

**LIMITED PHASE II
ENVIRONMENTAL SITE
ASSESSMENT REPORT**

**I-85 REHABILITATION PROJECT
MM 77.0 TO MM 84.0
SPARTANBURG AND CHEROKEE
COUNTIES, SOUTH CAROLINA**

PREPARED FOR:

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AUGUST 5, 2015

F&ME Project No. G5439.00

August 5, 2015

Mr. Derek C. Staton, PE
Vice President
TranSystems Corporation
1780 Corporate Drive, Suite 400
Norcross, Georgia 30093

Re: Limited Phase II Environmental Site Assessment Report
I-85 Rehabilitation Project (MM 77.0 to MM 84.0)
Spartanburg and Cherokee Counties, South Carolina
F&ME Project No.: G5439.00

Dear Mr. Staton:

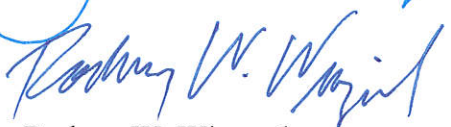
Submitted herein is F&ME's Limited Phase II Environmental Site Assessment Report for the proposed I-85 rehabilitation project. This report includes a summary of our records research, field investigation, findings, and recommendations for proceeding with our geotechnical investigation and culvert inspection.

It has been a pleasure working with you on this project and we appreciate the opportunity to be of service. Please notify us if there are any questions or if we may be of further assistance.

Sincerely,

F&ME CONSULTANTS


Zane W. Abernethy, PE
President


Rodney W. Wingard
Environmental Manager


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TABLE OF CONTENTS

Executive Summary	2
1.0 Introduction.....	6
2.0 Limited Environmental Records Research	7
2.1 History of Site Ownership and Operations	7
2.2 Voluntary Cleanup Contract (VCC)	8
2.3 Potential Impacts on Field Investigations, Design, and Construction	8
2.4 Contaminants of Concern (COCs).....	9
3.0 Limited Phase II Environmental Site Assessment	10
3.1 Scope of Environmental Site Assessment.....	10
3.2 Railroad Coordination.....	10
3.3 Development of Site Specific Health and Safety Plan (HASP).....	10
3.4 Field Investigation	12
4.0 Phase II Findings.....	15
4.1 Records Research.....	15
4.2 Test Borings	16
4.3 Comparison to Data Research.....	18
4.4 Results of Chemical Analysis	18
5.0 Impact of Findings	21
5.1 Overview	21
5.2 Geotechnical Investigation.....	21
5.3 Culvert Inspection.....	22
5.4 Design Strategy/Risk Mitigation.....	22
Appendices.....	24

EXECUTIVE SUMMARY

The South Carolina Department of Transportation (SCDOT) proposes to rehabilitate I-85 from near mile marker 77 to approximately mile marker 84. The project includes rehabilitation of existing travel lanes in each direction and the replacement of the CSX Bridge over I-85 at mile marker 80.7. The replacement of the CSX Bridge will require realignment of approximately 3,500 linear feet of railroad track and replacement of the bridge carrying Conway Black Road over the railroad. Approximately 2,500 linear feet of Shady Lane will be realigned to a location north of I-85 that will allow for the widening of I-85 to six lanes under a separate project.

The following is a summary of F&ME's findings and recommendations for proceeding with our geotechnical investigation and culvert inspection associated with the proposed I-85 rehabilitation project. We have also included preliminary design strategies for environmental risk mitigation.

I. Findings

- A. Records research indicated that soil and groundwater contamination has occurred on the Auriga Polymers, Inc. site in the past. For the purpose of this report, this site will be referred to as the Auriga Industrial Facility (AIF).
- B. Records research identified several primary sources of soil and groundwater contamination, to include facility components, catchments, and lagoons where industrial chemicals were contained. One of the primary source areas adjoins the proposed project construction area. Additionally, the lagoon located next to the railroad tracks is within an identified contamination source location. This source is less than 400 feet from the proposed railroad bridge north end bent. A retaining structure is proposed, which will adjoin the source area at the railroad embankment.
- C. A plume of contamination has migrated off the AIF and under the South Carolina Department of Transportation's (SCDOT) right-of-way.
- D. Figure 1 herein is a map that schematically depicts the relationship of the area of known soil and/or groundwater contamination on the AIF and the project construction footprint.
- E. Our assessment focused on testing for contaminants of concern (COCs) associated with the ongoing AIF cleanup activities. Other environmental contaminants are known to exist on the AIF. While the AIF is continuing to go through cleanup, they are also continuing to assess and investigate as required to address legacy contamination as well as any newly discovered contamination.
- F. Chemical analysis of soil and groundwater samples from our field investigation revealed the presence of COCs within the project area. However, these results did not reveal high levels of COCs in the soil and groundwater.

- G. The subsurface stratification (soil, rock, and groundwater) is variable and complex. If not properly planned and executed, investigation and/or construction activities could create a migration of contaminants into the project construction area.

II. Geotechnical Investigation

Based on the findings from our records research and environmental assessment to date, F&ME recommends modifications to our geotechnical investigation scope of work. The current scope does not include site-specific environmental protocols or testing. F&ME proposes that a “scaled down” version of the environmental protocols utilized for our Phase II field investigation be implemented. We recommend the following general requirements and considerations for all geotechnical fieldwork:

- Full-time supervision by a person with OSHA 40-hour HAZWOPER certification;
- Use of a photoionization detector (PID) to screen soil samples and soil cuttings;
- Predetermined responses to PID findings and evaluation, to include upgraded worker protection, material containment, and analytical testing; and
- A Certified Industrial Hygienist (CIH) on-call for consultation if necessary.

The main difference in the protocols utilized in this assessment versus those recommended for F&ME’s geotechnical investigation is that for this initial Phase II Environmental Site Assessment all samples were assumed to be contaminated until proven otherwise. For our geotechnical investigation, we will proceed with continuous monitoring, assuming the soil will contain only low levels of contamination until proven otherwise.

F&ME’s recommended environmental protocols are required to provide worker safety and gather additional environmental data for developing design strategy and risk mitigation for the project.

III. Culvert Inspection

F&ME’s scope of work for culvert inspections includes utilizing robotic cameras for small diameter culverts and direct inspection for large pipe and box culverts. Based on our findings, potential impacts exist to the culverts and/or culvert inspections resulting from contaminants in the sediment load and contributing to contaminant vapors in the air. F&ME recommends a change in inspection methodology to eliminate direct inspections for worker safety. While using robotic cameras for large culverts will add to the complexity of the inspection, this approach will avoid potential worker safety issues.

IV. Design Strategy/Risk Mitigation

Based on F&ME's findings to date, we have developed preliminary global design strategies for the subsurface structure components to be constructed in the area of this assessment to mitigate SCDOT's environmental risk. These strategies will be refined as we develop additional information from our geotechnical investigation.

Bridge Foundation Elements

At this time, F&ME recommends driven steel H-piles for bridge support. Driven piles will not require the removal of soil and rock, particularly below the water table, nor will they require dewatering for concreting operations.

F&ME recognizes the advantages of drilled shaft foundation elements, particularly for the I-85 median bent. A focus in our geotechnical investigation will be the median bent to better define the environmental issues and assess the possibility of utilizing drilled shafts.

Soil Excavation

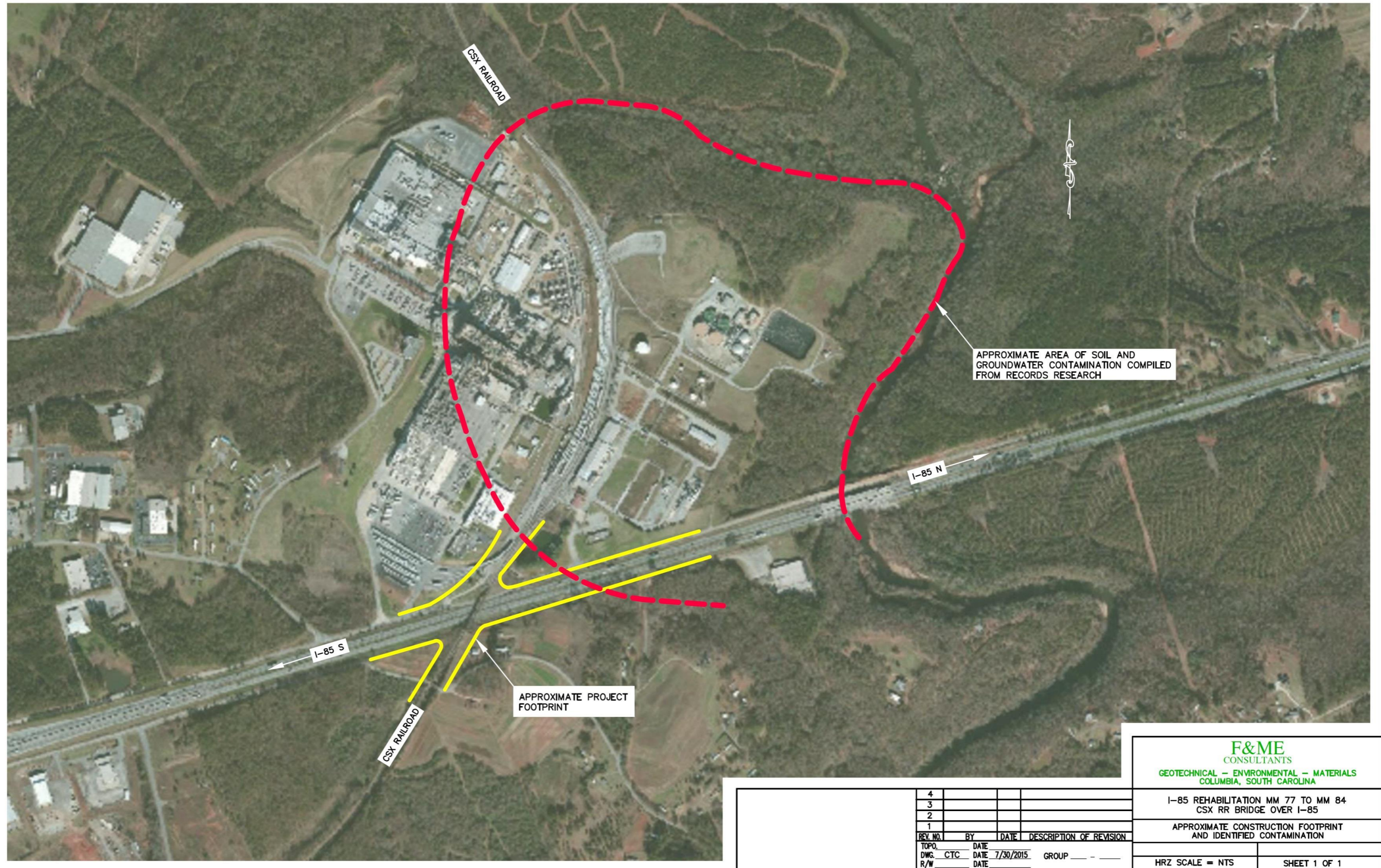
Excavation of shallow near surface soils will be required for bridge foundation, roadway widening, retaining structures, and utilities. F&ME recommends an overall strategy to minimize soil excavation depths and removal of soil from the AIF. This is of particular importance in work north of I-85 along the frontage road and railroad embankment.

Environmental Risk Zones

The environmental protocol recommended for inclusion in F&ME's geotechnical investigation will be utilized to assess and possibly identify hazardous environmental risk zones within the overall construction footprint. The objective will be to assess the need for protocols to manage hazardous environmental issues during construction, as well as address worker safety during the geotechnical investigation. It is anticipated that some hazardous environmental protocols will be required during construction and that different levels and requirements could be necessary based on the various areas or zones within the overall construction footprint. Information obtained during our geotechnical investigation will also help refine and assess the risk zones and protocols used during construction.

Figure 1. Approximate Construction Footprint and Identified Contamination

FED. RD. DIST. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	SPARTANBURG	0040692	I-85	



F&ME
CONSULTANTS
GEOTECHNICAL - ENVIRONMENTAL - MATERIALS
COLUMBIA, SOUTH CAROLINA

I-85 REHABILITATION MM 77 TO MM 84
CSX RR BRIDGE OVER I-85

APPROXIMATE CONSTRUCTION FOOTPRINT
AND IDENTIFIED CONTAMINATION

HRZ SCALE = NTS SHEET 1 OF 1

REV. NO.	BY	DATE	DESCRIPTION OF REVISION
4			
3			
2			
1			

TOPO.	DATE		
DWG. CTC	DATE 7/30/2015	GROUP	-- --
R/W	DATE		

1.0 INTRODUCTION

The South Carolina Department of Transportation (SCDOT) proposes to rehabilitate I-85 from near mile marker 77 (south of SC 85, Exit 77) on the southern terminus to approximately mile marker 84 (north of SC 110, Exit 83) on the northern terminus. The project (“Project”) includes rehabilitation of existing travel lanes in each direction and the replacement of the CSX Bridge over I-85 at mile marker 80.7. The replacement of the CSX Bridge will require realignment of approximately 3,500 linear feet of railroad track and replacement of the bridge carrying Conway Black Road over the railroad. Approximately 2,500 linear feet of Shady Lane will be realigned to a location north of I-85 that will allow for the widening of I-85 to six lanes under a separate project.

During F&ME’s initial Project reviews and scoping discussions with the Project’s lead design consultant, TranSystems Corporation, and SCDOT, it was noted that the Auriga Polymers, Inc. site is located north of I-85. For the purpose of this report, this site will be referred to as the Auriga Industrial Facility (AIF). The AIF was known to have extensive Resource Conservation and Recovery Act (RCRA) hazardous environmental contamination in the soil and groundwater, as well as considerable public involvement from local community groups within Spartanburg County.

F&ME held discussions with TranSystems and SCDOT regarding the potential impact of hazardous environmental contamination that could be encountered during our field investigations, as well as during construction of the roadway and bridge. As a result, SCDOT authorized F&ME to conduct a Limited Environmental Records Research relative to the AIF. Documents provided by the South Carolina Department of Health and Environmental Control (SCDHEC) included over 16,500 pages of information relative to the site contamination and ongoing cleanup operations.

Utilizing the information contained within the SCDHEC documents, F&ME identified specific contaminants of concern (COCs) at the AIF and developed a scope of work for performing a Limited Phase II Environmental Site Assessment (Phase II). F&ME’s Phase II included collecting soil and groundwater samples to be analyzed for the presence of the identified COCs. Additionally, based on the SCDHEC records, F&ME developed a Site Specific Health and Safety Plan (HASP) to be used during our Phase II field investigation. This plan outlined environmental protocols, as well as procedures for sampling and handling soil and groundwater.

This report describes F&ME’s field operations, findings, and recommendations for performing additional required site investigations and monitoring. We have also provided preliminary design strategies to mitigate SCDOT’s environmental risk.

2.0 LIMITED ENVIRONMENTAL RECORDS RESEARCH

F&ME conducted a Limited Environmental Records Research to investigate the history of environmental contamination at the AIF. Information provided by the SCDHEC Freedom of Information (FOI) office included over 16,500 pages of documents relative to the site contamination and ongoing cleanup operations. Additionally, F&ME utilized the AIF-specific information posted on SCDHEC's website for further reference: <http://www.scdhec.gov/homeandenvironment/pollution/cleanupprograms/ongoingprojectupdates/hoechst/>.

The following contains consolidated paraphrases of information obtained through F&ME's FOI request. We have included a copy of the SCDHEC documents on a DVD in Appendix E.

2.1 History of Site Ownership and Operations

The AIF property is identified by the County of Spartanburg as Tax Map Serial Number 3-06-00-027.00. Since the 1960's, various manufacturing facilities and operations have been located on this property. Based on the Voluntary Cleanup Contract 13-5841-RP executed March 12, 2013, the following is a brief description of the site's ownership and operations.

The property was first developed by Hercules, Inc. in 1966 as a Dimethyl Terephthalate (DMT) production facility. The DMT facility was closed in 1978 and has since been dismantled.

In October 1967, Hystron Fibers, Inc. leased a portion of the property from Hercules and constructed a fiber production area west of the DMT facility. In May 1970, Hystron Fibers purchased the DMT facility from Hercules and Farbwerke Hoechst AG acquired 100% of the stock ownership of Hystron Fibers (renamed Hoechst Fibers, Inc.).

In 1971, Farbwerke Hoechst became American Hoechst. In 1987, American Hoechst acquired Celanese Corporation in a stock purchase and formed Hoechst Celanese. In 1986, Messer Greishiem, Inc. leased an area in the southeast portion of the property, which was part of the former DMT area. Messer Greishiem became part of Hoechst Celanese in 1987 when they merged.

The polyester business was divested by Hoechst Celanese in 1998 to Arteva Specialties (operating as KoSa). Celanese (as HNA Holdings) also sold a portion of the property to Johns Mansville. KoSa and INVISTA merged in 2004 and subsequently changed its name to Invista. Invista sold 384 acres to Auriga Polymers, Inc. in 2011. Auriga is presently operating at the property. CNA Holdings, LLC is the legal successor to HNA Holdings.

2.2 Voluntary Cleanup Contract (VCC)

Contamination at the AIF was first identified in 1988 when SCDHEC discovered abnormalities in the groundwater data. Since 1990, CNA Holdings has voluntarily conducted multiple site investigations under the oversight of SCDHEC to identify, delineate, and address contamination on the AIF. On March 12, 2013, SCDHEC and CNA Holdings entered into a Voluntary Cleanup Contract (VCC) in the matter of the former Auriga/KoSa/Hoechst Celanese Site, which is ongoing. The VCC 13-5841-RP is included in Appendix F.

Through CNA Holdings' investigations, groundwater flow direction has been extensively evaluated and contaminants, and areas of soil and groundwater degradation have been delineated. Additionally, contaminants, including 1,4-dioxane, 1,1-biphenyl, biphenyl ether, chloroform, and low concentrations of other constituents, have been identified. Chloroform is the only constituent known to have migrated off-site in a groundwater plume. However, monitoring and further assessment are continuing at the AIF.

According to the VCC, three sources for various contaminants have been identified at the AIF: the former DMT site, wastewater treatment plant sludge impoundments and basins, and the DowTherm Heater area. In 1978, the DMT facility was closed, which was the source of chloroform releases. In the mid-1990's, several known sources of 1,4-dioxane impact to groundwater were removed, including the ground basins associated with the wastewater treatment plant sludge holding and sludge drying lagoons. Process and other improvements were made to the DowTherm Heater area to prevent future potential releases of constituents.

CNA Holdings continues to perform remedial activities along with continued monitoring and further assessment at the AIF. SCDHEC has conducted supplemental private well sampling, which confirmed that at the time of sampling, the private wells were not impacted by the AIF. SCDHEC also performed a cancer cluster study in August 2011, which concluded that there were no increases in cancer incidences or mortality among residents of the 29307 zip code between 1996 and 2007. The Agency for Toxic Substances and Disease Registry (ATSDR) concurred with these conclusions in October 2011.

2.3 Potential Impacts on Field Investigations, Design, and Construction

Based on F&ME's review of the information provided by the SCDHEC FOI office, significant known contamination exists at the AIF in the soil and groundwater. Contamination has also migrated off-site onto adjacent properties in the form of a groundwater plume. Contamination in the Project area can potentially impact F&ME's geotechnical investigation, as well as other field investigations, design, and construction in this area.

2.4 Contaminants of Concern (COCs)

As part of F&ME's Limited Environmental Records Research, information pertaining to assessments, investigations, corrective actions, and ongoing environmental monitoring were included in the SCDHEC FOI documents for review. Additionally, the VCC was used to determine the type of work that had previously been performed at the AIF and the major COCs found.

From our research, the primary COCs identified in the soil and groundwater of the Project area include chloroform, 1,4-dioxane, and 1,2-dichloroethene, as well as other organic compounds (e.g., acetone). Acetone has been detected in monitoring wells (in bedrock) on and off-site and has been reported to SCDHEC in Annual Progress Reports. The latest progress report developed by AECOM and titled, "Auriga Spartanburg Voluntary Cleanup Contract 13-2841-RP Progress Report #4, September 2014," is provided in Appendix G. For this assessment, we have included these identified COCs in our chemical analysis of soil and groundwater samples. Data sheets for the COCs, which include toxicological, physical, and chemical information, are included in Appendix H.

3.0 LIMITED PHASE II ENVIRONMENTAL SITE ASSESSMENT

3.1 Scope of Environmental Site Assessment

Utilizing the data gathered during F&ME's Limited Environmental Records Research, a scope was developed for a Limited Phase II Environmental Site Assessment. To assess whether contamination was present, a limited number of drill rig borings and hand auger borings were performed within the Project area for the purpose of collecting soil and groundwater samples to be analyzed for the presence of COCs. A sampling protocol was developed for soil and groundwater.

3.2 Railroad Coordination

As part of F&ME's Phase II field investigation, borings were performed in the CSX railroad right-of-way. Prior to the field investigation, F&ME coordinated with CSX Corporation to obtain an "Environmental Right of Entry" to perform environmental sampling in the existing railroad right-of-way. Contact was established with CSX Corporation and arrangements were made for sampling requirements, as well as to have a CSX flagman's presence when work activities occurred within the CSX railroad right-of-way.

3.3 Development of Site Specific Health and Safety Plan (HASP)

To safely implement F&ME's Phase II field investigation and protect field personnel from exposure to hazardous environmental contamination, F&ME utilized a Certified Industrial Hygienist (CIH) to develop a HASP. This plan was created in accordance with Occupational Safety and Health Administration (OSHA) regulations, as well as F&ME's Worker Safety Program.

The HASP was developed from the review of past assessment data and other information gathered during F&ME's Limited Environmental Records Research. The HASP was prepared to address the protection of personnel performing the field investigation and establish protocols to address various circumstances in regards to potentially hazardous environmental contamination that might be encountered during the field investigation.

A MiniRAE 3000 portable handheld photoionization detector (PID) equipped with an 11.7 eV bulb was utilized during all drilling and hand augering operations. The PID is a broadband field monitoring device that detects most volatile organic compounds (VOCs). The PID was calibrated with a 100-ppm isobutylene span gas on a daily basis and was used to assist in providing real-time gas measurements to assess whether COCs were present. The PID was utilized to screen soil cuttings generated during drilling activities and soil samples collected, and to monitor the ambient air in the direct vicinity of the field investigation. In addition, the PID was used to screen and select split-spoon soil samples for analytical testing.

F&ME's HASP addressed the following procedures.

3.3.1 Monitoring Ambient Air

F&ME monitored ambient air utilizing a PID within the breathing zone of personnel closest to the drilling and hand augering operations to assure proper personal protective equipment (PPE) were in use.

3.3.2 Screening of Soil Samples



F&ME screened soil samples collected during the Phase II field investigation with a PID to assess whether contamination was present. PID readings aided in making gauged decisions to assure proper PPE was being utilized and to assist with proper safety methods for containerizing and staging soil cuttings from borings in 55-gallon drums.

3.3.3 Handling of Soil and Groundwater Samples

F&ME properly handled soil and groundwater samples collected during the field investigation to prevent dermal contact by personnel of hazardous environmental contamination. Additionally, decontamination procedures of equipment and personnel were established in the event that hazardous environmental contamination was encountered.

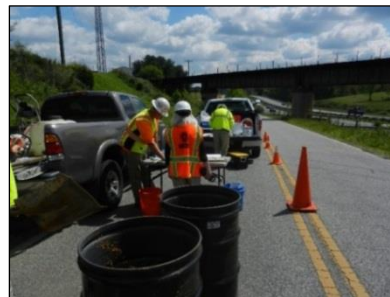
3.3.4 Assuring Worker Safety

To assure worker safety, F&ME provided field personnel with appropriate PPE (i.e., Tyvek suits, chemical resistance suits, safety face shields, and rubber boots), so they would have the proper equipment to adapt to various circumstances that might have arisen from the known contaminants. Safety equipment utilized at the start of F&ME field investigation included typical safety equipment (i.e., hard hats, steel-toe boots, safety glasses, and safety vests), as well as nitrile gloves for those personnel coming in direct contact with soil samples cuttings and samples.

All activities were completed under the direction of an on-site supervisor with OSHA 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training. Additionally, personnel performing drilling and decontamination were 40-hour HAZWOPER certified. The CIH was on-site for the initial field investigation and on-call thereafter to provide technical support in the event that additional hazards were encountered.

3.4 Field Investigation

In order to assess the presence of contamination in the Project area, F&ME conducted a field investigation on April 27 to April 28, 2015 and June 17 to June 18, 2015 utilizing methods similar to standard geotechnical field practices. F&ME performed five drill rig borings and five hand auger borings in the locations indicated on the Phase II Soil Test Boring Location Plan included in Appendix A. Boring logs are located in Appendix B.



Environmental protocols were established to contain soil generated during drilling operations and protect workers from exposure to hazardous materials that might be encountered.

