NAPL AREA FOCUSED FEASIBILITY STUDY REPORT

CTS OF ASHEVILLE, INC. SUPERFUND SITE

235 Mills Gap Road
Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762

Prepared for:

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Amec Foster Wheeler Project 6252-12-0006

July 31, 2015

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July 31, 2015

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Subject: **NAPL Area Focused Feasibility Study Report**
CTS of Asheville, Inc. Superfund Site
235 Mills Gap Road, Asheville, Buncombe County, North Carolina
EPA ID: NCD003149556
CERCLA Docket No. CERCLA-04-2012-3762
Amec Foster Wheeler Project 6252-12-0006

Dear Mr. Zeller:

Please find attached the Non-aqueous Phase Liquid (NAPL) Area Focused Feasibility Study (FFS) Report for the above-referenced Site. Amec Foster Wheeler Environment & Infrastructure, Inc. prepared this NAPL Area FFS Report on behalf of CTS Corporation in accordance with the Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study between the United States Environmental Protection Agency Region 4 and CTS Corporation (effective date of January 26, 2012).

If you have questions regarding this NAPL Area FFS Report, please contact us at (828) 252-8130.

Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

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ACRONYMS

AOC	Administrative Order on Consent
API	American Petroleum Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CHP	catalyzed hydrogen peroxide
cis-1,2-DCE	cis-1,2-dichloroethene
cm/sec	centimeter/second
COC	contaminant of concern
CSAP	Confirmation Sampling and Analysis Plan
DPT	direct-push technology
DRO	diesel range organics
EC	engineering control
ECD	electron capture detector
EPH	extractable petroleum hydrocarbons
ERH	electrical resistance heating
FFS	Focused Feasibility Study
GRA	general response action
HASP	Health and Safety Plan
IC	institutional control
IDW	investigation derived waste
IFT	interfacial tension
ISCO	in-situ chemical oxidation
kWh/yd^3	kilowatt-hours per cubic yard
Kow	octanol-water coefficient
LIF	laser induced fluorescence
LNAPL	light non-aqueous phase liquid
MCL	Maximum Contaminant Level
MDL	method detection limit
MGRA	Mills Gap Road Associates
MPE	multi-phase extraction
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter
NAPL	non-aqueous phase liquid
NCDENR	North Carolina Department of Environment and Natural Resources
NCGS	North Carolina Geological Survey
NCP	National Contingency Plan
NPL	National Priorities List
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
PID	photoionization detector
PWR	partially weathered rock
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
REAC	Response Engineering and Analytical Contract

RML	Removal Management Level
RSL	Regional Screening Level
SVE	soil vapor extraction
SVOC	semivolatile organic compound
1,1,1-TCA	1,1,1-trichloroethane
TBC	to be considered
TCE	trichloroethene
TCH	thermal conductive heating
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRS	TRS Group, Inc.
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
VPH	volatile petroleum compounds

1.0 INTRODUCTION

This document presents the Non-Aqueous Phase Liquid (NAPL) Area Focused Feasibility Study (FFS) for the CTS of Asheville, Inc. Superfund Site (Site) located at 235 Mills Gap Road in Asheville, Buncombe County, North Carolina (Figure 1). The activities described in this FFS were performed pursuant to the 2012 Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study (RI/FS) between the United States Environmental Protection Agency (USEPA) Region 4 and CTS Corporation (Settlement Agreement).

1.1 INTRODUCTION AND SCOPE

The purpose of this FFS is to summarize recent findings, identify Applicable or Relevant and Appropriate Requirements (ARARs), identify the media of concern and remedial areas, evaluate/compare remedial alternatives and present the recommended remedial alternative.

In accordance with the National Contingency Plan (NCP), under the Code of Federal Regulations (CFR) 40 CFR 300.430(e), “the primary objective of the feasibility study (FS) is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to a decision-maker and an appropriate remedy selected. The lead agency may develop a feasibility study to address a specific site problem or the entire site.” This FFS focuses on a defined area of the Site (i.e., the light NAPL [LNAPL] Area) for an interim remedy. The Site-wide RI/FS will be presented under separate cover and will focus on the remainder of the Site.

1.2 REPORT ORGANIZATION

This FFS Report contains seven sections, as follows:

Section 1, Introduction describes the purpose and organization of the report.

Section 2, Site Description and History provides summaries of the operations conducted at the Site, previous investigations, and previous and current removal actions.

Section 3, NAPL Area FFS Activities and Results describes activities that were conducted to collect information for development of the FFS and the results of these activities.

Section 4, Conceptual Site Model provides a description of the Site's characteristics and the nature and extent of contamination at the Site.

Section 5, Development of Remedial Alternatives presents the remedial action objective, describes ARARs, and describes general response actions.

Section 6, Detailed Evaluation of Remedial Alternatives contains an evaluation of the remedial alternatives with respect to USEPA criteria.

Section 7, Recommended Remedial Alternative presents the recommended remedial alternative.

2.0 SITE DESCRIPTION AND HISTORY

2.1 SITE DESCRIPTION

The approximate center of the Site is located at north latitude 35°29’36” and west longitude 82°30’25”. The Site formerly contained an approximate 95,000-square foot, single-story brick and metal-framed structure on the southern portion of the Site. The building was demolished in December 2011 and the concrete building slab remains intact. The northeastern portion of the Site contains an asphalt-paved parking area and asphalt-paved driveways are located parallel to the north (front) of the former building and southeast (rear) of the former building. A six-foot high chain-link fence surrounds the Site and a locked gate at the north end of the Site controls access to the Site from Mills Gap Road. The Site is unoccupied. The Site and adjacent property boundaries are illustrated on Figure 2.

2.2 SITE OPERATIONAL HISTORY

Northrop Grumman Systems Corporation is one of the former owners/operators of the Site as the result of a series of mergers from the original International Resistance Company, which owned and operated the Site from 1952 through 1959, when CTS of Asheville, Inc. purchased the real property, building, and equipment. CTS of Asheville, Inc. manufactured electronic components at the facility from 1959 until April 1986. Arden Electroplating, Inc. leased a portion of the building from approximately December 1, 1985, until November 30, 1986, and the Site was conveyed to Mills Gap Road Associates (MGRA) on December 23, 1987. MGRA reportedly leased portions of the facility to various tenants, and otherwise utilized the building for business interests. The Site has been vacant/unoccupied since the mid-1990s.

Electronic components utilized in automotive parts and hearing aids were manufactured by CTS of Asheville, Inc. until plant operations ceased in April 1986. Small electronic components were electroplated with tin, nickel, zinc, and silver as one step in the process. Wastes generated from the process included sludge containing metals and solvents. Solvents, including trichloroethene (TCE) and acetone were used in the process to clean and/or degrease metal objects prior to electroplating. Disposal/recycling activities at the facility prior to 1959 are unknown. From 1959 to 1986, solvents and metals were reportedly reclaimed. Between 1959 and 1980, metal-bearing rinse waters and alkaline cleaners that could not be reclaimed from the electroplating process were reportedly disposed of through the municipal sewer system, while concentrated metals and solvent wastes were placed in drums for off-site disposal/recycling. After 1980, wastes were accumulated in drums on-site prior to off-site disposal or recycling.

2.3 PREVIOUS INVESTIGATIONS

Environmental investigations have been conducted at the Site since the late 1980s. Table 1 contains a summary of previous investigations.

Law Environmental, Inc. conducted assessment activities at the Site in 1987. The assessment activities were performed for CTS Corporation (CTS) for the purpose of obtaining a general environmental status of the facility. Assessment activities performed inside the former building included subsurface soil sampling, surface wipes, sampling of compressor oil, and sampling of solid residue. Assessment activities performed outside of the building included subsurface soil sampling. Laboratory analytical results of samples collected inside the former building indicated the presence of volatile organic compounds (VOCs), including TCE, in the plating and paint curing areas. Laboratory results of soil samples collected outside of the former building also indicated the presence of VOCs.

In 1989 and 1990, a USEPA contractor (NUS) conducted Site Screening Investigations at the Site. NUS collected surface and subsurface soil samples, sediment and surface water samples from surface waters east and west of the Site and a water sample from a private water supply well. Concentrations of VOCs were detected in the surface water and sediment samples. Based on the analysis of possible migration pathways and the results of the sampling investigation, NUS recommended that no further action be planned for the Site.

In July 1999, the North Carolina Department of Environment and Natural Resources (NCDENR) collected water samples from three springs east of the Site. The spring samples contained VOCs related to chlorinated solvents and petroleum. TCE was detected at concentrations ranging from 8.7 to 21,000 micrograms per liter (µg/L).

Also in July 1999, NCDENR identified nine private water supply wells within a one-quarter mile of the Site. Water supply well samples were collected and analyzed for VOCs. One of the nine wells contained TCE at 270 µg/L (pre-filter) and 170 µg/L (post-filter). TCE was not detected in the other eight water supply wells sampled. NCDENR requested that the USEPA Emergency Response and Removal Branch review Site information to determine if the Site qualified for a removal action under the federal Superfund program.

In November 1999, a USEPA contractor (Tetra Tech) conducted a Site reconnaissance and sampling investigation. Tetra Tech collected surface soil samples, subsurface soil samples and sediment samples. The soil and sediment samples contained VOCs related to chlorinated solvents and petroleum.

In August 2000, USEPA Response Engineering and Analytical Contract (REAC) personnel conducted a geophysical investigation to determine if buried sources of contamination (e.g., drums of waste material) were located at the Site. REAC personnel identified several potential target areas through the geophysical surveys and observations of surface debris. In September 2000, trenches were excavated in these areas and soil samples were collected. Samples were also collected from two of the springs east of the Site. The soil and spring samples contained VOCs related to chlorinated solvents and petroleum. Buried sources of contamination were not identified during the trenching activities.

In May 2001, a USEPA contractor (Lockheed Martin) collected subsurface soil samples from 12 borings located below or near the former building. The soil samples contained VOCs related to chlorinated solvents and petroleum.

In February 2003, a USEPA contractor (Weston Solutions) collected five spring/surface water samples and eight private water supply well samples. The spring/surface water samples collected from the springs area east of the Site contained VOCs related to chlorinated solvents and petroleum. Concentrations of VOCs, semivolatile compounds (SVOCs), or total petroleum hydrocarbons (TPH) were not detected in the water supply well samples.

In June and July 2004, CTS' contractor (MACTEC) conducted an investigation pursuant to the 2004 Administrative Order on Consent for Removal Action (2004 AOC) between the USEPA Region 4, CTS, and MGRA. The primary intent of the investigation was to delineate the extent of contamination in unsaturated soil at the Site. Fifty-five soil samples were collected from 22 borings in and adjacent to the former Site building. Three piezometers were installed to provide groundwater elevation information. A temporary well was installed east of the Site near the previously-identified contaminated springs and water samples were collected from the springs and the temporary well. All of the samples were analyzed for VOCs, SVOCs, TPH, and polychlorinated biphenyls. Selected samples were analyzed for metals, cyanide, and pesticides. A reconnaissance was also conducted to identify water supply wells near the Site and an evaluation of surface water discharge from the springs east of the Site was conducted. The soil and spring samples contained VOCs, SVOCs, and TPH related to chlorinated solvents and petroleum.

In August 2004, a soil vapor extraction (SVE) pilot study was conducted to evaluate the feasibility of using SVE for removing VOCs from unsaturated soil beneath and adjacent to the former Site building, as delineated in the 2004 investigation. The results of the pilot study indicated that SVE would be an appropriate removal methodology. A SVE system was designed and constructed at the Site in June and July 2006 and became operational on July 20, 2006, as further described in Section 2.4.

In February 2006, CTS' contractor (MACTEC) collected water supply well samples from five locations within a one-quarter mile radius of the Site. Samples were analyzed for VOCs, SVOCs, and TPH. The analyzed compounds were not detected in the water supply well samples.

From November 2007 through January 2008, NCDENR, with assistance from USEPA contractors, collected water supply samples from 75 residences and analyzed the samples for VOCs. Site-related VOCs (cis-1,2-dichloroethene [cis-1,2-DCE] and TCE) were detected in two water supply well samples collected from wells located approximately 4,000 feet northeast of the Site.

In November and December 2007, NCDENR, with assistance from USEPA contractors, collected 14 surface soil samples and spring/surface water samples. The soil samples were collected from locations within approximately 1,500 feet of the Site boundary and analyzed for VOCs, SVOCs, and metals. Site-related VOCs were not detected in the soil samples. Three SVOCs and seven metals were detected at concentrations below USEPA's residential Removal Action Levels. The spring/surface water samples were collected from springs located east and west of the Site, springs located on Sweeten Creek Road, and from the unnamed tributary that is formed from the springs east of the Site. Site-related VOCs and SVOCs were detected in the spring and surface water samples collected nearest the Site (i.e., not in the Sweeten Creek Road spring samples).

In December 2007 and January 2008, a USEPA contractor (TN & Associates) collected 15 subsurface soil and groundwater samples from locations at the Site and within approximately 1,200 feet of the Site boundary. The subsurface soil samples were collected from depths ranging from 2 to 30 feet below ground surface (bgs). The soil and groundwater samples were submitted for analysis of VOCs, SVOCs, metals and cyanide. Site-related VOCs and SVOCs were not detected in the soil samples. Site-related VOCs and one SVOC were detected in groundwater samples collected at and immediately adjacent to the Site to the east. Metals were detected in the soil and groundwater samples at concentrations that were within naturally-occurring metal concentrations. Cyanide was detected in the soil and groundwater samples; however, cyanide has not been historically detected at elevated concentrations at the Site and is not considered a Site-related contaminant of concern (COC).

In December 2007, USEPA and their contractors collected air samples within approximately 1,200 feet of the Site boundary. The following air samples were collected: 18 soil gas, 10 sub-slab, 12 crawlspace/basement, and 7 ambient. The air samples were submitted for analysis of VOCs. Site-related VOC concentrations in samples collected from residences were below USEPA's then-applicable removal action concentrations.

Also in December 2007, a USEPA contractor (Lockheed Martin) conducted an air investigation using a Trace Atmospheric Gas Analyzer to scan ambient air in the vicinity of the Site.

In August 2008, a USEPA Contractor (TN & Associates) collected eight residential air samples (i.e., sub-slab, crawlspace, and indoor) and 11 ambient air samples. The air samples were submitted for analysis of VOCs. Site-related VOC concentrations in samples collected from residences were below USEPA's then-applicable removal action concentrations.

From September 2008 through March 2012, a USEPA contractor (OTIE) collected water supply samples on a quarterly basis from water supply wells located within one mile of the Site. The water supply well samples were submitted for analysis of VOCs, SVOCs, metals, and cyanide. Site-related compounds were not detected in the water supply samples.

In September and October 2008, CTS' contractor (MACTEC) collected soil and groundwater samples in the vicinity of the springs area east of the Site. The samples were used to design an ozone injection pilot study to determine the feasibility of an ozone injection system reducing VOC concentrations in the groundwater that discharges to the springs. The pilot study was conducted from March 2009 through January 2010.

From September 2008 through July 2009, CTS' contractor (MACTEC) conducted Phase I Remedial Investigation activities under the direction of NCDENR. Monitoring wells were installed on- and off-Site, and soil, groundwater and surface water samples were collected during several phases of work. The extent of the VOC groundwater plume was delineated in overburden (i.e., above bedrock) to the north and south. Analytical results of surface water samples were similar to historical results.

From January 2009 to May 2010, USEPA and their contractors conducted a series of studies to collect data for listing the Site on the National Priorities List (NPL). The North Carolina Geological Survey (NCGS) and the United States Geological Survey also conducted studies in the vicinity of the Site to support the NPL listing. Hydrogeologic information, primarily related to groundwater conditions in bedrock, was gathered during these studies.

In December 2010, CTS' contractor (MACTEC) conducted a geophysical investigation to determine if buried sources of contamination (e.g., drums of waste) were located in the southern portion of the Site. Several surface geophysical methods were used to survey the area. Buried sources of contamination were not identified.

In October 2012, CTS' contractor (AMEC) conducted vapor intrusion assessment activities at three residences located west of the Site. Crawlspace/basement and ambient air samples were collected and analyzed for Site-related VOCs. Concentrations of the detected VOCs were below unacceptable risk levels for residential occupants.

Beginning in January 2013, CTS' contractor (AMEC) began quarterly sampling of water supply wells located within one mile of the Site. As of May 2015, 10 quarterly water supply sampling events had been conducted. Water supply samples are analyzed for Site-associated VOCs, as well as toluene as requested by USEPA. Site-related VOCs have not been detected in the water supply samples.

From September 2013 to February 2014, CTS' contractor (AMEC) conducted a NAPL Investigation at the Site. The objective of the NAPL Investigation was to gain an understanding of the nature and extent of NAPL in the overburden at the Site. The NAPL Investigation included collection of significant qualitative data using direct sensing methods. Quantitative data (e.g., measurement and analysis of NAPL, soil and groundwater sample analyses, etc.) was also collected to correlate/confirm the direct sensing data. Relevant information from the NAPL Investigation is described in Section 4.0.

In November 2013, CTS' contractor (AMEC) conducted confirmation soil sampling and analysis associated with the SVE system. The objective of the Confirmation Sampling and Analysis Plan (CSAP) was to evaluate the effectiveness of the SVE system at removing VOCs from the unsaturated zone at the Site. Comparison of TCE concentrations in pre-removal soil samples to post-removal CSAP soil samples indicates an average TCE percent reduction of 95 percent in unsaturated soil. Concentrations of TCE in the upper 10 feet of soil in the identified source area were below the USEPA's Regional Screening Level (RSL) for industrial soil.

In April 2014, CTS' contractor (AMEC) conducted vapor intrusion assessment activities three at residences located east of the Site. Indoor, crawlspace, and ambient air samples were collected and analyzed for Site-related VOCs. Concentrations of TCE in the indoor air samples were greater than USEPA Region 4's recommended residential indoor air Removal Management Level (RML) of 2 micrograms per cubic meter (µg/m³). Based on these results, USEPA requested air assessment at additional residences located further northeast and east of the Site. Indoor, crawlspace, and/or ambient air samples were collected at six residences in June 2014. Concentrations of TCE in the crawlspace/indoor air samples were less than USEPA's RML.

From October 2014 to April 2015, CTS' contractor (AMEC and Amec Foster Wheeler) collected air samples from in and/or near the nine residences east of the Site where samples were collected in April and June 2014. A springs area removal action, consisting of installation of a Springs Vapor Removal and Capture System, was completed in October 2014, as described in Section 2.4, and concentrations of TCE in indoor air samples were less than USEPA's RML following installation of the System.

2.4 PREVIOUS AND CURRENT REMOVAL ACTIONS

Three removal actions have been conducted under the direction of the USEPA's Emergency Response and Removal Branch, and pursuant to the 2004 AOC.

An SVE system, consisting of 15 vapor extraction wells and blower equipment, operated at the Site from July of 2006 to July 2010. The objective of the SVE system was to remove previously detected organic compounds (primarily TCE) from the unsaturated soil. SVE discharge air samples were collected on a monthly basis during system operation and analyzed for VOCs and TPH diesel range organics (DRO). Based on laboratory analysis of the discharge air samples, an estimated 6,473 pounds of VOCs were removed from the unsaturated soil by the SVE system.

From September 2012 to August 2014, 101 whole-house water supply filtration systems were installed in residences located within one mile of the Site who relied on groundwater as their drinking water source, and who elected to have the filtration system installed. The filtration systems were installed as a precautionary measure while the RI/FS activities are conducted at the Site. Municipal water supply lines were installed in the vicinity of the Site in 2014 and 2015, and 87 of the residences with filtration systems elected to connect to the municipal water line. The remaining water filtration systems will continue to be maintained by CTS until such point the filtration systems are not warranted.

As previously described, air sampling in the area of the springs east of the Site in April 2014 indicated concentrations of TCE in indoor air above USEPA Region 4’s recommended residential indoor air RML of 2 µg/m³. To reduce TCE concentrations in indoor air of residences in the vicinity of the springs, a Springs Vapor Removal and Capture System (System) that consists of a cap/cover over the springs/seep area, air sparge and vapor extraction equipment, and vapor-phase carbon vessels was installed in the area of the springs in September and October 2014. The System has been operational since October 21, 2014. An estimate of the mass removed by the System was determined using influent and effluent air samples collected from the System. From October 23, 2014, until April 17, 2015 (100 days), approximately 42 pounds of VOCs were removed, approximately 11 pounds of which was TCE. The System will continue to operate until TCE concentrations in groundwater discharging to the springs are reduced to concentrations that do not generate unacceptable TCE concentrations in indoor air of residences in the vicinity of the springs.

3.0 NAPL AREA FFS ACTIVITIES AND RESULTS

As described in the NAPL Area FFS Work Plan dated August 11, 2014, the following activities were completed to provide additional Site characterization information for the FFS.

3.1 GROUNDWATER LEVEL MEASUREMENT

The depth to groundwater in overburden Site monitoring wells was measured on January 5, 2015. The depth to groundwater measurements and corresponding groundwater elevations are tabulated in Table 2 and historical groundwater elevations are presented in Table 3. From 2009 to 2013, groundwater elevations increased up to 13 feet. From 2013 to 2015, groundwater elevations decreased up to 8 feet.

3.2 GROUNDWATER SAMPLING

Groundwater samples were collected from 15 Site monitoring wells, on and off the former plant property, in January 2015. Groundwater samples were collected using low-flow purging/sampling techniques and analyzed for VOCs and SVOCs according to USEPA Methods 8260 and 8270, respectively. Copies of the logbook and groundwater sampling field data records are included in Appendix A. The laboratory analytical reports are included as Appendix B.

3.2.1 Discussion of Analytical Results

The analytical results of the groundwater samples are generally similar in order of magnitude to the analytical results of groundwater samples collected in 2008/2009. Table 4 contains a summary of the January 2015 analytical results, as well as the 2008/2009 analytical results.

3.2.2 Data Validation and Usability Summary

Data validation was conducted based on procedures in the USEPA Region 4 Data Validation Standard Operating Procedures for Organic Analysis (USEPA, 2008). Full validation, including raw data verification and calculation checks, was completed on ten percent of the laboratory data. The data validation report is included in Appendix C.

A subset of results were qualified as estimated values due to quality control measurements that were outside precision and/or accuracy goals specified in the Quality Assurance Project Plan or validation guidelines. The results are determined to be useable as estimated values. Results for the VOC 1,4-dioxane and the SVOC benzaldehyde were qualified as rejected (unusable data). The reasons for data qualification are discussed in detail in Appendix C, and interpretations on data usability are provided in the following sections.

3.2.2.1 VOCs

A subset of VOC results are qualified as estimated values due to calibration response, internal standard response, or spike recovery. A summary of qualified results is provided in Appendix C, Table C.3. The uncertainty regarding the estimated values is interpreted to be fairly low for the VOC results. In general, results will be within two times the detected concentration or the reporting limit values reported by the laboratory.

3.2.2.2 SVOCs

Most of the SVOC results are qualified as estimated values due to low surrogate recovery or spike recovery. A summary of qualified results is provided in Appendix C, Table C.3. Project accuracy limits for base-neutral (70 to 130 percent) and acid fraction (40 to160) were used to evaluate accuracy during validation. These limits are narrower than the statistical limits provided by the laboratory and represent a goal for a high level of accuracy for the SVOC method.

In most cases, base-neutral compound recoveries for estimated results are greater than 40 percent and within the laboratory control limits. The majority of these compounds were not detected and reporting limits in associated samples were qualified as estimated values. Reporting limits and detected concentrations for qualified compounds are potentially biased low. The uncertainty regarding the estimated values is interpreted to be within two times the detected concentration or the reporting limit values reported by the laboratory.

In most cases, acid fraction compound (phenols) recoveries were greater than 30 percent and within the laboratory control limits. The majority of these compounds were not detected and reporting limits in associated samples were qualified as estimated values.

Reporting limits and detected concentrations for qualified compounds are potentially biased low. The uncertainty regarding the estimated values is interpreted to be within three times the detected concentration or the reporting limit values reported by the laboratory.

3.3 SOIL SAMPLING

Soil sampling was conducted in the NAPL Area using direct-push technology (DPT) equipment the week of January 19, 2015. Boring locations are depicted in Figure 3. Soil samples were collected for LNAPL mobility and bench testing, as described in Sections 3.6.2 and 3.8, respectively. For collection of soil samples, the borings were advanced to the target depth using a macro-core sampler assembly. Soil cores were retrieved at five-foot intervals and the soil core was scanned with a photoionization detector (PID) at approximate one-foot intervals. Hydrophobic dye tests were conducted where elevated PID readings were observed. The soil was also observed for indications of NAPL. The soil lithology, PID readings, and sample information were recorded on soil boring records, which are included as Appendix D.

3.4 MONITORING WELL INSTALLATION

Three monitoring wells (MW-12, MW-13, and MW-14) were installed within the identified NAPL Area the week of February 23, 2015. The monitoring wells were developed by the pump and surge method on March 4, 2015. Approximately one foot of LNAPL was identified in monitoring well MW-12 at the time of well development. Measurable LNAPL was not identified in monitoring wells MW-13 and MW-14. In an effort to potentially promote accumulation of mobile LNAPL in the vicinity of monitoring wells MW-13 and MW-14, the wells were re-developed several times, but measureable LNAPL was not detected. Measurement of LNAPL in the monitoring wells is described in Section 3.5. Monitoring well construction details are presented in Table 5. North Carolina Well Construction Records and monitoring well construction details are included as Appendix E. The horizontal and vertical locations of the monitoring wells were surveyed by a North Carolina Licensed Surveyor.

3.5 NAPL MEASUREMENT

The thickness of LNAPL was measured in monitoring wells MW-3, MW-12, MW-13, and MW-14 and piezometer PZ-2 following installation of the new monitoring wells. The depth to the top and bottom of the LNAPL was measured with an oil-water interface probe. A summary of the LNAPL measurements is presented in Table 6.

Dense NAPL was not detected in the new monitoring wells.

3.6 LNAPL ANALYSES

LNAPL testing was conducted to determine the characteristics of the LNAPL and to determine if the LNAPL present at the Site is mobile.

3.6.1 LNAPL Properties

A sample of LNAPL was collected from monitoring well MW-12 and submitted to PTS Laboratories for analysis of the following:

- American Society for Testing and Materials (ASTM) D1481: Standard Test Method for Density and Relative Density (Specific Gravity) of Viscous Materials by Lipkin Bicapillary Pycnometer
- ASTM D971: Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method
- ASTM D445: Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

Three temperatures were used to determine the density, specific gravity, and viscosity. The testing report is included as Appendix F and a summary of the results is presented in Table 7.

Based on the specific gravity (0.86) and dynamic viscosity (3.5 centipoise) of the LNAPL tested at 70 degrees Fahrenheit, the LNAPL is similar to a No. 2 fuel oil and diesel fuel (API, 2004).

