/Date: SEA 11/02/17

CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

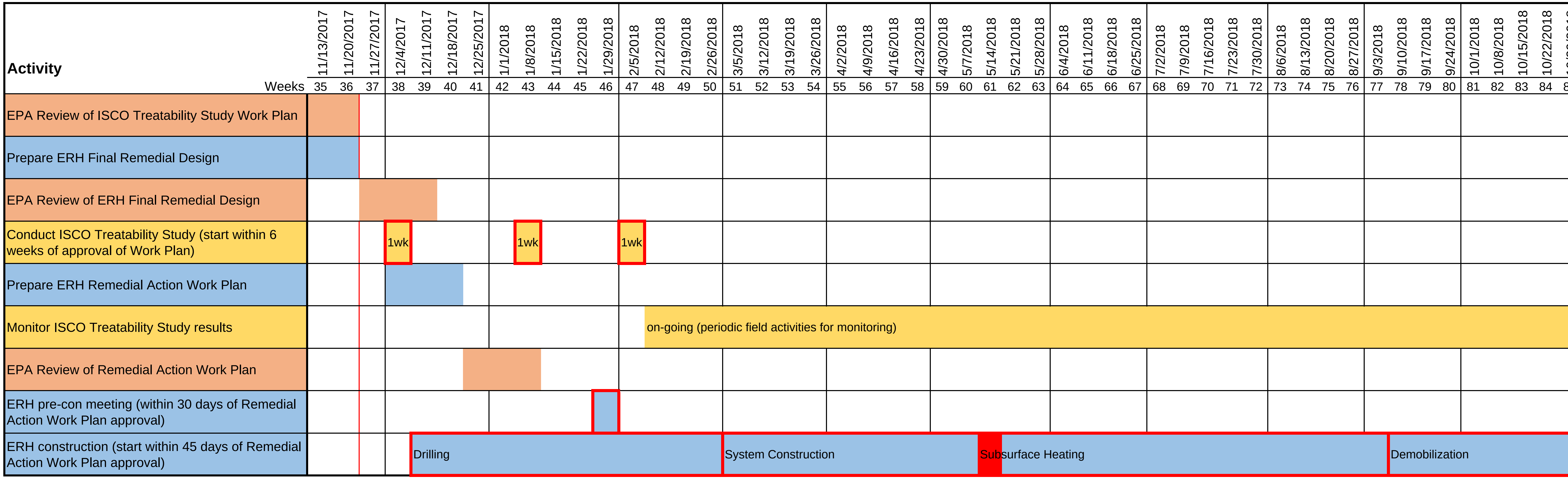
amec foster wheeler

Proposed Treatability Study Layout

Project 6252162012

Figure 3

CTS OF ASHEVILLE, INC. SUPERFUND SITE
SCHEDULE FOR INTERIM REMEDIAL DESIGN/REMEDIAL ACTION



Notes:
The schedule is based on indicated period for EPA approval or conditional approval of submittals without significant revisions, and is dependant on weather conditions and equipment availability, as applicable.
The project deliverable submittal dates shown above meet the stipulated schedules listed in the Consent Decree.
Schedule based on notice to proceed from EPA (approval of Coordinator and Contractor) received on March 20, 2017, and approval of Remedial Design and Pre-Design Investigation Work Plans on May 1, 2017.
Date indicates the beginning of the week (period of work).

ERH - Electrical Resistance Heating
ISCO - In Situ Chemical Oxidation
EPA document review and finalization period
Field activities/site visits are in red outline