3.4.1 Worker Safety

At the onset of the drilling operations, safety protocols were implemented as noted in the HASP to screen for the presence of contamination. On the initial day of F&ME's Phase II field investigation, the CIH was present to assist with screening soils, which were generated during boring activities, for contamination. The CIH also evaluated the air concentrations within the breathing zone of personnel working in the direct vicinity of the drilling operations as well as those handling and containerizing soil cuttings. The CIH was on call for the remaining days of the field investigation to address any changes or emergencies that might impact established protocols.

3.4.2 Sampling

Deep borings were accomplished using standard geotechnical standard penetration test (SPT) drilling techniques with added environmental protocols. All deep borings were completed utilizing hollow stem augers (HSA) and were extended to auger refusal, which occurred once the top of rock was encountered.

Hand augers were performed utilizing standard geotechnical hand augering equipment to evaluate and assess shallow upper surface soils.

3.4.2.1 Soil

Split-spoon soil samples from each of the drill rig borings were collected continuously in the top 10 feet. Thereafter, samples were collected on semi-continuous intervals; the split-spoon was driven 18 inches every 2.5 feet. The collected soil samples were immediately placed in plastic zipper bags and screened with a PID for the presence of COCs. Those samples that exhibited the highest PID reading were collected for analytical testing.

Two soil samples were collected from each drill rig boring. One sample was collected from the soils in the upper 6 feet, while the other was collected from the soils down to the depth of boring termination. All samples were containerized in appropriate jars and vials provided by the analytical laboratory and placed on ice in a cooler for safe and proper transport to the laboratory. Proper protocol and handling procedures were followed to prevent cross contamination of samples and to provide timely analysis.

Hand augers were completed in roadway and railroad right-of-way areas to assess the presence of COCs in the shallow upper surface soils. Samples were collected at 1-foot intervals and screened with the PID. One sample from each sample exhibiting the highest PID reading was collected for analytical testing. PID readings are included on the boring logs in Appendix B.

3.4.2.2 Groundwater

Once auger refusal was achieved in each of the drill rig borings, a 2-inch PVC standpipe with a 5-foot slotted well screen was temporarily lowered down through the HSA. Water was allowed to stabilize for approximately 15 to 20 minutes. A water level measurement was taken to record the water table at the time of the boring.

After the water level was measured, a clean disposable bailer was lowered down the PVC standpipe for the collection of a groundwater sample to be submitted for laboratory analysis. Groundwater samples collected were containerized in appropriate jars and vials provided by the analytical laboratory and placed on ice in a cooler for safe and proper transport to the laboratory. Proper protocol and handling procedures were followed to prevent cross contamination of samples and to provide timely analysis.

3.4.3 Decontamination of Drilling Equipment

Prior to the initiation of F&ME's Phase II field investigation, all drilling equipment and tools were decontaminated with a hot water pressure washer. Due to the presence of contamination within the Project area, decontamination of all drilling equipment was performed between borings. After the completion of each boring, all equipment was transported to the off-site remote decontamination/staging area.

At the decontamination/staging area, a containment area was constructed utilizing boards and polyethylene sheeting creating a bermed area to capture and contain water generated during decontamination activities. All drilling equipment and tools were cleaned with a hot water pressure washer before being transported back to the Project area. Decontamination water generated during the cleaning process was collected and containerized in 55-gallon drums for proper disposal.

3.4.4 Containment of Soil Cuttings



Soil cuttings collected during drilling operations were immediately containerized in 55-gallon drums. Soil cuttings from each boring were kept in separate drums. Drums were labeled with the corresponding boring number and a pending analytical results label. Drums were loaded into a truck and transported to an off-site remote decontamination/staging area. The staging area was located at a closed rest area along southbound I-85.

3.4.5 Characterization and Disposal of Contaminated Materials

Composite samples were collected from each boring and corresponding soil containment drum. These samples were collected for Toxicity Characteristic Leaching Procedure (TCLP) analysis to determine the appropriate disposal method for the containerized soils.

All soil cuttings generated from F&ME's Phase II field investigation were to be containerized and properly disposed of. All soils were collected and containerized in 55-gallon drums on-site, and transported to the remote staging/decontamination area. Additionally, water generated during decontamination was collected and containerized.

At the completion of F&ME's Phase II field investigation, drums were collected by Regulatory Solutions, Inc. and transported to a Class 3 Landfill for proper disposal. Disposal manifests are found in Appendix D.

3.4.6 Hole Closure

Once groundwater samples were collected, the temporary PVC standpipe utilized to obtain the samples was removed. All boreholes were filled with a neat cement bentonite grout utilizing a tremie pipe, which allowed filling from the bottom to the top of the boring. All boreholes completed in paved areas were patched at the surface with a high strength non-shrink grout.



4.0 PHASE II FINDINGS

4.1 Records Research

Based on F&ME's review of the information provided by the SCDHEC FOI office, significant known contamination exists at, and adjacent to, the AIF in the soil and groundwater. Information pertaining to assessments, investigations, corrective actions, and ongoing environmental monitoring were included for review. From our research, COCs identified include chloroform, 1,4-dioxane, and 1,2-dichloroethene, as well as other organic compounds (e.g., acetone).

The portion of the construction footprint that encompasses the northern bridge end, associated track tie-ins, and work along the frontage road, adjoins an area of the AIF identified as a major contaminant source and area of known contamination. As the AIF approaches the Pacolet River, an identified contaminant plume is located under SCDOT right-of-way. A schematic plan showing the approximate area of known soil and/or groundwater contamination compiled from our research is attached in Appendix A. This figure also shows the relationship to the construction footprint.

4.1.1 Issues

Three main issues evaluated during the course of F&ME's records research and this assessment were to identify the sources of release and locations, subsurface soils and groundwater contamination, and off-site contamination.

4.1.1.1 Release Locations Identified at the AIF

According to the VCC, three sources for various contaminants have been identified at the AIF: the former DMT site, wastewater treatment plant sludge impoundments and basins, and the DowTherm Heater area.

The former DMT site is understood to be the primary source of chloroform releases. To date, chloroform is the only known constituent migrating off-site in a groundwater plume.

In the mid-1990's, the wastewater treatment plant sludge impoundments were closed and sludge was excavated. Although the sources of contamination were removed, the groundwater still shows elevated levels of 1,4-dioxane.

Process and other improvements were made to the DowTherm Heater area to prevent future potential releases of constituents. However, groundwater at the AIF still contains constituents believed to originate from the DowTherm release.

4.1.2 Voluntary Cleanup Contract (VCC)

On March 12, 2013, SCDHEC and CNA Holdings entered into a VCC in the matter of the former Auriga/KoSa/Hoechst Celanese Site. CNA Holdings is the legal successor to HNA Holdings and is responsible for the cleanup at the AIF. Ongoing cleanup operations are being conducted pursuant to the Brownfields/Voluntary Cleanup Program; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and South Carolina Hazardous Waste Management Act (HWMA).

Based on CNA Holdings' site investigations to date, under the oversight of SCDHEC, groundwater flow direction has been extensively evaluated and contaminants, and areas of soil and groundwater degradation have been delineated. Additionally, contaminants, including 1,4-dioxane, 1,1-biphenyl, biphenyl ether, chloroform, and low concentrations of other constituents, have been identified. Chloroform is the only constituent known to have migrated off-site in a groundwater plume. However, monitoring and further assessment are continuing at the AIF.

4.1.3 Contaminants of Concern (COCs)

From our records research, the primary COCs identified in the soil and groundwater of the Project area include chloroform, 1,4-dioxane, and 1,2-dichloroethene, as well as other organic compounds (e.g., acetone). Acetone has been detected in monitoring wells (in bedrock) on and off-site and has been reported to SCDHEC in Annual Progress Reports. These COCs were the focus of our laboratory analysis.

4.2 Test Borings

4.2.1 Physical Subsurface Stratification

4.2.1.1 Soil/Rock/Water Table

The five SPT borings (B-1 through B-5) were advanced to auger refusal on rock. Depth to rock is important not only for structure foundation design but also in formulating a better understanding of potential movements of the primary COCs. Likewise, groundwater and its occurrence relative to rock are important in understanding potential movements of the primary COCs.

Table 1 summarizes the relative occurrence of rock and groundwater at each boring location. For more detailed information regarding individual borings, refer to Appendix B.

Table 1. Summary of Locations for Soil, Rock, and Groundwater

Boring No.	Surface Elevation (ft)	Depth to Rock (ft)	Elevation of Rock (ft)	Depth to Groundwater (ft)	Elevation of Groundwater (ft)	Groundwater Above Rock (ft)
B-1	743.8	42	701.8	34.5	709.3	7.5
B-2	729.8	16	713.8	7	722.8	9
B-3	724.7	17.5	707.2	9.5	715.2	8
B-4	727.5	44	683.5	5.5	722.0	38.5
B-5	758.5	54.5	704.0	32.5	726.0	22

4.2.1.2 Variations in Subsurface Stratification

All of the five SPT borings were located within an approximate 250-foot radius of the northern bridge end bent. Variations of strata and topography were noted between the individual soil boring locations.

Table 2 shows a comparison between the individual boring locations and variability of elevations and strata, measured vertically. The Site Topographic Map in Appendix A shows the topography in the area of F&ME’s Phase II field investigation and the AIF.

Table 2. Variation in Subsurface Stratification

Elevation/Location	Approximate Variation Vertically (ft)
Surface Elevation	34
Depth to Rock	39
Elevation of Rock	30
Depth to Groundwater	29
Elevation of Groundwater	17
Height of Water above Rock	31

4.2.1.3 Corrosion Potential

To provide an initial indication of the impact of soil contamination conditions on the corrosion and/or deterioration of steel and concrete foundation elements, a series of tests to measure electro chemical properties was performed on selected soil samples. These samples included shallow soils (upper 4 to 10 feet) and deeper soils (17 to 26 feet) at or below the water table.

Results of the test borings and American Association of State Highway and Transportation Officials (AASHTO) guidelines for assuring the various results are contained in Appendix C. The test results did not indicate an above normal potential for corrosion. F&ME will further evaluate erosion in our geotechnical evaluation.

4.3 Comparison to Data Research

Based F&ME's field observations, there appears to be a high degree of variability in the elevations, subsurface soil stratification, and groundwater. This variability is consistent with the data received during our records research.

4.4 Results of Chemical Analysis

The highly variable nature of the subsurface stratigraphy and groundwater makes it very difficult to predict the occurrence of (and absence of) COCs over short spatial distances. This is borne out by the extensive investigations performed over an approximately 27-year period on the AIF. This occurrence and migration of the COCs is directly influenced by rock, to include elevation, undulations, and fractures, as well as groundwater in the soil above rock and rock fractures.

4.4.1 Soil

Soil sample results from F&ME's Phase II field investigation revealed low concentrations of COCs in the soil. The results were compared to the United States Environmental Protection Agency (EPA) Regional Screening Levels (RSL). These are the levels that EPA and SCDHEC will likely require CNA Holdings to compare their own sample results to when ultimately establishing restrictive covenants in the future. All of the sample results were below RSL Residential values found in the EPA table. See the EPA's website for RSL: <http://www.epa.gov/region9/superfund/prg/>. This means that the levels found in soil sample results would not warrant, in and of themselves, disposal as a hazardous waste. However, the presence of contaminants at, and adjacent to, the AIF in the soil and groundwater warrants continued measures and protocols to understand the hazards and risk, protect workers, and provide for ultimate disposition of any contaminated media.

Table 3 shows the sample results for soil and groundwater. Appendix C contains the laboratory analytical reports for all soil and groundwater samples taken during our field investigation.

4.4.2 Groundwater

Water sample results from our field investigation did not reveal any COCs above the detection limit in the groundwater.

Table 3. Soil and Groundwater Laboratory Test Results

CONTAMINANTS OF CONCERN ¹ Analytical Method EPA SW5035/SW8260B									
Matrix Type/ Sample Date	Sample Depth (ft)	Chloroform	1,4-Dioxane	<i>cis</i> -1,2- Dichloroethene ²	<i>trans</i> -1,2- Dichloroethene ²	Tetra-chloroethene	Tri-chloroethene	Acetone	Carbon Disulfide
Drill Rig Borings (B)									
Sample ID: B-1		<i>Date of Sample: 04/27/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	32.5-34.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	34.5	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-2		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	0.5-2.0	BRL	BRL	BRL	BRL	BRL	BRL	150	19
Soil (ug/Kg-dry)	15.0-16.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	7.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-3		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	0.0-2.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	6.0-8.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	9.2	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-4		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	25.0-26.5	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	5.4	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-5		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	170	BRL
Soil (ug/Kg-dry)	27.5-29.0	BRL	BRL	BRL	7.4	BRL	BRL	130	BRL
Groundwater (ug/L)	32.8	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL

¹ United States Environmental Protection Agency (EPA); Hand Auger (HA); Boring (B); Below Reporting Limit (BRL); Micrograms per Kilogram (ug/Kg); Micrograms per Liter (ug/L); Parts per Million (ppm); Milligram per Cubic Meter (mg/m³).

² This compound can exist as either of two geometric isomers: *cis*-1,2-dichloroethene or *trans*-1,2-dichloroethene.

CONTAMINANTS OF CONCERN¹
Analytical Method EPA SW5035/SW8260B

Matrix Type/ Sample Date	Sample Depth (ft)	Chloroform	1,4-Dioxane	<i>cis</i> -1,2- Dichloroethene ²	<i>trans</i> -1,2- Dichloroethene ²	Tetra-chloroethene	Tri-chloroethene	Acetone	Carbon Disulfide
Hand Auger Borings (HA)									
Sample ID: HA-4		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-5		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	94	BRL
Sample ID: HA-6		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	4.5-5.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-7		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	2.5-3.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-8		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	160	BRL

¹ United States Environmental Protection Agency (EPA); Hand Auger (HA); Boring (B); Below Reporting Limit (BRL); Micrograms per Kilogram (ug/Kg); Micrograms per Liter (ug/L); Parts per Million (ppm); Milligram per Cubic Meter (mg/m³).

² This compound can exist as either of two geometric isomers: *cis*-1,2-dichloroethene or *trans*-1,2-dichloroethene.

5.0 IMPACT OF FINDINGS

5.1 Overview

F&ME's Limited Environmental Records Research indicated that soil and groundwater contamination has occurred on the AIF in the past. Soil contamination above the groundwater table tends to be localized to the area where contaminants enter the ground. Soil contamination below the groundwater table is influenced by the downward migration of the contaminant, as well as the lateral migration of contaminants transported above or within the groundwater. Contaminated groundwater has moved laterally beyond the area where contaminants enter the ground through diffusion within the water mass or through flow of groundwater.

The records reviewed identified three primary sources of soil and groundwater contamination: plant facility components, catchments, and lagoons where industrial chemicals were contained. One of these areas adjoins the proposed Project area. The lagoon adjoining the railroad tracks is an identified contamination source location. This source is less than 400 feet from the proposed bridge End Bent 1. A retaining structure is planned adjoining the source area at the railroad embankment. We do note that the reviewed records indicate environmental sampling in this source area, which verifies groundwater contamination has occurred.

Chemical analysis of soil and groundwater samples from F&ME's Phase II field investigation revealed the presence of COCs within the Project area. However, these results did not reveal high levels of COCs in the soil and groundwater. The long history of contamination at the AIF combined with the low levels of contamination found during F&ME's field investigation indicate there is a high probability of encountering contamination in the Project area.

5.2 Geotechnical Investigation

Based on the findings from our records research and environmental assessment to date, F&ME recommends modifications to our geotechnical investigation scope of work. The current scope of work does not include site-specific environmental protocols or testing. F&ME proposes that a "scaled down" version of the environmental protocols utilized for our Phase II be implemented. We recommend the following general requirements and considerations for all geotechnical fieldwork.

5.2.1 Field Supervision

F&ME will provide a full-time environmental supervisor on-site for the duration of the geotechnical investigation to conduct PID readings and make decisions regarding worker safety. The environmental supervisor will be OSHA 40-hour HAZWOPER certified.

5.2.2 Personal Protective Equipment (PPE)

All field personnel will wear nitrile gloves during F&ME's geotechnical investigation to limit dermal contact with the soil.

5.2.3 Field Screening

The on-site environmental supervisor will screen all soil samples and soil cuttings using a PID during F&ME's geotechnical investigation. If PID readings indicate unsafe conditions while performing a boring, samples of the soil and/or water will be taken for analytical testing. The boring will be terminated and grouted full depth, and drilling equipment will be decontaminated.

Polyethylene sheeting will be used to capture soil and water resulting from the decontamination process. Contaminated soil, water, and polyethylene sheeting will be placed in drums and temporarily stored on-site until analytical testing is complete. F&ME will assume that contaminated soil, water, and decontamination materials will be able to be disposed of in a Class 3 landfill.

Upon completion of these activities, F&ME will move to another boring location identified on the approved geotechnical boring location plan and continue with the investigation.

5.2.4 Certified Industrial Hygienist (CIH)

F&ME will have a CIH on-call for consultation if necessary throughout the geotechnical investigation.

5.3 Culvert Inspection

F&ME's scope of work for culvert inspections includes utilizing robotic cameras for small diameter culverts and direct inspection for large pipe and box culverts. Based on our findings, potential impacts exist to the culverts and/or culvert inspections resulting from contaminants in the sediment load and contributing to contaminant vapors in the air. F&ME recommends a change in inspection methodology to eliminate direct inspections for worker safety. While using robotic cameras for large culverts will add to the complexity of the inspection, this approach will avoid potential worker safety issues.

5.4 Design Strategy/Risk Mitigation

Based on F&ME's findings to date, we have developed preliminary global design strategies for the subsurface structure components (i.e., piles, retaining walls, etc.) to be constructed in the area of this assessment to mitigate SCDOT's environmental risk. These strategies will be refined as we develop additional information from our geotechnical investigation.

5.4.1 No Drilled/Augered Foundation Elements – Bridge Foundation Elements

At this time, F&ME recommends driven steel H-piles for bridge support. Driven piles will not require the removal of soil and rock, particularly below the water table, nor will they require dewatering for concreting operations.

F&ME recognizes the advantages of drilled shaft foundation elements, particularly for the I-85 median bent. A focus in our geotechnical investigation will be the median bent to better define the environmental issues and assess the possibility of utilizing drilled shafts.

5.4.2 Minimize Required Excavation

Excavation of shallow near surface soils will be required for bridge foundation, roadway widening, retaining structures, and utilities. F&ME recommends an overall strategy to minimize soil excavation depths and removal of soil from the AIF. This is of particular importance in work north of I-85 along the frontage road and railroad embankment.

5.4.3 Minimize Removal of Soil from the AIF

All material excavated from the AIF, to include the railroad right-of-way, should be reused on the AIF to the maximum extent possible.

The environmental protocol recommended for inclusion in our geotechnical investigation will be utilized to assess environmental hazardous material risk zones within the overall construction footprint. This objective will be to assess the need for environmental protocols during construction. It is assumed that if construction environmental protocols were required, different levels of worker protection may be needed in various areas or zones of the overall construction footprint.

Based upon our information gathered to date, all construction at the Frontage Road should be designed and constructed assuming groundwater, soil, and rock contamination. Any work within approximately 1,200 feet of the Pacolet River should be assumed to be within the identified contaminant plume.

5.4.4 Environmental Risk Zones

The environmental protocol recommended for inclusion in F&ME's geotechnical investigation will be utilized to assess and possibly identify hazardous environmental risk zones within the overall construction footprint. The objective will be to assess the need for protocols to manage hazardous environmental issues during construction, as well as address worker safety during the geotechnical investigation. It is anticipated that some hazardous environmental protocols will be required during construction and that different levels and requirements could be necessary based on the various areas or zones within the overall construction footprint. Information obtained during our investigation will also help refine and assess the risk zones and protocols used during construction.

APPENDICES

Appendix A: Figures

Appendix B: Boring Logs

Appendix C: Results from Chemical Analyses

Appendix D: Disposal Manifests

Appendix E: FOI Documents

Appendix F: Voluntary Cleanup Contract

Appendix G: Voluntary Cleanup Contract Progress Report

Appendix H: Toxicological Technical Support Documentation

APPENDIX A: FIGURES

Site Vicinity Map

Approximate Construction Footprint and Identified Contamination

Phase II Soil Test Boring Location Plan



SITE VICINITY MAP

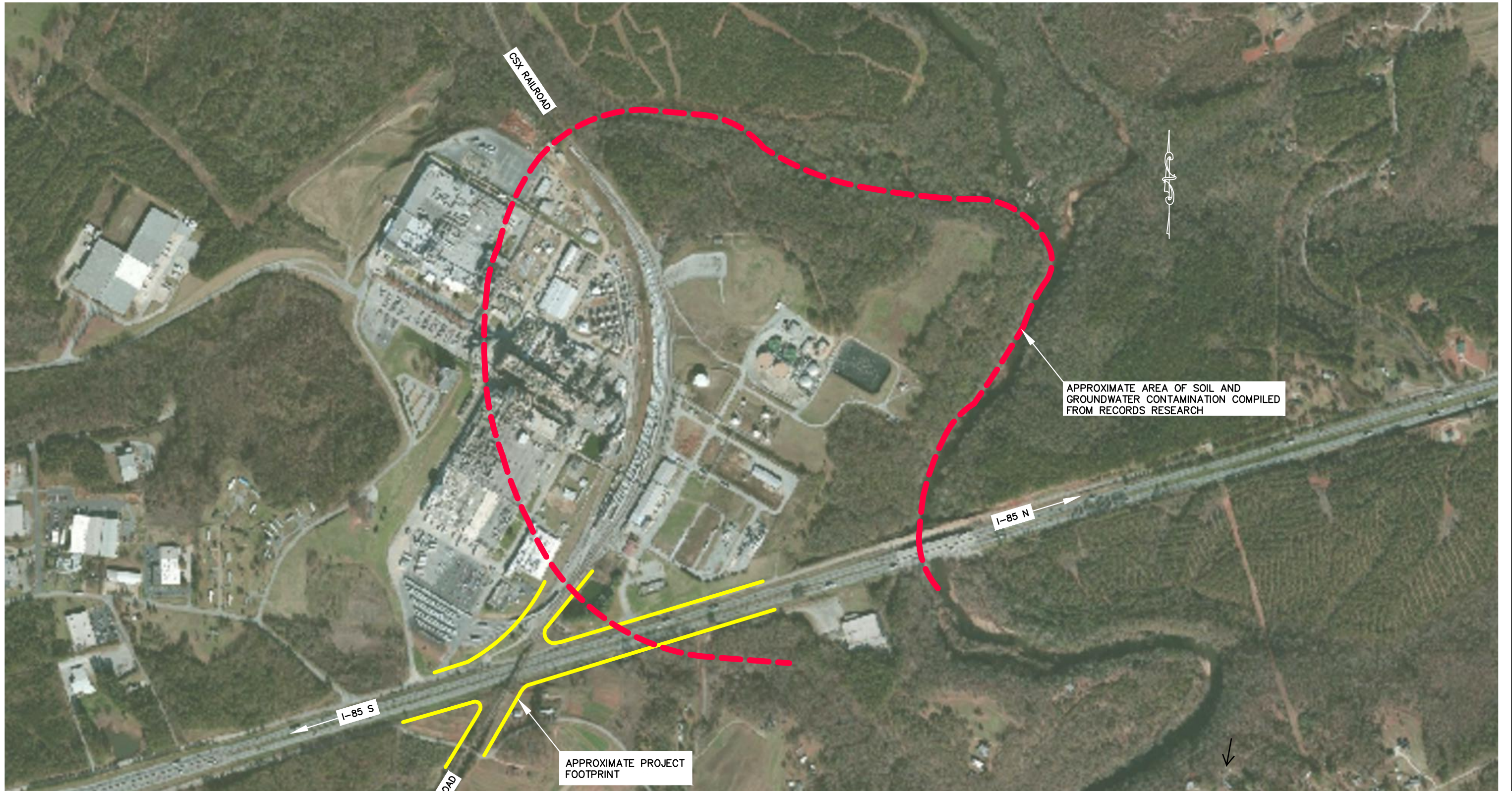
I-85 REHABILITATION PROJECT MM 77.0 TO MM 84.0
 SPARTANBURG COUNTY, SOUTH CAROLINA