3.6.2 LNAPL Mobility

Soil sampling locations/depths for the LNAPL mobility evaluation were presented in the NAPL Area FFS Work Plan Field Sampling and Analysis Plan. The proposed locations were based on previous investigations that indicated the presence of LNAPL at a similar location/depth, as the intent of the testing was to determine if LNAPL, where present, was potentially mobile. However, several proposed samples were not collected due to indications in the field that LNAPL was not present in the soil. Instead, soil samples were collected from other locations/depths where potential LNAPL was indicated.

Ten soil samples were collected in January 2015 and submitted to PTS Laboratories for NAPL mobility testing according to the following methods:

- American Petroleum Institute (API) RP40: Dean Stark Extraction Method
- ASTM D425: Standard Test Method for Centrifuge Moisture Equivalent of Soils (modified for samples with water and NAPL)

In the mobility tests conducted, the mobility of the LNAPL is determined by placing the sample in a centrifuge for one hour with a force equal to 1,000 times that of gravity at a temperature of 20 degrees Celsius. The amount of LNAPL in the pores ("LNAPL saturation") is determined before and after the centrifuge test. Where a decrease in LNAPL saturation is determined, a portion of LNAPL is presumed to be mobile. The high test force applied to the sample is much higher than forces present in actual subsurface conditions and, as such, the test method generates a conservative fluid mobility interpretation (Brady and Kunkel, 2005).

Based on the mobility testing, three of the ten soil samples contained LNAPL that is potentially mobile. This interpretation is based on a measurable difference between the initial and post-centrifuge LNAPL saturation values and the accumulation of LNAPL from the centrifuge procedure. A summary of the results, including the locations of sample collection, is presented in Table 8, and the LNAPL mobility testing report is included as Appendix G.

3.6.3 LNAPL Baildown Testing

LNAPL baildown tests were conducted at monitoring wells MW-3 and MW-12. LNAPL was removed from each well using a bailer and the depth to the top and bottom of the LNAPL was measured periodically for 11 days. The LNAPL in MW-12 recovered to 61 percent of the pre-test LNAPL thickness.

Prior to bailing, the LNAPL in monitoring well MW-3 was located approximately three feet above the top of the screened interval of the well. The LNAPL was bailed down to a thickness of 0.2 feet. The LNAPL did not recover because the LNAPL was located in the unscreened portion of the well.

Using the differential LNAPL thickness measurements from monitoring well MW-12, the transmissivity of the LNAPL was calculated using Cooper-Bredehoeft-Papadopulos solution. The transmissivity was determined to be 1.8 x 10^{-5} squared centimeters per second (cm^2/sec), with a hydraulic conductivity of 1.4 x 10^{-5} centimeters per second (cm/sec). The transmissivity test data is included in Appendix H.

3.7 HYDROGEOLOGIC TESTING

Hydrogeologic testing was conducted to estimate the hydraulic conductivity of the saturated zone at the Site.

3.7.1 Grain-size Analyses

Four soil samples collected during DPT soil sampling were submitted for grain-size analysis according to ASTM C136 (Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates). The test data worksheets and a graph of the results are included as Appendix I.

Based on the grain-size analyses, the four soil samples are characterized as a fine to medium sand with little (i.e., 15 to 25 percent) silt and clay. Based on this type of unconsolidated soil, the hydraulic conductivity of the saturated soil is expected to be in the 10^{-3} to 10^{-5} cm/sec range (Fetter, 1994).

3.7.2 Slug Testing

Field hydraulic conductivity (slug) testing was conducted at monitoring wells MW-2, MW-5A, MW-6A, MW-7 and MW-13 using the following procedures:

- Groundwater in monitoring wells MW-2, MW-5A, MW-6A and MW-13 was displaced by placing a slug (sealed polyvinyl chloride pipe filled with sand) through the water table in the well (falling head test). The slug remained in the monitoring well until the water level was approximately 95 percent of the initial water level. The slug was then removed (rising head test).

- Groundwater in monitoring well MW-7 was displaced using a pneumatic slug system. This procedure consisted of pressurizing the well using a small air pump, which forced the water down. A valve was then opened to the atmosphere and the displaced water returned to the static water level (rising head test only).
- Monitoring well MW-13 had a water level that was below the top of the screen; therefore, only the rising head test was reported for this well (i.e., the falling head test is not applicable when the screen is not fully submerged below the water table).
- The change in head during these tests was measured using a pressure transducer and logarithmic time recording.

Parameters used in the calculations are presented in Table 9 and the results are presented in Table 10. Hydraulic conductivity test data are included in Appendix J.

The results of the field hydraulic conductivity testing indicate that the average hydraulic conductivity ranges from 1.2 x 10^{-5} cm/sec (MW-6A; falling head test) to 1.2 x 10^{-3} cm/sec (MW-7; rising head test). The overall average of the slug tests is 2.3 x 10^{-4} cm/sec.

3.8 BENCH TESTING

Soil, groundwater, and LNAPL samples were submitted for bench testing to evaluate remedial alternatives, as described below.

3.8.1 Electrical Resistivity Heating

Saturated soil from borings SB-42C and SB-42D was submitted to TRS Group, Inc. (TRS) for thermal bench testing. The bench test report is included as Appendix K.

The objective of the bench test was to determine the amount of heat required to remove TCE from the Site soil. TRS tested the soil to determine the wet density, dry density, percent moisture, total organic carbon, and electrical resistivity of the soil. The results of these tests are presented in Tables 1 and 2 in the TRS report.

TRS analyzed the sample for VOCs according to USEPA Method 3810. TRS also submitted a subsample of the soil to ESC Lab Sciences for analysis of VOCs and TPH-DRO according to USEPA Methods 8260 and 3546, respectively. TCE was detected at concentrations of 108 milligrams per kilogram (mg/kg) and 120 mg/kg according to

USEPA Methods 3810 and 8260, respectively. TPH-DRO was detected at a concentration of 14,000 mg/kg.

TRS divided the soil sample into five sub-samples. Four of the samples were heated to simulate electrical resistivity heating (ERH) treatment; the fifth sample was a control sample and was not heated. The samples were heated until approximately 25 percent, 50 percent, 75 percent, and 90 percent of moisture in the samples was evaporated. Based on the density and moisture data, TRS determined the energy density for the sub-samples. The post-treated samples were analyzed for TCE and TPH-DRO and the results were plotted against the corresponding energy densities of the samples (see Figure 3 in the TRS report).

The results indicate that a steaming energy of approximately 165 kilowatt-hours per cubic yard (kWh/yd^3) will reduce the TCE concentration by 99 percent. The total energy required for remediation also includes the energy to increase the temperature of the subsurface to the target temperature (typically 50 kWh/yd^3) and the heat losses from the system, which is generally estimated to be 24 percent. A design energy density of 240 kWh/yd^3 is estimated to achieve a 99 percent TCE reduction.

3.8.2 In-situ Chemical Oxidation

Saturated soil from borings SB-41B(2) and SB-42D, and a groundwater sample collected from monitoring well MW-13, was submitted to Geo-Cleanse International, Inc. (Geo-Cleanse) for in-situ chemical oxidation (ISCO) bench testing. Geo-Cleanse's bench test report is included as Appendix L.

The objective of the bench test was to determine if ISCO via catalyzed hydrogen peroxide (CHP) would degrade TCE and, if so, how much oxidant would be required. Geo-Cleanse also tested the soil to determine the buffering capacity of the soil and the reactivity of the soil to hydrogen peroxide.

Geo-Cleanse submitted sub-samples of the soil and groundwater to ESC Lab Sciences for analysis of VOCs according to USEPA Method 8260; SVOCs according to USEPA Method 8270; and extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) according to the Massachusetts Department of Environmental

Protection methods. TCE was detected at concentrations of 430 mg/kg in SS-41B(2) and 86 mg/kg in SS-42D. TCE was detected at a concentration of 13,000 micrograms per liter (µg/L) in the groundwater sample collected from MW-13. Total VPH was detected at 420 mg/kg in SS-41B(2) and 380 mg/kg in SS-42D. Total EPH was detected at 12,000 mg/kg in both SS-41B(2) and SS-42D. Total VPH and EPH were detected in the groundwater sample collected from MW-13 at concentrations of 6,100 and 1,500 µg/L, respectively.

Geo-Cleanse conducted soil buffering tests to determine the amount of acid necessary to achieve a pH of 4, which is optimal for ISCO via CHP. The baseline pH of the soil slurries (50 grams of soil and 50 milliliters of groundwater) ranged from 5.7 to 6.1, indicating that the subsurface materials are slightly acidic. The results of the buffering tests indicate that the buffering capacity of the soil is low and the target pH can be achieved. Once the target pH was achieved, the pH was monitored over a 120-minute period to evaluate pH rebound and assess ongoing acid addition requirements. Geo-Cleanse indicated that the mildly acidic pH conditions that are optimum for CHP can be maintained during an ISCO treatment program.

Geo-Cleanse conducted soil reactivity tests to determine if the naturally-occurring iron in the soil was sufficient for CHP treatment, or if additional iron would be required to catalyze the hydrogen peroxide. The results indicated that naturally-occurring iron and/or other metals are present in low concentrations. Therefore, iron would likely be required and monitored as part of the CHP treatment program.

Geo-Cleanse conducted CHP oxidation tests using the Site soil and groundwater. The tests were conducted at three hydrogen peroxide-to-contaminant mass ratios. Sulfuric acid and ferrous sulfate were added to the reactors containing the Site soil and groundwater. Soil and groundwater samples were collected after the tests were completed and submitted to ESC Lab Sciences for the same analyses as the baseline samples. The results indicate TCE was reduced greater than 99 percent in both reactors using the lowest hydrogen peroxide dose (around 100 grams per kilogram of soil). The greatest total mass reductions (i.e., total mass of VOCs, SVOCs, EPH, and VPH) were at the middle oxidant dosage (146 grams of hydrogen peroxide to grams of contaminant [g/g] in SS-41B(2) and 45 g/g in SS-42D) corresponding to 74 and 94 percent reduction for SS-41B(2) and SS-42D, respectively.

3.8.3 Surfactant Enhanced Removal

Soil from boring SB-31B and SB-42D, a groundwater sample collected from monitoring well MW-13, and LNAPL collected from MW-12 was submitted to Surbec Environmental (Surbec), on behalf of Tersus Environmental. Surbec's bench test report is included as Appendix M.

The objective of the surfactant enhanced removal bench test was to develop a surfactant formulation capable of mobilizing LNAPL at the Site for removal via pumping.

Surbec determined the density and viscosity of the LNAPL, as well as the density and total dissolved solid content of the groundwater. A series of phase behavior studies were conducted using different combinations of LNAPL, groundwater, surfactant, and salt. The interfacial tension (IFT) was measured to determine which formulation created the lowest IFT, which is the optimum condition for removal of LNAPL. Precipitation and phase separation studies were conducted to determine the tolerance of the surfactant formulation to the divalent cation calcium in the form of calcium chloride, which is present in groundwater, as surfactant lost to precipitation is no longer available to decrease the IFT of the LNAPL. Soil sorption studies were conducted to determine if sorption of the surfactant to soil was a limiting factor. Column studies were then conducted to evaluate the surfactant formulation under flow-through conditions using a simulated soil/ groundwater/LNAPL system.

A surfactant formulation capable of producing microemulsion systems with low IFT between the Site LNAPL and groundwater was developed and tested. The surfactant formulation exhibited minimal sorption to the Site soil, good precipitation, and an acceptable phase separation tolerance with divalent cation calcium. A trace amount of solubilized LNAPL was observed in the effluent, indicating that additional residence time might be required for LNAPL/water separation after extraction. Based on the two column studies, the percent recovery of the LNAPL was determined to be 56 percent and 84 percent.

3.9 INVESTIGATIVE DERIVED WASTE

Investigative derived waste (IDW), including soil cuttings and decontamination water, was containerized in 55-gallon drums and labeled for accumulation at the Site. Liquid IDW was accumulated separately from soil IDW and each drum was labeled as to the drum's contents. Excess soil was removed from sampling materials, such as plastic and gloves, and the sampling material was then collected in plastic bags and removed from the Site for disposal in a permitted, municipal solid waste landfill. The waste disposal manifest for soil and water IDW is included as Appendix N.

4.0 CONCEPTUAL SITE MODEL

The following Conceptual Site Model is based on data collected to date related to the overburden formation.

4.1 SITE PHYSICAL SETTING

The area surrounding the Site is considered rural and contains residential and light commercial properties. The Site is situated on a topographic “saddle” between two prominent mountains - Busbee Mountain to the north and Brown Mountain to the south and southwest. Properties northwest and southeast are topographically downgradient of the Site. The majority of the Site is relatively flat and natural surface drainage at the Site is to the northwest. The surrounding area contains mountains and rolling hills, typical of the eastern flank of the Appalachian Mountain range.

4.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

The Site is located in the Blue Ridge Physiographic Province, which is characterized by mountainous terrain, relatively high precipitation and a dense network of perennial streams. The Site is underlain by metasedimentary and metavolcanic rocks of the Ashe Metamorphic Suite (NCGS, 2008). Metasedimentary rocks in the Ashe Metamorphic Suite are metamorphosed clastic sediments, such as deepwater sandstone and shale, and are generally described in the area of the Site as schistose metagraywacke, mica schist, and metagraywacke. Amphibolite, formed by the metamorphism of subaqueous volcanic intrusions, is present in isolated deposits in the metasedimentary assemblages.

The bedrock is generally overlain by a mantle of unconsolidated residual soil (overburden) formed by the in-place weathering of bedrock. The typical residual soil profile in areas not disturbed by erosion or human activities consists of silty or clayey soils near the surface where weathering is more advanced, underlain by sandy silt and silty sand. Less weathered rock, commonly termed partially weathered rock (PWR), forms a “rind” on the bedrock that ranges in thickness from several feet to tens of feet. The contact between partially weathered rock and competent bedrock is irregular, even over short horizontal distances. Alluvial and floodplain deposits (water deposited) are typically found overlying residual soil in areas near streams and drainage features. Soils transported downslope by gravity (mudflows or landslides), termed colluvium, are often found on or near the toe of natural slopes.

Groundwater flow in the Blue Ridge region is typically divided into two, connected but characteristically different, flow regimes - flow through the porous overburden and flow through discrete fractures in bedrock. The overburden typically acts as an infiltration medium for precipitation and, if sufficiently thick/deep, becomes saturated at some depth creating a saturated zone above bedrock. Man-made features (e.g., subsurface conveyance lines) and natural features (e.g., weathered quartz veins) can influence the rate and direction of infiltration of precipitation, and similarly, contaminants.

Groundwater flows laterally through the overburden toward a discharge zone (surface water feature) or downward into fractures in the underlying bedrock. Positive/downward vertical hydraulic gradients in the overburden are typical in recharge areas and negative/upward vertical hydraulic gradients in the overburden are present in discharge areas. Upward hydraulic gradients are also present in the overburden where fractures in the underlying bedrock extend to the overburden interface and have an upward hydraulic gradient that transmits groundwater from the bedrock upward to the overburden. The rate and direction of groundwater flow in the overburden is controlled primarily by topographic features, the porosity of the overburden, and structural features that create preferential flow paths (e.g., quartz veins, sandy lenses, etc.).

4.3 SITE GEOLOGY

Fill material, residual soil (overburden) and bedrock have been identified at the Site. Fill material, consisting of loose silty sand with gravel, has been observed to a depth of approximately 19 feet bgs in the western portion of the Site where two drainage swales formed by intermittent streams were historically backfilled for development/grading. Overburden is located below the fill material, where present, and has been observed to a depth of approximately 81 feet bgs at the Site, where the apparent top of bedrock is encountered. The uppermost zone of overburden generally consists of fine to medium sand with 10 to 15 percent silt. The overburden “fabric” ranges from massive (i.e., no apparent structure) to strongly foliated. Foliated zones were observed to be approximately horizontal to steeply dipping (i.e., greater than 50 degrees). Quartz veins ranging in thickness from less than 0.5 inches to approximately 12 inches, and consisting of sand to gravel-sized fragments, have been observed in the overburden. The PWR zone has been observed to range in thickness from approximately two to 27 feet and typically samples as fine to coarse sand with minor amounts of silt and gravel-sized rock fragments. The fabric of the PWR is similar to the overburden fabric (MACTEC, 2009).

The depth to bedrock at the Site ranges from approximately 28 feet bgs to approximately 81 feet bgs, based on the depth to drilling refusal using rotary/roller cone drilling equipment (MACTEC, 2009). The bedrock surface has been observed to be highly variable within short distances. The bedrock surface appears to be similar to the ground surface in the vicinity of the Site in that a “saddle” is apparent in the north-central portion of the Site. The bedrock surface northeast and southwest of the saddle has an apparent slope of 10 to 15 percent. The slope west of the saddle is somewhat flatter (approximately 8 percent).

4.4 SITE HYDROGEOLOGY

A groundwater divide is present in the overburden in the north-central portion of the Site (Figure 4). As previously discussed, the Site is located on a topographic saddle between mountains to the north and south. A portion of groundwater that is flowing from each mountain is presumed to be toward the saddle. Therefore, a groundwater divide has developed where groundwater in the overburden flows from the mountains and turns east or west to respective discharge zones. The position and shape of the groundwater divide likely changes in response to precipitation/infiltration.

The direction of shallow groundwater flow (water table) and groundwater flow in the PWR zone (Figure 5) are similar. Groundwater flow in the southern portion of the Site appears to flow radially, to the north and east. From the central portion of the Site, groundwater flows northwest toward Spring-05 and east/southeast toward the spring/seep area east of the Site.

In January 2015, the depth to groundwater, where flowing artesian conditions were not observed, ranged from 15 to 49 feet bgs. The horizontal hydraulic gradient in the shallow overburden in the source area at the Site is approximately 0.031. The horizontal hydraulic gradient in the shallow overburden from the Site toward the springs east of the Site ranges from approximately 0.066 to 0.077 and the horizontal gradient from the Site toward the spring west of the Site is approximately 0.015.

The horizontal hydraulic gradient in the PWR in the source area at the Site is approximately 0.018. The horizontal hydraulic gradient in the PWR from the Site toward the springs east of the Site ranges from approximately 0.063 to 0.065 and the horizontal gradient from the Site toward the spring west of the Site is approximately 0.014.

The groundwater seepage velocity (v) is calculated as:

$v = ki/n_e$, where

k = hydraulic conductivity
i= hydraulic gradient
n_e = effective porosity

Based on the average conductivity of 2.3×10^{-4} cm/sec determined by slug testing (described in Section 3.7.2) and an assumed effective porosity of 0.25, the groundwater seepage velocity ranges from 13 to 73 feet per year.

Upward and downward hydraulic gradients were measured between proximal overburden shallow and PWR monitoring wells. The maximum downward gradient (0.039) was measured at the MW-4/4A well cluster and the maximum upward gradient (-0.12) was measured at the MW-6/6A well cluster.

Monitoring well MW-11A, which is installed in the PWR, is a flowing artesian well. Similarly, flowing artesian conditions have been observed in the vicinity of the springs east of the Site, indicating significant upward groundwater flow through the overburden east of the Site. It is not clear if this upward groundwater flow is the result of groundwater from the bedrock discharging to the overburden, groundwater in the deep overburden discharging upward to the springs, or a combination of these conditions.

Groundwater elevations have fluctuated since monitoring wells were installed in 2009. From 2009 to 2013 groundwater elevations increased up to 13 feet, with the greatest elevation gains being in the eastern portion of the Site and farthest from discharge zones located east and west of the Site. From 2013 to 2015, groundwater elevations decreased up to 8 feet.

The depth to water has been measured at the Site during periods of drought (2007) and during record-high levels of precipitation (2013). The difference in groundwater elevation between drought periods and record-high precipitation is approximately 18 feet.

4.5 SURFACE WATER

A “seep” area containing springs and seeps is located east of the Site (Figure 3). An unnamed tributary emanates from the seep area and flows east toward Robinson Creek. During the NAPL Investigation, artesian conditions were observed in the seep area, indicating that a upward vertical hydraulic gradient is present in this area.

An unnamed tributary also originates west of the Site and flows northwest toward Dingle Creek. Spring-05 emanates from the ground and forms the eastern branch of the unnamed tributary (Figure 4). Water also flows from a culvert located south of Spring-05. The source of the water that flows from the culvert is unclear. A leaking municipal fire hydrant has been identified at the Site, approximately 100 feet from the culvert, and a storm water ditch terminates at the former contingency basin located on the inlet side of the culvert. An intermittent stream was formerly identified in this area. Therefore, the tributary forming the southern branch of the unnamed tributary likely receives a component of groundwater discharge.

4.6 NATURE AND EXTENT OF CONTAMINATION

As determined from previous investigations, and confirmed during the 2013/2014 NAPL Investigation, the source area is located below the south-central portion of the former building and extends to the immediate south. The nature of the chlorinated VOC contamination, whether from pure product or from a mixed material/liquid containing a portion of chlorinated VOCs, is unknown. The primary release mechanism(s) associated with the chlorinated VOC contamination observed at the Site is also unknown.

The petroleum contamination identified at the Site consists primarily of fuel oil or diesel constituents. The primary release mechanism(s) associated with the petroleum contamination observed at the Site is unknown; however, the petroleum is suspected of originating from an aboveground fuel oil storage tank formerly used to store and supply fuel oil to the facility's boiler.

4.6.1 Soil

Contamination has been identified in unsaturated soil below the south-central portion of the former building and immediately south of the former building. Based on confirmation soil sampling and analysis conducted in 2014, there are minor concentrations of VOC or petroleum constituents remaining in the unsaturated soil. TCE concentrations in the upper 10 feet of soil in the identified source area are below the USEPA's RSL for industrial soil of 1.9 mg/kg (USEPA, 2015). The analytical results of soil samples collected from ground surface to 10 feet bgs indicate polycyclic aromatic hydrocarbon (PAH) concentrations are less than 0.1 mg/kg. The PAH concentrations are below their respective USEPA RSLs, where RSLs have been established.

Soil samples were collected below the water table (i.e., saturated soil) during the NAPL Investigation to determine contaminant concentrations where contaminants are potentially sorbed to the soil matrix. TCE concentrations in soil samples collected below the water table ranged from 0.076 to 1,120 mg/kg, with an average concentration of 141 mg/kg.

4.6.2 LNAPL

An approximate one-acre area of the subsurface at the Site has been delineated as containing some amount of LNAPL (Figure 6). The LNAPL is a weathered fuel oil or diesel fuel, which have similar formulations. Most of the petroleum-related compounds that were detected are long-chain hydrocarbons, indicating that the petroleum has weathered, and the shorter-chained hydrocarbons have been removed via weathering processes that include evaporation, dissolution into groundwater, and biodegradation. The LNAPL also contains chlorinated VOCs, primarily TCE.

The LNAPL is primarily present in an immobile residual phase, as indicated by the LNAPL mobility testing and the baildown testing. The LNAPL saturation results indicate LNAPL is present from 1.5 percent to 15.9 percent of the pore space. LNAPL is rarely observed to exhibit significant mobility at residual saturations less than 20 to 25 percent (Rousseau, et. al. 2012). Only small amounts of LNAPL were recovered in three of the ten soil samples submitted for mobility testing, indicating the lack of significantly mobile LNAPL. Additionally, the transmissivity of the LNAPL (1.8×10^{-5} cm^2/sec, or 1.7×10^{-3} ft^2/day) is two orders of magnitude less than what is considered recoverable using standard extraction methods. LNAPL is considered potentially recoverable with LNAPL transmissivities greater than 0.1 ft^2/day (ITRC, 2009).

The water table has fluctuated up to 18 feet in the NAPL Area since environmental investigations have been conducted at the Site. The thickness of the zone of water table fluctuation since the fuel oil/diesel release(s) to the subsurface is not known, but could be in excess of 18 feet. As the water table has fluctuated, a smear zone has developed. As the water table rises and falls, disconnected LNAPL ganglia is retained in soil pores leaving behind residual LNAPL in the smear zone. Based on the NAPL Investigation and activities conducted for this FFS, the LNAPL zone is present up to approximately 20 feet below the water table as measured in early 2015. In January 2015, LNAPL was observed in dye tests from depths of approximately 14 feet bgs (SB-36B) to 49 feet bgs (SB-68B).

Some portion of the LNAPL is mobile, as evidenced by the accumulation of “free-product” LNAPL in monitoring wells MW-3 and MW-12, and piezometer PZ-2. The LNAPL thickness measured in monitoring wells MW-3 and MW-12 is approximately one foot and the LNAPL thickness in PZ-2 is approximately four feet. The apparent thickness of LNAPL in monitoring wells is typically greater than the actual thickness of LNAPL in the formation by a factor estimated to between two and ten (USEPA, 1995).

In the source area, TCE has largely partitioned into the LNAPL, as evidenced by the concentration of TCE detected in samples of the LNAPL. TCE has an octanol-water distribution coefficient (Kow) of 251 (calculated from log Kow of 2.4; USEPA, 2014) indicating that TCE will more readily partition into (i.e., dissolve into) the octanol phase than into groundwater. Octanol is a non-polar solvent (water is polar) that is similar to oil, such as petroleum fuels. The NAPL Investigation results indicate that chlorinated VOC concentrations decrease below the LNAPL zone, indicating that the bulk of the TCE is partitioned in the above-lying petroleum LNAPL.

The amount of petroleum that was released into the subsurface is not known. However, the extent of the LNAPL has been delineated and the LNAPL does not appear to be mobile or migrating (i.e., LNAPL has not been detected in downgradient monitoring wells).

4.6.3 Groundwater

The LNAPL acts as the primary source to the dissolved-phase groundwater plume, which extends north from the north lobe of the LNAPL zone, and east from the east lobe of the LNAPL zone. From the northern portion of the Site, the dissolved-phase groundwater plume extends east and west to discharge zones.

4.6.3.1 Chlorinated VOCs

The dissolved-phase chlorinated VOC plume in overburden, primarily consisting of TCE, generally extends east and west from the source area toward groundwater discharge zones. Concentrations of chlorinated VOCs have not been identified above the method detection limit (MDL) in groundwater samples collected from monitoring wells MW-1, MW-8, MW-9, MW-9A, MW-10 and MW-10A indicating that the horizontal extent of the dissolved phase chlorinated VOC plume in overburden has been delineated in the northern and southern directions.

The LNAPL acts as the primary source to the dissolved-phase plume. Over time, constituents in the LNAPL dissolve into the groundwater migrating through the LNAPL area, creating the dissolved-phase plume. Based on results from the NAPL Investigation, the core (i.e., area of highest VOC contamination) of the groundwater plume extends from the LNAPL lobes and is relatively narrow (Figure 6). Concentrations of TCE in the dissolved-phase core downgradient of the LNAPL are elevated (in the tens of thousands µg/L). As noted by Bernard Kueper, PhD, one of the preeminent scientists studying NAPLs, concentrations of constituents exceeding the one percent solubility of the constituent (one percent of the solubility of TCE is 11,000 µg/L) does not mean that NAPL conditions are present at that location. Dr. Kueper indicates "There never was a technical basis for the exact 1% value. It is a very rough guide to simply alert investigators that if 1% solubility is exceeded, it is possible that the groundwater flow path leading to the monitoring well in question may have contacted [NAPL] at some point in time, and at some location up-gradient or side-gradient of the monitoring point in question" (Kueper, 2013).

In the source area, the VOC concentrations generally decrease with depth below the LNAPL zone. The permeability of the soil in the source area generally increases with depth, and based on electron capture device responses in some high permeability zones, this appears to allow for “flushing” of the dissolved-phase VOCs. The dissolved-phase plume extends to bedrock at the Site.

High permeability soils and an upward hydraulic gradient in the area of the springs east of the Site enable discharge of the majority of the eastern overburden plume to the springs (i.e., the dissolved-phase plume core does not extend beyond the springs based on groundwater samples collected from monitoring wells MW-11 and MW-11A located east of the springs).

Constituents in the chlorinated VOC dissolved-phase plume include TCE, tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), and degradation products of these compounds. TCE is the primary chlorinated VOC present in soil and groundwater and cis-1,2-DCE, which is a degradation product of TCE, is the primary degradation product at the Site. The cis-1,2-DCE concentrations are generally less than one percent of the TCE concentrations indicating that little biodegradation is occurring. Additionally, vinyl chloride, which is a breakdown product of cis-1,2-DCE, has not been regularly detected in soil and groundwater samples. The pH of groundwater at the Site is typically around 5, which could be one of the factors limiting the ability of microbes to anaerobically degrade TCE to cis-1,2-DCE.

Groundwater samples were collected in the LNAPL area during the NAPL Investigation. TCE concentrations in the groundwater samples ranged from 2,200 to 86,100 µg/L, with an average concentration of 21,500 µg/L.

4.6.3.2 Petroleum Constituents

Petroleum constituents have been detected in spring and surface water samples collected east of the Site since 1999. In general, the number of detected constituents, as well as the concentration of the detected constituents, were highest in samples collected from Spring-02. The highest concentrations of petroleum constituents have been detected in groundwater samples collected from within the LNAPL area. Concentrations of petroleum constituents decrease relatively significantly downgradient of the LNAPL Area. Therefore, it appears that there is a narrow petroleum plume core that migrates from the LNAPL Area to the springs area.

Based on groundwater samples collected in the western area of the Site and west of the former plant boundary, the dissolved-phase petroleum plume does not extend west/northwest of the LNAPL Area.

4.6.4 Surface Water

Surface water features originate east and west of the Site at seep/spring areas. The surface water features east of the Site contain chlorinated VOCs and petroleum-related compounds. The surface water features west of the Site contain chlorinated VOCs. Previous investigations indicate that the VOCs in the unnamed tributary east of the Site dissipate rapidly downstream, and the same is anticipated for the western unnamed tributary. The cis-1,2-DCE concentrations increase in the springs area relative to the TCE concentrations, and vinyl chloride is often detected, indicating increased biodegradation activity in/at the spring/seep areas.

4.7 FATE AND TRANSPORT

The fate and transport of contaminants in soil and groundwater is influenced by numerous factors, including the primary and secondary release mechanisms; the physical and chemical properties of the constituents that were released; and the characteristics of the subsurface medium through which the contaminants migrate.

4.7.1 Contaminants of Concern

For the purposes of this NAPL Area FFS, the primary COC is TCE. Other COCs are PCE, 1,1,1-TCA and chlorinated VOC breakdown products.

4.7.2 Contaminant Transport Pathways

Several pathways are present for contaminant migration. The unsaturated soil pathway, where contaminants leach from the soil to the underlying groundwater, is not considered a significant transport pathway, as the majority of COC contamination in the unsaturated zone has been removed. The majority of COC contamination in the unsaturated soil has already leached to below the water table, remains in the smear zone, or was removed by the SVE system. Therefore, the primary contaminant transport pathway is via groundwater. The dissolved-phase groundwater plume discharges at surface water features east and west of the Site resulting in an airborne contaminant pathway via volatilization of VOCs, as well as a surface water contaminant transport pathway. Some component of groundwater from the overburden likely also migrates into the underlying bedrock.

4.7.3 Mass Distribution

The area of LNAPL at the Site contains the largest mass of contaminants. The highest COC concentrations have been detected within the LNAPL Area. COCs dissolve into groundwater in the source area from the LNAPL, thereby developing the dissolved-phase groundwater plume.

4.7.4 Risk Assessment

Based on data collected to date, there are currently no human exposures above USEPA's risk management levels. Ecological exposures will be evaluated during the site-wide RI/FS.

5.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 212 (d)(4)(A) states that a remedial alternative can be selected that does not attain a level or standard of control at least equivalent to a legally applicable or relevant and appropriate requirement, criteria, or limitation if the remedial action selected is part of a total remedial action that will attain such level or standard of control when completed. The remedial alternatives developed for this FFS are focused on remediating TCE in the NAPL source area to a degree that the TCE concentrations in the downgradient dissolved-phase plume will begin to decrease.

5.1 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are medium-specific or operable-specific goals for protecting human health and the environment and specify contaminants of concern, media of concern, potential exposure pathways, and remedial goals (USEPA, 1988). USEPA guidance states that RAOs should specify:

- The COC(s)
- Exposure route(s) and receptor(s)
- An acceptable contaminant level or range of levels for each exposure route (i.e., a preliminary remediation goal)

The objective of the NAPL Area interim remedy is to significantly reduce the mass of TCE in the source area to remove the continuing source to the dissolved-phase groundwater plume. Over time, and while the Site-wide RI/FS is being conducted, the dissolved-phase plume is expected to decrease in size and concentration. The specific RAO of the remedial action is to reduce TCE concentrations in saturated soil and groundwater in the area of identified LNAPL (Figure 5) by 95 percent based on soil and groundwater concentrations. This RAO has been developed for the interim remedy, which is acceptable under CERCLA Section 121 (d)(4)(A), so state or federal regulatory standards (e.g., the maximum contaminant level for TCE) are not relevant.

5.2 IDENTIFICATION OF POTENTIAL ARARS

Section 121 of CERCLA specifies that Superfund remedial actions meet the more stringent of federal or state standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. In accordance with the NCP at 40 CFR 300.430(e)(9)(iii)(B), ARARs are identified to ensure that the proposed remedial alternative(s) can be implemented.

Under CERCLA Section 121(e)(1), federal, state, or local permits are not required for the portion of any removal or remedial action conducted entirely on site as defined in 40 CFR 300.5 (see also 40 CFR 300.400(e)(1) and (2)). In addition, CERCLA actions must only comply with the "substantive requirements," not the administrative requirements of regulations. Administrative requirements include permit applications, reporting, record keeping, and consultation with administrative bodies. Although consultation with state and federal agencies responsible for issuing permits is not required, it is recommended to consult with the agencies for determining compliance with certain requirements, such as those typically identified as location-specific ARARs.

Applicable requirements, as defined in 40 CFR 300.5, are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or state facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site.

Relevant and appropriate requirements, as defined in 40 CFR 300.5, are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or state facility siting laws that, while not "applicable" to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well-suited to the particular site.

Per 40 CFR 300.400(g)(4), only those state standards which are promulgated, are identified in a timely manner, and are more stringent than federal requirements may be applicable or relevant and appropriate. For the purposes of identification and notification of promulgated state standards, the term "promulgated" means that the standards are of general applicability and are legally enforceable. State ARARs are considered more stringent where there is no corresponding federal ARAR, where the state ARAR provides a more stringent concentration of a contaminant, or the where a state ARAR is broader in scope than a federal requirement.

In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to be considered for a particular release. The “to be considered” (TBC) category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies (40 CFR 300.400(g)(3)). TBCs can be used in the absence of ARARs, when ARARs are insufficient to develop cleanup goals, or when multiple contaminants may be posing a cumulative risk (USEPA, 1987).

For purposes of ease of identification, USEPA has created three categories of ARARs: chemical-, location-, and action-specific. Under 40 CFR 300.400(g)(5), the responsible party and the lead and support agencies shall identify the specific ARARs for a particular site and notify each other in a timely manner as described in 40 CFR 300.515(d).

5.2.1 Chemical-specific ARARs

Chemical-specific ARARs are health- or risk-based numerical concentration limits or discharge limitations in/to environmental media (e.g., soil, groundwater, surface water, etc.) for specific hazardous substances, pollutants, or chemicals. Chemical-specific ARARs are defined by the Safe Drinking Water Act, the Clean Water Act, the Clean Air Act, state programs, etc. The RAO proposed for the interim remedy is reduction of TCE concentrations by 95 percent. Therefore, chemical-specific ARARs for TCE or other Site-related VOCs are not relevant.

5.2.2 Location-specific ARARs

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances, establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, coastal areas), or establish siting parameters for facilities based on their proximity to special locations. Potential location-specific ARARs are presented in Table 11.

5.2.3 Action-specific ARARs

Action-specific ARARs are usually technology-based or activity-based requirements or limitations that control actions taken at hazardous waste sites. Action-specific requirements often include performance, design and controls, or restrictions on particular kinds of activities related to management of hazardous substances. Action-specific ARARs are triggered by the types of remedial activities and types of wastes that are generated, stored, treated, disposed, emitted, discharged, or otherwise managed. Potential action-specific ARARs/TBCs are presented in Table 12.

5.2.4 Evaluation and Waiver of ARARs

The remedial alternatives have been evaluated in this FFS to assess whether they comply with identified chemical-, action-, and location-specific ARARs. As stated above, compliance with ARARs is a threshold requirement of CERCLA that every remedy must meet, unless an ARAR waiver can be used (see 40 CFR 300.430(f)(1)(ii)(C)). Under CERCLA Section 121(d)(4), a remedial action that does not attain an ARAR may be selected if USEPA finds that one of the six waivers is justified. The six statutory ARAR waivers are (USEPA, 1989):

- Interim measure: the preferred alternative is an interim measure and will become part of the overall remedial action that will attain the ARAR.
- Equivalent standard of performance: the preferred alternative will attain a standard of performance that is equivalent to that required by another ARAR, which requires use of a particular design or operating standard.
- Greater risk to health and the environment: compliance with the requirement will result in greater risk to human health and the environment.
- Technical impracticability: compliance with the ARAR is technically impracticable from an engineering perspective.
- Inconsistent application of state standard: evidence demonstrates that the state ARAR has not been consistently applied at other remedial sites.
- Fund-balancing: for Superfund-financed remedial actions, the cost involved in meeting the ARAR will not provide a balance between the added degree of protection or reduction of risk and the availability of Superfund funds for remedial actions at other sites.

Remediation of the NAPL Area at the Site is considered an interim measure that will become part of the overall Site remediation that will attain all applicable ARARs.

5.3 GENERAL RESPONSE ACTIONS

General response actions (GRAs) are broad categories of remedial technologies (i.e., containment, treatment, excavation, etc.) that could be implemented to satisfy RAOs. Volumes or areas of media to which the GRAs would be applied are then determined. Applicable technologies for each GRA are then identified and screened to determine which alternatives would be most effective at satisfying the RAOs. The alternatives can be media-specific, area-specific, or site-wide. After specific alternatives are identified, a detailed analysis of alternatives is conducted, as specified in the NCP.

5.3.1 No Action

No action includes implementation of no remedial measures. According to the NCP (40 CFR 300.430(e)(6)), no action is retained for detailed analysis and used as a baseline in comparing alternatives.

5.3.2 Institutional Controls and Engineering Controls

Institutional controls (ICs) and engineering controls (ECs) are intended to restrict exposure to impacted media. ICs/ECs can include security measures, deed/land use restrictions, fences, and warning signs. ICs/ECs, as a stand-alone remedial action, are appropriate where constituents are immobile, where the risk assessment does not identify constituents as potential future hazards, where the costs to implement remedial measures outweigh the benefits, or where the short-term risk to implement a technology outweighs the benefit. ICs/ECs will not meet the RAOs and will not be considered as a remedial alternative for remediation of the LNAPL source area.

5.3.3 Excavation/Removal

Removal involves excavating impacted media followed by either on-site or off-site treatment and/or disposal. CERCLA Section 121(b)(1) states “the [off-site] transport and disposal of hazardous substances or contaminated materials without such treatment should be the least favored alternative remedial action where practical treatment technologies are available.”

Benching for excavation of soil to depths of 60 feet is logistically prohibitive, as there is insufficient space for proper benching (i.e., benching to this depth would be similar to open-pit mining). Vertical excavations, which are achieved using shoring, walls, etc., require a wide access corridor around the excavation for excavation equipment.

Volatilization of TCE from the large areas of exposed soil would create a significant risk to nearby residents from TCE in the ambient air. Treatment of ambient air in this situation would not be possible. Dewatering would be required for excavation of soil. On-site treatment methods for excavated soil and water would require more space than is available at the Site, given the size of the excavation, access roadways, areas of stockpiled clean soil, treatment equipment, etc.

If off-site treatment/disposal were considered, which it is not a preferred method by USEPA (CERCLA Section 121(b)(1)), approximately 2,700 trucks with a 13 cubic yard capacity would be required for transport of soil, and a large quantity of tanker trucks would be required for transport of water generated during dewatering operations. The volume of truck traffic, and risk of an accident with a truck carrying hazardous waste, poses great risk to the nearby community and the communities along the roadways on which the trucks would travel.

Excavation/removal to meet the RAOs will not be considered as a remedial alternative for remediation of the LNAPL source area.

5.3.4 Extraction

Extraction involves pumping/removal of groundwater/NAPL and ex-situ treatment prior to disposal. Remediation of contaminated groundwater via “pump and treat” typically takes decades to complete. In many cases, pump and treat does not achieve RAOs and other remedial methods are required.

Extraction also includes enhanced removal via flooding/flushing. A “washing” solution (e.g., surfactants, steam, etc.) is injected into the subsurface and a physical reaction occurs that enables the contaminant mass to be more easily extracted than conventional pump and treat. The extracted groundwater is treated ex-situ for disposal.

Extraction via enhanced removal will be considered as a remedial alternative for the remediation of the LNAPL source area.

5.3.5 Containment

Containment includes preventing direct exposure to impacted media and limiting contaminant mobility. Long-term, in-place management would be required along with a long-term monitoring program. Capping and engineered barriers are examples of containment. Containment methods will not meet the RAOs and will not be considered as a remedial alternative for remediation of the LNAPL source area.

5.3.6 Treatment

Treatment involves applying chemical, biological, or physical processes to the contaminated media to degrade, remove, or immobilize contaminants. Treatment can be conducted in-situ or ex-situ. In-situ treatment technologies include ISCO, ERH, and enhanced bioremediation. Ex-situ treatment technologies include soil washing and thermal desorption. In-situ treatment will be considered as a remedial alternative for the remediation of the LNAPL source area.

5.4 AREA/VOLUME AND MEDIA TO BE ADDRESSED

The area to be addressed is the approximate one-acre LNAPL source area at the Site. Soil and groundwater in the overburden (i.e., above bedrock) below the water table are targeted for remediation. The depth to groundwater in the source area in January 2015 ranged from approximately 15 to 25 feet bgs. The depth to bedrock in the source area ranges from approximately 30 to 60 feet bgs. Based on an average depth to groundwater of 20 feet bgs and an average depth to bedrock of 45 feet bgs, the volume to be treated is approximately 40,500 cubic yards.

6.0 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

The purpose of the remedial action is to reduce TCE concentrations at and below the water table (i.e., saturated soil and groundwater) in the area of the identified LNAPL. The following GRAs have been identified for the LNAPL source area:

- No action
- In-situ treatment/reduction of contaminants
- Enhanced extraction and ex-situ treatment

As required by the NCP, remedial technologies are evaluated based on their effectiveness, implementability, and cost.

Effectiveness is evaluated based on how well a technology satisfies the RAOs for a specific medium; protects human health and the environment in the short and long term; attains federal and state ARARs; and permanently reduces the toxicity, mobility, or volume of hazardous constituents through treatment.

Implementability is evaluated based on the technical feasibility of implementation, and the availability of the technology. Implementability also considers the technical and institutional ability to monitor, maintain, and replace a technology, and the administrative feasibility of implementing the technology.

During the technology screening process, cost is evaluated on a relative basis. A high level of accuracy in estimating costs is not required, although the relative costs of competing technologies should be reasonably well defined. Cost estimates for technologies that are retained and incorporated into remedial alternative(s) are more accurately estimated during the detailed alternative analysis.

Effectiveness, implementability, and cost were generally evaluated in the Preliminary Action Plan for Springs and NAPL Area submitted to USEPA on June 27, 2014, for four conceptual remedial action approaches to reduce TCE concentrations from the source area. The four proposed potential remedial alternatives have been determined to meet the three criteria and have been screened in the detailed analysis of alternatives described below.

6.1 ASSESSMENT CRITERIA

The USEPA has outlined nine criteria to be used in evaluating remedial alternatives (40 CFR 300.430(e)(9)(iii)). The detailed analysis presents facts/data which are assembled and evaluated to develop the rationale for remedy selection (USEPA, 1988). The nine criteria are further divided into three categories (threshold criteria, balancing criteria, and modifying criteria), as summarized in the following table and described in the following sections.

Threshold Criteria	Balancing Criteria	Modifying Criteria
- Overall protection of human health and the environment - Compliance with ARARs	- Long-term effectiveness and permanence - Reduction of mobility, toxicity, and volume through treatment - Short-term effectiveness - Implementability - Cost	- State acceptance - Community acceptance

6.1.1 Threshold Criteria

Overall protection of human health and the environment and compliance with ARARs (unless an ARAR(s) is waived) are statutory criteria that must be met in order to be eligible for selection.

6.1.1.1 Overall Protection of Human Health and the Environment

The assessment of overall protection draws on other evaluations, such as long term-effectiveness and permanence, short-term effectiveness, and compliance with ARARs. This evaluation focuses on how the alternatives achieve adequate protection and how risks are eliminated, reduced, or controlled.

6.1.1.2 Compliance with ARARs

Compliance with identified ARARs is required for an alternative to be eligible for selection. If an ARAR(s) cannot be met, the basis for justifying one of the six waivers is discussed. The determination of which requirements are applicable or relevant and appropriate is made by the USEPA.

6.1.2 Balancing Criteria

Balancing criteria are the technical criteria upon which the detailed analysis is primarily based.

6.1.2.1 Long-term Effectiveness and Permanence

Long-term effectiveness addresses the protection of human health and the environment after the RAOs have been met. In evaluating alternatives for their long-term effectiveness, the analysis considers: the ability to perform intended functions such as containment or removal; the adequacy and reliability of long-term engineering or institutional controls; and long-term performance, operation, and maintenance requirements.

6.1.2.2 Reduction of Mobility, Toxicity, and Mobility through Treatment

This criterion evaluates ability of the alternatives to meet the statutory preference for treatment as a principal element of remediation. For each alternative, reduction of the toxicity, mobility, and volume of impacted material achieved through treatment are discussed. This criterion includes the permanence of the remedy and the nature of residuals remaining after treatment.

6.1.2.3 Short-term Effectiveness

Short-term effectiveness evaluates the alternative during construction and implementation until RAOs are achieved. Specific considerations include potential exposures to the community, environment, and on-site workers during construction and the relative duration of the alternative to achieve RAOs.

6.1.2.4 Implementability

Implementability addresses the ability to implement an alternative, as well as technical factors involved in implementation and administrative issues. Considerations include the relative ease of installation (constructability) and technical feasibility of implementing the selected technologies at the site (including compatibility with site features, site constraints and limitations, and accessibility of the area), administrative feasibility of coordinating implementation of the alternative among various state and federal agencies, acquiring required permits and approvals, and the availability of the technologies services, equipment, and materials necessary for implementation.

6.1.2.5 Cost

This criterion considers the costs associated with implementing an alternative, and includes a breakdown of capital costs and annual operations, maintenance, and monitoring costs. Cost estimates are based on conceptual designs of the remedial alternatives. Labor and material costs are estimated from published unit costs and experience on similar projects, as contractor and vendor bids generally are not obtained. Actual project costs may vary depending on the final design of the remedial system, site conditions, additional evaluations, regulatory and community requirements, and availability of labor and materials at the time of implementation.

6.1.3 Modifying Criteria

Modifying criteria, including state and community acceptance, will be addressed in the Interim Record of Decision after comments on the FFS and proposed remedy have been received.

6.2 ALTERNATIVE 1: NO ACTION

No action is retained as an alternative because it provides the baseline for comparing alternatives. Its inclusion among the alternatives is mandated by USEPA guidance. The no action alternative assumes that current restrictions on trespassing would not be enforced and additional monitoring would not be conducted.

6.2.1 Overall Protection of Human Health and the Environment

The no action alternative is not protective of human health or the environment, as the NAPL Area would continue to create a dissolved phase contaminant plume which would continue to discharge at spring/seep areas east and west of the Site.

6.2.2 Compliance with ARARs

The no action alternative complies with ARARs, as chemical-specific ARARs are not relevant. Location and action-specific ARARs would not be relevant as there would be no activity to be regulated.

6.2.3 Long-term Effectiveness and Permanence

The no action alternative is not considered effective in the long term.

6.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The no action alternative does not reduce toxicity, mobility, or volume through treatment.

6.2.5 Short-term Effectiveness

The no action alternative is not considered effective in the short term.

6.2.6 Implementability

No measures are implemented under this alternative.

6.2.7 Cost

There are no capital or maintenance costs associated with this alternative, making the no action alternative the least expensive remedial alternative.

6.3 ALTERNATIVE 2: MULTI-PHASE EXTRACTION

Multi-phase extraction (MPE) is a removal method where a vacuum is applied to a well to remove groundwater, LNAPL, and soil vapor from the subsurface (USEPA, 2014). The extracted vapor and fluids are treated aboveground by either on-site treatment and/or off-site treatment/disposal.

Extraction of LNAPL is possible if the LNAPL exceeds the residual saturation threshold. However, LNAPL that is present below the residual saturation threshold cannot be removed directly via vacuum extraction, because the LNAPL does not fill the void space between soil particles and is consequently immobile.

MPE would involve installation of extraction wells and construction of a system to extract the LNAPL. The LNAPL and groundwater would be separated and the groundwater treated on-site using carbon or other means. The LNAPL would be containerized and disposed of off-site.

6.3.1 Overall Protection of Human Health and the Environment

The success of TCE reduction via MPE at the Site is dependent upon the ability to remove LNAPL from the subsurface (i.e., the TCE is partitioned into the LNAPL, so removal of the LNAPL is necessary to remove the bulk of TCE mass). Based on the results of the LNAPL mobility testing and the baildown testing, significant mobile LNAPL is not present in the source area at the Site. Although some LNAPL would be recovered, the bulk of the LNAPL mass would remain as residual LNAPL and would not be recovered.

The LNAPL acts as the primary source to the TCE dissolved-phase plume. If sufficient LNAPL is not removed via MPE, the source of TCE contamination would remain and the dissolved-phase plume would not be affected. MPE alone is not considered protective of human health and the environment, as a significant reduction of TCE in the source area would not be achieved.

6.3.2 Compliance with ARARs

MPE would meet the proposed ARARs. Applicable ARARs are generally associated with waste collection, handling, and disposal.

6.3.3 Long-term Effectiveness and Permanence

Because residual-phase LNAPL would remain, MPE would not be effective over the long term. MPE is not a permanent alternative as the remaining residual LNAPL would serve as a continuing source of TCE to the dissolved-phase groundwater plume.

6.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The volume of LNAPL, and thus TCE, present in the source area would decrease somewhat, but the bulk of mass would likely remain. The toxicity of the TCE would not likely increase or decrease if MPE were implemented, as the geochemistry of the subsurface materials would not change. MPE would not significantly impact the mobility of contamination in the NAPL source area.

6.3.5 Short-term Effectiveness

Implementation of MPE would not meet the RAOs in the short term. Adverse impacts on human health and the environment during construction and implementation would be minimal.

6.3.6 Implementability

MPE is readily implementable, due to the ease of construction, available materials and equipment. An access agreement would be required for remediation of the portion of the NAPL Area on the property east of the former plant property.

6.3.7 Cost

The estimated cost for implementation of MPE is $2,550,000. This estimated cost includes installation of permanent extractions wells and operation of a MPE system for up to ten years. This estimated cost does not include post-remediation sampling or long-term monitoring.

6.4 ALTERNATIVE 3: ELECTRICAL RESISTIVITY HEATING

ERH involves heating of the subsurface using electrodes installed in the zone of contamination. An alternating current voltage is applied to the electrodes, which generates an electric current. The electric current causes heating of the subsurface and contaminants that are volatile, such as TCE, volatize and are recovered from vent wells that are located adjacent to the electrodes. The vapors are then treated aboveground and discharged to the atmosphere. Condensate from the vapors also is collected and treated. The treated condensate is used to provide “drip water” to the electrodes or discharged to the sanitary sewer system.

Heating occurs in the saturated zone where there is sufficient moisture to conduct electricity. Temperature monitoring points are installed at multiple depths to monitor the temperature of the subsurface. Heating of the subsurface has the potential to decrease the viscosity of the LNAPL in the source area, which would increase the mobility of the LNAPL. LNAPL might accumulate in vent wells and can be recovered via skimmer pumps or vacuum equipment. The LNAPL would be containerized and transported to a regulated facility for disposal

The ERH bench test indicated that ERH could reduce TCE concentrations to greater than 95 percent. ERH bench tests are typically highly representative of what removal levels can be achieved in the field. Pilot testing is typically not conducted, as the cost to benefit ratio is small.

Borings for the electrodes would be installed using hollow-stem augers. Borings would be advanced to auger refusal. Although the target zone for remediation is the LNAPL zone, installing the electrodes below the LNAPL zone has the added benefit of remediating contaminated soil/groundwater to the maximum depth possible in overburden.

ERH is safe to site workers and the community, as ERH work is performed with numerous safeguards. Isolation transformers only allow electricity to flow between electrodes within the work area. Thus, electricity cannot travel beyond the ERH treatment area.

6.4.1 Overall Protection of Human Health and the Environment

Implementation of ERH is protective of human health and the environment, as TCE in the source area can be reduced by up to 95 percent. Concentrations of TCE in the downgradient dissolved-phase plume would be expected to decline after implementation of ERH.

6.4.2 Compliance with ARARs

ERH would meet the proposed ARARs. Applicable ARARs are generally associated with waste collection, handling, and disposal or discharge.