3112 Devine Street, Columbia, SC 29205
 P 803.254.4540 | F 803.254.4542

IMAGE SOURCE:	Microsoft	SCALE:	NTS
PREPARED BY:	NRK	DATE:	8/3/2015
CHECKED BY:	GME	PROJECT:	G5439.00

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	SPARTANBURG	0040692	I-85	



APPROXIMATE AREA OF SOIL AND GROUNDWATER CONTAMINATION COMPILED FROM RECORDS RESEARCH

APPROXIMATE PROJECT FOOTPRINT

F&ME
CONSULTANTS
GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

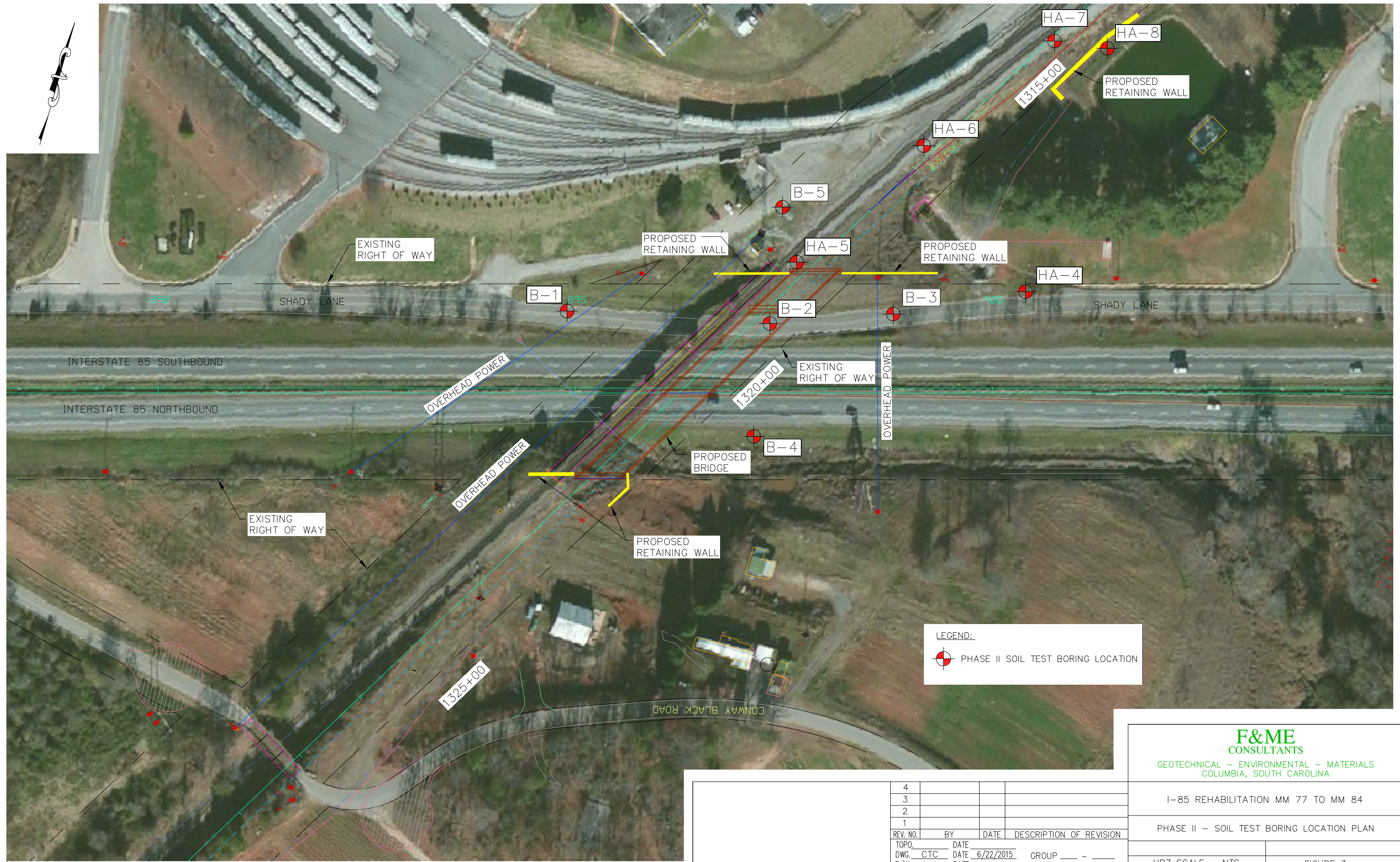
I-85 REHABILITATION MM 77 TO MM 84
CSX RR BRIDGE OVER I-85


APPROXIMATE CONSTRUCTION FOOTPRINT
AND IDENTIFIED CONTAMINATION

HRZ SCALE = NTS SHEET 1 OF 1

4				
3				
2				
1				
REV. NO.	BY	DATE	DESCRIPTION OF REVISION	
TOPO.		DATE		
DWG. CTC		DATE 7/30/2015	GROUP	
R/W		DATE		

FED. RD. DIV. NO.	STATE	COUNTY	PROJECT ID	ROAD / ROUTE NO.	SHEET NO.
3	SC	SPARTANBURG	0040692	I-85	



LEGEND:
 PHASE II SOIL TEST BORING LOCATION

F&ME
CONSULTANTS
GEOTECHNICAL – ENVIRONMENTAL – MATERIALS
COLUMBIA, SOUTH CAROLINA

I-85 REHABILITATION MM 77 TO MM 84

PHASE II – SOIL TEST BORING LOCATION PLAN

HRZ SCALE = NTS FIGURE 3

4			
3			
2			
1			
REV. NO.	BY	DATE	DESCRIPTION OF REVISION
TOPO.		DATE	
DWG.	CTC	DATE 6/22/2015	GROUP ____ - ____
R/W		DATE	

APPENDIX B: BORING LOGS

Environmental Boring Logs (B-1 to B-5)

Environmental Hand Auger Boring Logs (HA-4 to HA-8)

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-1

Station:
Offset:

Date Drilled: 4/27/2015

Supervisor: M Touchberry

Ground Elevation (ft): 743.8

Water Level: 34.5 Feet at T.O.B.

Notes:

Geoprobe 7822 Track Rig

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.3	ASPHALT (3.5")		0.0			
	1.0	Stiff, Dry to Moist, Yellowish Red, Fine Sandy / SILT (ML)			SS-1	3.5	
		Stiff, Dry to Moist, Red, Fine Sandy CLAY (CL)		2.0			
	4.0	Stiff, Dry to Moist, Yellowish Red, Fine to Coarse Sandy SILT (ML) , with Gravel		4.0	SS-2	3.0	
738.8					SS-3	0.1	Soil Sample Collected at 4.0 to 6.0 Feet
	6.0	SAPROLITE Stiff to Firm, Moist to Wet, Yellowish Red, SILT (ML) , Micaceous, Mottled		6.0	SS-4	0.0	
733.8		=>1" Fine Quartz Gravel Seam			SS-5	0.0	
				12.5			
					SS-6	0.0	
728.8		=>1" Fine Quartz Gravel Seam			SS-7	0.0	
				15.0			
					SS-8	0.0	
				17.5			
					SS-9	0.0	
723.8		=>1" Fine Quartz Gravel Seam			SS-10	0.0	
				20.0			
					SS-10	0.0	
				22.5			
					SS-10	0.0	
				25.0			

LEGEND

Continued Next Page

SAMPLER TYPE

ABBREVIATIONS

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

I-85 Rehab MM77 to MM84 Spartanburg, SC G5439.00				LOG OF BORING No. B-1			
Date Drilled: 4/27/2015				Station: Offset: Notes: Geoprobe 7822 Track Rig All Drilling Equipment Decontaminated Prior to Start of Boring.			
Supervisor: M Touchberry							
Ground Elevation (ft): 743.8							
Water Level: 34.5 Feet at T.O.B.							
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
713.8		=>1" Fine Quartz Gravel Seam		27.5	SS-11	0.0	
		=>Very Stiff to Hard, Olive Brown		30.0	SS-12	0.0	
		=>1" Fine Quartz Gravel Seam		32.5	SS-13	0.0	
	33.5	PARTIALLY WEATHERED ROCK (PWR)		35.0	SS-14	0.0	Soil Sample Collected at 32.5 to 34.0 Feet
708.8		Hard, Wet, Olive Brown, <u>SILT (ML)</u>		37.5	SS-15	0.0	Water Sample Collected 34.5 Feet at T.O.B.
		=>Dark Brown		40.0	SS-16	0.0	
703.8		=>Black		41.5	SS-17	0.0	
	42.0	Boring Terminated at 42.0 feet Due to Auger Refusal					
698.8							

LEGEND

SAMPLER TYPE		ABBREVIATIONS	
DS - Disturbed Sample	PT - Push Tube	WOH - Weight Of Hammer	T.O.B. - Time Of Boring
SS - Split Tube Sampler	CU - Cuttings		
WS - Water Sample	CT - Continuous Tube		

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-2

Station:
Offset:

Date Drilled: 6/17/2015

Supervisor: M Touchberry

Ground Elevation (ft): 729.8

Water Level: 7 Feet at T.O.B.

Notes:

CME-550 ATV

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.5	ASPHALT (6.0")		0.0			
		Stiff, Dry to Moist, Brown/Orange, Fine to Medium Sandy <u>SILT (ML)</u>			SS-1	0.5	Soil Sample Collected at 0.5 to 2.0 Feet
		=>Firm		2.0			
	2.5	Firm to Soft, Dry to Moist, Light Brown/Yellow, <u>SILT (ML)</u> , with Mica			SS-2	0.4	
				4.0			
724.8				6.0	SS-3	0.0	
				8.0	SS-4	0.0	
		=>with trace Quartz fragments			SS-5	0.3	Water Sample Collected at 7.0 Feet at T.O.B.
719.8				12.5	SS-6	0.0	
		Stiff, Moist to Wet, Reddish Brown, with Quartz rock					
714.8	15.0	PARTIALLY WEATHERED ROCK (PWR)		15.0	SS-7		Soil Sample Collected at 15.0 to 16.5 Feet
	16.0	Hard, Wet, Light Brown/Red/White, Fine to Coarse Sandy <u>SILT (ML)</u> , with Quartz rock		16.0		0.5	
		Boring Terminated at 16.0 feet due to Auger Refusal					
709.8							

LEGEND

SAMPLER TYPE	
DS - Disturbed Sample	PT - Push Tube
SS - Split Tube Sampler	CU - Cuttings
WS - Water Sample	CT - Continuous Tube

ABBREVIATIONS	
WOH - Weight Of Hammer	T.O.B. - Time Of Boring

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-3

Station:
Offset:

Date Drilled: 4/28/2015

Supervisor: M Touchberry

Ground Elevation (ft): 724.7

Water Level: 9.2 Feet at T.O.B.

Notes:

Geoprobe 7822 Track Rig

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.3	ASPHALT (3.0")		0.0			
		Firm, Dry, Red, Silty <u>CLAY (CL)</u> , with Fine Sand			SS-1	36.5	Soil Sample Collected at 0.0 to 2.0 Feet
				2.0		738.8	
	3.0	Firm to Soft, Moist, Light Yellowish Brown, <u>SILT (ML)</u>		4.0	SS-2	333.0	
719.7		=>Orangish Brown		6.0	SS-3	148.6	
	7.5	=>1" Fine Quartz Gravel Seam		8.0	SS-4	97.7	Soil Sample Collected at 6.0 to 8.0 Feet
		SAPROLITE			SS-5		
714.7		Firm, Moist, Reddish Brown, <u>SILT (ML)</u> , Mottled				46.3	Water Sample Collected at 9.2 Feet at T.O.B.
	13.0	Very Dense, Wet, Dark Reddish Brown, Silty Fine to Coarse <u>SAND (SM)</u> , with Fine Quartz Gravel		12.5	SS-6		
709.7		=> Loose		15.0	SS-7	0.8	
	16.0	Stiff, Moist, Reddish Brown, <u>SILT (ML)</u>			SS-8	2.0	
	17.5	Boring Terminated at 17.5 feet Due to Auger Refusal		17.4			
704.7							

LEGEND

SAMPLER TYPE

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

ABBREVIATIONS

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-4

Station:
Offset:

Date Drilled: 4/28/2015

Supervisor: M Touchberry

Ground Elevation (ft): 727.5

Water Level: 5.4 Feet at T.O.B.

Notes:

Geoprobe 7822 Track Rig

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.5	TOPSOIL (6") Firm to Stiff, Moist, Light Reddish Brown, Fine to Coarse Sandy <u>CLAY (CL)</u> =>Light Orangish Brown		0.0			
				2.0	SS-1	0.58	
				4.0	SS-2	0.34	
722.5		▽=>Light Yellowish Brown		6.0	SS-3	0.76	Soil Sample Collected at 4.0 to 6.0 Feet Water Sample Collected at 5.4 Feet at T.O.B.
	6.5	Loose, Wet, Orange, Clayey Fine to Coarse <u>SAND (SC)</u>		8.0	SS-4	0.42	
	8.0	Very Soft, Wet, Light Yellowish Brown, <u>SILT (ML)</u>			SS-5	0.46	
717.5				12.5			
	12.5	SAPROLITE Firm, Moist to Wet, Dark Brown/Orange, <u>SILT (ML)</u> , with Gravel Seams, Mottled =>Very Soft to Soft, Light Orangish Brown		15.0	SS-6	0.56	
712.5				17.5	SS-7	0.69	
				20.0	SS-8	0.42	
707.5				22.5	SS-9	0.54	
		=>Firm to Stiff		25.0	SS-10	1.05	

LEGEND

Continued Next Page

SAMPLER TYPE

ABBREVIATIONS

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

I-85 Rehab MM77 to MM84 Spartanburg, SC G5439.00				LOG OF BORING No. B-4			
Date Drilled: 4/28/2015				Station: Offset: Notes: Geoprobe 7822 Track Rig All Drilling Equipment Decontaminated Prior to Start of Boring.			
Supervisor: M Touchberry							
Ground Elevation (ft): 727.5							
Water Level: 5.4 Feet at T.O.B.							
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
697.5		=>Hard, Dark Brownish Black with Orange		27.5	SS-11	1.25	Soil Sample Collected at 25.0 to 26.50 Feet
				30.0	SS-12	0.43	
				32.5	SS-13	0.65	
		=>Dark Reddish Brown		35.0	SS-14	0.72	
692.5		=>Olive Brown		37.5	SS-15	0.0	
				40.0	SS-16	0.0	
		=>Reddish Brown		42.5	SS-17	0.0	
687.5	40.0	PARTIALLY WEATHERED ROCK (PWR) Hard, Moist to Wet, Dark Brownish Black, SILT (ML), with Gravel		43.3	SS-18	0.0	
				44.0	SS-19	0.0	
682.5	44.0	Boring Terminated at 44.0 feet Due to Auger Refusal					

ENVIRO G5439.00 ENVIRO.LOGS.GPJ PEN.GDT 7/27/15

LEGEND

SAMPLER TYPE		ABBREVIATIONS	
DS - Disturbed Sample	PT - Push Tube	WOH - Weight Of Hammer	T.O.B. - Time Of Boring
SS - Split Tube Sampler	CU - Cuttings		
WS - Water Sample	CT - Continuous Tube		

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-5

Station:
Offset:

Date Drilled: 6/17/2015

Supervisor: M Touchberry



Ground Elevation (ft): 758.5

Water Level: 32.8 Feet at T.O.B.

Notes:

CME-550 ATV

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.5	TOPSOIL (6") Stiff to Very Stiff, Dry to Moist, Brownish Red, Fine Sandy <u>SILT (ML)</u> =>with Rock		0.0	SS-1	0.1	Soil Sample Collected 4.0 - 6.0 Feet
				2.0	SS-2	0.0	
	3.5			4.0	SS-3	0.0	
753.5	4.0	Medium Dense, Dry, Light Orangish Yellow, Silty Fine to Coarse <u>SAND (SM)</u> , with Quartz rock Firm to Soft, Dry to Moist, Brownish Red, <u>SILT (ML)</u> , with Gravel and Mica		6.0	SS-4	0.0	
		=>Very Soft, Dark Brownish Red, no rock		8.0	SS-5	0.0	
748.5				12.5			
		=>Stiff to Very Stiff =>2" Quartz rock layer =>Reddish Orange		15.0	SS-6	0.1	
743.5		=>with Rock		17.5			
				20.0	SS-7	0.5	
				22.5	SS-8	0.2	
738.5		=>Light Brown with Mica		25.0	SS-9	0.0	
		=>1" Quartz rock layer			SS-10	0.0	

LEGEND

Continued Next Page

SAMPLER TYPE

ABBREVIATIONS

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. B-5

Station:
Offset:

Date Drilled: 6/17/2015

Supervisor: M Touchberry

Ground Elevation (ft): 758.5

Water Level: 32.8 Feet at T.O.B.

Notes:

CME-550 ATV

All Drilling Equipment Decontaminated Prior to Start of Boring.

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
728.5					SS-11	0.0	
				27.5			
					SS-12	0.0	Soil Sample Collected 27.5 - 29.0 Feet
				30.0			
					SS-13	0.0	
				32.5			
	32.5	PARTIALLY WEATHERED ROCK (PWR) Hard, Wet, Dark Brown/Black, Fine Sandy <u>SILT (ML)</u> , with rock			SS-14	0.0	Water Sample Collected at T.O.B. 32.8 Feet
723.5					SS-15	0.0	
				37.5			
					SS-16	0.0	
718.5					SS-17	0.0	
				42.5			
					SS-18	0.0	
713.5					SS-19	0.0	
				47.5			
					SS-20	0.0	
				50.0			

LEGEND

Continued Next Page

SAMPLER TYPE

ABBREVIATIONS

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample

PT - Push Tube
CU - Cuttings
CT - Continuous Tube

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

I-85 Rehab MM77 to MM84 Spartanburg, SC G5439.00	LOG OF BORING No. B-5 Station: Offset: Notes: CME-550 ATV All Drilling Equipment Decontaminated Prior to Start of Boring.
Date Drilled: 6/17/2015	
Supervisor: M Touchberry	
Ground Elevation (ft): 758.5	
Water Level: 32.8 Feet at T.O.B.	

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS	
703.5	54.5	Boring Terminated at 54.5 feet due to Auger Refusal			SS-21	0.0		
				52.5				
					54.3	SS-22	0.0	
				54.5	SS-23	0.0		
698.5								
693.5								
688.5								

LEGEND

<p style="text-align: center;">SAMPLER TYPE</p> DS - Disturbed Sample SS - Split Tube Sampler WS - Water Sample PT - Push Tube CU - Cuttings CT - Continuous Tube	<p style="text-align: center;">ABBREVIATIONS</p> WOH - Weight Of Hammer T.O.B. - Time Of Boring
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**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. HA-4

Station:
Offset:




Date Drilled: 4/28/2015

Supervisor: M Touchberry

Ground Elevation (ft): 722.3

Water Level: None at T.O.B.

Notes:

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
717.3	0.5	Moist, Yellowish Brown, Clayey Fine to Medium <u>SAND (SC)</u>		0.5	DS-1	0.0	Soil Sample Collected at 5.5 to 6.0 Feet
	1.5			DS-2	0.1		
	2.5	Moist, Yellowish Brown, Fine to Medium Sandy <u>SILT (ML)</u> , with Clay		2.5	DS-3	0.2	
	3.5			DS-4	0.3		
	4.5	Moist, Reddish Brown <u>SILT (ML)</u> =>Light Reddish Brown		4.5	DS-5	0.3	
	5.5			DS-6	0.3		
6.0	6.0	Hand Auger Terminated at 6.0 feet					
712.3							
707.3							
702.3							

LEGEND

SAMPLER TYPE

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

ABBREVIATIONS

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. HA-5

Station:
Offset:






Date Drilled: 6/17/2015

Supervisor: M Touchberry

Ground Elevation (ft): 758.0

Water Level: None at T.O.B.

Notes:

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	1.5	RAILROAD BALLAST		1.5			
		Moist, Red, Fine to Medium Sandy <u>SILT (ML)</u>		2.5	DS-1	0.0	
		=>with Black Organics		3.5	DS-2	0.0	
		Moist, Brown, <u>SILT (ML)</u> , with Mica and Gravel		4.5	DS-3	0.0	
753.0		Moist, Brown, Silty Fine to Medium <u>SAND (SM)</u> , with Mica		5.5	DS-4	0.0	
	6.0	Hand Auger Terminated at 6.0 feet			DS-5	0.0	Soil Sample Collected at 5.5 to 6.0 Feet
748.0							
743.0							
738.0							

LEGEND

SAMPLER TYPE

DS - Disturbed Sample
SS - Split Tube Sampler
WS - Water Sample
PT - Push Tube
CU - Cuttings
CT - Continuous Tube

ABBREVIATIONS

WOH - Weight Of Hammer
T.O.B. - Time Of Boring

I-85 Rehab MM77 to MM84 Spartanburg, SC G5439.00				LOG OF BORING No. HA-6			
Date Drilled: 6/18/2015				Station: Offset: Notes:			
Supervisor: M Touchberry							
Ground Elevation (ft): 755.6							
Water Level: None at T.O.B.							
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.5	RAILROAD BALLAST		0.5	DS-1	0.0	Soil Sample Collected at 4.5 to 5.0 Feet
		STONEBASE		1.5	DS-2	0.0	
	1.7	Moist, Orangish Brown, Silty <u>CLAY (CL-ML)</u> , with Fine to Medium Sand and Mica =>Reddish Brown		2.5	DS-3	0.0	
				3.5	DS-4	0.2	
750.6		=>Orangish Brown		4.5	DS-5	0.2	
				5.5	DS-6	0.1	
	6.0	Hand Auger Terminated at 6.0 feet					
745.6							
740.6							
735.6							

LEGEND

SAMPLER TYPE		ABBREVIATIONS	
DS - Disturbed Sample	PT - Push Tube	WOH - Weight Of Hammer	T.O.B. - Time Of Boring
SS - Split Tube Sampler	CU - Cuttings		
WS - Water Sample	CT - Continuous Tube		

**I-85 Rehab MM77 to MM84
Spartanburg, SC
G5439.00**

LOG OF BORING No. HA-7

Station:
Offset:

Date Drilled: 6/18/2015

Supervisor: M Touchberry

Ground Elevation (ft): 754.8

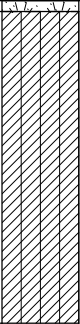
Water Level: None at T.O.B.

Notes:

Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.5	RAILROAD BALLAST		0.5	DS-1	0.0	Soil Sample Collected at 2.5 to 3.0 Feet
	1.5	Moist, Brownish Orange, Fine to Medium Sandy <u>SILT (ML)</u> , with Clay		1.5	DS-2	0.0	
	2.5	Moist, Brownish Orange, Silty <u>CLAY (CL-ML)</u> , with Fine to Coarse Sand, Gravel, and Mica		2.5	DS-3	0.0	
	3.5	Moist to Wet, Brownish Orange, Fine to Medium Sandy <u>SILT (ML)</u> , with Rock and Mica		3.5	DS-4	0.0	
749.8	5.0	Moist, Light Brown, <u>SILT (ML)</u> , with Mica and Gravel		4.5	DS-5	0.0	
	6.0	Hand Auger Terminated at 6.0 feet		5.5	DS-6	0.0	
744.8							
739.8							
734.8							

LEGEND

SAMPLER TYPE		ABBREVIATIONS	
DS - Disturbed Sample	PT - Push Tube	WOH - Weight Of Hammer	T.O.B. - Time Of Boring
SS - Split Tube Sampler	CU - Cuttings		
WS - Water Sample	CT - Continuous Tube		

I-85 Rehab MM77 to MM84 Spartanburg, SC G5439.00				LOG OF BORING No. HA-8			
Date Drilled: 6/18/2015				Station: Offset: Notes:			
Supervisor: M Touchberry							
Ground Elevation (ft): 742.5							
Water Level: None at T.O.B.							
Elevation (ft)	Depth (ft)	MATERIAL DESCRIPTION	Graphic Log	Sample Depth (ft)	Sample Type-No.	PID (ppm)	COMMENTS
	0.2	TOPSOIL (2.0") Dry to Moist, Brownish Red, Silty <u>CLAY</u> (CL-ML), with Fine to Medium Sand and Mica		0.5	DS-1	0.0	Soil Sample Collected at 5.5 to 6.0 Feet
				1.5	DS-2	0.0	
				2.5	DS-3	0.0	
		=>Brownish Orange		3.5	DS-4	0.0	
737.5		=>Wet		4.5	DS-5	0.0	
	6.0	Hand Auger Terminated at 6.0 feet		5.5	DS-6	0.0	
732.5							
727.5							
722.5							

LEGEND

<p style="text-align: center;">SAMPLER TYPE</p> <p>DS - Disturbed Sample PT - Push Tube SS - Split Tube Sampler CU - Cuttings WS - Water Sample CT - Continuous Tube</p>	<p style="text-align: center;">ABBREVIATIONS</p> <p>WOH - Weight Of Hammer T.O.B. - Time Of Boring</p>
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APPENDIX C: RESULTS FROM LABORATORY CHEMICAL ANALYSES

Soil and Groundwater Laboratory Test Results

Access Analytical Laboratory Report (#1504Q37)

Access Analytical Laboratory Report (#1506M69)

Measure of Electro Chemical Testing of Soil Samples

Summary of Soil Data

Access Analytical Laboratory Report (#1505070)

SOIL AND GROUNDWATER LABORATORY TEST RESULTS

CONTAMINANTS OF CONCERN ¹ Analytical Method EPA SW5035/SW8260B									
Matrix Type/ Sample Date	Sample Depth (ft)	Chloroform	1,4-Dioxane	<i>cis</i> -1,2- Dichloroethene ²	<i>trans</i> -1,2- Dichloroethene ²	Tetra-chloroethene	Tri-chloroethene	Acetone	Carbon Disulfide
Drill Rig Borings (B)									
Sample ID: B-1		<i>Date of Sample: 04/27/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	32.5-34.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	34.5	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-2		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	0.5-2.0	BRL	BRL	BRL	BRL	BRL	BRL	150	19
Soil (ug/Kg-dry)	15.0-16.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	7.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-3		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	0.0-2.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	6.0-8.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	9.2	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-4		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Soil (ug/Kg-dry)	25.0-26.5	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Groundwater (ug/L)	5.4	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: B-5		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	4.0-6.0	BRL	BRL	BRL	BRL	BRL	BRL	170	BRL
Soil (ug/Kg-dry)	27.5-29.0	BRL	BRL	BRL	7.4	BRL	BRL	130	BRL
Groundwater (ug/L)	32.8	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL

¹ United States Environmental Protection Agency (EPA); Hand Auger (HA); Boring (B); Below Reporting Limit (BRL); Micrograms per Kilogram (ug/Kg); Micrograms per Liter (ug/L); Parts per Million (ppm); Milligram per Cubic Meter (mg/m³).