6.4.3 Long-term Effectiveness and Permanence

ERH is effective for the long term. Contamination does not rebound after treatment, making ERH a permanent remedial alternative for the NAPL source area at the Site.

6.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

ERH reduces the volume of contaminants from the subsurface via transfer of the contaminants from the solid or dissolved phase into the vapor phase for subsequent extraction and treatment/destruction. The toxicity of the contaminants, primarily TCE, will not increase, as the contaminants are directly removed (i.e., not chemically degraded) and will not form more toxic compounds.

6.4.5 Short-term Effectiveness

ERH is considered to be effective in the short-term, as the timeframe required for remediation is typically less than one year after heating begins. Monitoring and engineering controls are implemented to protect workers and the community. Engineering controls would be used to prevent contaminated materials from migrating with surface runoff water or becoming airborne during construction. Air monitoring would be implemented during construction activities that come into contact with contaminated media to ensure workers don the proper protective equipment for the level of contamination present. Air and wastewater discharge monitoring would also be implemented to ensure that contaminants being discharged do not exceed applicable standards, which are protective of the surrounding environment.

6.4.6 Implementability

ERH is technically and administratively implementable. ERH is somewhat innovative, but experienced contractors are available to design, construct, and operate an ERH system. An access agreement would be required for remediation of the portion of the NAPL Area on the property east of the former plant property.

6.4.7 Cost

The estimated cost for implementation of ERH is $4,000,000. This estimated cost includes installation, operation, and maintenance of an ERH system over a 19-month period from the notice to proceed. This estimated cost does not include confirmation sampling (sampling can be conducted at different times during remediation to evaluate progress at meeting goals) or long-term monitoring following implementation of ERH.

6.5 ALTERNATIVE 4: IN-SITU CHEMICAL OXIDATION

ISCO involves injection of oxidant chemical substances into the contaminated zone via injection points. The chemicals oxidize the contaminants to form non-hazardous substances such as carbon dioxide and water. ISCO is typically implemented with a primary injection event and one or more polishing injections to reduce contaminant concentrations/mass to the desired level (USEPA, 2006).

CHP was chosen as an oxidant for ISCO evaluation, as the hydroxyl radical generated by CHP is the most powerful oxidant utilized in environmental remediation. ISCO with CHP is exothermic, therefore, heat is generated. Volatilization of volatile contaminants, such as TCE, is likely and would be controlled using vent wells. Vapors created by the heat are extracted from the vent wells and treated aboveground before discharge to the atmosphere. Heat generated during the injection has the potential to decrease the viscosity of the LNAPL in the source area. LNAPL might accumulate in vent or injection wells and can be recovered via skimmer pumps or vacuum equipment. The LNAPL would be containerized and transported to a regulated facility for disposal.

ISCO using CHP is a rapid reaction, with oxidation generally complete in minutes. Intermediates products formed during the reaction are mainly carboxylic acids and the end products are primarily carbon dioxide and water. Unconsumed hydrogen peroxide degrades to oxygen and water following injection.

Permanent injection wells would be installed with approximately four injection intervals at each injection location. Permanent wells allow for subsequent injections to be implemented without additional drilling expenses. Two or more injection events would likely be required given the high concentrations of TCE present in the source area.

The ISCO bench test indicated that ISCO could reduce TCE concentrations to greater than 95 percent. Pilot testing is typically conducted to better design the full-scale system. Pilot testing is conducted to determine the injection radius of influence, to evaluate operating conditions (e.g., operating pressure, amount of LNAPL production, amount of off-gassing, etc.), and to evaluate contaminant reductions.

Borings for the injection wells would be installed using sonic drilling. Borings would be advanced to refusal with the drilling equipment. Although the target zone for remediation is the LNAPL zone, installing the injection wells below the LNAPL zone has the added benefit of remediating contaminated soil/groundwater to the maximum depth possible in overburden.

6.5.1 Overall Protection of Human Health and the Environment

Implementation of ISCO is protective of human health and the environment, as TCE in the source area will be reduced. Concentrations of TCE in the dissolved-phase plume will decline after implementation of ISCO.

6.5.2 Compliance with ARARs

ISCO would meet the proposed ARARs. Applicable ARARs are generally associated with waste collection, handling, and disposal or discharge.

6.5.3 Long-term Effectiveness and Permanence

ISCO is effective for the long-term, as contaminants are destroyed in-situ. However, contamination typically rebounds after the initial injection as contaminants desorb from the soil matrix and dissolve from NAPL. Additional injection events are required to reduce the rebounded contamination. The number of additional injection events is difficult to accurately determine, as the amount of rebound cannot be estimated.

The primary factors affecting the length of time for remediation include delivery of the oxidant substrate and the presence of LNAPL. In order for ISCO to be effective, the oxidant has to directly contact the contaminants to allow for the chemical reaction to occur. When injected, chemical substrates will migrate along the path of least resistance and fracturing of the soil matrix can occur if injection pressures are too high. The oxidant substrate can, therefore, migrate around low permeability zones, which might contain a significant mass of the contamination. This condition can be a significant impediment to effective/uniform oxidant delivery in the subsurface (USEPA, 2006).

ISCO is an aqueous-phase process and does not directly remove NAPL. NAPL depletion occurs as contaminants are degraded in the dissolved and sorbed phases and contaminants in the NAPL phase dissolve into the surrounding groundwater. The time required for all of the TCE in the LNAPL phase to dissolve into the dissolved-phase for subsequent oxidation via ISCO is difficult to determine.

6.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

ISCO would reduce the mass of TCE in the source area. Given the relatively low pH of the subsurface materials in the source area, as well as the lowering of the pH during oxidation, creation of daughter product cis-1,2-DCE is not expected to be significant. Therefore, formation of vinyl chloride, the more toxic daughter product of cis-1,2-DCE, is not expected to be significant. Overall, the toxicity of contamination will be reduced. The mobility of the contaminant plume in the source area is not expected to change. However, injection of large volumes of the oxidant substrate has the potential to increase the area of the high concentration source zone by "pushing" groundwater away from the source area.

6.5.5 Short-term Effectiveness

ISCO is considered to be somewhat effective in the short-term, as the timeframe required for remediation is typically less than five years. A pilot study would be required to design the full-scale injection system and would take approximately six months to complete. Monitoring and engineering controls are implemented to protect workers and the community. Engineering controls would be used to prevent contaminated materials from migrating with surface runoff water or becoming airborne during construction. Air monitoring would be implemented during construction activities that come into contact with contaminated media to ensure workers don the proper protective equipment for the level of contamination present. Air discharge monitoring would also be implemented to ensure that contaminants being discharged from the vent well system do not exceed applicable standards, which are protective of the surrounding environment. Potential LNAPL recovered from the system would be collected and transported for disposal at a regulated off-Site facility.

6.5.6 Implementability

ISCO is technically and administratively implementable. A pilot study would be conducted prior to design and implementation of the full-scale system. Experienced contractors are available to design, construct, and operate an ISCO system. An access agreement would be required for remediation of the portion of the NAPL Area on the property east of the former plant property.

6.5.7 Cost

The estimated cost for implementation of ISCO is $3,700,000. This estimated cost includes performance of a pilot test, installation of permanent injection and vent wells, a primary injection event, and two polishing injection events. This injection scenario is estimated to take up to three years to complete from the notice to proceed. This estimated cost does not include additional polishing events, post-remediation sampling, or long-term monitoring.

6.6 ALTERNATIVE 5: SURFACTANT FLOODING

Surfactant flooding involves injecting a surfactant substrate into the saturated subsurface to increase the mobility of the LNAPL phase. The LNAPL is then removed via extraction wells. The extracted LNAPL and groundwater are separated aboveground. The groundwater is treated and discharged to the sanitary sewer system. The LNAPL is disposed of off-Site at a regulated facility.

A surfactant formulation capable of producing microemulsion systems with low IFT between the Site LNAPL and groundwater was developed and tested. Based on the two column studies, the percent recovery of the LNAPL was determined to be 56 percent and 84 percent. Pilot testing is typically implemented to better design the full-scale system. Pilot testing is conducted to determine the injection radius of influence, to evaluate operating conditions (e.g., operating pressure, LNAPL/groundwater extraction rates, etc.), and to evaluate contaminant reductions.

Permanent injection and extraction wells would be installed with several injection intervals at each injection location. Permanent wells allow for subsequent flooding events to be implemented without additional drilling expenses. More than one flooding event would likely be required given the results of the bench test (i.e., not all of the LNAPL was removed with one flushing event).

Surfactant flooding is only applicable to LNAPL and not contamination in the dissolved-phase groundwater plume. Removal of residual-phase and mobile phase LNAPL is possible as the surfactant lowers the IFT of the LNAPL so that it becomes mobile and can be recovered via extraction wells.

6.6.1 Overall Protection of Human Health and the Environment

Enhanced removal of LNAPL via surfactant flooding would reduce TCE concentrations in the source area and would be, therefore, protective of human health and the environment. Elevated TCE in the dissolved-phase groundwater below the LNAPL will likely not be reduced significantly, as the surfactant flooding would only be implemented in the zone of identified LNAPL. With the removal of LNAPL, the mass of TCE available for dissolution to the dissolved-phase plume will be decreased. However, the high concentrations of dissolved-phase TCE below the LNAPL zone would still contribute to the dissolved-phase plume. Therefore, a significant reduction of TCE would likely not be realized for several years in the downgradient dissolved-phase groundwater plume.

6.6.2 Compliance with ARARs

Surfactant flooding would meet the proposed ARARs. Applicable ARARs are generally associated with waste collection, handling, and disposal or discharge.

6.6.3 Long-term Effectiveness and Permanence

Surfactant flooding would largely be ineffective in the long-term, as only the TCE that has partitioned to the LNAPL would be removed. Dissolved-phase TCE in the source area below the LNAPL zone would not be removed. Surfactant flooding has the potential to remove a large percentage of the LNAPL at the Site, but the remaining LNAPL would serve as a continuing source of TCE to the dissolved-phase plume.

6.6.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Surfactant flooding would remove some portion of TCE from the source area. Degradation of TCE to more toxic compounds, such as vinyl chloride, would not be anticipated. As previously described, TCE is partitioned into the LNAPL, where present. By definition, addition of a surfactant will increase the mobility of the LNAPL, and thus the TCE. Hydraulic control using groundwater injection wells would be required with the surfactant injection/extraction system to ensure the LNAPL does not mobilize beyond the identified LNAPL area.

6.6.5 Short-term Effectiveness

Surfactant flooding is considered to be somewhat effective in the short term, as the timeframe required for remediation is typically less than five years. A pilot study would be required to design the full-scale system and would take approximately six months to complete. Monitoring and engineering controls would implemented to protect workers and the community. Engineering controls would be used to prevent contaminated materials from migrating with surface runoff water or becoming airborne during construction. Air monitoring would be implemented during construction activities that come into contact with contaminated media to ensure workers don the proper protective equipment for the level of contamination present. Wastewater discharge monitoring would also be implemented to ensure that contaminants being discharged do not exceed applicable standards.

6.6.6 Implementability

Surfactant flooding is technically and administratively implementable. A pilot study would be conducted prior to design and implementation of the full-scale system. Although historically used in the petroleum industry for product extraction, surfactant flooding remains a somewhat innovative technology in the environmental remediation industry, as it has not been implemented at many sites. However, the technology is well understood and experienced contractors are available to design, construct, and operate a surfactant flooding system. An access agreement would be required for remediation of the NAPL area on the property east of the former plant property.

6.6.7 Cost

The estimated cost for implementation of surfactant flooding is $3,400,000. This estimated cost includes performance of a pilot test, installation of permanent injection and extractions wells, a primary flooding event, and one follow-up flooding event. This flooding scenario is estimated to take up to two years to complete from the notice to proceed. This estimated cost does not include additional flooding events, post-remediation sampling, or long-term monitoring.

6.7 COMPARATIVE ANALYSIS OF ALTERNATIVES

The following sections include a comparison of the remedial alternatives with respect to the criteria required by USEPA.

6.7.1 Overall Protection of Human Health and the Environment

ERH provides the highest level of protection of human health and the environment, followed by ISCO and surfactant flooding. The no action alternative and MPE are not considered protective of human health and the environment, as they will not meet the RAO. ERH is considered to provide the highest level of protection, as the technology has been demonstrated to be capable of contaminant removal levels greater than 99 percent (Shroo, et. al., 2012).

6.7.2 Compliance with ARARs

All of the evaluated alternatives will be compliant with ARARs. Applicable ARARs are generally associated with waste collection, handling, and disposal or discharge.

6.7.3 Long-term Effectiveness and Permanence

ERH would have the highest level of long-term effectiveness and permanence, as the significant portion of the mass of TCE can be removed with ERH.

6.7.4 Reduction of Toxicity, Mobility, or Volume through Treatment

ERH will reduce the toxicity and volume of contaminants in the source area by the greatest amount. The mobility of the contaminants would be increased the greatest with surfactant flooding and least with MPE.

6.7.5 Short-term Effectiveness

Source area remediation with ERH can be completed in the least amount of time (mobilization to Site within approximately seven months from the notice to proceed, five months of installation activities, and five months of heating). ISCO and surfactant flooding pilot testing would be completed within six months, with full-scale implementation beginning within 12 months. Overall timeframe for ISCO and surfactant flooding are estimated to take up to 3 years and 2 years, respectively.

6.7.6 Implementability

The remedial alternatives evaluated are all technically and administratively implementable. Pilot tests would be necessary for ISCO and surfactant flooding to design full-scale systems.

Although the bench tests for ISCO or surfactant flooding indicated that these technologies could successfully remediate the source area as intended, the technologies typically perform less efficiently in the field. In the laboratory, the oxidant/surfactant substrates are applied to a sample of the soil media that does not have structural properties of the subsurface. The residual subsurface soil has zones of high and low permeability, which affects how the injected substrates are distributed. The soil samples used in the bench testing are small relative to the subsurface, and do not maintain the structure of the soil matrix. The substrates have much better contact in the laboratory with the contaminated media versus in the field.

With ISCO, the life span of the oxidant can become expended before it can reach the contaminant. Variations in total organic carbon in soil (TOC) can also cause the oxidant to be expended even faster in areas of elevated TOC. With surfactants, there are interactions with the different charged substances in the soils that can cause the field results to differ from the bench tests.

With ERH, there are no contact limitations because groundwater is boiled in all soil types and throughout the soil matrix. There are also no interfering chemical reactions or charge interactions. ERH vendors consistently observe that the energy demand determined by the bench test correlates well with the actual energy used for the remediation in the field. Therefore, there is a higher level of confidence that ERH will reach the RAO than the other remedial technologies because it is the most implementable.

6.7.7 Cost

The estimated costs of the remedial alternatives presented herein, not including the no action alternative, range from $2,550,00 (MPE) to $4,000,000 (ERH). Although ERH has the highest capital cost, there are no long-term operation and maintenance costs (i.e., such as with MPE), there is one remediation event, and there is the most certainty in the technology to reach the proposed RAO of 95 percent reduction of TCE concentrations.

7.0 RECOMMENDED REMEDIAL ALTERNATIVE

The recommended NAPL Area remedial alternative is ERH. This alternative is protective of human health and the environment, is implementable using somewhat readily-available equipment, reduces the volume of contaminants (primarily TCE), and is effective both in the short- and long-term.

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TABLES

TABLE 1
Summary of Previous Site Investigations
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Date of Investigation	Description of Investigation Activities	Agency/Company Performing Work	Regulatory Program
1987	Environmental Assessment	CTS Contractor (Law Environmental)	N/A
1989	Phase I Site Screening Investigation	USEPA Contractor (NUS Corporation)	USEPA
1990	Phase II Site Screening Investigation	USEPA Contractor (NUS Corporation)	USEPA
July 1999	Collection of spring samples east of the Site and private water supply well samples	NCDENR	NCDENR
November 1999	Collection of soil and sediment samples	USEPA Contractor (Tetra Tech)	USEPA ERRB
August/ September 2000	Geophysical survey, trenching/soil sampling, collection of spring samples	USEPA/REAC	USEPA ERRB
May 2001	Collection of soil samples	USEPA Contractor (Lockheed Martin)	USEPA ERRB
February 2003	Collection of spring water, surface water, and water supply well samples	USEPA Contractor (Weston Solutions)	USEPA ERRB
June/July 2004	Collection of soil and spring water samples; installation of piezometers	CTS Contractor (MACTEC)	USEPA ERRB
August 2004	Soil vapor extraction (SVE) pilot study	CTS Contractor (MACTEC)	USEPA ERRB
February 2006	Collection of water supply well samples	CTS Contractor (MACTEC)	USEPA ERRB
November/ December 2007	Collection of water supply well samples	NCDENR	NCDENR
December 2007	Trace Analytic Gas Analyzer (TAGA) air study	USEPA Contractor (Lockheed Martin)	USEPA ERRB
December 2007/ January 2008	Collection of soil, groundwater, and air samples at and near the Site	USEPA Contractor (TN & Associates)	USEPA ERRB
August 2008	Collection of air samples	USEPA Contractor (TN & Associates)	USEPA ERRB
September/ October 2008	Collection of soil and groundwater samples for evaluation of ozone study	CTS Contractor (MACTEC)	USEPA ERRB
September 2008 - March 2012	Collection of water supply well samples (14 sampling events)	USEPA Contractor (TN & Associates/OTIE)	USEPA ERRB
September 2008 - July 2009	Installation of monitoring wells; collection of soil, groundwater, spring, and surface water samples	CTS Contractor (MACTEC)	NCDENR
January 2009	Geophysical logging of water suppply wells	USEPA Contractor (MACTEC)	USEPA SRSEB
February 2009 - December 2009	Ozone pilot study in springs area (collection of groundwater, spring, surface water, and ambient air samples)	CTS Contractor (MACTEC)	USEPA ERRB
April 2009	Packer testing and collection of water supply wells samples	USEPA Contractor (Lockheed Martin)	USEPA SRSEB

TABLE 1
Summary of Previous Site Investigations
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Date of Investigation	Description of Investigation Activities	Agency/Company Performing Work	Regulatory Program
August 2009	Installation of bedrock wells; geophyical logging, packer testing, and collection of water supply well samples; collection of soil gas, sediment and surface water samples	USEPA Contractor (Lockheed Martin)	USEPA SRSEB
August/ September 2009	Location of sewer line at Site; collection of soil samples	CTS Contractor (MACTEC)	NCDENR
November 2009	Collection of soil, surface water, and sediment samples	USEPA SESD	USEPA SRSEB
March 2010 - May 2010	Geophysical logging, packer testing, and collection of water supply well samples; collection of sediment and surface water samples	USEPA Contractor (Lockheed Martin)	USEPA SRSEB
December 2010	Geophysical survey in southern area of Site	CTS Contractor (MACTEC)	USEPA ERRB
October 2012	Collection of air samples west of the Site	CTS Contractor (AMEC)	USEPA SRSEB
September 2012 - ongoing	Installation and management of filtration systems at residences relying on water from a water supply well	CTS Contractor (AMEC)	USEPA ERRB
January 2013 - ongoing	Quarterly collection of water supply well samples	CTS Contractor (AMEC)	USEPA SRSEB
September 2013 - February 2014	NAPL Investigation (collection of direct sensing data; collection of soil, groundwater, and NAPL samples)	CTS Contractor (AMEC)	USEPA SRSEB
November 2013	Collection of SVE confirmation soil samples	CTS Contractor (AMEC)	USEPA ERRB
April 2014 - April 2015	Collection of air samples east of Site (8 sampling events)	CTS Contractor (AMEC)	USEPA SRSEB
January 2015 - April 2015	Collection of data for NAPL FFS (collection of soil and groundwater samples for bench testing and analysis; measurement of NAPL thickness; slug testing; sieve analyses; NAPL baildown testing)	CTS Contractor (Amec Foster Wheeler)	USEPA SRSEB

Notes:
USEPA - United States Environmental Protection Agency
ERRB - Emergency Response and Removal Branch
NCDENR - North Carolina Environment and Natural Resources
SRSEB - Superfund Remedial & Site Evaluation Branch
SESD - Science and Ecosystem Support Division

TABLE 2
Monitoring Well Construction Details and Groundwater Elevations
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Monitoring Well	Monitored Zone	Installation Date	Drilling Method	Well Materials	Surface Casing Depth (bgs)	Well Depth (bgs)	Screened Interval (bgs)	Ground Surface Elevation	Top of Casing Elevation	Depth to Water 1/5/15 (toc)	Potentiometric Elevation 1/5/15
MW-1	PWR/water table	9/9/2008	MR	PVC		41.7	31.7 - 41.3	2,438.39	2,436.03	29.99	2,406.04
MW-2	PWR/water table	9/24/2008	MR	SS		28.3	18.3 - 28.0	2,416.46	2,416.42	15.76	2,400.66
MW-3	water table	9/25/2008	HSA	SS		36.1	26.1 - 35.8	2,417.18	2,417.03	22.50	2,394.53*
MW-3A	PWR	9/25/2008	HSA (casing); MR (well)	PVC (casing and well)	39.7	47.8	42.7 - 47.5	2,417.21	2,417.01	20.57	2,396.44
MW-4	water table	9/22/2008	HSA	PVC		25.2	15.2 - 24.8	2,410.92	2,410.98	19.31	2,391.67
MW-4A	PWR	9/22/2008	HSA (casing); MR (well)	PVC (casing and well)	54.4	72.3	67.2 - 72.0	2,410.65	2,410.37	20.62	2,389.75
MW-5	water table	9/18/2008	HSA	PVC		27.1	17.1 - 26.7	2,407.60	2,407.52	15.12	2,392.40
MW-5A	PWR	9/25/2008	HSA (casing); MR (well)	PVC (casing and well)	49.9	70.6	65.5 - 70.3	2,407.38	2,407.35	15.61	2,391.74
MW-6	water table	9/16/2008	HSA	PVC		47.2	37.2 - 46.8	2,421.53	2,421.35	33.28	2,388.07
MW-6A	PWR	9/15/2008	HSA (casing); MR (well)	PVC (casing and well)	68.2	80.7	75.6 - 80.4	2,421.71	2,421.21	29.56	2,391.65
MW-7	water table	3/6/2009	HSA	PVC		30.4	20.4 - 29.8	2,412.04	2,411.86	17.09	2,394.77
MW-7A	PWR	3/6/2009	MR (casing and well)	PVC (casing and well)	55.0	71.5	66.8 - 71.3	2,412.04	2,411.79	17.06	2,394.73
MW-8	PWR/water table	3/7/2009	HSA	PVC		62.7	52.9 - 62.3	2,436.91	2,436.98	48.73	2,388.25
MW-9	water table	4/8/2009	HSA	PVC		40.7	30.6 - 40.1	2,406.70	2,406.50	22.79	2,383.71
MW-9A	PWR	4/8/2009	HSA	PVC		57.3	52.5 - 57.2	2,407.04	2,406.75	23.40	2,383.35
MW-10	water table	2/24/2009	HSA	PVC		25.3	15.3 - 24.7	2,387.08	2,386.67	7.45	2,379.22
MW-10A	PWR	2/24/2009	HSA	PVC		58.8	54.0 - 58.6	2,387.06	2,386.63	7.52	2,379.11
MW-11	water table	2/26/2009	HSA	PVC		13.1	3.1 - 12.5	2,347.34	2,347.01	0.20	2,346.81
MW-11A	PWR	2/25/2009	HSA	PVC		45.9	41.1 - 45.7	2,347.61	2,347.28	-1.50	2,348.78**
PZ-1	water table	6/22/2004	DPT	PVC		16.90	9.4 - 19.4	DNM	2,417.05	15.68	2,401.37
PZ-2	water table	6/22/2004	DPT	PVC		33.75	23.5 - 33.5	DNM	2,417.03	23.05	2,393.98*
PZ-3	water table	6/23/2004	DPT	PVC		38.35	28.1 - 38.1	DNM	2,425.25	28.23	2,397.02
TW-1	water table	6/22/2004	DPT	PVC		13.75	3.5 - 16.5	DNM	2,371.96	2.80	2,369.16

Notes:

1. Depths are in feet relative to ground surface (bgs) or top of well casing (toc).
2. Elevations are in feet relative to mean sea level.
3. Water Table - zone of fluctuating, unconfined groundwater; PWR - partially weathered rock zone above bedrock.
4. MR - mud rotary; HSA - hollow-stem auger; DPT - direct push technology; PVC - Schedule 40 polyvinyl chloride; CS - Carbon Steel; SS - Type 304 Stainless Steel.
5. DNS - did not survey.
6.* - Free product identified in well, so actual water table elevation is greater than indicated.
7. ** - Depth to groundwater measured on 1/15/15.

Prepared By: SEK 5/8/15
Checked By: CN 5/13/15

TABLE 3
Historical Groundwater Elevations
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Monitoring Well	Groundwater Elvation (6/8/2009)	Groundwater Elevation (9/23/2013)	Groundwater Elevation (1/5/2015)
MW-1	2,407.39	2410.85	2406.04
MW-2	2,396.78	2409.67	2400.66
MW-3	2,389.71	2,401.78*	2,394.53*
MW-3A	2,389.97	2404.29	2396.44
MW-4	2,389.76	2396.06	2391.67
MW-4A	2,388.02	2393.22	2389.75
MW-5	2,388.29	2396.29	2392.40
MW-5A	2,387.65	2395.37	2391.74
MW-6	2,381.81	2393.01	2388.07
MW-6A	2,382.33	2394.79	2391.65
MW-7	2,389.01	2400.15	2394.77
MW-7A	2,389.18	2399.99	2394.73
MW-8	2,381.71	2393.87	2388.25
MW-9	2,372.53	2386.07	2383.71
MW-9A	2,372.38	2385.70	2383.35
MW-10	2,374.58	2379.82	2379.22
MW-10A	2,374.96	2380.78	2379.11
MW-11	2,346.43	2346.74	2346.81
MW-11A	2,348.09	2348.98	2,348.78**
PZ-1	DNM	2409.41	2401.37
PZ-2	DNM	2,399.09*	2,393.98*
PZ-3	DNM	2404.90	2397.02
TW-1	DNM	2368.96	2369.16

Notes:

1. Elevations are in feet relative to mean sea level.
2. DNM - did not measure.
3.* - Free product identified in well, so actual water table elevation is greater than indicated.
4. ** - Depth to groundwater measured on 1/15/15.

Prepared By: SEK 5/8/15
Checked By: CN 5/13/15

TABLE 4
Summary of Groundwater Analytical Results
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Monitoring Well	Date	USEPA Method 8260 VOCs																				USEPA Method 8270 SVOCs				
		Benzene	Chloroform	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Ethylbenzene	Isopropylbenzene	Methylcyclohexane	Naphthalene	Tetrachloroethene	Toluene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	Trichloroethene	1,1,2-Trichlorotrifluoroethane	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	m&p-Xyleme	o-Xylene	Biphenyl	Fluorene	2-Methylnaphthalene	Naphthalene	Phenanthrene
MW-2	10/14/2008													47		7,200										
	10/14/2008 (duplicate)													49		6,500										
	1/8/2015									14.7 J						1,240										
	1/8/2015 (duplicate)															1,270										
MW-3A	10/14/2008				34		14 J	18 J	12 J		63			1,300		15,000		48	16 J	14 J	33		3.1J	3.3 J		3.5 J
	1/8/2015						38.3			64.8 J				277 J		6,310					13.1 J	3.9 J	2.0 J	42.9 J	14.1 J	3.2 J
MW-4	10/9/2008		7.7 JB	4.3	0.65 J		100					2.2		11		250										
	1/7/2015		0.20 J		0.39 J		7.0					0.68 J		4.1		111										
MW-4A	10/15/2008		2.4 JB													1.8 J										
	1/7/2015																									
MW-5	10/10/2008				6.3 J		12									4,500										
	1/9/2015															3,840										
MW-5A	10/14/2008		0.59 JB													77										
	1/9/2015						0.33 J									154	0.21 J									
MW-6	10/13/2008				49											19,000										
	1/7/2015		5.7 J		16.9		2.1 J			198		4.8 J			3.3 J	18,700	4.7 J			15.8 J	12.2					
	1/7/2015 (duplicate)	13.2 J	5.6 J		17.0		2.5 J			211		5.5 J	3.4 J		3.2 J	17,900					3.1 J					
MW-6A	10/13/2008				97 J											42,000										
	1/8/2015															62,100										
MW-7	3/13/2009															3,700										
	1/9/2015		7.2			0.89 J										195										
MW-7A	3/13/2009															35,000										
	1/9/2015															52,800								1.2 J	1.0 J	
MW-11	3/12/2009															6.4										
	1/15/2015																									
MW-11A	3/12/2009															73										
	1/15/2015															2.4										

Notes:
1. VOCs - volatile organic compounds; SVOCs - semivolatile organic compounds.
2. Concentrations are reported as micrograms per liter (μg/L).
3. Analytes detected in one or more samples above the Method Detection Limit (MDL) are shown; refer to laboratory report for the list of analytes.
4. Blank cells indicate analyte not detected above MDL; refer to laboratory report for associated MDLs.
5. J - Constituent concentration is estimated.
6. JB - Constituent concentration is estimated based on the detection of the same constituent above the laboratory reporting limit in a laboratory blank or field blank.

Prepared By: SEK 5/8/15
Checked By: CN 5/13/15

TABLE 5
New Monitoring Well Construction Details
CTS of Asheville, Inc. Superfund Site
Skyland, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Monitoring Well	Installation Date	Drilling Method	Well Material	Well Depth (bgs)	Screened Interval (bgs)	Ground Surface Elevation	Top of Casing Elevation	Northing	Easting
MW-12	2/23/2015	HSA	SS	40.6	10.6 - 40.3	2,418.07	2,417.69	652735.2784	956547.0455
MW-13	2/23/2015	HSA	SS	45.3	10.3 - 45.0	2,418.12	2,417.80	652650.6432	956494.0951
MW-14	2/25/2015	HSA	SS	30.4	10.4 - 30.1	2417.93	2,417.34	652588.0319	956478.0460

Notes:

1. Depths are in feet relative to ground surface (bgs).
2. Elevations are in feet relative to mean sea level.
3. HSA - hollow-stem auger; SS - Type 304 Stainless Steel.

Prepared By: SEK 5/13/15
Checked By: MEW 7/21/15

TABLE 6
Summary of LNAPL Measurements
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Date	Monitoring Well	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
3/18/2015	MW-3	21.57	22.88	1.31
	MW-12	21.67	22.42	0.75
	MW-13	ND	ND	ND
	MW-14	18.25	18.26	<0.01
	PZ-2	19.51	23.88	4.37
3/26/2015	MW-3	21.47	22.75	1.28
	MW-12	21.46	22.37	0.91
	MW-13	ND	ND	ND
	MW-14	ND	ND	ND
	PZ-2	19.46	23.45	3.99
4/1/2015	MW-3	21.57	22.89	1.32
	MW-12	21.71	22.63	0.92
	MW-13	ND	ND	ND
	MW-14	ND	ND	ND
	PZ-2	19.56	23.70	4.14
4/6/2015	MW-3	21.57	22.91	1.34
	MW-12	21.71	22.77	1.06
	MW-13	ND	ND	ND
	MW-14	ND	ND	ND
	PZ-2	19.61	23.62	4.01
4/27/2015	MW-3	21.01	22.32	1.31
	MW-12	21.15	22.11	0.96
	MW-13	ND	ND	ND
	MW-14	ND	ND	ND
	PZ-2	19.14	23.08	3.94

Notes:

1. Depths are in feet relative to top of casing.
2. Thickness is in feet.
3. ND - not detected

Prepared By: SEK 5/13/15
Checked By: EPM 7/21/15

TABLE 7
Summary of LNAPL Properties
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Sample Location	Sample Date	Analysis Temperature (°F)	Specific Gravity	Density (g/cc)	Kinematic Viscosity (centistokes)	Dynamic Viscosity (centipoise)
MW-12	3/30/2015	70	0.8554	0.8536	4.12	3.52
		100	0.8489	0.8430	2.72	2.30
		130	0.8430	0.8311	2.01	1.67

Sample Location	Sample Date	Interfacial Tension (dynes/cm)		
		LNAPL/Water	LNAPL/Air	Water/Air
MW-12	3/30/2015	17.4	28.0	71.3

Notes:
^{o}F - degrees Fahrenheit
g/cc - grams per cubic centimeter
cm - centimeter

Prepared By: SEK 4/22/15
Checked By: CN 5/13/15

TABLE 8
Summary of LNAPL Mobility Testing Results
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Sample ID	Date	Sample Interval (feet bgs)	Density		Total Porosity (%Vb)	Pore Fluid Saturation				NAPL Produced from Centrifuge?	Mobile NAPL Present?
						Initial		Post Centrifuge			
			Dry Bulk (g/cc)	Grain (g/cc)		Water (%Pv)	NAPL (%Pv)	Water (%Pv)	NAPL (%Pv)		
SS-24B-27	1/21/2015	26 - 27	1.21	2.77	56.5	32.8	7.2	18.7	7.2	Trace	Not Likely
SS-36B-25	1/20/2015	24 - 25	1.55	2.69	42.5	51.2	11.1	22.9	10.0	Yes	Potential
SS-42B-30	1/21/2015	29 - 30	1.84	2.69	31.6	67.2	15.2	38.0	15.0	Trace	Not Likely
SS-42B-37	1/21/2015	36 - 37	1.33	2.68	50.5	68.8	1.8	21.3	1.8	No	No
SS-43B-32	1/21/2015	31 - 32	1.27	2.76	53.9	59.4	13.7	24.0	9.6	Yes	Potential
SS-43B-43	1/21/2015	42 - 43	1.34	2.72	50.6	53.3	1.5	22.6	1.5	No	No
SS-43C-19	1/21/2015	18 - 19	1.59	2.80	43.0	58.0	11.7	34.4	11.6	Trace	Not Likely
SS-47B-24	1/21/2015	23.5 - 24.5	1.68	2.66	36.8	52.5	6.8	34.9	6.8	No	No
SS-68B-43	1/20/2015	42.5 - 43.5	1.58	2.85	44.7	44.5	7.4	24.5	6.9	Yes	Potential
SS-68B-49	1/20/2015	48 - 49	1.58	2.84	44.3	78.0	6.6	38.8	6.6	No	No

Notes:

NAPL = non-aqueous phase liquid
bgs = below ground surface
% = percent
g/cc = grams per cubic centimeter
Vb = bulk volume
Pv = pore volume

Prepared By: SEK 3/30/15
Checked By: CN 5/13/15

TABLE 9
Summary of Input Parameters for Hydraulic Conductivity Test Analyses
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Well ID	Test Date	Test Method	Test Type	Well Depth (ft, btoc)	Static Water Level (ft, btoc)	Static Water Column Height (ft)	Saturated Thickness (ft)	Aquifer Type	Maximum Displacement Reading (ft)	Recovered Head (ft)	Percent Recovery	Depth to Top of Screen (ft, btoc)	Depth to Top of Screen from Static Water Level (ft)	Well Screen Length (ft)	Radius of Well Casing (ft)	Radius of Screen (ft)	Filter Pack Porosity
MW-2	4/9/2015	Mechanical slug	Falling Head	28.15	15.59	12.56	13	Unconfined	5.47	0.014	99.7%	18.15	2.86	9.7	0.086	0.25	0.28
MW-2	4/9/2015	Mechanical slug	Rising Hed	28.15	15.59	12.56	13	Unconfined	5.93	0.004	99.9%	18.15	2.86	9.7	0.086	0.25	0.28
MW-5A	4/9/2015	Mechanical slug	Falling Head	70.57	16.36	54.21	55	Unconfined	3.36	0.079	97.7%	65.47	49.41	4.8	0.086	0.25	0.28
MW-5A	4/9/2015	Mechanical slug	Rising Head	70.57	16.36	54.21	55	Unconfined	3.82	0.450	88.2%	65.47	49.41	4.8	0.086	0.25	0.28
MW-6A	4/9/2015	Mechanical slug	Falling Head	80.20	33.03	47.17	48	Unconfined	5.35	0.855	84.0%	75.10	42.37	4.8	0.086	0.25	0.28
MW-6A	4/9/2015	Mechanical slug	Rising Head	80.20	33.03	47.17	48	Unconfined	4.72	0.157	96.7%	75.10	42.37	4.8	0.086	0.25	0.28
MW-7	4/9/2015	Pneumatic	Rising Head	30.24	17.77	12.47	55	Unconfined	2.22	0.012	99.5%	20.24	3.07	9.4	0.086	0.33	0.28
MW-13	4/9/2015	Mechanical slug	Rising Head	45.29	18.57	26.72	27	Unconfined	4.38	0.303	93.1%	10.30	-7.98	34.7	0.086	0.25	0.28

Notes:
1. btoc - below top of casing
2. Anisotropy ratio (Kv/Kh) is assumed to be 1.
3. Saturated thickness values were assumed to be the same as the static water column height (well fully penetrates aquifer).
4. Maximum Displacement Reading - the pressure transducer reading in feet for the maximum displacement observed during the test.
5. Recovered Head - final measurement recorded by the pressure transducer prior to stopping the test.
6. The length of screen used for hydraulic conductivity test analysis extends from the bottom of the screen interval to the water-table elevation if the screen interval brackets the water-table.
7. According to James Butler in *The Design, Performance, and Analysis of Slug Tests* (1998), the effective radius of the well screen should include both the nominal radius of the well screen and the radius of the filter pack.

Prepared By: CHB 4/21/15
Checked By: SEK 4/22/15

TABLE 10
Summary of Hydraulic Conductivity Test Results
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Slug Test ID	Test Type	Test Date	Rising Head and Falling Head Test Results (K) (cm/sec)		Average K (cm/sec)
			Bouwer & Rice	Hvorslev	
MW-2	Falling Head	4/9/2015	7.63E-05	1.03E-04	8.96E-05
MW-2	Rising Head	4/9/2015	9.65E-05	1.36E-04	1.16E-04
MW-5A	Falling Head	4/9/2015	8.61E-05	9.20E-05	8.90E-05
MW-5A	Rising Head	4/9/2015	7.43E-05	6.78E-05	7.10E-05
MW-6A	Falling Head	4/9/2015	1.08E-05	1.36E-05	1.22E-05
MW-6A	Rising Head	4/9/2015	2.03E-05	2.00E-05	2.01E-05
MW-7	Rising Head	4/9/2015	9.79E-04	1.40E-03	1.19E-03
MW-13	Rising Head	4/9/2015	1.90E-04	2.64E-04	2.27E-04
		Average	1.92E-04	2.62E-04	2.27E-04

Notes:
K - hydraulic conductivity
cm/sec - centimeters per second

Prepared By: CHB 4/21/15
Checked By: SEK 4/22/15

TABLE 11
Location-specific ARARs
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Regulatory Authority	Location Characteristic	Requirement	Status	Requirement Description
Federal	Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 or critical habitat of such species listed in 50 CFR 17.95	16 USC 1538(a)	Relevant and Appropriate	Actions that jeopardize the existence of a listed species or results in the destruction of adverse modification of critical habitat must be avoided or reasonable and prudent mitigation measures taken.
Federal	Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 or critical habitat of such species listed in 50 CFR 17.95	16 USC 1536(a)(2); 50 CFR 402.13(a), 402.14	Relevant and Appropriate	Each Federal agency shall, in consultation with and with the assistance of the Sectretary [of DOI], ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in destruction or adverse modification of habitat of such species which is determined by [DOI] to be critical.
Federal	Presence of migratory birds, as defined by 50 CFR 10.3	16 USC 703(a)	Relevant and Appropriate	It shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, any part, nest, or eggs of any such bird.

Prepared By: SEK 7/30/15
Checked By: MEW 7/30/15

TABLE 12
Action-specific ARARs/TBCs
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Description
Federal	Identification of hazardous wastes	40 CFR Part 261 Identification and Listing of Hazardous Waste	Applicable	This requirement defines those solid wastes that are subject to regulation as hazardous waste under parts 262 through 265, 268, and parts 270, 271, and 124 of this chapter and which are subject to the notification requirements of section 3010 of RCRA.
Federal	Treating, storing, or disposing of hazardous wastes	40 CFR Part 262 Standards Applicable to Generators of Hazardous Waste	Applicable	These regulations establish standards for generators of hazardous waste, including standards applicable to treatment, storage, and disposal of hazardous waste and closure of hazardous waste facilities. Subpart B describes manifesting requirements.
Federal	Transporting manifested hazardous wastes	40 CFR Part 263 Standards Applicable to Transporters of Hazardous Waste	Applicable	This regulation establishes procedures to be followed when transporting manifested hazardous waste within the United States.
Federal	Management of hazardous waste	40 CFR Part 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Applicable	This regulation outlines the minimum national standards which define the acceptable management of hazardous waste.
Federal	Disposal of soil that contains hazardous waste	40 CFR Part 268 Land Disposal Restrictions	Applicable	Land disposal of RCRA hazardous wastes without specified treatment is restricted. Land disposal restrictions require that such wastes must be treated either by a treatment technology or to a specific concentration prior to disposal in a RCRA Subtitle C permitted facility.
Federal	Transporting hazardous wastes	49 CFR 171	Applicable	These Department of Transportation regulations apply to persons who transport hazardous materials in commerce and to persons who cause hazardous materials to be transported in commerce.
Federal	Treatment of wastewater generated from a remediation process	40 CFR Part 403 General Pretreatment Regulations for Existing and New Sources of Pollution	Applicable	Establishes responsibilities of Federal, State, and local government, industry and the public to implement National Pretreatment Standards to control pollutants which pass through or interfere with treatment processes in Publicly Owned Treatment Works (POTWs).
Federal	Testing of wastewater generated from a remediation process	40 CFR Part 136 Guidelines Establishing Test Procedures for the Analysis of Pollutants	Applicable	Provides guidelines establishing test procedures for the analysis of pollutants.

TABLE 12
Action-specific ARARs/TBCs
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

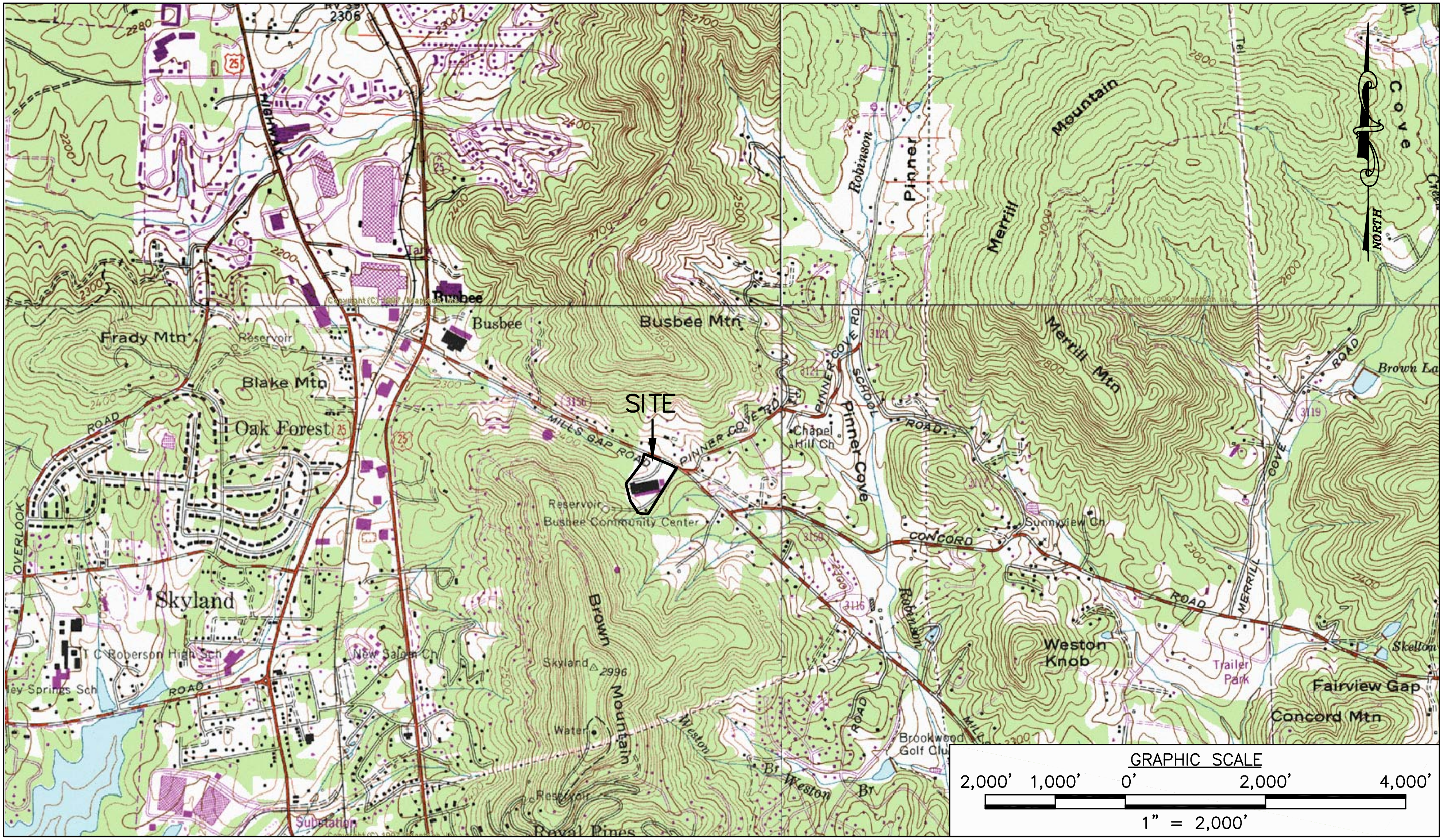
Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Description
Federal	Risk-based limits protective of human health from air emissions	40 CFR Part 50 National Primary and Secondary Ambient Air Quality Standards	Applicable	Established ambient air quality standards for protection of public health.
Federal	Emissions of hazardous air pollutants	40 CFR Part 61 National Emissions Standards for Hazardous Air Pollutants	Applicable	These regulations apply to any stationary source of substances designated as hazardous air pollutants or have serious health effects from ambient exposure to the substance.
Federal	Control of air emissions from air strippers at Superfund sites	OSWER Directive 9355.0-28	To Be Considered	The guidance establishes the control of air emissions from air strippers used at Superfund sites for groundwater treatment and establishes procedures for implementation.
Federal	Underground injections	40 CFR Parts 144 and 146 Underground Injection Control Program	Relevant and Appropriate	Regulates injections into underground sources of drinking water by specific classes of injection.
Federal	Human health and risk-based limits for exposure to hazardous wastes	29 CFR Part 1910 Subpart I Personal Protective Equipment	To Be Considered	Establishes time-weighted air concentrations for protection of worker breathing zones and requirements for personal protective equipment, medical monitoring, respiratory protection, and HAZMAT training. Establishes health and safety requirements for cleanup operations at National Priority Lists sites.
Federal	Emissions of hazardous air pollutants	40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants for Source Categories	Applicable	These standards regulate specific categories of stationary sources that emit (or have the potential to emit) one or more hazardous air pollutants listed in this part pursuant to section 112(b) of the Clean Air Act
State	Handling of hazardous waste	15A NCAC 13A Hazardous Waste Management	Applicable	Establishes standards for characterization, storage, treatment, and disposal of hazardous waste.
State	Storage of non-hazardous solid waste	15A NCAC 13B.0104 Storage of Solid Waste	Relevant and Appropriate	This regulation establishes the requirements for storage of non-hazardous solid waste.
State	Emissions of hazardous air pollutants	15A NCAC 02D Air Pollution Control Requirements	Applicable	Regulations governing emissions of hazardous air pollutants.
State	Construction and abandonment of wells	15A NCAC 02C.0100 Well Construction Standards: Criteria and Standards Applicable to Water-supply and Certain Other Type Wells	Applicable	These regulations detail the construction and abandonment of wells, including monitoring wells.

TABLE 12
Action-specific ARARs/TBCs
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina
Amec Foster Wheeler Project 6252-12-0006

Regulatory Authority	Action/Trigger	Requirement	Status	Requirement Description
State	Underground injections	15A NCAC 02C.0200 Well Construction Standards: Criteria and Standards Applicable to Injection Wells	Applicable	These regulations establish classes of injection wells and set forth requirements and procedures for permitting, constructing, operating, monitoring, reporting, and abandoning approved types of injection wells and abandoning, monitoring, and reporting nonpermitted wells used for the injection of wastes or any substance of a composition and concentration such that, if it were discharged to the land or waters of the state, would adversely affect human health or would otherwise render those waters unsuitable for their best intended usage.
State	Control of storm water from construction activities	15A NCAC 4B Erosion and Seimentation Control	Applicable	The regulations establish controls when land disturbing activities are conducted.
Local	Emissions of hazardous air pollutants	Western North Carolina Regional Air Quality Agency: Air Quality Code Chapter 4 Air Quality Control Requirements	Applicable	These regulations establish, administer, and enforce a local air quality program for the County of Buncombe and City of Asheville in accordance with the provisions of North Carolina General Statutes Section 143-215.112

Prepared By: SEK 7/30/15
Checked By: MEW 7/30/15

FIGURES

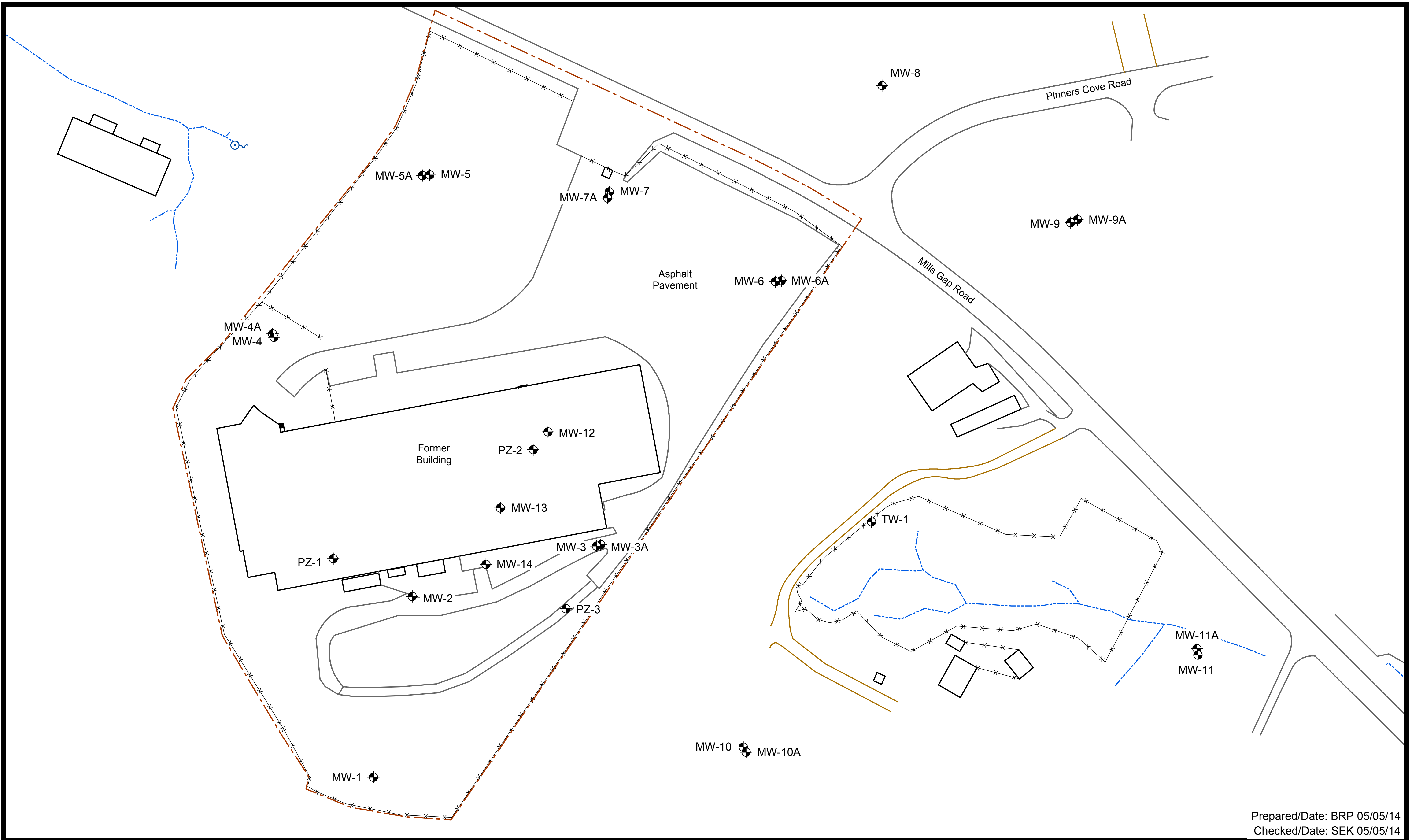


TOPOGRAPHIC SITE LOCATION MAP
CTS OF ASHEVILLE, INC. SUPERFUND SITE
ASHEVILLE, NORTH CAROLINA

amec foster wheeler

DRAWN: SEK	ENG CHECK: --	DATE: JULY 2015	PROJECT: 6252120006
DFT CHECK: MEW	APPROVAL: MEW	SCALE: 1" = 2,000'	FIGURE: 1

REFERENCE: USGS QUADRANGLES: ASHEVILLE (1961), OTEEN (1962), FRUITLAND (1978) AND SKYLAND (1978)