² This compound can exist as either of two geometric isomers: *cis*-1,2-dichloroethene or *trans*-1,2-dichloroethene.

SOIL AND GROUNDWATER LABORATORY TEST RESULTS

CONTAMINANTS OF CONCERN ¹ Analytical Method EPA SW5035/SW8260B									
Matrix Type/ Sample Date	Sample Depth (ft)	Chloroform	1,4-Dioxane	<i>cis</i> -1,2- Dichloroethene ²	<i>trans</i> -1,2- Dichloroethene ²	Tetra-chloroethene	Tri-chloroethene	Acetone	Carbon Disulfide
Hand Auger Borings (HA)									
Sample ID: HA-4		<i>Date of Sample: 04/28/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-5		<i>Date of Sample: 06/17/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	94	BRL
Sample ID: HA-6		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	4.5-5.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-7		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	2.5-3.0	BRL	BRL	BRL	BRL	BRL	BRL	BRL	BRL
Sample ID: HA-8		<i>Date of Sample: 06/18/2015</i>							
Soil (ug/Kg-dry)	5.5-6.0	BRL	BRL	BRL	BRL	BRL	BRL	160	BRL

¹ United States Environmental Protection Agency (EPA); Hand Auger (HA); Boring (B); Below Reporting Limit (BRL); Micrograms per Kilogram (ug/Kg); Micrograms per Liter (ug/L); Parts per Million (ppm); Milligram per Cubic Meter (mg/m³).

² This compound can exist as either of two geometric isomers: *cis*-1,2-dichloroethene or *trans*-1,2-dichloroethene.



ACCESS
ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION

Glynn Ellen

PROJECT ID

I-85 Rehab.

LABORATORY REPORT NUMBER

1504Q37

DATE

May 06, 2015

Primary Data Review By

Chantelle Kanhai
Project Manager, AES

Secondary Data Review By

Ashley Amick

Project Manager, Access Analytical
aamick@axs-inc.com

PLEASE NOTE:

- Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3080 Presidential Drive, Atlanta, GA 30340.
- AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll free at 883.315.4243

Client: F&ME Consultants

Project: I-85 Rehab.

Lab ID: 1504Q37

Case Narrative

Sample Receiving Nonconformance:

One of the vials for sample 1504Q37-007 was received with headspace present as signified by >1/4 inch bubble present. We proceeded with the analysis using the remaining vial.

1,4-Dioxane Analysis by Method 8260:

Matrix spike and matrix spike duplicate analyses were not performed with Batch 206836 due to insufficient sample volume.

Client: F&ME Consultants	Client Sample ID: B-1 (4.0'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 11:30:00 AM
Lab ID: 1504Q37-001	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	160		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Dichlorodifluoromethane	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Chloromethane	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Bromomethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Chloroethane	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Trichlorofluoromethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,1-Dichloroethene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Acetone	BRL	110		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Freon-113	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Carbon disulfide	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Vinyl acetate	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Methyl acetate	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Methylene chloride	BRL	22		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Methyl tert-butyl ether	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
trans-1,2-Dichloroethene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,1-Dichloroethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
cis-1,2-Dichloroethene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
2-Butanone	BRL	54		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Chloroform	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,1,1-Trichloroethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Cyclohexane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Carbon tetrachloride	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Benzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2-Dichloroethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Trichloroethene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Methylcyclohexane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2-Dichloropropane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Bromodichloromethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
cis-1,3-Dichloropropene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
4-Methyl-2-pentanone	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Toluene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
trans-1,3-Dichloropropene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,1,2-Trichloroethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
2-Hexanone	BRL	11		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Tetrachloroethene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Dibromochloromethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2-Dibromoethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Chlorobenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Ethylbenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
m,p-Xylene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
o-Xylene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-1 (4.0'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 11:30:00 AM
Lab ID: 1504Q37-001	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B			(SW5035)					
Styrene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Bromoform	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,1,2,2-Tetrachloroethane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Isopropylbenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,3-Dichlorobenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,4-Dichlorobenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2-Dichlorobenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2-Dibromo-3-chloropropane	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
1,2,4-Trichlorobenzene	BRL	5.4		ug/Kg-dry	206710	1	05/01/2015 20:28	MD
Surr: 4-Bromofluorobenzene	103	70-128		%REC	206710	1	05/01/2015 20:28	MD
Surr: Dibromofluoromethane	107	78.2-128		%REC	206710	1	05/01/2015 20:28	MD
Surr: Toluene-d8	99.5	76.5-116		%REC	206710	1	05/01/2015 20:28	MD
PERCENT MOISTURE D2216								
Percent Moisture	17.1	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-1 (32.5'-34.0')
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 1:51:00 PM
Lab ID: 1504Q37-002	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	140		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Dichlorodifluoromethane	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Chloromethane	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Bromomethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Chloroethane	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Trichlorofluoromethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,1-Dichloroethene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Acetone	BRL	93		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Freon-113	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Carbon disulfide	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Vinyl acetate	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Methyl acetate	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Methylene chloride	BRL	19		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Methyl tert-butyl ether	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
trans-1,2-Dichloroethene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,1-Dichloroethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
cis-1,2-Dichloroethene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
2-Butanone	BRL	47		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Chloroform	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,1,1-Trichloroethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Cyclohexane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Carbon tetrachloride	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Benzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2-Dichloroethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Trichloroethene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Methylcyclohexane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2-Dichloropropane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Bromodichloromethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
cis-1,3-Dichloropropene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
4-Methyl-2-pentanone	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Toluene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
trans-1,3-Dichloropropene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,1,2-Trichloroethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
2-Hexanone	BRL	9.3		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Tetrachloroethene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Dibromochloromethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2-Dibromoethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Chlorobenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Ethylbenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
m,p-Xylene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
o-Xylene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-1 (32.5'-34.0')
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 1:51:00 PM
Lab ID: 1504Q37-002	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Bromoform	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,1,2,2-Tetrachloroethane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Isopropylbenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,3-Dichlorobenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,4-Dichlorobenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2-Dichlorobenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2-Dibromo-3-chloropropane	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
1,2,4-Trichlorobenzene	BRL	4.7		ug/Kg-dry	206710	1	05/01/2015 17:40	MD
Surr: 4-Bromofluorobenzene	87.8	70-128		%REC	206710	1	05/01/2015 17:40	MD
Surr: Dibromofluoromethane	95	78.2-128		%REC	206710	1	05/01/2015 17:40	MD
Surr: Toluene-d8	97.9	76.5-116		%REC	206710	1	05/01/2015 17:40	MD
PERCENT MOISTURE D2216								
Percent Moisture	15.2	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:	* Value exceeds maximum contaminant level	E Estimated (value above quantitation range)
	BRL Below reporting limit	S Spike Recovery outside limits due to matrix
	H Holding times for preparation or analysis exceeded	Narr See case narrative
	N Analyte not NELAC certified	NC Not confirmed
	B Analyte detected in the associated method blank	< Less than Result value
	> Greater than Result value	J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 6-May-15

Client: F&ME Consultants	Client Sample ID: B-1
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 2:15:00 PM
Lab ID: 1504Q37-003	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B (SW5030B)								
1,1,1-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,1,2,2-Tetrachloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,1,2-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,1-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,1-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2,4-Trichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2-Dibromo-3-chloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2-Dibromoethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,2-Dichloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,3-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
1,4-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
2-Butanone	BRL	10		ug/L	206971	1	05/06/2015 01:00	NH
2-Hexanone	BRL	10		ug/L	206971	1	05/06/2015 01:00	NH
4-Methyl-2-pentanone	BRL	10		ug/L	206971	1	05/06/2015 01:00	NH
Acetone	BRL	20		ug/L	206971	1	05/06/2015 01:00	NH
Benzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Bromodichloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Bromoform	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Bromomethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Carbon disulfide	BRL	5.0		ug/L	206971	1	05/06/2015 01:00	NH
Carbon tetrachloride	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
Chlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Chloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Chloroform	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Chloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
cis-1,2-Dichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
cis-1,3-Dichloropropene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Cyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
Dibromochloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Dichlorodifluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Ethylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Freon-113	BRL	5.0		ug/L	206971	1	05/06/2015 01:00	NH
Isopropylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
m,p-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Methyl acetate	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
Methyl tert-butyl ether	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Methylcyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
Methylene chloride	BRL	5.0		ug/L	206971	1	05/06/2015 01:00	NH
o-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-1
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 2:15:00 PM
Lab ID: 1504Q37-003	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B					(SW5030B)			
Styrene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Tetrachloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Toluene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
trans-1,2-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
trans-1,3-Dichloropropene	BRL	2.0		ug/L	206971	1	05/06/2015 01:00	NH
Trichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Trichlorofluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Vinyl chloride	BRL	1.0		ug/L	206971	1	05/06/2015 01:00	NH
Surr: 4-Bromofluorobenzene	92.4	70-130		%REC	206971	1	05/06/2015 01:00	NH
Surr: Dibromofluoromethane	99.6	70-130		%REC	206971	1	05/06/2015 01:00	NH
Surr: Toluene-d8	98.5	70-130		%REC	206971	1	05/06/2015 01:00	NH
1,4-Dioxane by SIM GC/MS SW8260B-SIM					(SW5030B)			
1,4-Dioxane	BRL	5.0		ug/L	206836	1	05/04/2015 19:49	JT
Surr: 4-Bromofluorobenzene	88.9	70.6-123		%REC	206836	1	05/04/2015 19:49	JT
Surr: Dibromofluoromethane	98.4	78-126		%REC	206836	1	05/04/2015 19:49	JT
Surr: Toluene-d8	97	77.1-119		%REC	206836	1	05/04/2015 19:49	JT

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-1
Project Name: I-85 Rehab.	Collection Date: 4/27/2015 1:05:00 PM
Lab ID: 1504Q37-004	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
VOLATILES, TCLP SW1311/8260B					(SW5030B)			
Chloroform	BRL	0.10		mg/L	206819	20	05/04/2015 13:58	TH
Surr: 4-Bromofluorobenzene	92.3	68.7-127		%REC	206819	20	05/04/2015 13:58	TH
Surr: Dibromofluoromethane	100	77.4-121		%REC	206819	20	05/04/2015 13:58	TH
Surr: Toluene-d8	94.6	79.2-120		%REC	206819	20	05/04/2015 13:58	TH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3 (0'-2')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 9:30:00 AM
Lab ID: 1504Q37-005	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	150		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Dichlorodifluoromethane	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Chloromethane	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Bromomethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Chloroethane	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Trichlorofluoromethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,1-Dichloroethene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Acetone	BRL	100		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Freon-113	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Carbon disulfide	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Vinyl acetate	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Methyl acetate	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Methylene chloride	BRL	20		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Methyl tert-butyl ether	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
trans-1,2-Dichloroethene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,1-Dichloroethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
cis-1,2-Dichloroethene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
2-Butanone	BRL	50		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Chloroform	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,1,1-Trichloroethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Cyclohexane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Carbon tetrachloride	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Benzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2-Dichloroethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Trichloroethene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Methylcyclohexane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2-Dichloropropane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Bromodichloromethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
cis-1,3-Dichloropropene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
4-Methyl-2-pentanone	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Toluene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
trans-1,3-Dichloropropene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,1,2-Trichloroethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
2-Hexanone	BRL	10		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Tetrachloroethene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Dibromochloromethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2-Dibromoethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Chlorobenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Ethylbenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
m,p-Xylene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
o-Xylene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3 (0'-2')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 9:30:00 AM
Lab ID: 1504Q37-005	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Bromoform	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,1,2,2-Tetrachloroethane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Isopropylbenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,3-Dichlorobenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,4-Dichlorobenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2-Dichlorobenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2-Dibromo-3-chloropropane	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
1,2,4-Trichlorobenzene	BRL	5.0		ug/Kg-dry	206710	1	05/01/2015 20:52	MD
Surr: 4-Bromofluorobenzene	90.9	70-128		%REC	206710	1	05/01/2015 20:52	MD
Surr: Dibromofluoromethane	102	78.2-128		%REC	206710	1	05/01/2015 20:52	MD
Surr: Toluene-d8	96.2	76.5-116		%REC	206710	1	05/01/2015 20:52	MD
PERCENT MOISTURE D2216								
Percent Moisture	17.4	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3 (6.0'-8.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 10:26:00 AM
Lab ID: 1504Q37-006	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	160		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Dichlorodifluoromethane	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Chloromethane	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Bromomethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Chloroethane	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Trichlorofluoromethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,1-Dichloroethene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Acetone	BRL	110		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Freon-113	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Carbon disulfide	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Vinyl acetate	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Methyl acetate	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Methylene chloride	BRL	21		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Methyl tert-butyl ether	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
trans-1,2-Dichloroethene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,1-Dichloroethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
cis-1,2-Dichloroethene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
2-Butanone	BRL	53		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Chloroform	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,1,1-Trichloroethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Cyclohexane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Carbon tetrachloride	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Benzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2-Dichloroethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Trichloroethene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Methylcyclohexane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2-Dichloropropane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Bromodichloromethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
cis-1,3-Dichloropropene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
4-Methyl-2-pentanone	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Toluene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
trans-1,3-Dichloropropene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,1,2-Trichloroethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
2-Hexanone	BRL	11		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Tetrachloroethene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Dibromochloromethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2-Dibromoethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Chlorobenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Ethylbenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
m,p-Xylene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
o-Xylene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3 (6.0'-8.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 10:26:00 AM
Lab ID: 1504Q37-006	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Bromoform	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,1,2,2-Tetrachloroethane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Isopropylbenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,3-Dichlorobenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,4-Dichlorobenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2-Dichlorobenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2-Dibromo-3-chloropropane	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
1,2,4-Trichlorobenzene	BRL	5.3		ug/Kg-dry	206710	1	05/04/2015 14:50	MD
Surr: 4-Bromofluorobenzene	100	70-128		%REC	206710	1	05/04/2015 14:50	MD
Surr: Dibromofluoromethane	103	78.2-128		%REC	206710	1	05/04/2015 14:50	MD
Surr: Toluene-d8	107	76.5-116		%REC	206710	1	05/04/2015 14:50	MD
PERCENT MOISTURE D2216								
Percent Moisture	23.1	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 6-May-15

Client: F&ME Consultants	Client Sample ID: B-3
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 10:27:00 AM
Lab ID: 1504Q37-007	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B (SW5030B)								
1,1,1-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,1,2,2-Tetrachloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,1,2-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,1-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,1-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2,4-Trichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2-Dibromo-3-chloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2-Dibromoethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,2-Dichloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,3-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
1,4-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
2-Butanone	BRL	10		ug/L	206971	1	05/06/2015 01:22	NH
2-Hexanone	BRL	10		ug/L	206971	1	05/06/2015 01:22	NH
4-Methyl-2-pentanone	BRL	10		ug/L	206971	1	05/06/2015 01:22	NH
Acetone	BRL	20		ug/L	206971	1	05/06/2015 01:22	NH
Benzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Bromodichloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Bromoform	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Bromomethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Carbon disulfide	BRL	5.0		ug/L	206971	1	05/06/2015 01:22	NH
Carbon tetrachloride	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
Chlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Chloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Chloroform	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Chloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
cis-1,2-Dichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
cis-1,3-Dichloropropene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Cyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
Dibromochloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Dichlorodifluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Ethylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Freon-113	BRL	5.0		ug/L	206971	1	05/06/2015 01:22	NH
Isopropylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
m,p-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Methyl acetate	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
Methyl tert-butyl ether	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Methylcyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
Methylene chloride	BRL	5.0		ug/L	206971	1	05/06/2015 01:22	NH
o-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 10:27:00 AM
Lab ID: 1504Q37-007	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B			(SW5030B)					
Styrene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Tetrachloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Toluene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
trans-1,2-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
trans-1,3-Dichloropropene	BRL	2.0		ug/L	206971	1	05/06/2015 01:22	NH
Trichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Trichlorofluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Vinyl chloride	BRL	1.0		ug/L	206971	1	05/06/2015 01:22	NH
Surr: 4-Bromofluorobenzene	93.1	70-130		%REC	206971	1	05/06/2015 01:22	NH
Surr: Dibromofluoromethane	103	70-130		%REC	206971	1	05/06/2015 01:22	NH
Surr: Toluene-d8	100	70-130		%REC	206971	1	05/06/2015 01:22	NH
1,4-Dioxane by SIM GC/MS SW8260B-SIM			(SW5030B)					
1,4-Dioxane	BRL	5.0		ug/L	206836	1	05/04/2015 18:55	JT
Surr: 4-Bromofluorobenzene	90	70.6-123		%REC	206836	1	05/04/2015 18:55	JT
Surr: Dibromofluoromethane	99.3	78-126		%REC	206836	1	05/04/2015 18:55	JT
Surr: Toluene-d8	98	77.1-119		%REC	206836	1	05/04/2015 18:55	JT

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-3/HA-4
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 10:00:00 AM
Lab ID: 1504Q37-008	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
VOLATILES, TCLP SW1311/8260B					(SW5030B)			
Chloroform	BRL	0.10		mg/L	206819	20	05/04/2015 14:22	TH
Surr: 4-Bromofluorobenzene	88	68.7-127		%REC	206819	20	05/04/2015 14:22	TH
Surr: Dibromofluoromethane	102	77.4-121		%REC	206819	20	05/04/2015 14:22	TH
Surr: Toluene-d8	93.9	79.2-120		%REC	206819	20	05/04/2015 14:22	TH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4 (4.0'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 2:17:00 PM
Lab ID: 1504Q37-009	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	120		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Dichlorodifluoromethane	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Chloromethane	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Bromomethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Chloroethane	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Trichlorofluoromethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,1-Dichloroethene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Acetone	BRL	83		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Freon-113	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Carbon disulfide	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Vinyl acetate	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Methyl acetate	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Methylene chloride	BRL	17		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Methyl tert-butyl ether	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
trans-1,2-Dichloroethene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,1-Dichloroethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
cis-1,2-Dichloroethene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
2-Butanone	BRL	42		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Chloroform	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,1,1-Trichloroethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Cyclohexane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Carbon tetrachloride	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Benzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2-Dichloroethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Trichloroethene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Methylcyclohexane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2-Dichloropropane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Bromodichloromethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
cis-1,3-Dichloropropene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
4-Methyl-2-pentanone	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Toluene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
trans-1,3-Dichloropropene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,1,2-Trichloroethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
2-Hexanone	BRL	8.3		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Tetrachloroethene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Dibromochloromethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2-Dibromoethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Chlorobenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Ethylbenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
m,p-Xylene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
o-Xylene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4 (4.0'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 2:17:00 PM
Lab ID: 1504Q37-009	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Bromoform	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,1,2,2-Tetrachloroethane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Isopropylbenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,3-Dichlorobenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,4-Dichlorobenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2-Dichlorobenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2-Dibromo-3-chloropropane	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
1,2,4-Trichlorobenzene	BRL	4.2		ug/Kg-dry	206710	1	05/04/2015 10:58	MD
Surr: 4-Bromofluorobenzene	95.2	70-128		%REC	206710	1	05/04/2015 10:58	MD
Surr: Dibromofluoromethane	105	78.2-128		%REC	206710	1	05/04/2015 10:58	MD
Surr: Toluene-d8	101	76.5-116		%REC	206710	1	05/04/2015 10:58	MD
PERCENT MOISTURE D2216								
Percent Moisture	19.7	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4 (25.0'-26.5')
Project Name: I-85 Rehab.	Collection Date: 4/29/2015 5:05:00 PM
Lab ID: 1504Q37-010	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	140		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Dichlorodifluoromethane	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Chloromethane	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Bromomethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Chloroethane	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Trichlorofluoromethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,1-Dichloroethene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Acetone	140	96		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Freon-113	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Carbon disulfide	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Vinyl acetate	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Methyl acetate	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Methylene chloride	BRL	19		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Methyl tert-butyl ether	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
trans-1,2-Dichloroethene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,1-Dichloroethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
cis-1,2-Dichloroethene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
2-Butanone	BRL	48		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Chloroform	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,1,1-Trichloroethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Cyclohexane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Carbon tetrachloride	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Benzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2-Dichloroethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Trichloroethene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Methylcyclohexane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2-Dichloropropane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Bromodichloromethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
cis-1,3-Dichloropropene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
4-Methyl-2-pentanone	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Toluene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
trans-1,3-Dichloropropene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,1,2-Trichloroethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
2-Hexanone	BRL	9.6		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Tetrachloroethene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Dibromochloromethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2-Dibromoethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Chlorobenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Ethylbenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
m,p-Xylene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
o-Xylene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4 (25.0'-26.5')
Project Name: I-85 Rehab.	Collection Date: 4/29/2015 5:05:00 PM
Lab ID: 1504Q37-010	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Bromoform	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,1,2,2-Tetrachloroethane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Isopropylbenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,3-Dichlorobenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,4-Dichlorobenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2-Dichlorobenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2-Dibromo-3-chloropropane	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
1,2,4-Trichlorobenzene	BRL	4.8		ug/Kg-dry	206710	1	05/04/2015 11:21	MD
Surr: 4-Bromofluorobenzene	99.4	70-128		%REC	206710	1	05/04/2015 11:21	MD
Surr: Dibromofluoromethane	107	78.2-128		%REC	206710	1	05/04/2015 11:21	MD
Surr: Toluene-d8	100	76.5-116		%REC	206710	1	05/04/2015 11:21	MD
PERCENT MOISTURE D2216								
Percent Moisture	23.5	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

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- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 6-May-15

Client: F&ME Consultants	Client Sample ID: B-4
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 5:00:00 PM
Lab ID: 1504Q37-011	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B (SW5030B)								
1,1,1-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,1,2,2-Tetrachloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,1,2-Trichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,1-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,1-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2,4-Trichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2-Dibromo-3-chloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2-Dibromoethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2-Dichloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,2-Dichloropropane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,3-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
1,4-Dichlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
2-Butanone	BRL	10		ug/L	206971	1	05/06/2015 01:44	NH
2-Hexanone	BRL	10		ug/L	206971	1	05/06/2015 01:44	NH
4-Methyl-2-pentanone	BRL	10		ug/L	206971	1	05/06/2015 01:44	NH
Acetone	BRL	20		ug/L	206971	1	05/06/2015 01:44	NH
Benzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Bromodichloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Bromoform	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Bromomethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Carbon disulfide	BRL	5.0		ug/L	206971	1	05/06/2015 01:44	NH
Carbon tetrachloride	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
Chlorobenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Chloroethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Chloroform	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Chloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
cis-1,2-Dichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
cis-1,3-Dichloropropene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Cyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
Dibromochloromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Dichlorodifluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Ethylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Freon-113	BRL	5.0		ug/L	206971	1	05/06/2015 01:44	NH
Isopropylbenzene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
m,p-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Methyl acetate	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
Methyl tert-butyl ether	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Methylcyclohexane	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
Methylene chloride	BRL	5.0		ug/L	206971	1	05/06/2015 01:44	NH
o-Xylene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 5:00:00 PM
Lab ID: 1504Q37-011	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B					(SW5030B)			
Styrene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Tetrachloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Toluene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
trans-1,2-Dichloroethene	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
trans-1,3-Dichloropropene	BRL	2.0		ug/L	206971	1	05/06/2015 01:44	NH
Trichloroethene	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Trichlorofluoromethane	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Vinyl chloride	BRL	1.0		ug/L	206971	1	05/06/2015 01:44	NH
Surr: 4-Bromofluorobenzene	93.5	70-130		%REC	206971	1	05/06/2015 01:44	NH
Surr: Dibromofluoromethane	103	70-130		%REC	206971	1	05/06/2015 01:44	NH
Surr: Toluene-d8	99.6	70-130		%REC	206971	1	05/06/2015 01:44	NH
1,4-Dioxane by SIM GC/MS SW8260B-SIM					(SW5030B)			
1,4-Dioxane	BRL	5.0		ug/L	206836	1	05/04/2015 19:22	JT
Surr: 4-Bromofluorobenzene	91.2	70.6-123		%REC	206836	1	05/04/2015 19:22	JT
Surr: Dibromofluoromethane	99.5	78-126		%REC	206836	1	05/04/2015 19:22	JT
Surr: Toluene-d8	97.4	77.1-119		%REC	206836	1	05/04/2015 19:22	JT