Prepared/Date: BRP 05/05/14
Checked/Date: SEK 05/05/14

N

0 50 100 Feet

Legend

⊕ Monitoring Well/Piezometer
⊙ Spring
×—× Fence
— - Property Line

amec foster wheeler

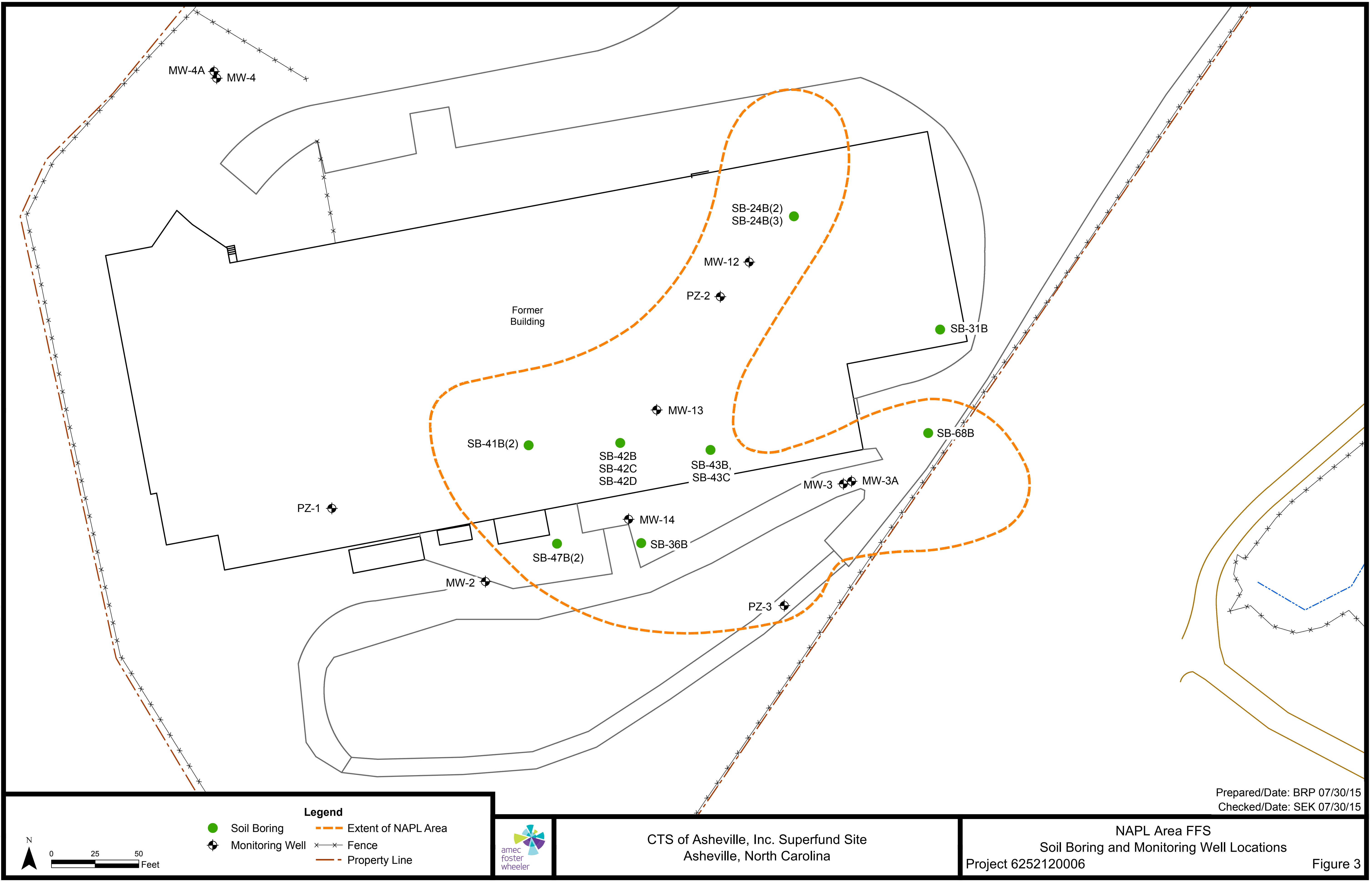
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Site Map

Project 6252120006

Figure 2

Document: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\MapDocuments\Site_Map_Jul2015_11x17LS.mxd PDF: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\Figures\July 2015\Figure 2 - Site Map.pdf 07/27/2015 1:29 PM brian.peters



Legend

- ● Soil Boring
- ⊕ Monitoring Well
- Extent of NAPL Area
- Fence
- Property Line

Prepared/Date: BRP 07/30/15
Checked/Date: SEK 07/30/15

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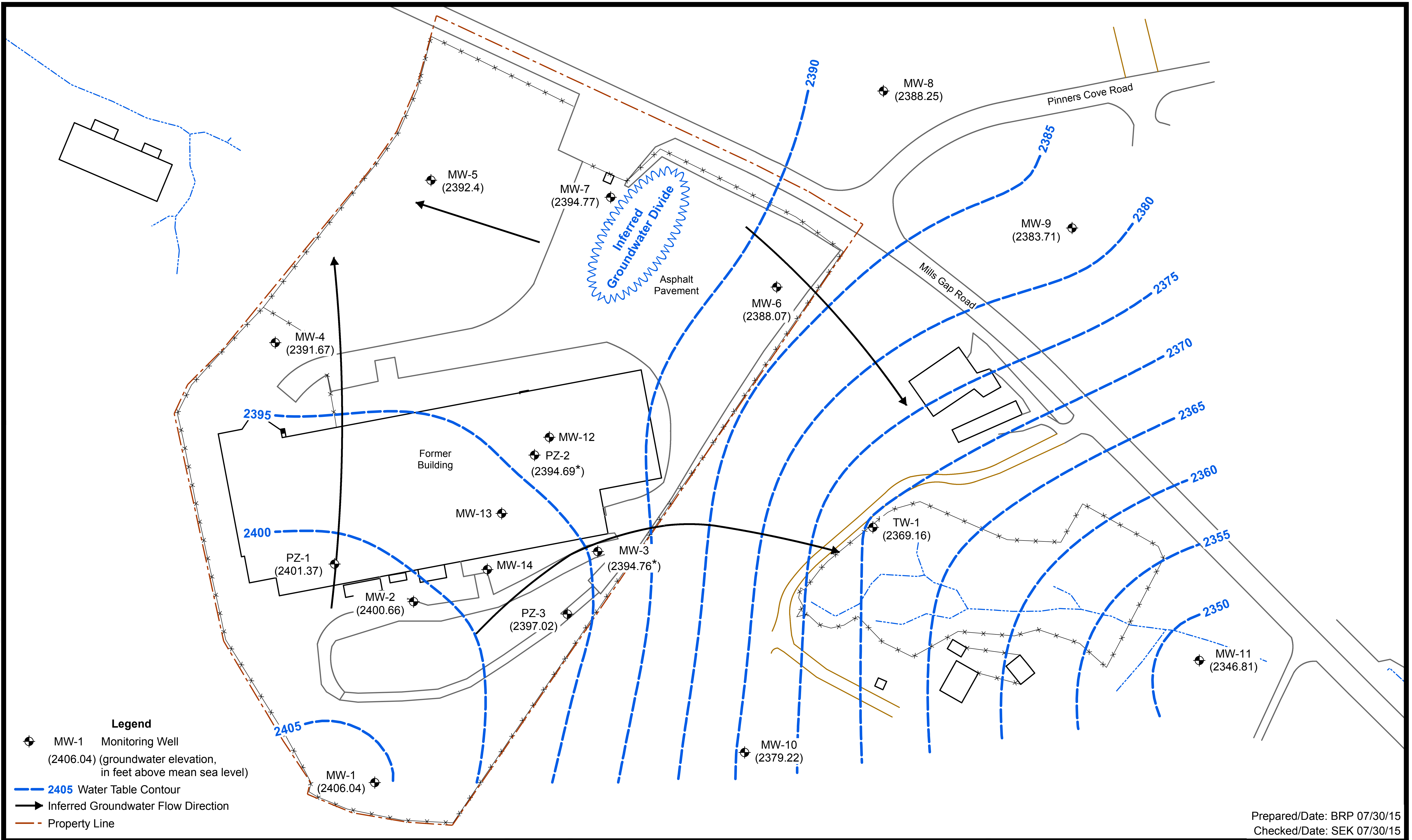
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

NAPL Area FFS
Soil Boring and Monitoring Well Locations
Project 6252120006

Figure 3

Document: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\MapDocuments\NAPL FFS\NAPL_FFS_11x17LS.mxd PDF: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\Figures\NAPL FFS\Figure 3 - NAPL Area FFS Borings Wells.pdf 07/30/2015 10:47 AM brian.peters



N

0 50 100 Feet

Notes:
Groundwater measurements collected on January 5, 2015.
* - groundwater elevation is estimated due to LNAPL in well.

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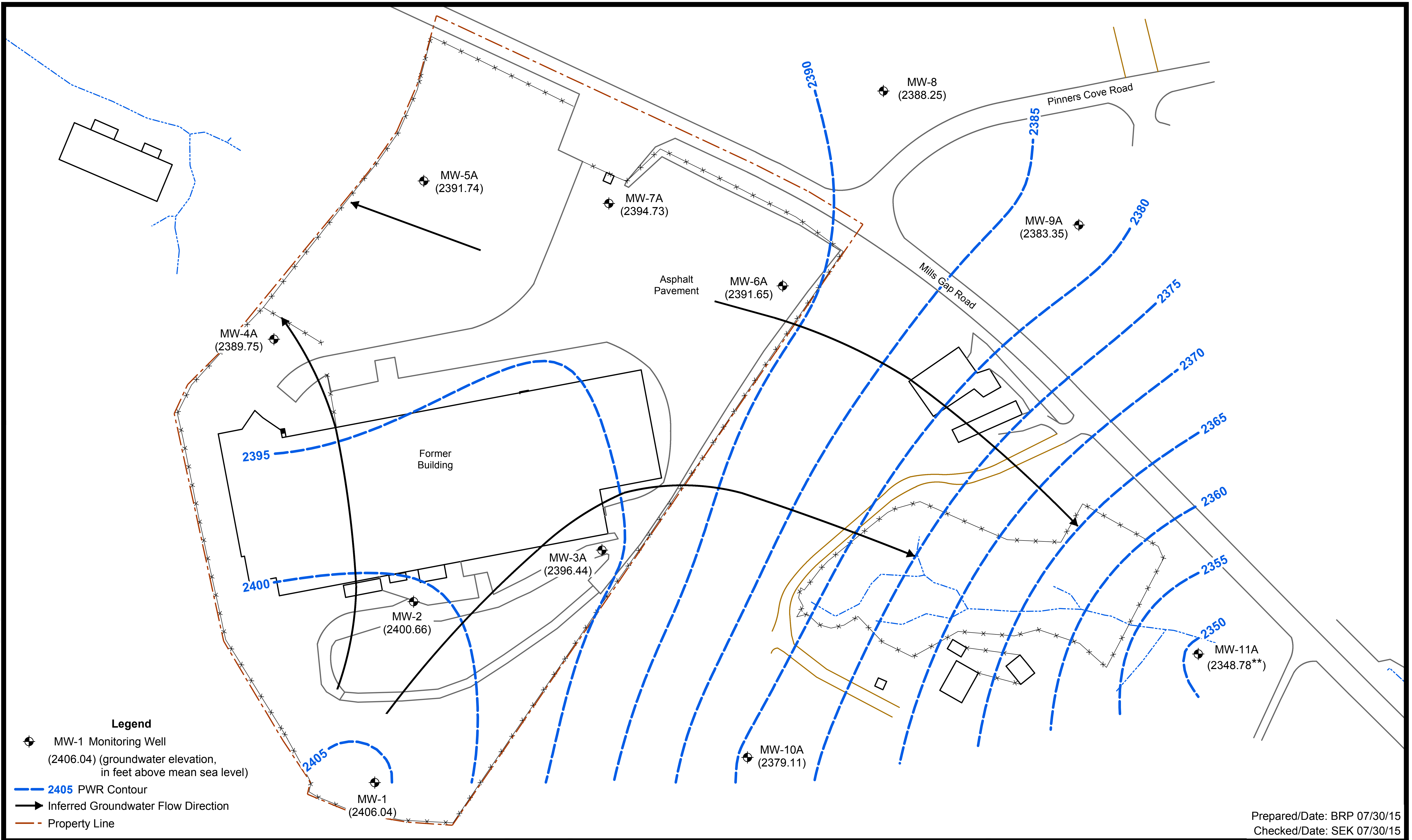
CTS of Asheville, Inc. Superfund Site
Asheville, North Carolina

Water Table Contour Map - January 2015

Project 6252120006

Figure 4

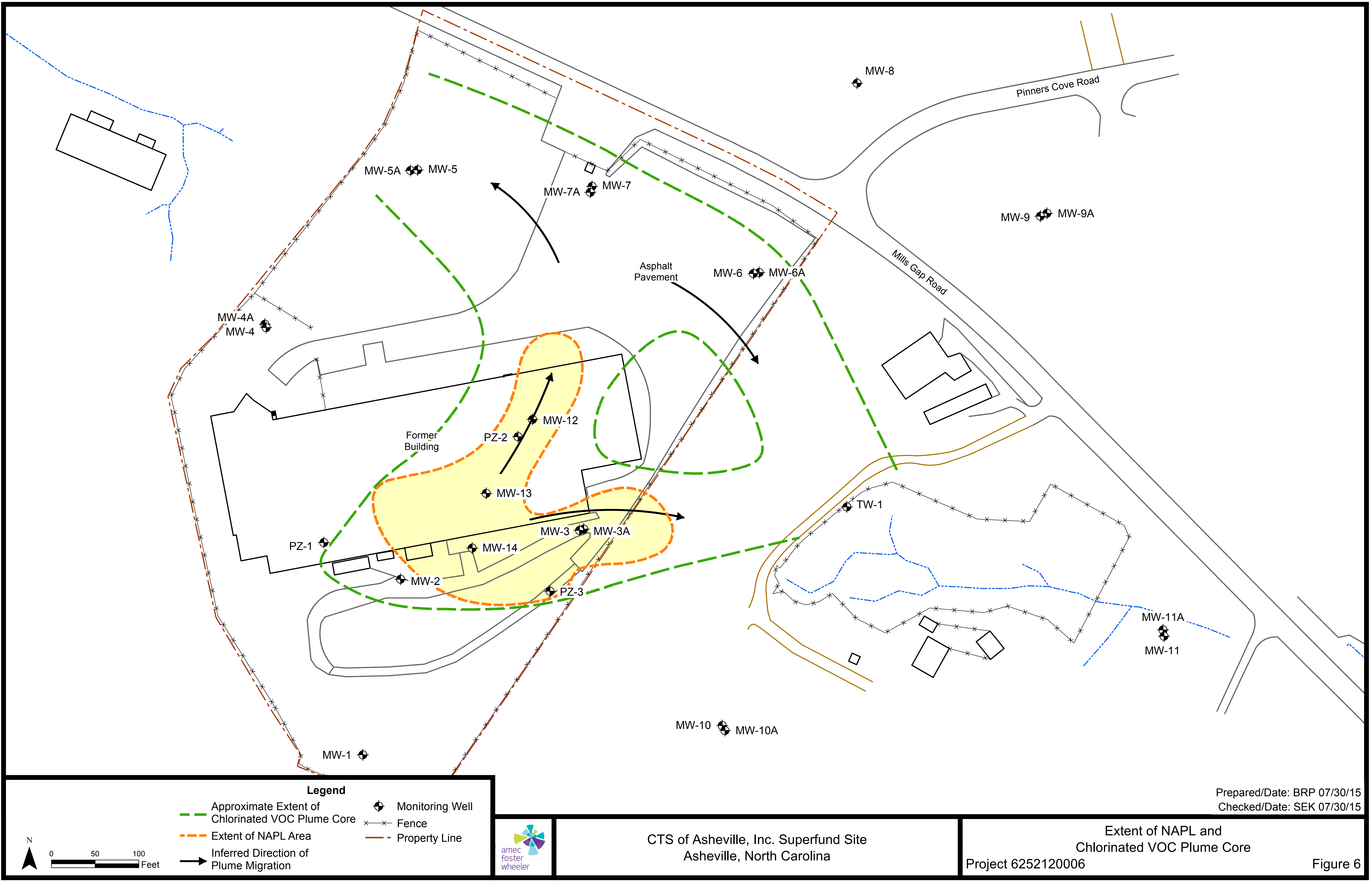


Notes:
PWR = partially weathered rock.
Groundwater measurements collected on January 5, 2015.
** - Groundwater measurement collected on January 15, 2015.

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

Potentiometric Surface of
Groundwater in PWR - January 2015
Project 6252120006
Figure 5

Document: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\MapDocuments\NAPL FFS\GW_Jan2015_11x17LS.mxd PDF: P:\Projects\CTS Corporation\4.0 Project Deliverables\4.5 Databases\GIS\Figures\NAPL FFS\Figure 5 - PWR GW Contours.pdf 07/30/2015 10:08 AM brian.peters



Prepared/Date: BRP 07/30/15
Checked/Date: SEK 07/30/15

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

Extent of NAPL and
Chlorinated VOC Plume Core
Project 6252120006

Figure 6

APPENDIX A

LOGBOOK AND FIELD DATA RECORDS

Location Asheville, NC Date 1/5/15

Project / Client UTS of Asheville, Inc.

0252120006 S.kelly/R.Clark/AMEC P.1/

1300 - S.kelly/AMEC arrives at Rice property east of site to gauge groundwater levels (R.Clark has purchased 55-gal drums for purge water and is staging them at the site)

- Dot Rice arrives

1315 - R.Clark/AMEC arrives

R.Clark now writing/

1315 - 1340 - Look for MW-10 & MW-10A / unable to locate

1340 - 1415 - Guage MW-9 & MW-9A

1415 - 1450 - Guage MW-11, MW-10 & MW-10A and TW-1 w/ S.Kelly

1450 - 1500 Guage MW-8 / S.Kelly stays at springs.

1500 - 1745 - Guage monitoring wells located within fenced portion of ~~MG~~ RUC 1/5/15 site.

1745 - R. Clark Leaves site.

1/5/15

Location Asheville, NC Date 1/7/15

Project / Client UTS of Asheville, Inc.

0252120006 S.kelly/AMEC P.1/1

1400 - S.kelly/AMEC arrives at site; R.Clark/AMEC is at MW-1; he has setup lowflow sampling equipment, but fuse in pump controller has blown

- S.kelly to the store to purchase new fuse

- Note: weather is cloudy, mid-20's F and decreasing, some snow flurries

- while S.kelly is off-site; R.Clark sets up low flow sampling equipment at MW-4

1500 - S.kelly at site

- R.Clark purges and samples MW-1 (15:35)

- S.kelly purges and samples MW-4 (15:40)

- S.kelly purges and samples MW-4A (16:45)

- R.Clark purges and samples MW-6 (17:20) and also collects a duplicate FD-01 with MW-6

1735 - S.kelly and R.Clark leave site

1/7/15

Location Asheville, NC Date 1/8/15
Project / Client CTS of Asheville, Inc.
6252120006 S.Kelly/AMEC P.1/2

7:05 - S.Kelly/AMEC receives phone call from A.Miller/EPA; A.Miller indicates that S.Urquhart-Foster, EPA (the site PM) is sick and will be unable to accompany/oversight AMEC's groundwater sampling activities
- A.Miller indicates that AMEC has been instructed by D.Rigger not to sample monitoring wells east of the site (Rice property) today
- S.Kelly calibrates water quality meter (see calibration form)

840 - S.Kelly and R.Clark/AMEC meet at site
- due to low temperature (less than 10°F); AMEC personnel will resume sampling in early afternoon when tempurature is expected to be near 20°F

1000 - at AMEC office, R.Clark decons submersible pump and collects equipment blank

Location Asheville, NC Date 1/8/15
Project / Client CTS of Asheville, Inc.
6252120006 S.Kelly/AMEC P.2/2

sample (EB-01) from water that has gone through pump

1150 - R.Clark transports cooler of samples to laboratory (Pace)
- R.Clark signs over samples to lab personnel; Pace will courier samples to Pace lab in Charlotte for analysis

1215 - R.Clark drives to site

1230 - R.Clark arrives at site and begins to set up low-flow sampling equipment at MW-6A

1305 - S.Kelly arrives at site and R.Clark/S.Kelly purge and sample MW-6A (see FDR) at ~~16:00~~ 14:00 SK 1/8/15

1420 - R.Clark and S.Kelly purge/sample MW-2 (1500) and also

1530 collect duplicate FD-02

SK 1/8/15 ~~1630~~ - R.Clark and S.Kelly purge/sample MW-6A (1615) and also collect samples for MS/MSD

1655 - S.Kelly & R.Clark leave site

1/8/15

Location Asheville, NC Date 1/9/15

Project / Client CTS of Asheville, NC

6252120006 S.kelly/AMEC P. 1/1

840 - S.kelly/AMEC arrives at site

-weather is clear, mid-20'sF

-S.kelly calibrated water quality and turbidity meters at home (see calibration FDR) before driving to site

850 - R.Clark/AMEC arrives at site

-R.Clark and S.kelly purge and sample MW-5 (9:40), MW-5A (10:15) ~~to~~ SK 1/9/15

1020 - S.kelly and R.Clark purge and sample MW-7 (11:05) and MW-7A (11:45)

1150 R.Clark empties purge water into drum at site

1200 - S.kelly leaves site

-R.Clark drives to laboratory (Pace) and signs over samples to lab custodian; lab will courier samples to Pace's lab in Charlotte for analysis

1/9/15

Location Asheville, NC Date 1/15/15

Project / Client CTS of Asheville, Inc.

6252120006 S.kelly/AMEC P. 1/4

820 - S.kelly/AMEC arrives at site; R.Clark/AMEC, A.Miller/EPA, and R.Stubbs/OTIE are at site

-discuss today's sampling activities, etc.

840 - travel to Rice property

-R.Clark and S.kelly set up and begin to purge MW-10

-Mrs. Rice and S.Wasileski/UNCA arrive and talk to A.Miller

-collect sample MW-10 (930)

935 - set up at MW-10A; purge and collect sample MW-10A (1015)

(back note: S.kelly calibrated water quality and turbidity meters at office before traveling to site; see calibration FDR)

1030 - move to MW-11/11A well set

-purge MW-11 and collect sample MW-11 (1135)

-S.Wasileski/UNCA, B.Durand & Mrs. Rice observing

-purge and collect sample MW-11A (1215)

Location Asheville, NC Date 1/15/15

Project / Client CTS of Asheville, Inc.

6252120006 S.Kelly/AMEC P.2/4

- M.Wallace/AMEC arrives

1230 - AMEC personnel to lunch

1345 - AMEC returns from lunch

- numerous people are in area of MW-11B, which is to be sampled, including Mrs. Rice, WLOS cameraman, J. Wilcox, B. Durand, S. Wasileski, B. Rice
- A. Miller directs above-listed people to stay on the hill, out of the way of AMEC
- J. Wilcox and B. Durand do not obey A. Miller's directions and continue to stand around MW-11B while AMEC is trying to set up for sampling
- S. Kelly directs B. Durand and J. Wilcox to move away from the sampling area, but J. Wilcox refuses to do so, and engages in an argument
- M. Wallace further directs group of people to stay out of the way of the sampling activities

Location Asheville, NC Date 1/15/15

Project / Client CTS of Asheville, Inc.

6252120006 S.Kelly/AMEC P.3/4

- M. Wallace indicates to group that if they do not stay out of the way of AMEC, we will not collect a sample from MW-11B
- AMEC continues to set up for sampling activities: place plastic sheeting on ground around wellhead and atop a berm of hay placed in the downslope direction of the wellhead; prepare submersible pump and battery; prepare sump pump with generator; place 55-gallon drum near sampling area; place 5 gallon buckets to containerize purge water for transport to another 55-gallon drum located in Springs easement area; place duct tape around wellhead to the plastic sheeting
- AMEC personnel open wellhead and observe the handle ~~to~~ SK 1/15/15

Location Asherill, NC Date 1/15/15

Project / Client CTS of Asheville, Inc.

6252120006 S.kelly/AMEC P 4/4

of the ball valve is gone, and the valve fitting used to open the valve is rusted, also barb fitting used to sample is oriented in such a way that there is not sufficient space to connect tubing to the barb fitting

- AMEC discusses the situation with R.Stubbs; decision is made not to sample MW-11B as wellhead fitting cannot be easily fixed/modified at this time, and there is the potential for significant leakage of contaminated groundwater if attempted
- AMEC cleans up sampling area/ loads equipment

1545 - AMEC, EPA, and OTIE personnel leave site

1/15/15

Location Asheville, NC Date 1/20/15

Project / Client CTS of Asheville

6252120006 S.kelly/AMEC P. 1/2

755 - S.kelly/AMEC arrives at site; R.Stubbs/OTIE and Zebra personnel (2) at site

- S.kelly unlocks gate for Zebra to unload equipment and then travels to store to purchase ~~driv~~ SK 1/20/15 dry ice

820 - S.kelly at site

- S.kelly calibrates PID
  - fresh air (0.0 ppm) = 0.2 ppm
  - isobutylene (100 ppm) = 101.5 ppm

840 - set up and begin DPT drilling at SB-24B (2)

1030 - boring terminated at 45 ft; samples not collected as SK 1/20/15 NAPL ~~at~~ SK 1/20/15 not identified at depths proposed and probe upper refused at 45 ft

- Zebra decons drill rods

1100 - Geoprobe moved to SB-36B

1115 - advancing DPT at SB-36B

- collect SS-36B-25 from 24 to 25 ft for NAPL mobility analysis

1230 - 1345 lunch; S.kelly to office and back

Location Asheville, NC Date 1/20/15

Project / Client CTS of Asheville, Inc.

6252120006 S.kelly | AMEC P. 2/2

1345 - Set up at SB-68B
- collect soil samples SS-68B-43 from 42.5 to 43.5 feet and SB-68B-49 from 48 to 49 feet; both samples will be submitted for NAPL mobility analysis

1635 - refusal with Geoprobe; pull drill rods and secure equipment

1715 - R. Stubbs leaves site

1725 - S.kelly and zebra leave site

1/20/15

Location Asheville, NC Date 1/21/15

Project / Client CTS of Asheville, Inc.

6252120006 S.kelly | AMEC P. 1/3

800 - S.kelly | AMEC and zebra crew (2) arrive at site
- S.kelly calibrates PID
  - fresh air (0.0ppm) = 0.0 ppm
  - iso~~propylene~~ butylene 1/21/15 (100ppm) = 99.7ppm
- setup Geoprobe at SB-43B and begin advancing probe

900 - R. Stubbs | OTIE arrives
- collect soil samples SS-43B-32 from 31 to 32 feet for NAPL mobility

950 - probe refusal at 44.5 feet; collect soil sample SS-43B-43 from 42 to 43 feet; unable to collect deeper planned soil sample due to refusal at 44.5 feet

1030 - move equipment to SB-42B and begin advancing drill rods
- collect soil samples SS-42B-30 from 29 to 30 feet and SS-42B-37 from 36 to 37 feet; both samples will be submitted for NAPL mobility

1250-1350 lunch

1350 - S.kelly packages soil samples for shipment

Location Asheville, NC Date 1/21/15
Project / Client CTS of Asheville, Inc.
6252120006 S.Kelly/AMEC P.2/3

-review sampling plan with R.Stubbs; three planned soil samples could not be collected due to shallow probe refusal (SS-24B from 48 to 49 ft; SB-43B from 52 to 53 ft; and SB-68B from 55 to 56 ft); a sample was collected at SB-68B (48 to 49 ft) where LNAPL was indicated in dye tests and elevated PID readings were measured; A sample will be collected at SB-24B from the 25 to 30 ft interval and another sample will be collected from SB-47B from a depth where positive NAPL identified in dye tests and elevated PID readings are observed

1415-move equipment to SB-42C; advance drill rods without soil sampling to 25 ft, then with soil sampling/retrieval to 30 ft.

-collect soil sample SS-24B-27 from 26 to 27 feet

Location AshevilleNC Date 1/21/15
Project / Client CTS of Asheville, Inc.
6252120006 S.Kelly/AMEC P.3/3

1510-move to SB-47B$^{(2)}$ and advance borings with soil sampling

-collect soil sample SB-47B-24 from 23.5 to 24.5 ft. for NAPL mobility

1635-move to SB-43C and advance boring to 10 ft without soil retrieval, then to 20 ft with soil retrieval

-collect soil sample SS-43C-19 from 18 to 19 ft for NAPL mobility

-pull drill rods and secure equipment

1740-all personnel leave site

-S.Kelly to purchase more dry ice, package samples for shipment and ship samples via FedEx to PTS Laboratories

1845-S.Kelly leaves FedEx

1/21/15

Location Asheville, NC Date 1/22/15
Project / Client CTS of Asheville, Inc.
6252120006 S.kelly /AMEC P. 1/2

830 - S.kelly /AMEC, R.Stubbs /OTIE and Zebra (2) arrive at site
- set up equipment at SB-42C
- S.kelly calibrates PID
- fresh air (0.0 ppm) = 0.0ppm
- isobutylene (100ppm) = 100.7ppm

855 - advance boring with out soil retrieval to 20feet
- collect soil from 28.5 to 38feet for thermal bench test; below approximately 30 ft, dye tests are negative for NAPL; however zone from approximately 20 to 28.5 ft is positive for NAPL; decide to split soil in next SB-42 boring from 20 ft to approx 29ft between sample for ~~ISD~~ SD 1/24/15 ISCO bench test with sample for thermal bench test
- ISCO soil sample collected from 20 to 34 ft at SB-42D
- thermal soil sample collected from 20 to 28 ft at SB-42D and 28.5 to 34 feet at SB-42C

Location Asheville, NC Date 1/22/15
Project / Client CTS of Asheville, Inc.
6252120006 S.kelly /AMEC P. 2/2

1135 - 1220 lunch

1220 - move equipment to SB-41B(2)
- advance boring without soil retrieval to ~~20 ft~~ SD 1/24/15 15 ft
- collect second sample for ISCO bench test from 17.5 to 27 ft.

1330 - move to SB-31B; advance boring with soil retrieval to 25 ft; collect sample for testing from 19 to 25 ft.

1430 - Zebra abandons SB-31B

1500 - Zebra abandons SB-24 borings

1530 - R.Clark /AMEC arrives

1540 - S.kelly leaves / R. Clark begins note taking.

1545 - Zebra abandons SB-43 borings.

1620 - Zebra abandons SB-42 borings / Danny / Zebra offsite to obtain more tap water for grouting.

1635 Danny w/ Zebra returns to site / Zebra abandons SB-41 borings and SB-47 borings.

1730 Zebra abandons SB-68 borings

1800 - All personnel leave site for day.

Location Asheville, N.C. Date 1/23/15

Project / Client CTS of Asheville, Inc.

6252120066 R.Clark /AMEC 1/1

0815 R.Clark and R.Stubbs/OTIE are onsite. Raining upon arrival.

0830 Zebra personnel (2) arrive onsite. Check grout settlement at each boring location.

0830-0930 - Zebra tops off grout at each boring location. Zebra closes soil and water containment drums (e.g. tighten lids).

0930 - All personnel leave site for day

1/23/15

Location Asheville, NC Date 2/23/15

Project / Client CTS of Asheville

6252120006 S.kelly/AMEC p. 1/2

930 - S.kelly/AMEC arrives at site; Geologic Exploration crew of 3 waiting at gate

- enter site and conduct safety meeting and discuss planned activities

950 - set up rig at MW-12; saw cut concrete

- Skelly calibrates PID
  - ~~isobutylene (0.0~~ SK 2/23/15
  - fresh air (0.0ppm) = 0.0ppm
  - isobutylene (100ppm) = 100ppm

1000 - advancing boring

1010 - R.Stubbs/OTIE arrives at site

1040 - at 40ft, set MW-12 with 30ft of screen, 10ft of riser (see well construction log)

- close drums, clean area

1120-1210 - lunch

1210 - PSNC at site to locate underground gas line

(drill crew to store for supplies)

1225 - PSNC technician leaves site

1325 - drill crew returns

Location Asheville, NC Date 2/23/15
Project / Client CTS of Asheville
6252120006 S.kelly |AMEC Pg/2

1330 - set rig up at MW-13 ; saw cut concrete for augers to advance through concrete pad

1350 - advancing soil boring with hollow stem augers

1410 - at 45 ft ; set monitoring well (see well construction diagram)
- sand bridges in augers at 40 to 45 ft ; drillers pull well screen / riser ; pull augers, put new plug at lead auger and re-advance boring

1450 re-set well
- sand bridges in augers again ; drillers pull well and augers

1530 - re-advance augers while charging augers with water ; set well with augers charged

1600 - R. Stubbs leaves site

1645 clean up work area ; secure / close drums

1725 . S.kelly and drillers leave site

2/23/15

Location Asheville, NC Date 2/25/15
Project / Client CTS of Asheville
6252120006 S.kelly |AMEC P. 1/2

815 - S.kelly |AMEC, R.Stubbs |OTIE, and Geologic Exploration arrive at site
- drillers decon augers

915 - Set up rig at MW-14, hand clear and advance augers

945 - auger refusal at 4 ft ; offset boring

1030 - terminate boring at 30 ft and set MW-14 (see well construction record

1115 - well set (sand and bentonite seal)
- drillers prepare to place grout in wells and construct well pads

1145 - R.Stubbs off-site

1215 - drillers grout wells as well as first boring advanced for MW-14

1310 - R.Stubbs returns
- driller placing concrete well pads

1325 - S.kelly offsite for lunch

Location Asheville, NC Date 2/25/15
Project / Client CTS of Asheville
6252120006 S. Kelly /AMEC p 2/2

1400 - S. kelly returns
1430 - drillers done constructing pads, load equipment
1450 - all personnel leave site

2/25/15

Location Asheville, NC Date 3/4/15
Project / Client CTS of Asheville, NC
6252120006 R. Clark /Amec Page 1 of 2

0800 At office/obtain supplies
0845 - At Springs Easement to trouble-shoot modem in trailer.
0900 - At site / R. Clark w/ Amec, to develop monitoring wells MW-12, MW-13 & MW-14 w/ Monsoon pump.
- Set-up on MW-12; develop well after checking for f.p. w/ poly. bailer, contain purge water in 55-gallon drum; label drum.
1100 Complete development of MW-12; decon pump (see field form for development details)
1130-1200 - Lunch
1200 - Set-up on MW-14; develop well w/ monsoon pump after checking for f.p. w/ poly. bailer Contain. water in 55-gal. drum. Label drum; decon pump (see field form for development details). Completed development of MW-14.

Location Asheville, NC Date 3/4/15

Project / Client CTS of Asheville

6252120006 R.Clark/Amec Page 2 of 2

1500 - Set-up on MW-13; develop well w/ monsoon pump after checking for f.p. w/ poly. bailer. Fose or pump is damaged.

1535-1550 - Obtain new fose from auto parts store offsite.

1550 - Return to site; continue development of MW-13.

- Complete development of MW-13; Contain purge water in 55-gallon drum. Decon pump. Contain decon water in 55-gallon drum. Label drum. (see field form for development data)

1705 - Leave site for the day

3/4/15

Location Asheville, NC Date 3/18/15

Project / Client CTS of Asheville

6252120006 S.Kelly/Amec P. 1/1

1300 - S.Kelly/Amec arrives at site

- S.Kelly gauges LNAPL in MW-12, MW-13, MW-14, PZ-2, and MW-3 (see FDR)

1350 - S.Kelly leaves site

3/18/15

Location CTS of Asheville Date 3/26/15
Project / Client Asheville, NC
6252120006 S.kelly/Amec P.1/1

1300- S.kelly/Amec arrives at site to gauge NAPL and re-develop MW-13
- S.kelly gauges NAPL (see FDR)
- submersible pump not working, so cannot re-develop MW-13; Pine Envi is sending another pump

1400- S.kelly leaves site

3/26/15

Location Asheville, NC Date 3/27/15
Project / Client CTS of Asheville
6252120006 S.kelly/Amec P.1/1

1400- S.kelly/AMEC arrives at site
- re-develop MW-13 (see FDR)
- purged water into 55-gallon drums

1600- S.kelly leaves site

3/27/15

Location Asheville, NC Date 3/30/15

Project / Client CTS of Asheville

6252120006 S.kelly/Amec P.1/1

1400 - S.kelly/AmEc arrives at site
- gauge NAPL in MW-12 and collect sample of NAPL (NAPL-01@14:30) for evaluation/testing of NAPL characteristics by PTS laboratories
- S.kelly re-develops MW-14; pump not consistantly working, so only about 5 gallons purged

16:30 - S.kelly leaves site

3/30/15

Location Asheville, NC Date 4/1/15

Project / Client CTS of Asheville

6252120006 S.kelly/Amec P.1/1

1050 - S.kelly/Amec arrives at site
- A&D Environmental Services is at site gate
- A&D personnel load drums of IDW from NAPL FFS activities (Geoprobe, monitoring well installation, monitoring well development)

1145 - all personnel leave site

1400 - S.kelly returns to site (back note: S.kelly gauges NAPL in monitoring wells while A&D loading drums; see FDR)
- S.kelly develops MW-13 and MW-14 removing approximately 25 gallons of water from each

1650 - S.kelly leaves site

4/1/15

Location Asheville, NC Date 4/6/15
Project / Client CTS of Asheville
6252120006 S.kelly | Amec P. 1/1

1215 - S.kelly | Amec arrives at site
- gauge NAPL in monitoring wells (see FDR
- collect LNAPL from MW-12 for bench testing (ISCO and surfactant)

1320 - calibrate water quality meter (see FDR)

1345 - purge | sample MW-13 (samples for bench testing, including iron and alkalinity); see FDR

1630 - purge | sample MW-12 for iron and alkalinity; see FDR

1720 - S.kelly leaves site

4/6/15

Location Asheville, NC Date 4/9/15
Project / Client CTS of Asheville
6252120006 S.kelly | AMEC P. 1/2

845 - S.kelly (Amec arrives at site) C.Bruce | Amec is at front gate
- enter site and conduct tailgate safety meeting and discuss today's activities
- conduct falling | rising head slug tests at MW-2
- conduct background test at MW-5A, drop slug and begin falling head slug test

1215 - 1315 lunch

1315 - complete rising head slug test at MW-5
- conduct rising head slug test at MW-7 using a pneumatic slug (pressure slug using bike tire inflator)
- conduct falling | rising head slug tests at MW-13
- conduct background test at MW-6A; begin falling head test; initial results indicate it will take several hours possibly for water level

Location Asheville, NC Date 4/9/15
Project / Client CTS of Asheville
6252120006 S.kelly/Amec P. 2/2

to Stabilize
- will leave slug/Troll in the well and return tomorrow to complete rising head test finish falling head test and
1745 - S.kelly and C.Bruce leave site

4/9/15

Location Asheville, NC Date 4/9/15
Project / Client CTS of Asheville
6252120006 S.kelly/Amec P. 1/1

930 - S.kelly arrives at site
- finish falling head test @ MW-6A
- pull up slug and conduct rising head test
- will return in several hours to retrieve/download
1015 leave site

1245 - S.kelly arrives at site
- finish rising head test @ MW-6A
- re-develop MW-13, remove approx 40 gallons
- re-develop MW-14, remove approx. 25 gallons
1615 - leave site

4/9/15

DEPTH TO WATER MEASUREMENT RECORD

Project Site: CTS of Asheville, Inc. Superfund Site

Project Number: 6252-12-0006

Personnel: Rodney M. Clark

Date: 1/5/2015

Monitoring Well/ Piezometer	Depth to Water from Reference Point	Well Condition	Comments
MW-1	29.99	O.K.	None
MW-2	15.76	O.K.	None
MW-3	22.50	O.K.	Free Product present
MW-3A	20.57	O.K.	None
* MW-4	19.31	O.K.	Water in vault Vacuum pressure
MW-4A	20.62	O.K.	water in vault
* MW-5	15.12	O.K.	vacuum pressure
MW-5A	15.61	O.K.	water in vault
MW-6	33.28	1 bolt sheared	None
MW-6A	29.56	1 bolt sheared	None
MW-7	17.09	O.K.	None
MW-7A	17.06	O.K.	None
* MW-8	48.73	O.K.	under pressure
MW-9	22.79	O.K.	None
MW-9A	23.46	O.K.	None
MW-10	7.45	O.K.	None
MW-10A	7.52	O.K.	None
MW-11	0.20	O.K.	coupling @ top is loose
MW-11A	DNM	O.K.	None
PZ-1	15.68	O.K.	water in vault
PZ-2	23.05	O.K.	free product present water in vault
PZ-3	28.23	1 bolt sheared/bolt missing	lid loose/ water in vault
TW-1	2.80	O.K.	None

Depth to water measurement in feet.

* - monitorings wells under pressure or vaccuum pressure allowed time to equilibrate prior to guaging water level

DNM - did not measure

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Date: 1/7/15

Project Number: 6252-12-0006

Name: S. Kelly

Water Quality Meter Calibration

		Standard Value		Meter Value		Acceptance Criteria
Manufacturer: YSI	pH:	4	SU (low)	pH: 3.99	SU	+/- 10% of standard
Model No.: 556 MPS	pH:	7	SU (med)	pH: 7.02	SU	+/- 10% of standard
Unit ID: R194855	pH:	10	SU (high)	pH: 10.04	SU	+/- 10% of standard
	Conductivity:	1.413	mS/cm	Conductivity: 1.413	mS/cm	+/- 10% of standard
	ORP:	240	mV	ORP: 240.2	mV	+/- 10% of standard

Turbidity Meter Calibration

	Standard Value		Meter Value		Acceptance Criteria
Manufacturer: Hach	<0.1	NTU (low)	0.12	NTU	+/- 10% of standard
Model No.: 2100P	20	NTU (med)	20.2	NTU	+/- 10% of standard
Unit ID: 14871	100	NTU (high)	99.8	NTU	+/- 10% of standard
	800	NTU (high)	785	NTU	+/- 10% of standard

Photoionization Detector

						Acceptance Criteria
Manufacturer:	Background:		ppmv	Meter:	ppmv	within 5 ppmv of Zero
Model No.:	Span Gas:		ppmv	Meter:	ppmv	+/- 10% of standard
Unit ID:						

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	VWR	4	SU	1211655	10/2015
pH (med)	VWR	7	SU	4AF271	1/2016
pH (high)	VWR	10	SU	4402A48	8/2015
Conductivity	AquaPhoenix Scientific	1.413	mS/cm	4AH648	8/2015
ORP:	Hanna	240	mV	5245	11/2017
Turbidity (low)	Hach (Formazin)	<0.1	NTU	A4086	7/2015
Turbidity (med):	Hach (Formazin)	20	NTU	A4092	7/2015
Turbidity (high):	Hach (Formazin)	100	NTU	A4104	7/2015
Turbidity (high):	Hach (Formazin)	800	NTU	A4100A	7/2015
PID gas:			ppmv		

NOTES:

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD INSTRUMENT CALIBRATION RECORD

RMC 1/7/15

Project Name: CTS of Asheville, Inc. Superfund Site

Date: 1~~2~~/7/15

Project Number: 6252-12-0006

Name: RMC

Water Quality Meter Calibration

Manufacturer: HORIBA

Model No.: U-52

Unit ID: PINE 019102

	Standard Value		Meter Value		Acceptance Criteria
pH:	4	SU (low)	pH: 4.00	SU	+/- 10% of standard
pH:	7	SU (med)	pH: /	SU	+/- 10% of standard
pH:	10	SU (high)	pH: /	SU	+/- 10% of standard
Conductivity:	4.49 ~~1.413~~ RMC 1/7/15	mS/cm	Conductivity: 4.56	mS/cm	+/- 10% of standard
ORP:	~~240~~ RMC 1/7/15	mV	ORP: /	mV	+/- 10% of standard

temp: 4.48

Turbidity Meter Calibration

Manufacturer: HORIBA

Model No.: U-52

Unit ID: PINE 019102

Standard Value		Meter Value		Acceptance Criteria
0.0	NTU (low)	0.0	NTU	+/- 10% of standard
	NTU (med)		NTU	+/- 10% of standard
	NTU (high)		NTU	+/- 10% of standard
	NTU (high)		NTU	+/- 10% of standard

Photoionization Detector

Manufacturer:

Model No.:

Unit ID:

					Acceptance Criteria
Background:		ppmv	Meter:	ppmv	within 5 ppmv of Zero
Span Gas:		ppmv	Meter:	ppmv	+/- 10% of standard

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	Auto Cal Sln	4.00	SU	C471035	June 2015
pH (med)			SU		
pH (high)			SU		
Conductivity	Auto Cal Sln	4.49	mS/cm	"	"
ORP:			mV		
Turbidity (low)	Auto Cal Sln	0.0	NTU	"	"
Turbidity (med):			NTU		
Turbidity (high):			NTU		
Turbidity (high):			NTU		
PID gas:			ppmv		

NOTES: Standard is Auto-Cal Solution, no ORP

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Date: 1/8/15

Project Number: 6252-12-0006

Name: S. Kelly

Water Quality Meter Calibration

Manufacturer: YSI

Model No.: 556 MPS

Unit ID: R194855

	Standard Value		Meter Value		Acceptance Criteria
pH:	4	SU (low)	3.99	SU	+/- 10% of standard
pH:	7	SU (med)	7.01	SU	+/- 10% of standard
pH:	10	SU (high)	10.02	SU	+/- 10% of standard
Conductivity:	1.413	mS/cm	1.413	mS/cm	+/- 10% of standard
ORP:	240	mV	240.6	mV	+/- 10% of standard

Turbidity Meter Calibration

Manufacturer: Hach

Model No.: 2100P

Unit ID: 14871

Standard Value		Meter Value		Acceptance Criteria
<0.1	NTU (low)	0.14	NTU	+/- 10% of standard
20	NTU (med)	20.4	NTU	+/- 10% of standard
100	NTU (high)	98.7	NTU	+/- 10% of standard
800	NTU (high)	792	NTU	+/- 10% of standard

Photoionization Detector

Manufacturer:

Model No.:

Unit ID:

						Acceptance Criteria
Background:		ppmv	Meter:		ppmv	within 5 ppmv of Zero
Span Gas:		ppmv	Meter:		ppmv	+/- 10% of standard

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	VWR	4	SU	1211655	10/2015
pH (med)	VWR	7	SU	4AF271	1/2016
pH (high)	VWR	10	SU	4402A48	8/2015
Conductivity	AquaPhoenix Scientific	1.413	mS/cm	4AH648	8/2015
ORP:	Hanna	240	mV	5245	11/2017
Turbidity (low)	Hach (Formazin)	<0.1	NTU	A4086	7/2015
Turbidity (med):	Hach (Formazin)	20	NTU	A4092	7/2015
Turbidity (high):	Hach (Formazin)	100	NTU	A4104	7/2015
Turbidity (high):	Hach (Formazin)	800	NTU	A4100A	7/2015
PID gas:			ppmv		

NOTES:

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site

Date: 1/9/15

Project Number: 6252-12-0006

Name: S. Kelly

Water Quality Meter Calibration

Manufacturer: YSI

Model No.: 556 MPS

Unit ID: R194855

	Standard Value		Meter Value		Acceptance Criteria
pH:	4	SU (low)	3.99	SU	+/- 10% of standard
pH:	7	SU (med)	7.00	SU	+/- 10% of standard
pH:	10	SU (high)	9.99	SU	+/- 10% of standard
Conductivity:	1.413	mS/cm	1.414	mS/cm	+/- 10% of standard
ORP:	240	mV	240.2	mV	+/- 10% of standard

Turbidity Meter Calibration

Manufacturer: Hach

Model No.: 2100P

Unit ID: 14871

Standard Value		Meter Value		Acceptance Criteria
<0.1	NTU (low)	0.11	NTU	+/- 10% of standard
20	NTU (med)	20.0	NTU	+/- 10% of standard
100	NTU (high)	100	NTU	+/- 10% of standard
800	NTU (high)	790	NTU	+/- 10% of standard

Photoionization Detector

Manufacturer:

Model No.:

Unit ID:

					Acceptance Criteria
Background:		ppmv	Meter:	ppmv	within 5 ppmv of Zero
Span Gas:		ppmv	Meter:	ppmv	+/- 10% of standard

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	VWR	4	SU	1211655	10/2015
pH (med)	VWR	7	SU	4AF271	1/2016
pH (high)	VWR	10	SU	4402A48	8/2015
Conductivity	AquaPhoenix Scientific	1.413	mS/cm	4AH648	8/2015
ORP:	Hanna	240	mV	5245	11/2017
Turbidity (low)	Hach (Formazin)	<0.1	NTU	A4086	7/2015
Turbidity (med):	Hach (Formazin)	20	NTU	A4092	7/2015
Turbidity (high):	Hach (Formazin)	100	NTU	A4104	7/2015
Turbidity (high):	Hach (Formazin)	800	NTU	A4100A	7/2015
PID gas:			ppmv		

NOTES:

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site
Date: 1/15/15

Project Number: 6252-12-0006
Name: S. Kelly

Water Quality Meter Calibration

		Standard Value		Meter Value		Acceptance Criteria
Manufacturer:	YSI	pH: 4	SU (low)	pH: 3.99	SU	+/- 10% of standard
Model No.:	556 MPS	pH: 7	SU (med)	pH: 7.01	SU	+/- 10% of standard
Unit ID:	R194855	pH: 10	SU (high)	pH: 10.02	SU	+/- 10% of standard
		Conductivity: 1.413	mS/cm	Conductivity: 1.413	mS/cm	+/- 10% of standard
		ORP: 240	mV	ORP: ~~20~~ (S) 1/15/15 240.1	mV	+/- 10% of standard

Turbidity Meter Calibration

		Standard Value		Meter Value		Acceptance Criteria
Manufacturer:	Hach	<0.1	NTU (low)	0.12	NTU	+/- 10% of standard
Model No.:	2100P	20	NTU (med)	20.1	NTU	+/- 10% of standard
Unit ID:	14871	100	NTU (high)	98.9	NTU	+/- 10% of standard
		800	NTU (high)	788	NTU	+/- 10% of standard

Photoionization Detector

								Acceptance Criteria
Manufacturer:		Background:		ppmv	Meter:		ppmv	within 5 ppmv of Zero
Model No.:		Span Gas:		ppmv	Meter:		ppmv	+/- 10% of standard
Unit ID:								

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	VWR	4	SU	1211655	10/2015
pH (med)	VWR	7	SU	4AF271	1/2016
pH (high)	VWR	10	SU	4402A48	8/2015
Conductivity	AquaPhoenix Scientific	1.413	mS/cm	4AH648	8/2015
ORP:	Hanna	240	mV	5245	11/2017
Turbidity (low)	Hach (Formazin)	<0.1	NTU	A4086	7/2015
Turbidity (med):	Hach (Formazin)	20	NTU	A4092	7/2015
Turbidity (high):	Hach (Formazin)	100	NTU	A4104	7/2015
Turbidity (high):	Hach (Formazin)	800	NTU	A4100A	7/2015
PID gas:			ppmv		

NOTES:

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD INSTRUMENT CALIBRATION RECORD

Project Name: CTS of Asheville, Inc. Superfund Site
Date: 4/6/15
Project Number: 6252-12-0006
Name: Skelly

Water Quality Meter Calibration

		Standard Value		Meter Value		Acceptance Criteria
Manufacturer:	YSI	pH: 4	SU (low)	pH: 4.00	SU	+/- 10% of standard
Model No.:	556 MPS	pH: 7	SU (med)	pH: 7.00	SU	+/- 10% of standard
Unit ID:	26887	pH: 10	SU (high)	pH: 10.00	SU	+/- 10% of standard
		Conductivity: 1.413	mS/cm	Conductivity: 1.413	mS/cm	+/- 10% of standard
		ORP: 240	mV	ORP: 240.5	mV	+/- 10% of standard

Turbidity Meter Calibration

		Standard Value		Meter Value		Acceptance Criteria
Manufacturer:			NTU (low)		NTU	+/- 10% of standard
Model No.:			NTU (med)		NTU	+/- 10% of standard
Unit ID:			NTU (high)		NTU	+/- 10% of standard
			NTU (high)		NTU	+/- 10% of standard

Photoionization Detector

						Acceptance Criteria
Manufacturer:		Background:	ppmv	Meter:	ppmv	within 5 ppmv of Zero
Model No.:		Span Gas:	ppmv	Meter:	ppmv	+/- 10% of standard
Unit ID:						

Calibration Sources

	Source	Value		Lot Number	Expiration Date
pH (low)	Ricca Chemical	4	SU	1311655	10/2015
pH (med)	Aqua Phoenix	7	SU	4AJ909	10/2016
pH (high)	Aqua Phoenix	10	SU	4AD999	4/2016
Conductivity	Aqua Phoenix	1.413	mS/cm	4AK179	11/2015
ORP:	Hanna	240	mV	5425	11/2017
Turbidity (low)			NTU		
Turbidity (med):			NTU		
Turbidity (high):			NTU		
Turbidity (high):			NTU		
PID gas:			ppmv		

NOTES:

If a meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirements necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site