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-4
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 5:54:00 PM
Lab ID: 1504Q37-012	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
VOLATILES, TCLP SW1311/8260B					(SW5030B)			
Chloroform	BRL	0.10		mg/L	206819	20	05/04/2015 14:46	TH
Surr: 4-Bromofluorobenzene	86.3	68.7-127		%REC	206819	20	05/04/2015 14:46	TH
Surr: Dibromofluoromethane	107	77.4-121		%REC	206819	20	05/04/2015 14:46	TH
Surr: Toluene-d8	98.2	79.2-120		%REC	206819	20	05/04/2015 14:46	TH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-4 (5.5'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 8:00:00 AM
Lab ID: 1504Q37-013	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	150		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Dichlorodifluoromethane	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Chloromethane	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Bromomethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Chloroethane	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Trichlorofluoromethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,1-Dichloroethene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Acetone	BRL	100		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Freon-113	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Carbon disulfide	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Vinyl acetate	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Methyl acetate	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Methylene chloride	BRL	20		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Methyl tert-butyl ether	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
trans-1,2-Dichloroethene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,1-Dichloroethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
cis-1,2-Dichloroethene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
2-Butanone	BRL	51		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Chloroform	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,1,1-Trichloroethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Cyclohexane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Carbon tetrachloride	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Benzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2-Dichloroethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Trichloroethene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Methylcyclohexane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2-Dichloropropane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Bromodichloromethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
cis-1,3-Dichloropropene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
4-Methyl-2-pentanone	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Toluene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
trans-1,3-Dichloropropene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,1,2-Trichloroethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
2-Hexanone	BRL	10		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Tetrachloroethene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Dibromochloromethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2-Dibromoethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Chlorobenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Ethylbenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
m,p-Xylene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
o-Xylene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-4 (5.5'-6.0')
Project Name: I-85 Rehab.	Collection Date: 4/28/2015 8:00:00 AM
Lab ID: 1504Q37-013	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
Styrene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Bromoform	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,1,2,2-Tetrachloroethane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Isopropylbenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,3-Dichlorobenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,4-Dichlorobenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2-Dichlorobenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2-Dibromo-3-chloropropane	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
1,2,4-Trichlorobenzene	BRL	5.1		ug/Kg-dry	206710	1	05/04/2015 11:45	MD
Surr: 4-Bromofluorobenzene	90.1	70-128		%REC	206710	1	05/04/2015 11:45	MD
Surr: Dibromofluoromethane	97.1	78.2-128		%REC	206710	1	05/04/2015 11:45	MD
Surr: Toluene-d8	102	76.5-116		%REC	206710	1	05/04/2015 11:45	MD
PERCENT MOISTURE D2216								
Percent Moisture	21.1	0		wt%	R291241	1	05/06/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access

Work Order Number 1504037

Checklist completed by Tony Delia Signature Date 4/13/15

Carrier name: FedEx UPS Courier Client US Mail Other

Shipping container/cooler in good condition? Yes No Not Present

Custody seals intact on shipping container/cooler? Yes No Not Present

Custody seals intact on sample bottles? Yes No Not Present

Container/Temp Blank temperature in compliance? (0°≤6°C)* Yes No

Cooler #1 3-2 Cooler #2 _____ Cooler #3 _____ Cooler #4 _____ Cooler #5 _____ Cooler #6 _____

Chain of custody present? Yes No

Chain of custody signed when relinquished and received? Yes No

Chain of custody agrees with sample labels? Yes No

Samples in proper container/bottle? Yes No

Sample containers intact? Yes No

Sufficient sample volume for indicated test? Yes No

All samples received within holding time? Yes No

Was TAT marked on the COC? Yes No

Proceed with Standard TAT as per project history? Yes No Not Applicable

Water - VOA vials have zero headspace? No VOA vials submitted TP 4/30 Yes No Not Applicable

Water - pH acceptable upon receipt? Yes No Not Applicable

Sample Condition: Good Other(Explain) _____ Adjusted? _____ Checked by _____

(For diffusive samples or AIHA lead) Is a known blank included? Yes No

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: MB-206710	Client ID:	Units: ug/Kg	Prep Date: 05/01/2015	Run No: 290945							
Sample Type: MBLK	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190854							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	BRL	5.0									
1,1,2,2-Tetrachloroethane	BRL	5.0									
1,1,2-Trichloroethane	BRL	5.0									
1,1-Dichloroethane	BRL	5.0									
1,1-Dichloroethene	BRL	5.0									
1,2,4-Trichlorobenzene	BRL	5.0									
1,2-Dibromo-3-chloropropane	BRL	5.0									
1,2-Dibromoethane	BRL	5.0									
1,2-Dichlorobenzene	BRL	5.0									
1,2-Dichloroethane	BRL	5.0									
1,2-Dichloropropane	BRL	5.0									
1,3-Dichlorobenzene	BRL	5.0									
1,4-Dichlorobenzene	BRL	5.0									
1,4-Dioxane	BRL	150									
2-Butanone	BRL	50									
2-Hexanone	BRL	10									
4-Methyl-2-pentanone	BRL	10									
Acetone	BRL	100									
Benzene	BRL	5.0									
Bromodichloromethane	BRL	5.0									
Bromoform	BRL	5.0									
Bromomethane	BRL	5.0									
Carbon disulfide	BRL	10									
Carbon tetrachloride	BRL	5.0									
Chlorobenzene	BRL	5.0									
Chloroethane	BRL	10									
Chloroform	BRL	5.0									

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: MB-206710	Client ID:	Units: ug/Kg	Prep Date: 05/01/2015	Run No: 290945							
SampleType: MBLK	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190854							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloromethane	BRL	10									
cis-1,2-Dichloroethene	BRL	5.0									
cis-1,3-Dichloropropene	BRL	5.0									
Cyclohexane	BRL	5.0									
Dibromochloromethane	BRL	5.0									
Dichlorodifluoromethane	BRL	10									
Ethylbenzene	BRL	5.0									
Freon-113	BRL	10									
Isopropylbenzene	BRL	5.0									
m,p-Xylene	BRL	5.0									
Methyl acetate	BRL	5.0									
Methyl tert-butyl ether	BRL	5.0									
Methylcyclohexane	BRL	5.0									
Methylene chloride	BRL	20									
o-Xylene	BRL	5.0									
Styrene	BRL	5.0									
Tetrachloroethene	BRL	5.0									
Toluene	BRL	5.0									
trans-1,2-Dichloroethene	BRL	5.0									
trans-1,3-Dichloropropene	BRL	5.0									
Trichloroethene	BRL	5.0									
Trichlorofluoromethane	BRL	5.0									
Vinyl acetate	BRL	10									
Surr: 4-Bromofluorobenzene	47.77	0	50.00		95.5	70	130				
Surr: Dibromofluoromethane	53.56	0	50.00		107	70	130				
Surr: Toluene-d8	47.45	0	50.00		94.9	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: LCS-206710	Client ID:	Units: ug/Kg	Prep Date: 05/01/2015	Run No: 290945							
SampleType: LCS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190855							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	53.13	5.0	50.00		106	70	130				
1,1,2,2-Tetrachloroethane	47.21	5.0	50.00		94.4	70	130				
1,1,2-Trichloroethane	41.85	5.0	50.00		83.7	70	130				
1,1-Dichloroethane	49.24	5.0	50.00		98.5	70	130				
1,1-Dichloroethene	48.71	5.0	50.00		97.4	60	140				
1,2,4-Trichlorobenzene	42.10	5.0	50.00		84.2	70	130				
1,2-Dibromo-3-chloropropane	50.33	5.0	50.00		101	70	130				
1,2-Dibromoethane	47.40	5.0	50.00		94.8	70	130				
1,2-Dichlorobenzene	46.12	5.0	50.00		92.2	70	130				
1,2-Dichloroethane	50.38	5.0	50.00		101	70	130				
1,2-Dichloropropane	45.18	5.0	50.00		90.4	70	130				
1,3-Dichlorobenzene	45.65	5.0	50.00		91.3	70	130				
1,4-Dichlorobenzene	45.87	5.0	50.00		91.7	70	130				
Benzene	45.71	5.0	50.00		91.4	70	130				
Bromodichloromethane	46.70	5.0	50.00		93.4	70	130				
Bromoform	43.81	5.0	50.00		87.6	70	130				
Carbon tetrachloride	53.63	5.0	50.00		107	70	130				
Chlorobenzene	45.60	5.0	50.00		91.2	70	130				
Chloroform	51.10	5.0	50.00		102	70	130				
cis-1,2-Dichloroethene	50.78	5.0	50.00		102	70	130				
cis-1,3-Dichloropropene	47.17	5.0	50.00		94.3	70	130				
Dibromochloromethane	49.21	5.0	50.00		98.4	70	130				
Ethylbenzene	48.23	5.0	50.00		96.5	70	130				
Isopropylbenzene	44.24	5.0	50.00		88.5	70	130				
m,p-Xylene	95.82	5.0	100.0		95.8	70	130				
Methylene chloride	51.15	20	50.00		102	70	130				
o-Xylene	48.99	5.0	50.00		98.0	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: LCS-206710	Client ID:	Units: ug/Kg	Prep Date: 05/01/2015	Run No: 290945							
SampleType: LCS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190855							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Styrene	46.30	5.0	50.00		92.6	70	130				
Tetrachloroethene	48.40	5.0	50.00		96.8	70	130				
Toluene	44.41	5.0	50.00		88.8	70	130				
trans-1,2-Dichloroethene	47.65	5.0	50.00		95.3	70	130				
trans-1,3-Dichloropropene	40.09	5.0	50.00		80.2	70	130				
Trichloroethene	44.38	5.0	50.00		88.8	70	130				
Surr: 4-Bromofluorobenzene	52.20	0	50.00		104	70	130				
Surr: Dibromofluoromethane	54.28	0	50.00		109	70	130				
Surr: Toluene-d8	48.69	0	50.00		97.4	70	130				

Sample ID: 1504Q37-002AMS	Client ID: B-1 (32.5'-34.0')	Units: ug/Kg-dry	Prep Date: 05/01/2015	Run No: 290945							
SampleType: MS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190856							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	58.05	5.9	58.97		98.4	70	135				
1,1,2,2-Tetrachloroethane	59.53	5.9	58.97		101	70.2	126				
1,1,2-Trichloroethane	52.11	5.9	58.97		88.4	72.3	130				
1,1-Dichloroethane	55.49	5.9	58.97		94.1	60.8	140				
1,1-Dichloroethene	52.51	5.9	58.97		89.1	56.6	151				
1,2,4-Trichlorobenzene	50.79	5.9	58.97		86.1	62.2	135				
1,2-Dibromo-3-chloropropane	64.07	5.9	58.97		109	60.6	126				
1,2-Dibromoethane	60.60	5.9	58.97		103	74.1	123				
1,2-Dichlorobenzene	56.49	5.9	58.97		95.8	70.4	130				
1,2-Dichloroethane	60.31	5.9	58.97		102	70.2	129				
1,2-Dichloropropane	52.69	5.9	58.97		89.4	70.1	129				
1,3-Dichlorobenzene	55.76	5.9	58.97		94.6	70.7	130				
1,4-Dichlorobenzene	56.32	5.9	58.97		95.5	70.6	130				
Benzene	51.95	5.9	58.97		88.1	70.4	130				

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: 1504Q37-002AMS	Client ID: B-1 (32.5'-34.0')	Units: ug/Kg-dry	Prep Date: 05/01/2015	Run No: 290945							
SampleType: MS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190856							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Bromodichloromethane	56.32	5.9	58.97		95.5	70	125				
Bromoform	51.30	5.9	58.97		87.0	65.2	122				
Carbon tetrachloride	59.37	5.9	58.97		101	64.3	138				
Chlorobenzene	56.26	5.9	58.97		95.4	67.5	132				
Chloroform	57.04	5.9	58.97		96.7	73.9	130				
cis-1,2-Dichloroethene	57.47	5.9	58.97		97.5	70.9	139				
cis-1,3-Dichloropropene	59.28	5.9	58.97		101	60.4	120				
Dibromochloromethane	61.67	5.9	58.97		105	65.1	121				
Ethylbenzene	59.23	5.9	58.97	0.5981	99.4	64.9	136				
Isopropylbenzene	57.13	5.9	58.97		96.9	70.2	129				
m,p-Xylene	116.1	5.9	117.9		98.4	60.2	138				
Methylene chloride	56.71	24	58.97		96.2	64.5	158				
o-Xylene	56.18	5.9	58.97		95.3	61.5	134				
Styrene	54.45	5.9	58.97		92.3	72.9	130				
Tetrachloroethene	58.89	5.9	58.97		99.9	70.1	134				
Toluene	53.99	5.9	58.97	0.8037	90.2	70.4	130				
trans-1,2-Dichloroethene	52.92	5.9	58.97		89.7	60.4	158				
trans-1,3-Dichloropropene	52.92	5.9	58.97		89.7	60.1	117				
Trichloroethene	52.15	5.9	58.97		88.4	70.1	137				
Surr: 4-Bromofluorobenzene	56.98	0	58.97		96.6	70	128				
Surr: Dibromofluoromethane	59.26	0	58.97		100	78.2	128				
Surr: Toluene-d8	57.29	0	58.97		97.2	76.5	116				

Sample ID: 1504Q37-002AMSD	Client ID: B-1 (32.5'-34.0')	Units: ug/Kg-dry	Prep Date: 05/01/2015	Run No: 290945							
SampleType: MSD	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190857							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	59.87	5.9	58.97		102	70	135	58.05	3.10	18.7	
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Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: 1504Q37-002AMSD	Client ID: B-1 (32.5'-34.0')	Units: ug/Kg-dry	Prep Date: 05/01/2015	Run No: 290945
SampleType: MSD	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190857

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,2,2-Tetrachloroethane	61.80	5.9	58.97		105	70.2	126	59.53	3.73	15	
1,1,2-Trichloroethane	52.09	5.9	58.97		88.3	72.3	130	52.11	0.045	14.1	
1,1-Dichloroethane	56.24	5.9	58.97		95.4	60.8	140	55.49	1.35	14.1	
1,1-Dichloroethene	55.59	5.9	58.97		94.3	56.6	151	52.51	5.69	20.4	
1,2,4-Trichlorobenzene	48.86	5.9	58.97		82.9	62.2	135	50.79	3.88	23.9	
1,2-Dibromo-3-chloropropane	62.07	5.9	58.97		105	60.6	126	64.07	3.18	15.2	
1,2-Dibromoethane	63.36	5.9	58.97		107	74.1	123	60.60	4.45	14.4	
1,2-Dichlorobenzene	58.14	5.9	58.97		98.6	70.4	130	56.49	2.88	15	
1,2-Dichloroethane	61.63	5.9	58.97		105	70.2	129	60.31	2.17	15	
1,2-Dichloropropane	55.69	5.9	58.97		94.4	70.1	129	52.69	5.53	15.1	
1,3-Dichlorobenzene	56.55	5.9	58.97		95.9	70.7	130	55.76	1.41	15.2	
1,4-Dichlorobenzene	57.37	5.9	58.97		97.3	70.6	130	56.32	1.85	14.5	
Benzene	54.94	5.9	58.97		93.2	70.4	130	51.95	5.60	16.9	
Bromodichloromethane	56.84	5.9	58.97		96.4	70	125	56.32	0.917	15	
Bromoform	50.99	5.9	58.97		86.5	65.2	122	51.30	0.599	15.1	
Carbon tetrachloride	62.41	5.9	58.97		106	64.3	138	59.37	5.00	25.2	
Chlorobenzene	57.93	5.9	58.97		98.2	67.5	132	56.26	2.91	14.6	
Chloroform	59.39	5.9	58.97		101	73.9	130	57.04	4.03	15	
cis-1,2-Dichloroethene	58.53	5.9	58.97		99.3	70.9	139	57.47	1.83	15	
cis-1,3-Dichloropropene	61.68	5.9	58.97		105	60.4	120	59.28	3.96	15.6	
Dibromochloromethane	65.45	5.9	58.97		111	65.1	121	61.67	5.96	16.3	
Ethylbenzene	62.26	5.9	58.97	0.5981	105	64.9	136	59.23	4.99	16.3	
Isopropylbenzene	58.47	5.9	58.97		99.2	70.2	129	57.13	2.33	18.8	
m,p-Xylene	119.8	5.9	117.9		102	60.2	138	116.1	3.18	16.3	
Methylene chloride	60.98	24	58.97		103	64.5	158	56.71	7.25	23.7	
o-Xylene	57.47	5.9	58.97		97.5	61.5	134	56.18	2.26	16.1	
Styrene	53.49	5.9	58.97		90.7	72.9	130	54.45	1.77	15	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206710

Sample ID: 1504Q37-002AMSD	Client ID: B-1 (32.5'-34.0')	Units: ug/Kg-dry	Prep Date: 05/01/2015	Run No: 290945							
SampleType: MSD	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 206710	Analysis Date: 05/01/2015	Seq No: 6190857							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Tetrachloroethene	64.28	5.9	58.97		109	70.1	134	58.89	8.75	19.3	
Toluene	55.17	5.9	58.97	0.8037	92.2	70.4	130	53.99	2.16	16.6	
trans-1,2-Dichloroethene	54.11	5.9	58.97		91.8	60.4	158	52.92	2.23	54.5	
trans-1,3-Dichloropropene	53.74	5.9	58.97		91.1	60.1	117	52.92	1.55	15	
Trichloroethene	53.25	5.9	58.97		90.3	70.1	137	52.15	2.08	17	
Surr: 4-Bromofluorobenzene	54.50	0	58.97		92.4	70	128	56.98	0	0	
Surr: Dibromofluoromethane	59.05	0	58.97		100	78.2	128	59.26	0	0	
Surr: Toluene-d8	56.58	0	58.97		96.0	76.5	116	57.29	0	0	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206819

Sample ID: MB-206819	Client ID:	Units: mg/L	Prep Date: 05/04/2015	Run No: 291054							
SampleType: MBLK	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 206819	Analysis Date: 05/04/2015	Seq No: 6191675							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform	BRL	0.10									
Surr: 4-Bromofluorobenzene	0.8294	0	1.000		82.9	68.7	127				
Surr: Dibromofluoromethane	1.047	0	1.000		105	77.4	121				
Surr: Toluene-d8	0.9518	0	1.000		95.2	79.2	120				

Sample ID: LCS-206819	Client ID:	Units: mg/L	Prep Date: 05/04/2015	Run No: 291054							
SampleType: LCS	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 206819	Analysis Date: 05/04/2015	Seq No: 6191670							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform	0.8840	0.10	1.000		88.4	67.9	130				
Surr: 4-Bromofluorobenzene	0.9880	0	1.000		98.8	68.7	127				
Surr: Dibromofluoromethane	0.9852	0	1.000		98.5	77.4	121				
Surr: Toluene-d8	1.013	0	1.000		101	79.2	120				

Sample ID: 1505145-001EMS	Client ID:	Units: mg/L	Prep Date: 05/04/2015	Run No: 291054							
SampleType: MS	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 206819	Analysis Date: 05/04/2015	Seq No: 6191679							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform	0.8202	0.10	1.000		82.0	64.2	138				
Surr: 4-Bromofluorobenzene	0.9980	0	1.000		99.8	68.7	127				
Surr: Dibromofluoromethane	1.015	0	1.000		101	77.4	121				
Surr: Toluene-d8	1.040	0	1.000		104	79.2	120				

Sample ID: 1505145-001EDUP	Client ID:	Units: mg/L	Prep Date: 05/04/2015	Run No: 291054							
SampleType: DUP	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 206819	Analysis Date: 05/04/2015	Seq No: 6191814							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform	BRL	0.10						0	0	30	
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Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206819

Sample ID: 1505145-001EDUP	Client ID:	Units: mg/L	Prep Date: 05/04/2015	Run No: 291054							
SampleType: DUP	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 206819	Analysis Date: 05/04/2015	Seq No: 6191814							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Surr: 4-Bromofluorobenzene	0.8856	0	1.000		88.6	68.7	127	0.8420	0	0	
Surr: Dibromofluoromethane	1.035	0	1.000		103	77.4	121	1.045	0	0	
Surr: Toluene-d8	0.9618	0	1.000		96.2	79.2	120	0.9564	0	0	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206836

Sample ID: MB-206836	Client ID:	Units: ug/L	Prep Date: 05/04/2015	Run No: 291100							
SampleType: MBLK	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 206836	Analysis Date: 05/04/2015	Seq No: 6192941							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	BRL	5.0									
Surr: 4-Bromofluorobenzene	44.81	0	50.00		89.6	70.6	123				
Surr: Dibromofluoromethane	49.05	0	50.00		98.1	78	126				
Surr: Toluene-d8	48.43	0	50.00		96.9	77.1	119				

Sample ID: LCS-206836	Client ID:	Units: ug/L	Prep Date: 05/04/2015	Run No: 291100							
SampleType: LCS	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 206836	Analysis Date: 05/04/2015	Seq No: 6192939							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	6.920	5.0	10.00		69.2	67	135				
Surr: 4-Bromofluorobenzene	45.12	0	50.00		90.2	70.6	123				
Surr: Dibromofluoromethane	48.40	0	50.00		96.8	78	126				
Surr: Toluene-d8	47.77	0	50.00		95.5	77.1	119				

Sample ID: LCS-206836	Client ID:	Units: ug/L	Prep Date: 05/04/2015	Run No: 291100							
SampleType: LCS	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 206836	Analysis Date: 05/04/2015	Seq No: 6192940							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	6.960	5.0	10.00		69.6	67	135	6.920	0.576	20	
Surr: 4-Bromofluorobenzene	45.28	0	50.00		90.6	70.6	123	45.12	0	0	
Surr: Dibromofluoromethane	49.35	0	50.00		98.7	78	126	48.40	0	0	
Surr: Toluene-d8	48.51	0	50.00		97.0	77.1	119	47.77	0	0	

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: MB-206971	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MBLK	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196013							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	BRL	1.0									
1,1,2,2-Tetrachloroethane	BRL	1.0									
1,1,2-Trichloroethane	BRL	1.0									
1,1-Dichloroethane	BRL	1.0									
1,1-Dichloroethene	BRL	2.0									
1,2,4-Trichlorobenzene	BRL	1.0									
1,2-Dibromo-3-chloropropane	BRL	1.0									
1,2-Dibromoethane	BRL	1.0									
1,2-Dichlorobenzene	BRL	1.0									
1,2-Dichloroethane	BRL	1.0									
1,2-Dichloropropane	BRL	1.0									
1,3-Dichlorobenzene	BRL	1.0									
1,4-Dichlorobenzene	BRL	1.0									
2-Butanone	BRL	10									
2-Hexanone	BRL	10									
4-Methyl-2-pentanone	BRL	10									
Acetone	BRL	20									
Benzene	BRL	1.0									
Bromodichloromethane	BRL	1.0									
Bromoform	BRL	1.0									
Bromomethane	BRL	1.0									
Carbon disulfide	BRL	5.0									
Carbon tetrachloride	BRL	2.0									
Chlorobenzene	BRL	1.0									
Chloroethane	BRL	1.0									
Chloroform	BRL	1.0									
Chloromethane	BRL	1.0									