JOB NUMBER: 6252-12-0006

DATE: 1/7/15

WELL / SAMPLE NUMBER: MW-1

ACTIVITY TIME: START 1350/1505 START END 1535

TIME: ~~1525~~ RMC 1/7/15 1535

QC SAMPLES COLLECTED: None

ASSOCIATED TRIP BLANK: TB-1

WATER LEVEL / PUMP DATA

INITIAL DTW: 29.91 ft (TOC)

FINAL DTW: 33.48 ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft

SCREENED INTERVAL: 31.7 - 41.3

Set pump @ 36.5' btoc

BLADDER PUMP ☐

PERISTALTIC PUMP ☐

DISCHARGE: N/A

REFILL: N/A

✓ MONSCON #2752

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1510 1310	32.18	0.8	6.56	0.104	~~6.54~~ 5.70	12.53	270	182	
~~1314~~ —	pump stopped		WL @	31.5/increase purge rate/starts again					
1514 1314	34.15	0.8	8.53	0.085	5.55	7.65	124	201	lower purge rate
1518 1318	33.85	0.8	7.75	0.083	5.54	7.59	61.5	210	
1522 1322	33.91	0.8	7.58	0.082	5.53	7.17	27.3	215	
1526 1326	33.21	0.8	7.00	0.083	5.33	6.10	22.3	232	
1530 1330	33.41	0.8	6.93	0.085	5.39	6.43	21.5	230	
1534 1334	33.48	0.8	6.89	0.085	5.43	6.51	21.1	229	
RMC 1/7/15									

ANALYSES: TCL 8260, TCL 8270

NOTES: Removed appx. 3 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site

JOB NUMBER: 6252-12-0006

DATE: 1/7/15

WELL / SAMPLE NUMBER: MW-49

ACTIVITY TIME: START 1500 END 1600

TIME: 1540

QC SAMPLES COLLECTED:

ASSOCIATED TRIP BLANK: TB-01

WATER LEVEL / PUMP DATA

INITIAL DTW: 19.23 ft (TOC)

FINAL DTW: N/A ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft

SCREENED INTERVAL: 15.2 - 24.8

tubing intake at ~22 ft toc

BLADDER PUMP: N/A

PERISTALTIC PUMP: X

DISCHARGE: N/A

REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1517	19.50		11.82	0.039	6.25	9.65	2.76	204.0	
1520	19.63		12.43	0.039	5.22	6.90	DNM	215.0	
1523	19.70		12.80	0.039	5.07	6.02	4.25	232.6	
1526	19.72	0.24	12.91	0.042	4.93	5.69	DNM	251.7	
1529	19.72	↓	12.78	0.042	4.96 ~~5.08~~ 1/7/15	5.07	2.83	264.8	
1532	19.73		12.81	0.040	4.89	4.85	DNM	272.5	
1535	19.73		12.86	0.039	4.90	4.70	2.31	277.5	
1538	19.74		12.87	0.037	4.88	4.82	1.33	283.3	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM: did not measure; ~2 gallons purged

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/7/15

WELL / SAMPLE NUMBER: MW-4A
ACTIVITY TIME: START 1605 END
TIME: 1645

QC SAMPLES COLLECTED: N/A
ASSOCIATED TRIP BLANK: TB-01

WATER LEVEL / PUMP DATA

INITIAL DTW: 20.76 ft (TOC)
FINAL DTW: N/A ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 67.2-72.0 ft bgs

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1619	21.50		10.96	0.090	5.85	6.80	DNM	279.4	
1622	22.52		11.00	0.096	6.00	4.60	5.03	270.5	
1625	22.78		11.10	0.096	6.02	4.45	DNM	264.7	
1628	flow through cell leaking - take apart & reassemble								
1632	22.74		9.88	0.096	6.10	4.88	4.27	264.8	
1635	22.91		10.57	0.096	6.06	4.44	DNM	262.4	
1638	22.90		10.44	0.097	6.05	4.26	3.19	261.6	
1641	22.86		10.34	0.096	6.06	4.28	DNM	261.2	
1644	22.70		9.72	0.097	6.05	4.43	3.23	260.3	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/7/15
WELL / SAMPLE NUMBER: MW-6
ACTIVITY TIME: START 1600 END 1720
TIME: 1720
QC SAMPLES COLLECTED: FD-01
ASSOCIATED TRIP BLANK: TB-1

WATER LEVEL / PUMP DATA

INITIAL DTW: 33.49 ft (TOC)
FINAL DTW: 35.80 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 37.2 - 46.8

Set pump @ appx 42' btoc

BLADDER PUMP ☐
PERISTALTIC PUMP ☐
DISCHARGE: N/A
REFILL: N/A

☑ ~~[illegible]~~ RMC 1/7/15 MONSOON #2752

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
16:52	33.90	~~0.8~~ 1.0	6.45	0.049	4.96	9.38	557	246	Set pump @ ~ 42' bgs
16:56	34.65	~~0.8~~ 1.0	11.07	0.042	5.05	7.97	355	264	
17:00	34.98	~~0.8~~ 1.0	11.42	0.041	4.94	7.65	242	272	
17:04	36.00	0.8	11.54	0.040	4.83	7.97	99.3	287	slow purge rate
17:08	35.92	0.8	11.37	0.041	4.97	8.18	49.5	290	
17:12	35.82	0.8	11.48	0.041	4.97	8.16	23.5	292	
17:16	35.80	0.8	11.43	0.040	4.97	8.15	16.6	293	
17:20	~~36.80~~ 35.80	0.8	11.44	0.040	4.97	8.17	13.0	298	

RMC 1/7/15 (purge rate corrections)
RMC 1/7/15 (DTW correction)

ANALYSES: TCL 8260, TCL 8270

NOTES: Purged appx 6 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site

JOB NUMBER: 6252-12-0006

DATE: 1/8/15

WELL / SAMPLE NUMBER: MW-6B

ACTIVITY TIME: START 1230 END 10'

TIME: ~~1600~~ 1400

QC SAMPLES COLLECTED: N/A

ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 29.26 ft (TOC)

FINAL DTW: 42.65 ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft

SCREENED INTERVAL: 75.6 - 80.4

Pump intake at approx. 77.5

BLADDER PUMP: N/A

PERISTALTIC PUMP: N/A

DISCHARGE: N/A

REFILL: N/A

monsoon submersible

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1325	31.78	DNM	10.99	0.111	7.85	10.45	DNM	189.0	
1328	34.01	↓	13.84	0.135	8.55	2.21	DNM	181.7	
1331	37.15		14.61	0.126	8.37	1.17	DNM	183.6	
1335	37.92		14.00	0.120	8.00	1.08	47.5	184.4	
1340	39.05		12.80	0.118	7.55	1.15	DNM	179.0	
1344	39.46		12.19	0.116	7.43	1.08	DNM	175.5	
1347	41.10		14.40	0.114	7.31	1.00	DNM	167.8	
1350	42.44	0.21	14.30	0.112	7.22	0.97	DNM	160.6	
1353	42.63	0.21	13.53	0.111	7.17	0.98	DNM	157.3	
1356	42.65	0.21	12.71	0.110	7.12	0.98	39.1	153.5	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure ; ~2.5 gallons purged

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/8/15
WELL / SAMPLE NUMBER: MW-2
ACTIVITY TIME: START 1420 END 1530
TIME: 1500
QC SAMPLES COLLECTED: FD-02
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 15.62 ft (TOC)
FINAL DTW: 17.14 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 10.3 - 28.0

BLADDER PUMP: ~~X~~ GD 1/8/15
PERISTALTIC PUMP: ~~N/A~~ X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1436	15.53	~~15.~~ GD 1/8/15	11.29	0.066	5.78	4.45	DNM	170.9	
1439	16.91		11.92	0.066	5.55	4.68	14.8	180.5	
1442	17.00		11.83	0.065	5.43	4.08	DNM	195.5	
1446	17.07	0.16	11.75	0.066	5.35	3.11	DNM	207.7	
1449	17.13	↓	11.77	0.066	5.35	3.03	DNM	211.3	
1452	17.12		11.76	0.065	5.33	2.75	14.8	215.8	
1455	17.15		11.70	0.063	5.30	2.65	DNM	218.8	
1458	17.14		11.76	0.063	5.30	2.41	DNM	221.0	
							2.09 (during sampling)		

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure; purged approx. 1.5 gal

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/8/15

WELL / SAMPLE NUMBER: MW-3A
ACTIVITY TIME: START 1530 END 1630
TIME: 1615

QC SAMPLES COLLECTED: MS/MSD
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 20.46 ft (TOC)
FINAL DTW: 21.15 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 42.7-47.5

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1549	20.93		10.24	0.073	5.63	13.00	DNM	219.2	
1552	21.00		10.84	0.072	5.61	1.87	DNM	215.4	
1556	21.02		11.27	0.072	5.56	0.89	DNM	213.3	
1559	21.04		11.39	0.073	5.50	0.67	DNM	215.2	
1602	21.17	0.5	11.80	0.073	5.47	0.56	1.24	216.5	
1606	21.15	0.5	11.83	0.070	5.43	0.43	DNM	218.8	
1609	21.20		11.78	0.072	5.42	0.40	DNM	217.9	
1612	21.17		11.81	0.072	5.42	0.35	DNM	219.3	
1618	21.15		11.81	0.070	5.41	0.49	1.59	222.4	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM: did not measure; purged approx. 2 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/9/15

WELL / SAMPLE NUMBER: MW-5
ACTIVITY TIME: START 840 END 945
TIME: 940

QC SAMPLES COLLECTED: N/A
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 15.26 ft (TOC)
FINAL DTW: 16.55 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 17.1 - 26.7

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
912	15.90		12.99	0.115	5.18	3.13	DNM	225.5	
915	16.12		13.15	0.109	4.65	1.69	DNM	265.4	
919	16.21	~0.3	13.07	0.106	4.55	1.19	49.7	276.9	
922	16.51	↓	13.62	0.106	4.46	0.95	DNM	300.0	
925	16.43		13.27	0.106	4.44	0.89	DNM	309.4	
928	16.65		13.71	0.105	4.43	0.85	DNM	315.0	
931	16.55		13.87	0.105	4.42	0.83	SF 1/9/15 ~~[illegible]~~ 24.9	320.5	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure; purged approx 2 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/9/15
WELL / SAMPLE NUMBER: MW-5A
ACTIVITY TIME: START 945 END 1020
TIME: 1015
QC SAMPLES COLLECTED: N/A
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 15.90 ft (TOC)
FINAL DTW: 18.48 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 65.5 - 70.3

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
950	16.96		12.13	0.090	5.73	5.73	DNM	271.1	
953	17.65		12.49	0.090	5.78	4.53	DNM	262.5	
956	18.22		12.48	0.091	5.81	4.44	4.84	257.3	
959	18.31	0.17	12.42	0.091	5.81	4.28	DNM	253.3	
1002	18.40	↓	12.11	0.091	5.81	4.17	DNM	249.4	
1007	18.48		12.25	0.092	5.82	4.06	21.6	243.6	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM: did not measure; purged approx. 2 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/9/15

WELL / SAMPLE NUMBER: MW-7
ACTIVITY TIME: START 1025 END
TIME: 1105

QC SAMPLES COLLECTED: N/A
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 16.91 ft (TOC)
FINAL DTW: 17.11 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 20.4-29.8

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1036	17.10		14.52	0.199	5.30	4.14	DNM	271.0	
1039	17.10	0.3	15.38	0.207	5.23	3.30	DNM	278.6	
1042	17.11	↓	15.36	0.210	5.27	3.18	8.65	279.7	
1045	17.11		15.23	0.215	5.33	3.18	DNM	282.6	
1049	17.11		15.41	0.216	5.35	3.01	DNM	281.7	
1057	17.11		15.30	0.217	5.38	3.02	4.00	281.7	
1101	17.11		15.42	0.218	5.39	2.98	DNM	280.7	
1104	17.11		15.22	0.219	5.41	2.98	2.45	279.1	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure; purged approx. 2 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/9/15

WELL / SAMPLE NUMBER: MW-7A
ACTIVITY TIME: START 1110 END 1200
TIME: 1145

QC SAMPLES COLLECTED: N/A
ASSOCIATED TRIP BLANK: TB-02

WATER LEVEL / PUMP DATA

INITIAL DTW: 16.85 ft (TOC)
FINAL DTW: 20.10 ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 46.8 - 71.3

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1123			13.75	0.146	8.04	3.19	DNM	185.2	
1126	18.22		14.43	0.144	8.67	1.80	DNM	179.2	
1129	18.91		15.07	0.143	8.88	1.30	DNM	173.0	
1132	19.07		14.81	0.141	9.08	1.22	DNM	166.1	
1135	19.50		15.03	0.140	9.14	1.07	5.25	162.0	
1139	19.55	0.27	14.88	0.139	9.20	0.84	DNM	159.2	
1142	19.62		14.75	0.139	9.21	0.79	DNM	158.0	
1146	20.02		14.88	0.139	9.24	0.75	DNM	156.4	
1149	20.10		14.77	0.138	9.22	0.60	3.53	156.0	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure; purged approx.

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site
JOB NUMBER: 6252-12-0006
DATE: 1/15/15

WELL / SAMPLE NUMBER: MW-10
ACTIVITY TIME: START 850 END
TIME: 930

QC SAMPLES COLLECTED: ~~TB-03~~
ASSOCIATED TRIP BLANK: TB-03

WATER LEVEL / PUMP DATA

INITIAL DTW: 8.46 ft (TOC)
FINAL DTW: ft (TOC)
DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft
SCREENED INTERVAL: 15.3 - 24.7

BLADDER PUMP: N/A
PERISTALTIC PUMP: X
DISCHARGE: N/A
REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
8909	8.83		11.87 ~~7.08~~	0.099	6.86	14.74	DNM	DNM	
913	8.88		12.00	0.079	5.59	6.76	DNM	222.6	
916	8.88		12.07	0.075	5.39	6.01	8.11	234.0	
919	8.88		11.98	0.073	5.33	5.92	DNM	238.1	
923	8.92		12.01	0.072	5.29	5.83	DNM	246.8	
926	8.93		12.07	0.071	5.27	5.82	4.03	252.5	
929	8.95		12.04	0.071	5.25	5.66	DNM	257.1	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT: CTS of Asheville, Inc. Superfund Site

JOB NUMBER: 6252-12-0006

DATE: 1/15/15

WELL / SAMPLE NUMBER: MW-10A

ACTIVITY TIME: START 940 END 1030

TIME: 1015

QC SAMPLES COLLECTED:

ASSOCIATED TRIP BLANK: TB-03

WATER LEVEL / PUMP DATA

INITIAL DTW: 8.08 ft (TOC)

FINAL DTW: 8.74 ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT: N/A ft

SCREENED INTERVAL: ~~50~~.54.0-58.6

BLADDER PUMP: N/A

PERISTALTIC PUMP: X

DISCHARGE: N/A

REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
949	8.63		10.77	0.066	5.94	6.77	DNM	150.2	
953	8.83		11.00	0.059	5.96	5.38	DNM	133.4	
	—	— empty	flow through	cell			—	—	
957	8.63		10.25	0.057	5.96	7.35	DNM	143.1	
1000	8.79		10.91	0.057	5.92	5.50	19.4	145.5	
1004	9.04	0.2	11.47	0.056	5.89	6.08	DNM	153.6	
1007	8.88	↓	11.33	0.056	5.87	5.86	DNM	158.1	
1013	8.74	↓	11.06	0.056	5.87	5.61	7.96	159.6	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure; purged approx 2 gallons

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT	CTS of Asheville, Inc. Superfund Site	JOB NUMBER	6252-12-0006
DATE	4/15/15	TIME	1135
WELL / SAMPLE NUMBER	MW-11	ACTIVITY TIME	START 1045 END
QC SAMPLES COLLECTED	N/A	ASSOCIATED TRIP BLANK	TB-03

WATER LEVEL / PUMP DATA

INITIAL DTW	~0.3 ft (TOC)	FINAL DTW	1.15 ft (TOC)
SCREENED INTERVAL	3.1-12.5	DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT	N/A ft

BLADDER PUMP: N/A

PERISTALTIC PUMP: X

DISCHARGE: N/A

REFILL: N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1110	0.80		10.13	0.045	5.66	8.05	DNM	181.0	
1113	1.02		11.19	0.045	5.42	6.72	DNM	191.8	
1116	1.12	0.3	11.33	0.045	5.37	5.86	13.6	197.6	
1119	1.12	↓	11.22	0.044	5.35	5.87	DNM	203.5	
1121	1.14		11.24	0.044	5.33	5.89	DNM	208.2	
1124	1.14		11.24	0.044	5.33	5.79	DNM	211.2	
1127	1.14		11.22	0.044	5.33	5.88	11.2	214.8	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM = did not measure

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT CTS of Asheville, Inc. Superfund Site **JOB NUMBER** 6252-12-0006 **DATE** 1/15/15

WELL / SAMPLE NUMBER MW-11A **ACTIVITY TIME** START 1140 END **TIME** 1215

QC SAMPLES COLLECTED N/A **ASSOCIATED TRIP BLANK** TB-03

WATER LEVEL / PUMP DATA

INITIAL DTW 1.50 ft (TOC) temporary

FINAL DTW ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT N/A ft

SCREENED INTERVAL 41.1-45.7

BLADDER PUMP N/A

PERISTALTIC PUMP X

DISCHARGE N/A

REFILL N/A

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1156	1.77		11.23	0.062	5.82	3.61	DNM	166.0	
1159	1.78		11.79	0.064	5.73	4.65	DNM	155.3	
—	—	empty flow through cell					—	—	
1202	1.75		11.42	0.060	5.69	6.24	DNM	167.7	
1205	1.78		11.86	0.057	5.60	5.02	51.8	170.5	
1209	1.78		11.92	0.055	5.55	5.08	DNM	179.1	
1212	1.78		11.93	0.054	5.52	5.10	DNM	185.2	
1215	1.77		11.98	0.053	5.50	5.05	DNM	191.0	
1218	1.77		11.92	0.052	5.49	5.16	17.3	195.0	

ANALYSES: TCL 8260, TCL 8270

NOTES: DNM: did not measure

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT CTS of Asheville, Inc. Superfund Site **JOB NUMBER** 6252-12-0006 **DATE** 4/6/15

WELL / SAMPLE NUMBER MW-12 **ACTIVITY TIME** START 1300 END 1630 **TIME** 1700

QC SAMPLES COLLECTED N/A **ASSOCIATED TRIP BLANK** N/A

WATER LEVEL / PUMP DATA

INITIAL DTW 22.20 ft (TOC) **FINAL DTW** ft (TOC) **DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT** N/A ft

SCREENED INTERVAL 10-40

BLADDER PUMP ☐
PERISTALTIC PUMP X
DISCHARGE ☐ **REFILL** ☐
~28'

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1643	22.95		16.32	0.073	5.89	2.80↓		29.5↑	
1646	22.50		16.37	0.075	5.98	1.29		30.0	
1651	22.50		16.35	0.073	6.21	1.00		24.4	
1654	22.52		16.35	0.073	6.14	0.70		24.7	
1657	22.60		16.27	0.072	6.15	0.82		22.0	
→ Sample									

ANALYSES: ~~TCL 8260, TCL 8270~~

NOTES:

SIGNATURE:

FIELD DATA RECORD - GROUNDWATER SAMPLING

PROJECT CTS of Asheville, Inc. Superfund Site

JOB NUMBER 6252-12-0006

DATE 4/6/15

WELL / SAMPLE NUMBER MW-13

ACTIVITY TIME START 1630 END

TIME

QC SAMPLES COLLECTED N/A

ASSOCIATED TRIP BLANK N/A

WATER LEVEL / PUMP DATA

INITIAL DTW 18.63 ft (TOC)

FINAL DTW 19.22 ft (TOC)

DRAWDOWN VOL INITIAL - FINAL X 0.16 GAL/FT N/A ft

SCREENED INTERVAL 10-45

BLADDER PUMP ☐

PERISTALTIC PUMP ☒

DISCHARGE ☐ **REFILL** ☐

@~35'

PURGE DATA

TIME	DTW (ft)	PURGE RATE (L/min)	TEMP (C°)	SPECIFIC CONDUCTIVITY (mS/cm)	pH	DO (mg/L)	TUIBIDITY (NTU)	ORP (mV)	COMMENTS
1923	18.90		15.70	0.253	6.07	2.65 ↓	DNM	82.0	
1426	19.06		15.75	0.247	5.80	0.79		62.1	
1931	19.11	0.3	15.55	0.239	5.80	0.61		47.6	
1934	~~20~~19.15		15.54	0.239	5.82	0.52		40.0	
1438	19.20		15.47	0.231	5.82	0.51		34.2	
1941	19.21		15.51	0.229	5.82	0.45		33.4	
1945	19.22		15.45	0.228	5.83	0.53		31.9	
→ sample									

ANALYSES: ~~TCL 8260, TCL 8270~~

NOTES:

SIGNATURE:

LNAPL Measurement Record

Project: CTS of Asheville, Inc. Superfund Site

Project Number: 6252-12-0006

Name of Person Completing Form: S. Kelly

Date: 3/18/15

Monitoring Well ID	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
MW-3	21.57	22.88	1.31
MW-12	21.67	22.42	0.75
MW-13	not detected	not detected	0.0
MW-14	18.25	18.26	<0.01
PZ-2	19.51	23.88	4.37

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Measurement Record

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0006
Name of Person Completing Form: S. Kelly
Date: 3/26/15

Monitoring Well ID	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
MW-3	21.47	22.75	1.28
MW-12	21.46	22.37	0.91
MW-13	18.45 water		N/A
MW-14	18.10 water		N/A
PZ-2	19.46	23.45	3.99

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Measurement Record

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0006
Name of Person Completing Form: S. Kelly
Date: 4/1/15

Monitoring Well ID	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
MW-3	21.57	22.89	1.32
MW-12	21.71	22.63	0.92
MW-13	18.67 water	N/A	N/A
MW-14	18.25 water	N/A	N/A
PZ-2	19.56	23.70	4.14

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Measurement Record

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0006
Name of Person Completing Form: S. Kelly
Date: 4/6/15

Monitoring Well ID	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
MW-3	21.57	22.91	1.34
MW-12	21.71	22.77	1.06
MW-13	18.71 water	N/A	N/A
MW-14	18.29 water	N/A	N/A
PZ-2	19.61	23.62	4.01

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Measurement Record

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0006
Name of Person Completing Form: Skelly
Date: 4/27/15

Monitoring Well ID	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
MW-3	21.01	22.32	1.31
MW-12	21.15	22.11	0.96
MW-13	18.03 water	N/A	N/A
MW-14	17.41 water	N/A	N/A
PZ-2	19.14	23.08	3.94

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Baildown Test

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0005
Name of Person Completing Form: S. Kelly
Monitoring Well: MW-12

Date	Time	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
4/27/15	10:40	21.15	22.11	0.96
→	bail out LNAPL			
4/27/15	1130	21.57	21.78	0.21
	1131	21.54	21.75	0.21
	1132	21.51	21.72	0.21
	1133	21.44	21.69	0.25
	1134	21.47	21.68	0.21
	1135	21.45	21.66	0.21
	1136	21.44	21.65	0.21
	1137	21.42	21.64	0.22
	1142	21.38	21.59	0.21
	1150	21.32	21.55	0.23
	1201	21.31	21.47	0.16
	1211	21.29	21.46	0.17
	1221	21.28	21.44	0.16
	1247	21.27	21.43	0.16
	1252	21.23	21.45	0.19
	12:57	21.20	21.39	0.19
	13:49	21.11	21.31	0.20
	1505	21.22	21.40	0.18
	1905	21.18	21.36	0.18
4/28/15	915	21.22	21.47	0.25
	1808	21.08	21.30	0.22
4/29/15	821	21.05	21.28	0.23

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Baildown Test

Project: CTS of Asheville, Inc. Superfund Site

Project Number: 6252-12-0005

Name of Person Completing Form: Skelly / R. Clark

Monitoring Well: MW-12

Date	Time	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
4/29/15	19:08	21.00	21.28	0.21
4/30/15	8:08	21.03	21.35	0.32
	17:45	21.00	21.42	0.42
5/1/15	8:18	21.06	21.49	0.43
	17:45	21.07	21.53	0.46
5/2/15	09:22	21.09	21.57	0.48
	17:40	20.98	21.43	0.45
5/3/15	0755	21.06	21.60	0.54
	1822	20.96	21.48	0.52
5/4/15	0822	21.06	21.62	0.56
	1820	20.98	21.54	0.56
5/5/15	824	21.02	21.59	0.57
5/6/15	810	20.93	21.48	0.55
5/7/15	814	20.91	21.47	0.56
5/8/15	819	20.88	21.51	0.63

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Baildown Test

Project: CTS of Asheville, Inc. Superfund Site

Project Number: 6252-12-0005

Name of Person Completing Form: S.Kelly / R.Clark

Monitoring Well: MW-3

Date	Time	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
4/27/15	1045	21.01	22.32	1.31
→	bail out	LNAPL		
4/27/15	1236	21.88	22.06	0.18
	1237	21.76	21.93	0.17
	1238	21.65	21.81	0.16
	1239	21.55	21.71	0.16
	1240	21.48	21.67	0.19
	1241	21.42	21.59	0.17
	1242	21.39	21.56	0.17
	1243	21.36	21.53	0.17
	1244	21.33	21.52	0.19
	1249	21.26	21.43	0.17
	1347	21.11	21.31	0.20
	1503	21.10	21.30	0.20
	1908	21.09	21.30	0.21
4/28/15	918	21.12	21.33	0.21
	1811	20.99	21.18	0.19
4/29/15	825	20.91	21.11	0.20
	1911	20.85	21.05	0.20
4/30/15	811	20.86	21.08	0.22
	1755	20.87	21.10	0.23
5/1/15	8:22	20.89	21.13	0.24
	17:55	20.93	21.17	0.24
5/2/15	09:14	20.97	21.20	0.23

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.

LNAPL Baildown Test

Project: CTS of Asheville, Inc. Superfund Site
Project Number: 6252-12-0005
Name of Person Completing Form: S. Kelly / R. Clark
Monitoring Well: MW-3

Date	Time	Depth to Top of LNAPL	Depth to Bottom of LNAPL	LNAPL Thickness
5/2/15	17:47	20.84	21.05	0.21
5/3/15	08:05	20.92	21.15	0.23
	18:24	20.83	21.05	0.22
5/4/15	08:27	20.91	21.15	0.24
	18:24	20.83	21.03	0.20
5/5/15	8:28	20.86	21.06	0.20
5/6/15	814	20.73	20.93	0.20
5/7/15	817	20.67	20.88	0.21
5/8/15	822	20.65	20.86	0.21

Depths to be referenced to top of casing and measured in feet.
Thickness measurements in feet.