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: MB-206971	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MBLK	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196013							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

cis-1,2-Dichloroethene	BRL	1.0									
cis-1,3-Dichloropropene	BRL	1.0									
Cyclohexane	BRL	2.0									
Dibromochloromethane	BRL	1.0									
Dichlorodifluoromethane	BRL	1.0									
Ethylbenzene	BRL	1.0									
Freon-113	BRL	5.0									
Isopropylbenzene	BRL	1.0									
m,p-Xylene	BRL	1.0									
Methyl acetate	BRL	2.0									
Methyl tert-butyl ether	BRL	1.0									
Methylcyclohexane	BRL	2.0									
Methylene chloride	BRL	5.0									
o-Xylene	BRL	1.0									
Styrene	BRL	1.0									
Tetrachloroethene	BRL	1.0									
Toluene	BRL	1.0									
trans-1,2-Dichloroethene	BRL	2.0									
trans-1,3-Dichloropropene	BRL	2.0									
Trichloroethene	BRL	1.0									
Trichlorofluoromethane	BRL	1.0									
Vinyl chloride	BRL	1.0									
Surr: 4-Bromofluorobenzene	46.14	0	50.00		92.3	70	130				
Surr: Dibromofluoromethane	50.57	0	50.00		101	70	130				
Surr: Toluene-d8	49.12	0	50.00		98.2	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: LCS-206971	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: LCS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196012							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	52.75	1.0	50.00		106	70	130				
1,1,2,2-Tetrachloroethane	46.09	1.0	50.00		92.2	70	130				
1,1,2-Trichloroethane	49.13	1.0	50.00		98.3	70	130				
1,1-Dichloroethane	48.74	1.0	50.00		97.5	70	130				
1,1-Dichloroethene	55.49	2.0	50.00		111	60	140				
1,2,4-Trichlorobenzene	47.30	1.0	50.00		94.6	70	130				
1,2-Dibromo-3-chloropropane	46.96	1.0	50.00		93.9	70	130				
1,2-Dibromoethane	49.21	1.0	50.00		98.4	70	130				
1,2-Dichlorobenzene	47.47	1.0	50.00		94.9	70	130				
1,2-Dichloroethane	49.07	1.0	50.00		98.1	70	130				
1,2-Dichloropropane	48.37	1.0	50.00		96.7	70	130				
1,3-Dichlorobenzene	46.78	1.0	50.00		93.6	70	130				
1,4-Dichlorobenzene	45.62	1.0	50.00		91.2	70	130				
Benzene	51.67	1.0	50.00		103	70	130				
Bromodichloromethane	50.17	1.0	50.00		100	70	130				
Bromoform	49.61	1.0	50.00		99.2	70	130				
Carbon tetrachloride	53.12	2.0	50.00		106	70	130				
Chlorobenzene	46.80	1.0	50.00		93.6	70	130				
Chloroform	49.81	1.0	50.00		99.6	70	130				
cis-1,2-Dichloroethene	51.25	1.0	50.00		102	70	130				
cis-1,3-Dichloropropene	52.57	1.0	50.00		105	70	130				
Dibromochloromethane	46.97	1.0	50.00		93.9	70	130				
Ethylbenzene	50.97	1.0	50.00		102	70	130				
Isopropylbenzene	51.73	1.0	50.00		103	70	130				
m,p-Xylene	102.3	1.0	100.0		102	70	130				
Methylene chloride	47.65	5.0	50.00		95.3	70	130				
o-Xylene	51.69	1.0	50.00		103	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: LCS-206971	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: LCS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196012							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Styrene	45.54	1.0	50.00		91.1	70	130				
Tetrachloroethene	48.66	1.0	50.00		97.3	70	130				
Toluene	50.25	1.0	50.00		100	70	130				
trans-1,2-Dichloroethene	51.46	2.0	50.00		103	70	130				
trans-1,3-Dichloropropene	54.27	2.0	50.00		109	70	130				
Trichloroethene	50.41	1.0	50.00		101	70	130				
Vinyl chloride	53.62	1.0	50.00		107	70	130				
Surr: 4-Bromofluorobenzene	51.83	0	50.00		104	70	130				
Surr: Dibromofluoromethane	52.02	0	50.00		104	70	130				
Surr: Toluene-d8	50.42	0	50.00		101	70	130				

Sample ID: 1505344-002AMS	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196015							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	5543	100	5000		111	64.1	145				
1,1,2,2-Tetrachloroethane	4769	100	5000		95.4	63.6	133				
1,1,2-Trichloroethane	5119	100	5000		102	71.9	136				
1,1-Dichloroethane	5189	100	5000		104	67.7	138				
1,1-Dichloroethene	5921	200	5000		118	60.5	156				
1,2,4-Trichlorobenzene	4256	100	5000		85.1	60	130				
1,2-Dibromo-3-chloropropane	5002	100	5000		100	60.6	128				
1,2-Dibromoethane	5109	100	5000		102	75	133				
1,2-Dichlorobenzene	4807	100	5000		96.1	71.7	127				
1,2-Dichloroethane	5111	100	5000		102	71.7	134				
1,2-Dichloropropane	4880	100	5000		97.6	69.6	137				
1,3-Dichlorobenzene	4713	100	5000		94.3	71.4	130				
1,4-Dichlorobenzene	4533	100	5000		90.7	72.7	123				

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: 1505344-002AMS	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/05/2015	Seq No: 6196015							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Benzene	5409	100	5000	116.0	106	70	135				
Bromodichloromethane	5092	100	5000		102	60.3	142				
Bromoform	5232	100	5000		105	50.2	139				
Carbon tetrachloride	5434	200	5000		109	64.4	146				
Chlorobenzene	4851	100	5000		97.0	70.5	132				
Chloroform	5253	100	5000		105	70.1	141				
cis-1,2-Dichloroethene	5374	100	5000		107	70.7	138				
cis-1,3-Dichloropropene	5280	100	5000		106	58.7	137				
Dibromochloromethane	5015	100	5000		100	63.2	130				
Ethylbenzene	5248	100	5000		105	73.7	135				
Isopropylbenzene	5070	100	5000		101	66.2	129				
m,p-Xylene	10740	100	10000		107	70.7	136				
Methylene chloride	5132	500	5000		103	70.1	132				
o-Xylene	5413	100	5000		108	71.3	137				
Styrene	4709	100	5000		94.2	72	135				
Tetrachloroethene	4864	100	5000		97.3	71.4	139				
Toluene	5216	100	5000	55.00	103	70.5	137				
trans-1,2-Dichloroethene	5363	200	5000		107	68.3	142				
trans-1,3-Dichloropropene	5515	200	5000		110	60.2	124				
Trichloroethene	5092	100	5000		102	71.8	139				
Vinyl chloride	5656	100	5000		113	70	132				
Surr: 4-Bromofluorobenzene	5205	0	5000		104	70	130				
Surr: Dibromofluoromethane	5189	0	5000		104	70	130				
Surr: Toluene-d8	5055	0	5000		101	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: 1505344-002AMSD	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MSD	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/06/2015	Seq No: 6196016							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	5093	100	5000		102	64.1	145	5543	8.46	20	
1,1,2,2-Tetrachloroethane	4400	100	5000		88.0	63.6	133	4769	8.05	20	
1,1,2-Trichloroethane	4689	100	5000		93.8	71.9	136	5119	8.77	20	
1,1-Dichloroethane	4818	100	5000		96.4	67.7	138	5189	7.41	20	
1,1-Dichloroethene	5370	200	5000		107	60.5	156	5921	9.76	20	
1,2,4-Trichlorobenzene	4083	100	5000		81.7	60	130	4256	4.15	26.5	
1,2-Dibromo-3-chloropropane	4545	100	5000		90.9	60.6	128	5002	9.57	20.4	
1,2-Dibromoethane	4678	100	5000		93.6	75	133	5109	8.81	20	
1,2-Dichlorobenzene	4496	100	5000		89.9	71.7	127	4807	6.69	20	
1,2-Dichloroethane	4722	100	5000		94.4	71.7	134	5111	7.91	20	
1,2-Dichloropropane	4534	100	5000		90.7	69.6	137	4880	7.35	20	
1,3-Dichlorobenzene	4395	100	5000		87.9	71.4	130	4713	6.98	20	
1,4-Dichlorobenzene	4268	100	5000		85.4	72.7	123	4533	6.02	20	
Benzene	4985	100	5000	116.0	97.4	70	135	5409	8.16	20	
Bromodichloromethane	4695	100	5000		93.9	60.3	142	5092	8.11	20	
Bromoform	4745	100	5000		94.9	50.2	139	5232	9.76	20	
Carbon tetrachloride	4995	200	5000		99.9	64.4	146	5434	8.42	19.3	
Chlorobenzene	4484	100	5000		89.7	70.5	132	4851	7.86	20	
Chloroform	4849	100	5000		97.0	70.1	141	5253	8.00	20	
cis-1,2-Dichloroethene	4941	100	5000		98.8	70.7	138	5374	8.40	20	
cis-1,3-Dichloropropene	5023	100	5000		100	58.7	137	5280	4.99	20	
Dibromochloromethane	4657	100	5000		93.1	63.2	130	5015	7.40	20	
Ethylbenzene	4844	100	5000		96.9	73.7	135	5248	8.01	20	
Isopropylbenzene	4780	100	5000		95.6	66.2	129	5070	5.89	20	
m,p-Xylene	9843	100	10000		98.4	70.7	136	10740	8.68	20	
Methylene chloride	4735	500	5000		94.7	70.1	132	5132	8.05	20	
o-Xylene	4924	100	5000		98.5	71.3	137	5413	9.46	20	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1504Q37

ANALYTICAL QC SUMMARY REPORT

BatchID: 206971

Sample ID: 1505344-002AMSD	Client ID:	Units: ug/L	Prep Date: 05/05/2015	Run No: 291219							
SampleType: MSD	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 206971	Analysis Date: 05/06/2015	Seq No: 6196016							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Styrene	4369	100	5000		87.4	72	135	4709	7.49	20	
Tetrachloroethene	4570	100	5000		91.4	71.4	139	4864	6.23	20	
Toluene	4816	100	5000	55.00	95.2	70.5	137	5216	7.97	20	
trans-1,2-Dichloroethene	4934	200	5000		98.7	68.3	142	5363	8.33	20	
trans-1,3-Dichloropropene	5194	200	5000		104	60.2	124	5515	5.99	20	
Trichloroethene	4589	100	5000		91.8	71.8	139	5092	10.4	20	
Vinyl chloride	5321	100	5000		106	70	132	5656	6.10	20	
Surr: 4-Bromofluorobenzene	5144	0	5000		103	70	130	5205	0	0	
Surr: Dibromofluoromethane	5051	0	5000		101	70	130	5189	0	0	
Surr: Toluene-d8	4952	0	5000		99.0	70	130	5055	0	0	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		



ACCESS
ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION

Glynn Ellen

PROJECT ID

I-85 Rehab.

LABORATORY REPORT NUMBER

1506M69

DATE

July 01, 2015

Primary Data Review By

Chantelle Kanhai
Project Manager, AES

Secondary Data Review By

Ashley Amick

Project Manager, Access Analytical
aamick@axs-inc.com

PLEASE NOTE:

- Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3080 Presidential Drive, Atlanta, GA 30340.
- AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll free at 883.315.4243

Access Analytical - Chain of Custody Record

Project Work Order # 1506469

Sales Order # _____

PO # G 5439

Access Quote # _____

Laboratory ID: _____

Company Name: F&ME Consultants
 Report To: Glynn Ellen
 Address: 3112 Devine St.
 City: Columbia State: SC Zip: 29205
 Phone: (803) 254-4540 Fax: (803) 254-4542
 Email: glynn@fme.col.com
 Project ID: I-85 Rehab.
 Sampled By: Jeff Leary / Glynn Ellen

Preservative: (*see codes)	<u>1</u>																			
Container Type: (*see codes)	<u>G</u>	<u>G</u>	<u>G</u>																	



ACCESS ANALYTICAL, INC.
 7478 Carlisle Street
 Irmo, SC 29063
 Phone: (803) 781-4243
 Fax: 781-4303
 www.axs-inc.com

***Preservative Codes** (place corresponding # in block above analysis field):
 0 = None, 1 = HCL, 2 = HNO₃, 3 = H₂SO₄, 4 = NaOH, 5 = Na₂S₂O₈,
 6 = Method 5035 set w/ NaHSO₄ & CH₃OH, 7 = NaOH/ZnOAC, 8 = H₃PO₄.

***Matrix Codes** (place corresponding code in matrix column):
 GW = ground water, WW = waste water, DW = drinking water, S = soil,
 SL = sludge, A = air, IW = industrial waste, WO = waste oil, OT = other
 (specify in comments section)

***Program Area Codes:** CWA = Clean Water Act (for wastewaters), SDWA = Safe Drinking Water Act (for drinking waters), SHW = Solid and Hazardous Wastes (for soils, ground waters and waste samples)

***Container Type:** G = Glass, P = Plastic

Sample ID/Description	Date Collected:	Time Collected:	Type: (grab or composite)	Matrix: (see codes)	Program Area (see codes)	TOTAL # of containers	# of containers collected	# of containers analyzed
B-2 (0.5'-2.0')	6-17-15	10:55	G	S	SHW	4		
B-2 (15.0'-16.5')	6-17-15	11:00	G	S	SHW	4		
B-2	6-17-15	11:05	G	GW	SHW	3	3	
B-2/HA-6, 7, 8	6-17-15	11:00	C	S	SHW	1		1
B-5 (4.0'-6.0')	6-17-15	16:35	G	S	SHW	4		4
B-5 (27.5'-29.0')	6-17-15	17:05	G	S	SHW	4		4
B-5	6-17-15	17:05	G	GW	SHW	3	3	
B-5/HA-5	6-17-15	17:10	C	S	SHW	1		1
HA-5 (5.5'-6.0')	6-17-15	13:44	G	S	SHW	4		4
HA-6 (4.5'-5.0')	6-18-15	9:40	G	S	SHW	4		4

REQUESTED LAB ANALYSIS: ↓
 VOC's plus 1, 2 Dichlorobiphenyls
 and 1,4-Dioxene by 5035 / 8200B
 VOC's plus 1, 2 Dichlorobiphenyls
 and 1,4-Dioxene by 5035 / 8200B
 TCLP-VOC - Chloroform Only

NOTES / COMMENTS
 (if sample is a composite please use space below to note start/finish times & dates)

Also E-mail Results to
jleary@fme.col.com

Turnaround Time:
 Standard
 RUSH*
 *Date Required: _____
 (For rush work, results emailed/faxed by end of business day on date required)

Project Location:
 SC
 NC
 Other
 (specify) _____

Relinquished By:
Jeffery D. Leary
J. Leary

Received By:
J. Stua
FedEx
Katie Forum

Date (mm-dd-yy)
6/19/15
6/19/15
6/20/15

Time (24HR)
1454
1700
10:20

Sample Rec'd on Ice
 Y N
 Y N
 Y N
 Y N

Sample Temp. Upon Receipt (°C):
 _____ (°C) _____ (N/A)
 _____ (°C) _____ (N/A)
3.1 (°C) _____ (N/A)
 _____ (°C) _____ (N/A)

Client: F&ME Consultants
Project: I-85 Rehab.
Lab ID: 1506M69

Case Narrative

Volatile Organic Compounds Analysis by Method 8260B:

Percent recovery for the internal standard compound 1,4-Dichlorobenzene-d4 on sample 1506M69-001 A was outside control limits biased low due to suspected matrix interference.

Percent recovery for the internal standard compounds Pentafluorobenzene, Chlorobenzene-d5 and 1,4-Dichlorobenzene-d4 on sample 1506M69-005A was outside control limits biased low due to suspected matrix interference.

LCS-209428 recovery for 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride & Bromoform was outside control limits biased high. Target analytes were not detected in the analytical samples and data is reportable with high bias.

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-2 (0.5' - 2.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 10:55:00 AM
Lab ID: 1506M69-001	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	120		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Dichlorodifluoromethane	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Chloromethane	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Bromomethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Chloroethane	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Trichlorofluoromethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,1-Dichloroethene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Acetone	150	80		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Freon-113	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Carbon disulfide	19	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Vinyl acetate	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Methyl acetate	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Methylene chloride	BRL	16		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Methyl tert-butyl ether	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
trans-1,2-Dichloroethene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,1-Dichloroethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
cis-1,2-Dichloroethene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
2-Butanone	BRL	40		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Chloroform	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,1,1-Trichloroethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Cyclohexane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Carbon tetrachloride	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Benzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2-Dichloroethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Trichloroethene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Methylcyclohexane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2-Dichloropropane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Bromodichloromethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
cis-1,3-Dichloropropene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
4-Methyl-2-pentanone	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Toluene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
trans-1,3-Dichloropropene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,1,2-Trichloroethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
2-Hexanone	BRL	8.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Tetrachloroethene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Dibromochloromethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2-Dibromoethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Chlorobenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Ethylbenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
m,p-Xylene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
o-Xylene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-2 (0.5' - 2.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 10:55:00 AM
Lab ID: 1506M69-001	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B					(SW5035)			
Styrene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Bromoform	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,1,2,2-Tetrachloroethane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Isopropylbenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,3-Dichlorobenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,4-Dichlorobenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2-Dichlorobenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2-Dibromo-3-chloropropane	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
1,2,4-Trichlorobenzene	BRL	4.0		ug/Kg-dry	209428	1	06/29/2015 12:21	CG
Surr: 4-Bromofluorobenzene	103	70-128		%REC	209428	1	06/29/2015 12:21	CG
Surr: Dibromofluoromethane	133	78.2-128	S	%REC	209428	1	06/29/2015 12:21	CG
Surr: Toluene-d8	103	76.5-116		%REC	209428	1	06/29/2015 12:21	CG
PERCENT MOISTURE D2216								
Percent Moisture	13.4	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:	* Value exceeds maximum contaminant level	E Estimated (value above quantitation range)
	BRL Below reporting limit	S Spike Recovery outside limits due to matrix
	H Holding times for preparation or analysis exceeded	Narr See case narrative
	N Analyte not NELAC certified	NC Not confirmed
	B Analyte detected in the associated method blank	< Less than Result value
	> Greater than Result value	J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-2 (15.0' - 16.5')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 11:00:00 AM
Lab ID: 1506M69-002	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	140		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Dichlorodifluoromethane	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Chloromethane	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Bromomethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Chloroethane	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Trichlorofluoromethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,1-Dichloroethene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Acetone	BRL	93		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Freon-113	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Carbon disulfide	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Vinyl acetate	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Methyl acetate	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Methylene chloride	BRL	19		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Methyl tert-butyl ether	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
trans-1,2-Dichloroethene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,1-Dichloroethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
cis-1,2-Dichloroethene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
2-Butanone	BRL	47		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Chloroform	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,1,1-Trichloroethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Cyclohexane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Carbon tetrachloride	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Benzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2-Dichloroethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Trichloroethene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Methylcyclohexane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2-Dichloropropane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Bromodichloromethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
cis-1,3-Dichloropropene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
4-Methyl-2-pentanone	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Toluene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
trans-1,3-Dichloropropene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,1,2-Trichloroethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
2-Hexanone	BRL	9.3		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Tetrachloroethene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Dibromochloromethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2-Dibromoethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Chlorobenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Ethylbenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
m,p-Xylene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
o-Xylene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-2 (15.0' - 16.5')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 11:00:00 AM
Lab ID: 1506M69-002	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Bromoform	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,1,2,2-Tetrachloroethane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Isopropylbenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,3-Dichlorobenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,4-Dichlorobenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2-Dichlorobenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2-Dibromo-3-chloropropane	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
1,2,4-Trichlorobenzene	BRL	4.7		ug/Kg-dry	209428	1	06/29/2015 13:33	CG
Surr: 4-Bromofluorobenzene	103	70-128		%REC	209428	1	06/29/2015 13:33	CG
Surr: Dibromofluoromethane	124	78.2-128		%REC	209428	1	06/29/2015 13:33	CG
Surr: Toluene-d8	105	76.5-116		%REC	209428	1	06/29/2015 13:33	CG
PERCENT MOISTURE D2216								
Percent Moisture	18.8	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-2
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 11:05:00 AM
Lab ID: 1506M69-003	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B (SW5030B)								
1,1,1-Trichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,1,2,2-Tetrachloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,1,2-Trichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,1-Dichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,1-Dichloroethene	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2,4-Trichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2-Dibromo-3-chloropropane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2-Dibromoethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2-Dichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,2-Dichloropropane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,3-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
1,4-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
2-Butanone	BRL	10		ug/L	209186	1	06/23/2015 18:53	NP
2-Hexanone	BRL	10		ug/L	209186	1	06/23/2015 18:53	NP
4-Methyl-2-pentanone	BRL	10		ug/L	209186	1	06/23/2015 18:53	NP
Acetone	BRL	20		ug/L	209186	1	06/23/2015 18:53	NP
Benzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Bromodichloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Bromoform	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Bromomethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Carbon disulfide	BRL	5.0		ug/L	209186	1	06/23/2015 18:53	NP
Carbon tetrachloride	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
Chlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Chloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Chloroform	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Chloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
cis-1,2-Dichloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
cis-1,3-Dichloropropene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Cyclohexane	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
Dibromochloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Dichlorodifluoromethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Ethylbenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Freon-113	BRL	5.0		ug/L	209186	1	06/23/2015 18:53	NP
Isopropylbenzene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
m,p-Xylene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Methyl acetate	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
Methyl tert-butyl ether	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Methylcyclohexane	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
Methylene chloride	BRL	5.0		ug/L	209186	1	06/23/2015 18:53	NP
o-Xylene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-2
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 11:05:00 AM
Lab ID: 1506M69-003	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B					(SW5030B)			
Styrene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Tetrachloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Toluene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
trans-1,2-Dichloroethene	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
trans-1,3-Dichloropropene	BRL	2.0		ug/L	209186	1	06/23/2015 18:53	NP
Trichloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Trichlorofluoromethane	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Vinyl chloride	BRL	1.0		ug/L	209186	1	06/23/2015 18:53	NP
Surr: 4-Bromofluorobenzene	94.5	70-130		%REC	209186	1	06/23/2015 18:53	NP
Surr: Dibromofluoromethane	109	70-130		%REC	209186	1	06/23/2015 18:53	NP
Surr: Toluene-d8	98.2	70-130		%REC	209186	1	06/23/2015 18:53	NP
1,4-Dioxane by SIM GC/MS SW8260B-SIM					(SW5030B)			
1,4-Dioxane	BRL	2.0		ug/L	209464	1	06/29/2015 11:18	NP
Surr: 4-Bromofluorobenzene	99.2	70.6-123		%REC	209464	1	06/29/2015 11:18	NP
Surr: Dibromofluoromethane	99.9	78-126		%REC	209464	1	06/29/2015 11:18	NP
Surr: Toluene-d8	102	77.1-119		%REC	209464	1	06/29/2015 11:18	NP

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-2/HA-6, 7, 8
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 11:00:00 AM
Lab ID: 1506M69-004	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
VOLATILES, TCLP SW1311/8260B					(SW5030B)			
Chloroform	BRL	0.10		mg/L	209275	20	06/24/2015 18:27	CH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5 (4.0' - 6.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 4:35:00 PM
Lab ID: 1506M69-005	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	130		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Dichlorodifluoromethane	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Chloromethane	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Bromomethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Chloroethane	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Trichlorofluoromethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,1-Dichloroethene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Acetone	170	89		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Freon-113	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Carbon disulfide	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Vinyl acetate	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Methyl acetate	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Methylene chloride	BRL	18		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Methyl tert-butyl ether	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
trans-1,2-Dichloroethene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,1-Dichloroethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
cis-1,2-Dichloroethene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
2-Butanone	BRL	44		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Chloroform	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,1,1-Trichloroethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Cyclohexane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Carbon tetrachloride	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Benzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2-Dichloroethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Trichloroethene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Methylcyclohexane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2-Dichloropropane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Bromodichloromethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
cis-1,3-Dichloropropene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
4-Methyl-2-pentanone	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Toluene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
trans-1,3-Dichloropropene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,1,2-Trichloroethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
2-Hexanone	BRL	8.9		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Tetrachloroethene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Dibromochloromethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2-Dibromoethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Chlorobenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Ethylbenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
m,p-Xylene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
o-Xylene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5 (4.0' - 6.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 4:35:00 PM
Lab ID: 1506M69-005	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Bromoform	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,1,2,2-Tetrachloroethane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Isopropylbenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,3-Dichlorobenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,4-Dichlorobenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2-Dichlorobenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2-Dibromo-3-chloropropane	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
1,2,4-Trichlorobenzene	BRL	4.4		ug/Kg-dry	209428	1	06/29/2015 13:57	CG
Surr: 4-Bromofluorobenzene	87.9	70-128		%REC	209428	1	06/29/2015 13:57	CG
Surr: Dibromofluoromethane	128	78.2-128		%REC	209428	1	06/29/2015 13:57	CG
Surr: Toluene-d8	101	76.5-116		%REC	209428	1	06/29/2015 13:57	CG
PERCENT MOISTURE D2216								
Percent Moisture	18.9	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5 (27.5' - 29.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 5:05:00 PM
Lab ID: 1506M69-006	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	130		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Dichlorodifluoromethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Chloromethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Bromomethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Chloroethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Trichlorofluoromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,1-Dichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Acetone	130	90		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Freon-113	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Carbon disulfide	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Vinyl acetate	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Methyl acetate	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Methylene chloride	BRL	18		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Methyl tert-butyl ether	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
trans-1,2-Dichloroethene	7.4	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,1-Dichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
cis-1,2-Dichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
2-Butanone	BRL	45		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Chloroform	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,1,1-Trichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Cyclohexane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Carbon tetrachloride	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Benzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2-Dichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Trichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Methylcyclohexane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2-Dichloropropane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Bromodichloromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
cis-1,3-Dichloropropene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
4-Methyl-2-pentanone	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Toluene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
trans-1,3-Dichloropropene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,1,2-Trichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
2-Hexanone	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Tetrachloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Dibromochloromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2-Dibromoethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Chlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Ethylbenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
m,p-Xylene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
o-Xylene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5 (27.5' - 29.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 5:05:00 PM
Lab ID: 1506M69-006	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
Styrene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Bromoform	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,1,2,2-Tetrachloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Isopropylbenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,3-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,4-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2-Dibromo-3-chloropropane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
1,2,4-Trichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:21	CG
Surr: 4-Bromofluorobenzene	108	70-128		%REC	209428	1	06/29/2015 14:21	CG
Surr: Dibromofluoromethane	123	78.2-128		%REC	209428	1	06/29/2015 14:21	CG
Surr: Toluene-d8	104	76.5-116		%REC	209428	1	06/29/2015 14:21	CG
PERCENT MOISTURE D2216								
Percent Moisture	16.1	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 5:05:00 PM
Lab ID: 1506M69-007	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B (SW5030B)								
1,1,1-Trichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,1,2,2-Tetrachloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,1,2-Trichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,1-Dichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,1-Dichloroethene	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2,4-Trichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2-Dibromo-3-chloropropane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2-Dibromoethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2-Dichloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,2-Dichloropropane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,3-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
1,4-Dichlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
2-Butanone	BRL	10		ug/L	209186	1	06/23/2015 19:15	NP
2-Hexanone	BRL	10		ug/L	209186	1	06/23/2015 19:15	NP
4-Methyl-2-pentanone	BRL	10		ug/L	209186	1	06/23/2015 19:15	NP
Acetone	BRL	20		ug/L	209186	1	06/23/2015 19:15	NP
Benzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Bromodichloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Bromoform	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Bromomethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Carbon disulfide	BRL	5.0		ug/L	209186	1	06/23/2015 19:15	NP
Carbon tetrachloride	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
Chlorobenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Chloroethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Chloroform	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Chloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
cis-1,2-Dichloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
cis-1,3-Dichloropropene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Cyclohexane	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
Dibromochloromethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Dichlorodifluoromethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Ethylbenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Freon-113	BRL	5.0		ug/L	209186	1	06/23/2015 19:15	NP
Isopropylbenzene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
m,p-Xylene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Methyl acetate	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
Methyl tert-butyl ether	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Methylcyclohexane	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
Methylene chloride	BRL	5.0		ug/L	209186	1	06/23/2015 19:15	NP
o-Xylene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: B-5
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 5:05:00 PM
Lab ID: 1506M69-007	Matrix: Groundwater

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
TCL VOLATILE ORGANICS SW8260B					(SW5030B)			
Styrene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Tetrachloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Toluene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
trans-1,2-Dichloroethene	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
trans-1,3-Dichloropropene	BRL	2.0		ug/L	209186	1	06/23/2015 19:15	NP
Trichloroethene	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Trichlorofluoromethane	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Vinyl chloride	BRL	1.0		ug/L	209186	1	06/23/2015 19:15	NP
Surr: 4-Bromofluorobenzene	93.5	70-130		%REC	209186	1	06/23/2015 19:15	NP
Surr: Dibromofluoromethane	107	70-130		%REC	209186	1	06/23/2015 19:15	NP
Surr: Toluene-d8	98.1	70-130		%REC	209186	1	06/23/2015 19:15	NP
1,4-Dioxane by SIM GC/MS SW8260B-SIM					(SW5030B)			
1,4-Dioxane	BRL	2.0		ug/L	209464	1	06/29/2015 11:45	NP
Surr: 4-Bromofluorobenzene	100	70.6-123		%REC	209464	1	06/29/2015 11:45	NP
Surr: Dibromofluoromethane	102	78-126		%REC	209464	1	06/29/2015 11:45	NP
Surr: Toluene-d8	101	77.1-119		%REC	209464	1	06/29/2015 11:45	NP

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
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- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: B-5/HA-5
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 5:10:00 PM
Lab ID: 1506M69-008	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
VOLATILES, TCLP SW1311/8260B					(SW5030B)			
Chloroform	BRL	0.10		mg/L	209275	20	06/24/2015 18:57	CH

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: HA-5 (5.5'-6.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 1:44:00 PM
Lab ID: 1506M69-009	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	130		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Dichlorodifluoromethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Chloromethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Bromomethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Chloroethane	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Trichlorofluoromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,1-Dichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Acetone	94	90		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Freon-113	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Carbon disulfide	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Vinyl acetate	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Methyl acetate	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Methylene chloride	BRL	18		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Methyl tert-butyl ether	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
trans-1,2-Dichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,1-Dichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
cis-1,2-Dichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
2-Butanone	BRL	45		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Chloroform	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,1,1-Trichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Cyclohexane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Carbon tetrachloride	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Benzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2-Dichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Trichloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Methylcyclohexane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2-Dichloropropane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Bromodichloromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
cis-1,3-Dichloropropene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
4-Methyl-2-pentanone	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Toluene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
trans-1,3-Dichloropropene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,1,2-Trichloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
2-Hexanone	BRL	9.0		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Tetrachloroethene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Dibromochloromethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2-Dibromoethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Chlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Ethylbenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
m,p-Xylene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
o-Xylene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-5 (5.5'-6.0')
Project Name: I-85 Rehab.	Collection Date: 6/17/2015 1:44:00 PM
Lab ID: 1506M69-009	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B			(SW5035)					
Styrene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Bromoform	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,1,2,2-Tetrachloroethane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Isopropylbenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,3-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,4-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2-Dichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2-Dibromo-3-chloropropane	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
1,2,4-Trichlorobenzene	BRL	4.5		ug/Kg-dry	209428	1	06/29/2015 14:45	CG
Surr: 4-Bromofluorobenzene	105	70-128		%REC	209428	1	06/29/2015 14:45	CG
Surr: Dibromofluoromethane	126	78.2-128		%REC	209428	1	06/29/2015 14:45	CG
Surr: Toluene-d8	105	76.5-116		%REC	209428	1	06/29/2015 14:45	CG
PERCENT MOISTURE D2216								
Percent Moisture	15.6	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-6 (4.5'-5.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 9:40:00 AM
Lab ID: 1506M69-010	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
1,4-Dioxane	BRL	120		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Dichlorodifluoromethane	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Chloromethane	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Bromomethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Chloroethane	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Trichlorofluoromethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,1-Dichloroethene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Acetone	BRL	78		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Freon-113	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Carbon disulfide	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Vinyl acetate	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Methyl acetate	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Methylene chloride	BRL	16		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Methyl tert-butyl ether	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
trans-1,2-Dichloroethene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,1-Dichloroethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
cis-1,2-Dichloroethene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
2-Butanone	BRL	39		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Chloroform	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,1,1-Trichloroethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Cyclohexane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Carbon tetrachloride	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Benzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2-Dichloroethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Trichloroethene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Methylcyclohexane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2-Dichloropropane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Bromodichloromethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
cis-1,3-Dichloropropene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
4-Methyl-2-pentanone	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Toluene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
trans-1,3-Dichloropropene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,1,2-Trichloroethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
2-Hexanone	BRL	7.8		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Tetrachloroethene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Dibromochloromethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2-Dibromoethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Chlorobenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Ethylbenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
m,p-Xylene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
o-Xylene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-6 (4.5'-5.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 9:40:00 AM
Lab ID: 1506M69-010	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
Styrene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Bromoform	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,1,2,2-Tetrachloroethane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Isopropylbenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,3-Dichlorobenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,4-Dichlorobenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2-Dichlorobenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2-Dibromo-3-chloropropane	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
1,2,4-Trichlorobenzene	BRL	3.9		ug/Kg-dry	209428	1	06/27/2015 00:50	CG
Surr: 4-Bromofluorobenzene	113	70-128		%REC	209428	1	06/27/2015 00:50	CG
Surr: Dibromofluoromethane	129	78.2-128	S	%REC	209428	1	06/27/2015 00:50	CG
Surr: Toluene-d8	99.1	76.5-116		%REC	209428	1	06/27/2015 00:50	CG
PERCENT MOISTURE D2216								
Percent Moisture	11.0	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:	* Value exceeds maximum contaminant level	E Estimated (value above quantitation range)
	BRL Below reporting limit	S Spike Recovery outside limits due to matrix
	H Holding times for preparation or analysis exceeded	Narr See case narrative
	N Analyte not NELAC certified	NC Not confirmed
	B Analyte detected in the associated method blank	< Less than Result value
	> Greater than Result value	J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: HA-7 (2.5' - 3.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 10:15:00 AM
Lab ID: 1506M69-011	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
1,4-Dioxane	BRL	120		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Dichlorodifluoromethane	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Chloromethane	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Bromomethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Chloroethane	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Trichlorofluoromethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,1-Dichloroethene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Acetone	BRL	83		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Freon-113	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Carbon disulfide	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Vinyl acetate	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Methyl acetate	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Methylene chloride	BRL	17		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Methyl tert-butyl ether	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
trans-1,2-Dichloroethene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,1-Dichloroethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
cis-1,2-Dichloroethene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
2-Butanone	BRL	41		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Chloroform	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,1,1-Trichloroethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Cyclohexane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Carbon tetrachloride	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Benzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2-Dichloroethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Trichloroethene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Methylcyclohexane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2-Dichloropropane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Bromodichloromethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
cis-1,3-Dichloropropene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
4-Methyl-2-pentanone	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Toluene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
trans-1,3-Dichloropropene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,1,2-Trichloroethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
2-Hexanone	BRL	8.3		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Tetrachloroethene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Dibromochloromethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2-Dibromoethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Chlorobenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Ethylbenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
m,p-Xylene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
o-Xylene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 1-Jul-15

Client: F&ME Consultants	Client Sample ID: HA-7 (2.5' - 3.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 10:15:00 AM
Lab ID: 1506M69-011	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B (SW5035)								
Styrene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Bromoform	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,1,2,2-Tetrachloroethane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Isopropylbenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,3-Dichlorobenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,4-Dichlorobenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2-Dichlorobenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2-Dibromo-3-chloropropane	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
1,2,4-Trichlorobenzene	BRL	4.1		ug/Kg-dry	209428	1	06/27/2015 01:14	CG
Surr: 4-Bromofluorobenzene	110	70-128		%REC	209428	1	06/27/2015 01:14	CG
Surr: Dibromofluoromethane	133	78.2-128	S	%REC	209428	1	06/27/2015 01:14	CG
Surr: Toluene-d8	100	76.5-116		%REC	209428	1	06/27/2015 01:14	CG
PERCENT MOISTURE D2216								
Percent Moisture	9.57	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-8 (5.5' - 6.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 11:20:00 AM
Lab ID: 1506M69-012	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B				(SW5035)				
1,4-Dioxane	BRL	130		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Dichlorodifluoromethane	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Chloromethane	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Bromomethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Chloroethane	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Trichlorofluoromethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,1-Dichloroethene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Acetone	160	85		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Freon-113	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Carbon disulfide	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Vinyl acetate	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Methyl acetate	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Methylene chloride	BRL	17		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Methyl tert-butyl ether	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
trans-1,2-Dichloroethene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,1-Dichloroethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
cis-1,2-Dichloroethene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
2-Butanone	BRL	43		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Chloroform	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,1,1-Trichloroethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Cyclohexane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Carbon tetrachloride	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Benzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2-Dichloroethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Trichloroethene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Methylcyclohexane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2-Dichloropropane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Bromodichloromethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
cis-1,3-Dichloropropene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
4-Methyl-2-pentanone	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Toluene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
trans-1,3-Dichloropropene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,1,2-Trichloroethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
2-Hexanone	BRL	8.5		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Tetrachloroethene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Dibromochloromethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2-Dibromoethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Chlorobenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Ethylbenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
m,p-Xylene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
o-Xylene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: F&ME Consultants	Client Sample ID: HA-8 (5.5' - 6.0')
Project Name: I-85 Rehab.	Collection Date: 6/18/2015 11:20:00 AM
Lab ID: 1506M69-012	Matrix: Solid

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Volatile Organic Compounds by GC/MS SW8260B					(SW5035)			
Styrene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Bromoform	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,1,2,2-Tetrachloroethane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Isopropylbenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,3-Dichlorobenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,4-Dichlorobenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2-Dichlorobenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2-Dibromo-3-chloropropane	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
1,2,4-Trichlorobenzene	BRL	4.3		ug/Kg-dry	209428	1	06/27/2015 01:38	CG
Surr: 4-Bromofluorobenzene	98.9	70-128		%REC	209428	1	06/27/2015 01:38	CG
Surr: Dibromofluoromethane	111	78.2-128		%REC	209428	1	06/27/2015 01:38	CG
Surr: Toluene-d8	101	76.5-116		%REC	209428	1	06/27/2015 01:38	CG
PERCENT MOISTURE D2216								
Percent Moisture	13.7	0		wt%	R294824	1	06/26/2015 11:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access Analytical

Work Order Number 1506469

Checklist completed by Miriam Duran 06/22/2015
Signature Date

Carrier name: FedEx UPS Courier Client US Mail Other

Shipping container/cooler in good condition? Yes No Not Present

Custody seals intact on shipping container/cooler? Yes No Not Present

Custody seals intact on sample bottles? Yes No Not Present

Container/Temp Blank temperature in compliance? (0°≤6°C)* Yes No

Cooler #1 3.6 Cooler #2 3.1 Cooler #3 3.3 Cooler #4 _____ Cooler#5 _____ Cooler #6 _____

Chain of custody present? Yes No

Chain of custody signed when relinquished and received? Yes No

Chain of custody agrees with sample labels? Yes No

Samples in proper container/bottle? Yes No

Sample containers intact? Yes No

Sufficient sample volume for indicated test? Yes No

All samples received within holding time? Yes No

Was TAT marked on the COC? Yes No

Proceed with Standard TAT as per project history? Yes No Not Applicable

Water - VOA vials have zero headspace? No VOA vials submitted Yes No

Water - pH acceptable upon receipt? Yes No Not Applicable

Adjusted? _____ Checked by _____

Sample Condition: Good Other(Explain) _____

(For diffusive samples or AIHA lead) Is a known blank included? Yes No

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: MB-209186	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
Sample Type: MBLK	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275860							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	BRL	1.0									
1,1,2,2-Tetrachloroethane	BRL	1.0									
1,1,2-Trichloroethane	BRL	1.0									
1,1-Dichloroethane	BRL	1.0									
1,1-Dichloroethene	BRL	2.0									
1,2,4-Trichlorobenzene	BRL	1.0									
1,2-Dibromo-3-chloropropane	BRL	1.0									
1,2-Dibromoethane	BRL	1.0									
1,2-Dichlorobenzene	BRL	1.0									
1,2-Dichloroethane	BRL	1.0									
1,2-Dichloropropane	BRL	1.0									
1,3-Dichlorobenzene	BRL	1.0									
1,4-Dichlorobenzene	BRL	1.0									
2-Butanone	BRL	10									
2-Hexanone	BRL	10									
4-Methyl-2-pentanone	BRL	10									
Acetone	BRL	20									
Benzene	BRL	1.0									
Bromodichloromethane	BRL	1.0									
Bromoform	BRL	1.0									
Bromomethane	BRL	1.0									
Carbon disulfide	BRL	5.0									
Carbon tetrachloride	BRL	2.0									
Chlorobenzene	BRL	1.0									
Chloroethane	BRL	1.0									
Chloroform	BRL	1.0									
Chloromethane	BRL	1.0									

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: MB-209186	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
SampleType: MBLK	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275860							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

cis-1,2-Dichloroethene	BRL	1.0									
cis-1,3-Dichloropropene	BRL	1.0									
Cyclohexane	BRL	2.0									
Dibromochloromethane	BRL	1.0									
Dichlorodifluoromethane	BRL	1.0									
Ethylbenzene	BRL	1.0									
Freon-113	BRL	5.0									
Isopropylbenzene	BRL	1.0									
m,p-Xylene	BRL	1.0									
Methyl acetate	BRL	2.0									
Methyl tert-butyl ether	BRL	1.0									
Methylcyclohexane	BRL	2.0									
Methylene chloride	BRL	5.0									
o-Xylene	BRL	1.0									
Styrene	BRL	1.0									
Tetrachloroethene	BRL	1.0									
Toluene	BRL	1.0									
trans-1,2-Dichloroethene	BRL	2.0									
trans-1,3-Dichloropropene	BRL	2.0									
Trichloroethene	BRL	1.0									
Trichlorofluoromethane	BRL	1.0									
Vinyl chloride	BRL	1.0									
Surr: 4-Bromofluorobenzene	45.83	0	50.00		91.7	70	130				
Surr: Dibromofluoromethane	53.79	0	50.00		108	70	130				
Surr: Toluene-d8	48.59	0	50.00		97.2	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: LCS-209186	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
SampleType: LCS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275858							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	57.67	1.0	50.00		115	70	130				
1,1,2,2-Tetrachloroethane	46.08	1.0	50.00		92.2	70	130				
1,1,2-Trichloroethane	55.59	1.0	50.00		111	70	130				
1,1-Dichloroethane	54.29	1.0	50.00		109	70	130				
1,1-Dichloroethene	58.48	2.0	50.00		117	60	140				
1,2,4-Trichlorobenzene	44.01	1.0	50.00		88.0	70	130				
1,2-Dibromo-3-chloropropane	44.31	1.0	50.00		88.6	70	130				
1,2-Dibromoethane	54.29	1.0	50.00		109	70	130				
1,2-Dichlorobenzene	50.12	1.0	50.00		100	70	130				
1,2-Dichloroethane	56.26	1.0	50.00		113	70	130				
1,2-Dichloropropane	53.68	1.0	50.00		107	70	130				
1,3-Dichlorobenzene	49.84	1.0	50.00		99.7	70	130				
1,4-Dichlorobenzene	48.36	1.0	50.00		96.7	70	130				
Benzene	56.37	1.0	50.00		113	70	130				
Bromodichloromethane	55.46	1.0	50.00		111	70	130				
Bromoform	58.48	1.0	50.00		117	70	130				
Carbon tetrachloride	60.43	2.0	50.00		121	70	130				
Chlorobenzene	54.00	1.0	50.00		108	70	130				
Chloroform	54.93	1.0	50.00		110	70	130				
cis-1,2-Dichloroethene	52.41	1.0	50.00		105	70	130				
cis-1,3-Dichloropropene	56.34	1.0	50.00		113	70	130				
Dibromochloromethane	54.20	1.0	50.00		108	70	130				
Ethylbenzene	58.51	1.0	50.00		117	70	130				
Isopropylbenzene	50.85	1.0	50.00		102	70	130				
m,p-Xylene	118.0	1.0	100.0		118	70	130				
Methylene chloride	50.29	5.0	50.00		101	70	130				
o-Xylene	58.25	1.0	50.00		116	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: LCS-209186	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
SampleType: LCS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275858							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Styrene	51.35	1.0	50.00		103	70	130				
Tetrachloroethene	58.54	1.0	50.00		117	70	130				
Toluene	55.93	1.0	50.00		112	70	130				
trans-1,2-Dichloroethene	51.89	2.0	50.00		104	70	130				
trans-1,3-Dichloropropene	60.69	2.0	50.00		121	70	130				
Trichloroethene	54.74	1.0	50.00		109	70	130				
Vinyl chloride	41.60	1.0	50.00		83.2	70	130				
Surr: 4-Bromofluorobenzene	52.77	0	50.00		106	70	130				
Surr: Dibromofluoromethane	52.55	0	50.00		105	70	130				
Surr: Toluene-d8	50.35	0	50.00		101	70	130				

Sample ID: 1506K80-004AMS	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
SampleType: MS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275869							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	61.05	1.0	50.00		122	64.1	145				
1,1,2,2-Tetrachloroethane	46.88	1.0	50.00		93.8	63.6	133				
1,1,2-Trichloroethane	59.70	1.0	50.00		119	71.9	136				
1,1-Dichloroethane	56.66	1.0	50.00		113	67.7	138				
1,1-Dichloroethene	60.30	2.0	50.00		121	60.5	156				
1,2,4-Trichlorobenzene	35.31	1.0	50.00		70.6	60	130				
1,2-Dibromo-3-chloropropane	42.78	1.0	50.00		85.6	60.6	128				
1,2-Dibromoethane	56.43	1.0	50.00		113	75	133				
1,2-Dichlorobenzene	50.63	1.0	50.00		101	71.7	127				
1,2-Dichloroethane	59.37	1.0	50.00		119	71.7	134				
1,2-Dichloropropane	57.37	1.0	50.00		115	69.6	137				
1,3-Dichlorobenzene	49.69	1.0	50.00		99.4	71.4	130				
1,4-Dichlorobenzene	49.56	1.0	50.00		99.1	72.7	123				

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: 1506K80-004AMS	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434							
SampleType: MS	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275869							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Benzene	60.00	1.0	50.00		120	70	135				
Bromodichloromethane	59.68	1.0	50.00		119	60.3	142				
Bromoform	59.12	1.0	50.00		118	50.2	139				
Carbon tetrachloride	64.64	2.0	50.00		129	64.4	146				
Chlorobenzene	56.72	1.0	50.00		113	70.5	132				
Chloroform	58.41	1.0	50.00		117	70.1	141				
cis-1,2-Dichloroethene	55.85	1.0	50.00		112	70.7	138				
cis-1,3-Dichloropropene	60.70	1.0	50.00		121	58.7	137				
Dibromochloromethane	55.07	1.0	50.00		110	63.2	130				
Ethylbenzene	61.08	1.0	50.00		122	73.7	135				
Isopropylbenzene	51.69	1.0	50.00		103	66.2	129				
m,p-Xylene	124.3	1.0	100.0		124	70.7	136				
Methylene chloride	53.85	5.0	50.00		108	70.1	132				
o-Xylene	60.97	1.0	50.00		122	71.3	137				
Styrene	53.64	1.0	50.00		107	72	135				
Tetrachloroethene	60.29	1.0	50.00		121	71.4	139				
Toluene	60.36	1.0	50.00		121	70.5	137				
trans-1,2-Dichloroethene	54.18	2.0	50.00		108	68.3	142				
trans-1,3-Dichloropropene	63.22	2.0	50.00		126	60.2	124				S
Trichloroethene	57.07	1.0	50.00		114	71.8	139				
Vinyl chloride	46.02	1.0	50.00		92.0	70	132				
Surr: 4-Bromofluorobenzene	52.52	0	50.00		105	70	130				
Surr: Dibromofluoromethane	53.42	0	50.00		107	70	130				
Surr: Toluene-d8	51.58	0	50.00		103	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: 1506K80-004AMSD	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434
SampleType: MSD	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275875

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	60.37	1.0	50.00		121	64.1	145	61.05	1.12	20	
1,1,2,2-Tetrachloroethane	47.67	1.0	50.00		95.3	63.6	133	46.88	1.67	20	
1,1,2-Trichloroethane	58.49	1.0	50.00		117	71.9	136	59.70	2.05	20	
1,1-Dichloroethane	54.85	1.0	50.00		110	67.7	138	56.66	3.25	20	
1,1-Dichloroethene	60.38	2.0	50.00		121	60.5	156	60.30	0.133	20	
1,2,4-Trichlorobenzene	40.59	1.0	50.00		81.2	60	130	35.31	13.9	26.5	
1,2-Dibromo-3-chloropropane	45.82	1.0	50.00		91.6	60.6	128	42.78	6.86	20.4	
1,2-Dibromoethane	55.98	1.0	50.00		112	75	133	56.43	0.801	20	
1,2-Dichlorobenzene	50.47	1.0	50.00		101	71.7	127	50.63	0.317	20	
1,2-Dichloroethane	58.97	1.0	50.00		118	71.7	134	59.37	0.676	20	
1,2-Dichloropropane	55.81	1.0	50.00		112	69.6	137	57.37	2.76	20	
1,3-Dichlorobenzene	50.10	1.0	50.00		100	71.4	130	49.69	0.822	20	
1,4-Dichlorobenzene	48.34	1.0	50.00		96.7	72.7	123	49.56	2.49	20	
Benzene	58.97	1.0	50.00		118	70	135	60.00	1.73	20	
Bromodichloromethane	57.91	1.0	50.00		116	60.3	142	59.68	3.01	20	
Bromoform	58.62	1.0	50.00		117	50.2	139	59.12	0.849	20	
Carbon tetrachloride	63.24	2.0	50.00		126	64.4	146	64.64	2.19	19.3	
Chlorobenzene	54.95	1.0	50.00		110	70.5	132	56.72	3.17	20	
Chloroform	57.62	1.0	50.00		115	70.1	141	58.41	1.36	20	
cis-1,2-Dichloroethene	55.00	1.0	50.00		110	70.7	138	55.85	1.53	20	
cis-1,3-Dichloropropene	58.52	1.0	50.00		117	58.7	137	60.70	3.66	20	
Dibromochloromethane	54.75	1.0	50.00		110	63.2	130	55.07	0.583	20	
Ethylbenzene	59.41	1.0	50.00		119	73.7	135	61.08	2.77	20	
Isopropylbenzene	52.07	1.0	50.00		104	66.2	129	51.69	0.732	20	
m,p-Xylene	122.0	1.0	100.0		122	70.7	136	124.3	1.88	20	
Methylene chloride	53.89	5.0	50.00		108	70.1	132	53.85	0.074	20	
o-Xylene	60.43	1.0	50.00		121	71.3	137	60.97	0.890	20	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209186

Sample ID: 1506K80-004AMSD	Client ID:	Units: ug/L	Prep Date: 06/23/2015	Run No: 294434
SampleType: MSD	TestCode: TCL VOLATILE ORGANICS SW8260B	BatchID: 209186	Analysis Date: 06/23/2015	Seq No: 6275875

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Styrene	52.81	1.0	50.00		106	72	135	53.64	1.56	20	
Tetrachloroethene	58.10	1.0	50.00		116	71.4	139	60.29	3.70	20	
Toluene	58.97	1.0	50.00		118	70.5	137	60.36	2.33	20	
trans-1,2-Dichloroethene	54.77	2.0	50.00		110	68.3	142	54.18	1.08	20	
trans-1,3-Dichloropropene	62.68	2.0	50.00		125	60.2	124	63.22	0.858	20	S
Trichloroethene	55.78	1.0	50.00		112	71.8	139	57.07	2.29	20	
Vinyl chloride	28.38	1.0	50.00		56.8	70	132	46.02	47.4	20	SR
Surr: 4-Bromofluorobenzene	52.43	0	50.00		105	70	130	52.52	0	0	
Surr: Dibromofluoromethane	52.76	0	50.00		106	70	130	53.42	0	0	
Surr: Toluene-d8	50.34	0	50.00		101	70	130	51.58	0	0	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209275

Sample ID: MB-209275	Client ID:	Units: mg/L	Prep Date: 06/23/2015	Run No: 294519							
SampleType: MBLK	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 209275	Analysis Date: 06/23/2015	Seq No: 6278766							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform BRL 0.10

Sample ID: LCS-209275	Client ID:	Units: mg/L	Prep Date: 06/23/2015	Run No: 294519							
SampleType: LCS	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 209275	Analysis Date: 06/23/2015	Seq No: 6278860							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform 0.8564 0.10 1.000 85.6 67.9 130

Sample ID: 1506J94-001AMS	Client ID:	Units: mg/L	Prep Date: 06/23/2015	Run No: 294519							
SampleType: MS	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 209275	Analysis Date: 06/24/2015	Seq No: 6278782							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform 0.8644 0.10 1.000 86.4 64.2 138

Sample ID: 1506J94-001ADUP	Client ID:	Units: mg/L	Prep Date: 06/23/2015	Run No: 294519							
SampleType: DUP	TestCode: VOLATILES, TCLP SW1311/8260B	BatchID: 209275	Analysis Date: 06/24/2015	Seq No: 6278779							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloroform BRL 0.10 0 0 30

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: MB-209428	Client ID:	Units: ug/Kg	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MBLK	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284876							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	BRL	5.0									
1,1,2,2-Tetrachloroethane	BRL	5.0									
1,1,2-Trichloroethane	BRL	5.0									
1,1-Dichloroethane	BRL	5.0									
1,1-Dichloroethene	BRL	5.0									
1,2,4-Trichlorobenzene	BRL	5.0									
1,2-Dibromo-3-chloropropane	BRL	5.0									
1,2-Dibromoethane	BRL	5.0									
1,2-Dichlorobenzene	BRL	5.0									
1,2-Dichloroethane	BRL	5.0									
1,2-Dichloropropane	BRL	5.0									
1,3-Dichlorobenzene	BRL	5.0									
1,4-Dichlorobenzene	BRL	5.0									
1,4-Dioxane	BRL	150									
2-Butanone	BRL	50									
2-Hexanone	BRL	10									
4-Methyl-2-pentanone	BRL	10									
Acetone	BRL	100									
Benzene	BRL	5.0									
Bromodichloromethane	BRL	5.0									
Bromoform	BRL	5.0									
Bromomethane	BRL	5.0									
Carbon disulfide	BRL	10									
Carbon tetrachloride	BRL	5.0									
Chlorobenzene	BRL	5.0									
Chloroethane	BRL	10									
Chloroform	BRL	5.0									

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: MB-209428	Client ID:	Units: ug/Kg	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MBLK	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284876							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloromethane	BRL	10									
cis-1,2-Dichloroethene	BRL	5.0									
cis-1,3-Dichloropropene	BRL	5.0									
Cyclohexane	BRL	5.0									
Dibromochloromethane	BRL	5.0									
Dichlorodifluoromethane	BRL	10									
Ethylbenzene	BRL	5.0									
Freon-113	BRL	10									
Isopropylbenzene	BRL	5.0									
m,p-Xylene	BRL	5.0									
Methyl acetate	BRL	5.0									
Methyl tert-butyl ether	BRL	5.0									
Methylcyclohexane	BRL	5.0									
Methylene chloride	BRL	20									
o-Xylene	BRL	5.0									
Styrene	BRL	5.0									
Tetrachloroethene	BRL	5.0									
Toluene	BRL	5.0									
trans-1,2-Dichloroethene	BRL	5.0									
trans-1,3-Dichloropropene	BRL	5.0									
Trichloroethene	BRL	5.0									
Trichlorofluoromethane	BRL	5.0									
Vinyl acetate	BRL	10									
Surr: 4-Bromofluorobenzene	53.57	0	50.00		107	70	130				
Surr: Dibromofluoromethane	62.90	0	50.00		126	70	130				
Surr: Toluene-d8	53.55	0	50.00		107	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: LCS-209428	Client ID:	Units: ug/Kg	Prep Date: 06/26/2015	Run No: 295068							
SampleType: LCS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/30/2015	Seq No: 6289789							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,1-Trichloroethane	67.44	5.0	50.00		135	70	130				S
1,1,2,2-Tetrachloroethane	43.01	5.0	50.00		86.0	70	130				
1,1,2-Trichloroethane	52.62	5.0	50.00		105	70	130				
1,1-Dichloroethane	46.92	5.0	50.00		93.8	70	130				
1,1-Dichloroethene	54.96	5.0	50.00		110	60	140				
1,2,4-Trichlorobenzene	50.66	5.0	50.00		101	70	130				
1,2-Dibromo-3-chloropropane	54.03	5.0	50.00		108	70	130				
1,2-Dibromoethane	53.01	5.0	50.00		106	70	130				
1,2-Dichlorobenzene	50.27	5.0	50.00		101	70	130				
1,2-Dichloroethane	70.47	5.0	50.00		141	70	130				S
1,2-Dichloropropane	46.29	5.0	50.00		92.6	70	130				
1,3-Dichlorobenzene	49.81	5.0	50.00		99.6	70	130				
1,4-Dichlorobenzene	48.99	5.0	50.00		98.0	70	130				
Benzene	48.50	5.0	50.00		97.0	70	130				
Bromodichloromethane	64.99	5.0	50.00		130	70	130				
Bromoform	69.91	5.0	50.00		140	70	130				S
Carbon tetrachloride	80.58	5.0	50.00		161	70	130				S
Chlorobenzene	51.03	5.0	50.00		102	70	130				
Chloroform	55.79	5.0	50.00		112	70	130				
cis-1,2-Dichloroethene	49.00	5.0	50.00		98.0	70	130				
cis-1,3-Dichloropropene	48.33	5.0	50.00		96.7	70	130				
Dibromochloromethane	56.13	5.0	50.00		112	70	130				
Ethylbenzene	54.77	5.0	50.00		110	70	130				
Isopropylbenzene	47.10	5.0	50.00		94.2	70	130				
m,p-Xylene	113.7	5.0	100.0		114	70	130				
Methylene chloride	54.57	20	50.00	3.260	103	70	130				
o-Xylene	57.78	5.0	50.00		116	70	130				

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: LCS-209428	Client ID:	Units: ug/Kg	Prep Date: 06/26/2015	Run No: 295068							
SampleType: LCS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/30/2015	Seq No: 6289789							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Styrene	56.95	5.0	50.00		114	70	130				
Tetrachloroethene	58.95	5.0	50.00		118	70	130				
Toluene	51.90	5.0	50.00		104	70	130				
trans-1,2-Dichloroethene	48.14	5.0	50.00		96.3	70	130				
trans-1,3-Dichloropropene	49.79	5.0	50.00		99.6	70	130				
Trichloroethene	55.90	5.0	50.00		112	70	130				
Surr: 4-Bromofluorobenzene	60.05	0	50.00		120	70	130				
Surr: Dibromofluoromethane	61.16	0	50.00		122	70	130				
Surr: Toluene-d8	52.74	0	50.00		105	70	130				

Sample ID: 1506M69-011AMS	Client ID: HA-7 (2.5' - 3.0')	Units: ug/Kg-dry	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284878							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	72.34	5.5	55.29		131	70	135				
1,1,2,2-Tetrachloroethane	52.43	5.5	55.29		94.8	70.2	126				
1,1,2-Trichloroethane	58.76	5.5	55.29		106	72.3	130				
1,1-Dichloroethane	54.64	5.5	55.29		98.8	60.8	140				
1,1-Dichloroethene	61.12	5.5	55.29		111	56.6	151				
1,2,4-Trichlorobenzene	56.30	5.5	55.29		102	62.2	135				
1,2-Dibromo-3-chloropropane	60.88	5.5	55.29		110	60.6	126				
1,2-Dibromoethane	60.30	5.5	55.29		109	74.1	123				
1,2-Dichlorobenzene	55.55	5.5	55.29		100	70.4	130				
1,2-Dichloroethane	74.01	5.5	55.29		134	70.2	129				S
1,2-Dichloropropane	53.63	5.5	55.29		97.0	70.1	129				
1,3-Dichlorobenzene	56.72	5.5	55.29		103	70.7	130				
1,4-Dichlorobenzene	55.63	5.5	55.29		101	70.6	130				
Benzene	57.06	5.5	55.29		103	70.4	130				

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: 1506M69-011AMS	Client ID: HA-7 (2.5' - 3.0')	Units: ug/Kg-dry	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MS	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284878							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Bromodichloromethane	68.51	5.5	55.29		124	70	125				
Bromoform	76.06	5.5	55.29		138	65.2	122				S
Carbon tetrachloride	82.47	5.5	55.29		149	64.3	138				S
Chlorobenzene	58.82	5.5	55.29		106	67.5	132				
Chloroform	62.62	5.5	55.29		113	73.9	130				
cis-1,2-Dichloroethene	58.03	5.5	55.29		105	70.9	139				
cis-1,3-Dichloropropene	53.06	5.5	55.29		96.0	60.4	120				
Dibromochloromethane	62.72	5.5	55.29		113	65.1	121				
Ethylbenzene	62.37	5.5	55.29		113	64.9	136				
Isopropylbenzene	54.21	5.5	55.29		98.0	70.2	129				
m,p-Xylene	126.6	5.5	110.6		114	60.2	138				
Methylene chloride	62.07	22	55.29		112	64.5	158				
o-Xylene	64.28	5.5	55.29		116	61.5	134				
Styrene	64.24	5.5	55.29		116	72.9	130				
Tetrachloroethene	67.95	5.5	55.29	2.682	118	70.1	134				
Toluene	57.59	5.5	55.29		104	70.4	130				
trans-1,2-Dichloroethene	60.79	5.5	55.29		110	60.4	158				
trans-1,3-Dichloropropene	52.90	5.5	55.29		95.7	60.1	117				
Trichloroethene	60.90	5.5	55.29		110	70.1	137				
Surr: 4-Bromofluorobenzene	65.19	0	55.29		118	70	128				
Surr: Dibromofluoromethane	67.07	0	55.29		121	78.2	128				
Surr: Toluene-d8	57.51	0	55.29		104	76.5	116				

Sample ID: 1506M69-011AMSD	Client ID: HA-7 (2.5' - 3.0')	Units: ug/Kg-dry	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MSD	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284879							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,1,1-Trichloroethane	68.17	5.5	55.29		123	70	135	72.34	5.93	18.7	
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Qualifiers:	> Greater than Result value	< Less than Result value	B Analyte detected in the associated method blank
BRL	Below reporting limit	E Estimated (value above quantitation range)	H Holding times for preparation or analysis exceeded
J	Estimated value detected below Reporting Limit	N Analyte not NELAC certified	R RPD outside limits due to matrix
Rpt Lim	Reporting Limit	S Spike Recovery outside limits due to matrix	

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: 1506M69-011AMSD	Client ID: HA-7 (2.5' - 3.0')	Units: ug/Kg-dry	Prep Date: 06/26/2015	Run No: 294865							
SampleType: MSD	TestCode: Volatile Organic Compounds by GC/MS SW8260B	BatchID: 209428	Analysis Date: 06/26/2015	Seq No: 6284879							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
1,1,2,2-Tetrachloroethane	50.61	5.5	55.29		91.5	70.2	126	52.43	3.52	15	
1,1,2-Trichloroethane	57.55	5.5	55.29		104	72.3	130	58.76	2.09	14.1	
1,1-Dichloroethane	51.89	5.5	55.29		93.8	60.8	140	54.64	5.17	14.1	
1,1-Dichloroethene	57.65	5.5	55.29		104	56.6	151	61.12	5.85	20.4	
1,2,4-Trichlorobenzene	51.90	5.5	55.29		93.9	62.2	135	56.30	8.14	23.9	
1,2-Dibromo-3-chloropropane	58.09	5.5	55.29		105	60.6	126	60.88	4.68	15.2	
1,2-Dibromoethane	59.08	5.5	55.29		107	74.1	123	60.30	2.04	14.4	
1,2-Dichlorobenzene	53.91	5.5	55.29		97.5	70.4	130	55.55	2.99	15	
1,2-Dichloroethane	71.94	5.5	55.29		130	70.2	129	74.01	2.83	15	S
1,2-Dichloropropane	51.38	5.5	55.29		92.9	70.1	129	53.63	4.30	15.1	
1,3-Dichlorobenzene	53.65	5.5	55.29		97.0	70.7	130	56.72	5.55	15.2	
1,4-Dichlorobenzene	52.07	5.5	55.29		94.2	70.6	130	55.63	6.61	14.5	
Benzene	54.13	5.5	55.29		97.9	70.4	130	57.06	5.27	16.9	
Bromodichloromethane	66.86	5.5	55.29		121	70	125	68.51	2.43	15	
Bromoform	76.41	5.5	55.29		138	65.2	122	76.06	0.464	15.1	S
Carbon tetrachloride	76.15	5.5	55.29		138	64.3	138	82.47	7.98	25.2	
Chlorobenzene	55.46	5.5	55.29		100	67.5	132	58.82	5.88	14.6	
Chloroform	60.23	5.5	55.29		109	73.9	130	62.62	3.89	15	
cis-1,2-Dichloroethene	54.93	5.5	55.29		99.3	70.9	139	58.03	5.50	15	
cis-1,3-Dichloropropene	51.41	5.5	55.29		93.0	60.4	120	53.06	3.15	15.6	
Dibromochloromethane	60.71	5.5	55.29		110	65.1	121	62.72	3.26	16.3	
Ethylbenzene	56.20	5.5	55.29		102	64.9	136	62.37	10.4	16.3	
Isopropylbenzene	49.92	5.5	55.29		90.3	70.2	129	54.21	8.24	18.8	
m,p-Xylene	117.4	5.5	110.6		106	60.2	138	126.6	7.52	16.3	
Methylene chloride	59.97	22	55.29		108	64.5	158	62.07	3.44	23.7	
o-Xylene	60.12	5.5	55.29		109	61.5	134	64.28	6.68	16.1	
Styrene	60.39	5.5	55.29		109	72.9	130	64.24	6.18	15	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209428

Sample ID: **1506M69-011AMSD** Client ID: **HA-7 (2.5' - 3.0')** Units: **ug/Kg-dry** Prep Date: **06/26/2015** Run No: **294865**
 SampleType: **MSD** TestCode: **Volatile Organic Compounds by GC/MS SW8260B** BatchID: **209428** Analysis Date: **06/26/2015** Seq No: **6284879**

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Tetrachloroethene	61.46	5.5	55.29	2.682	106	70.1	134	67.95	10.0	19.3	
Toluene	55.88	5.5	55.29		101	70.4	130	57.59	3.02	16.6	
trans-1,2-Dichloroethene	52.39	5.5	55.29		94.8	60.4	158	60.79	14.8	54.5	
trans-1,3-Dichloropropene	51.97	5.5	55.29		94.0	60.1	117	52.90	1.77	15	
Trichloroethene	58.80	5.5	55.29		106	70.1	137	60.90	3.51	17	
Surr: 4-Bromofluorobenzene	65.80	0	55.29		119	70	128	65.19	0	0	
Surr: Dibromofluoromethane	66.99	0	55.29		121	78.2	128	67.07	0	0	
Surr: Toluene-d8	57.97	0	55.29		105	76.5	116	57.51	0	0	

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
Project Name: I-85 Rehab.
Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209464

Sample ID: MB-209464	Client ID:	Units: ug/L	Prep Date: 06/29/2015	Run No: 294917							
SampleType: MBLK	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 209464	Analysis Date: 06/29/2015	Seq No: 6285959							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	BRL	5.0									
Surr: 4-Bromofluorobenzene	49.83	0	50.00		99.7	70.6	123				
Surr: Dibromofluoromethane	47.50	0	50.00		95.0	78	126				
Surr: Toluene-d8	50.23	0	50.00		100	77.1	119				

Sample ID: LCS-209464	Client ID:	Units: ug/L	Prep Date: 06/29/2015	Run No: 294917							
SampleType: LCS	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 209464	Analysis Date: 06/29/2015	Seq No: 6285958							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	9.570	5.0	10.00		95.7	67	135				
Surr: 4-Bromofluorobenzene	49.66	0	50.00		99.3	70.6	123				
Surr: Dibromofluoromethane	45.97	0	50.00		91.9	78	126				
Surr: Toluene-d8	50.80	0	50.00		102	77.1	119				

Sample ID: 1506M69-003AMS	Client ID: B-2	Units: ug/L	Prep Date: 06/29/2015	Run No: 294917							
SampleType: MS	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 209464	Analysis Date: 06/29/2015	Seq No: 6285962							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	8.350	5.0	10.00		83.5	47.8	133				
Surr: 4-Bromofluorobenzene	51.52	0	50.00		103	70.6	123				
Surr: Dibromofluoromethane	49.98	0	50.00		100.0	78	126				
Surr: Toluene-d8	50.42	0	50.00		101	77.1	119				

Sample ID: 1506M69-003AMSD	Client ID: B-2	Units: ug/L	Prep Date: 06/29/2015	Run No: 294917							
SampleType: MSD	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 209464	Analysis Date: 06/29/2015	Seq No: 6285963							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

1,4-Dioxane	9.980	5.0	10.00		99.8	47.8	133	8.350	17.8	37.4	
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Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: F&ME Consultants
 Project Name: I-85 Rehab.
 Workorder: 1506M69

ANALYTICAL QC SUMMARY REPORT

BatchID: 209464

Sample ID: 1506M69-003AMSD	Client ID: B-2	Units: ug/L	Prep Date: 06/29/2015	Run No: 294917							
SampleType: MSD	TestCode: 1,4-Dioxane by SIM GC/MS SW8260B-SIM	BatchID: 209464	Analysis Date: 06/29/2015	Seq No: 6285963							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Surr: 4-Bromofluorobenzene	49.90	0	50.00		99.8	70.6	123	51.52	0	0	
Surr: Dibromofluoromethane	51.36	0	50.00		103	78	126	49.98	0	0	
Surr: Toluene-d8	51.23	0	50.00		102	77.1	119	50.42	0	0	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	BRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

MEASURE OF ELECTRO CHEMICAL TESTING OF SOIL SAMPLES

Sample Identification	Sample Depth (feet)	Soil Classification	Chloride (ppm)	Sulfate (ppm)	pH	Resistivity (ohm-em)
B-1	17.5-19.0	(ML)	BRL	BRL	5.88	14,000
B-2	8.0-10.0	(ML)	-	-	5.90	3,500
B-3	6.0-8.0	(ML)	25	BRL	4.88	16,000
B-4	4.0-6.0	(ML)	180	28	4.67	4,500
B-5	25.0-26.5	(ML)	-	-	4.60	24,000
AASHTO Guidelines for Corrosion Potential			None	> 1,000	< 5.50	< 2,000

F&ME/I-85 REHAB/SC
SUMMARY OF SOIL DATA

Sample Identification	Sample Type	Sample Depth	Soil Classification	Received Moisture Content (%)	Atterberg Limits				Grain Size Distribution			Compaction		pH	Resistivity of Soil		Additional Tests Conducted (See Notes)
									% Finer No. 4 Sieve	% Finer No. 200 Sieve	% Finer .005 mm	Maximum Dry Density (lb/cuft)	Optimum Moisture %		Moisture Content %	Lowest Resistivity (ohm-cm)	
					L.L.	P.L.	P.I.	L.I.									
B-1	Bag	17.5-19.0'	(ML)	30.2	-	-	-	-	-	-	-	-	-	39.6	14,000	-	
B-2	Bag	8.0-10.0	(ML)	31.1	-	-	-	-	-	-	-	-	5.9	41.0	3,500	-	
B-3	Bag	6.0-8.0'	(ML)	28.2	-	-	-	-	-	-	-	-	-	58.6	16,000	-	
B-4	Bag	4.0-6.0'	(ML)	20.5	-	-	-	-	-	-	-	-	-	40.5	4,500	-	
B-5	Bag	25.0-26.5	(ML)	18.9	-	-	-	-	-	-	-	-	4.6	49.1	24,000	-	

ABBREVIATIONS: LIQUID LIMIT (LL)
 PLASTIC LIMIT (PL)
 PLASTICITY INDEX (PI)
 LIQUIDITY INDEX (LI)
 SPECIFIC GRAVITY (Gs)
 MOISTURE (Mc)

NOTES: T = TRIAXIAL TEST
 U = UNCONFINED COMPRESSION TEST
 C = CONSOLIDATION TEST
 DS = DIRECT SHEAR TEST
 O = ORGANIC CONTENT
 P = pH

Determining Minimum Laboratory Soil Resistivity AASHTO T 288

PROJECT TITLE
PROJECT NO.
REMARKS

F&ME/I-85 REHAB/SC
1524908
F&ME Job No. G5439

SAMPLE ID
SAMPLE TYPE
SAMPLE DEPTH

B-2
Bag
8.0-10.0'

SAMPLE PREPARATION
TEST APPARATUS

Sieved through the #10 Sieve Yes
Miller Soilbox and Nilsson 400 Soil Resistance Meter.

Identification:

Lowest resistivity

SPECIMEN (Point)
RESISTIVITY (ohms-cm)

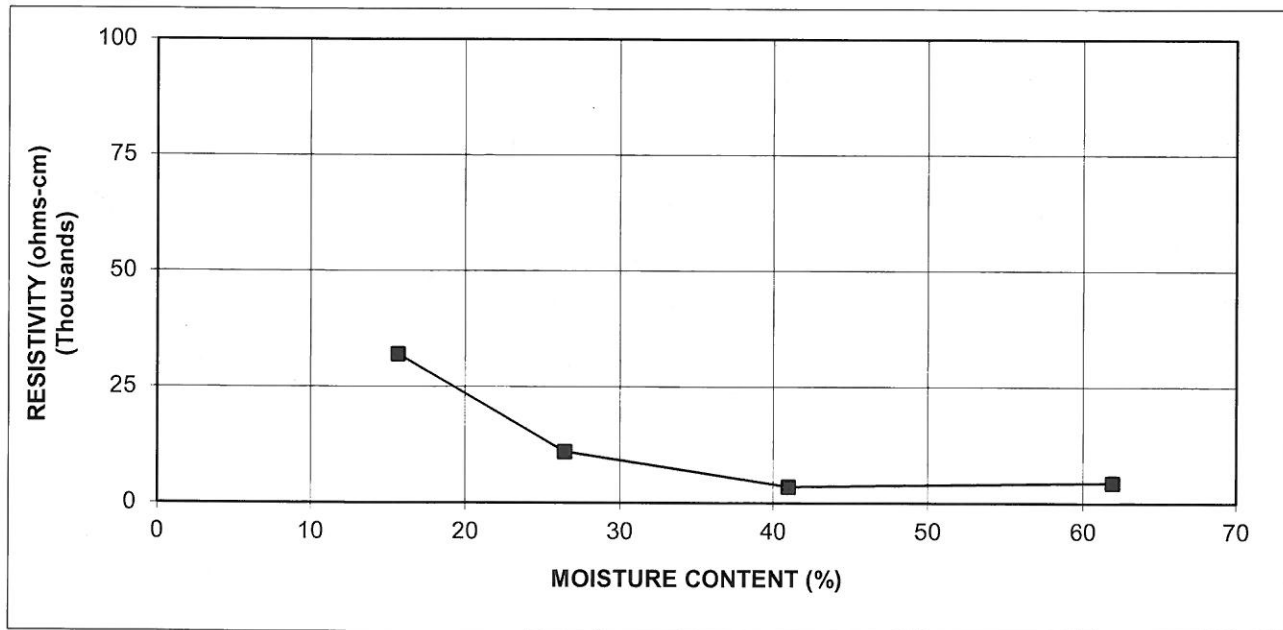
1	2	3	4	
	32,000	11,000	3,500	4,400

MOISTURE CONTENT

As-Received Moisture

WET WEIGHT & TARE
DRY WEIGHT & TARE
TARE WEIGHT
WEIGHT OF MOISTURE (gm)
WEIGHT OF DRY SOIL (gm)
MOISTURE CONTENT (%)

297.15	121.17	158.68	171.75	369.14
246.47	110.64	136.25	136.85	247.82
83.51	43.39	51.39	51.70	51.83
50.68	10.53	22.43	34.90	121.32
162.96	67.25	84.86	85.15	195.99
31.10	15.66	26.43	40.99	61.90



Description CLAYEY SILT; grayish brown.

USCS (ML)

TECH	TJ
DATE	6/25/15
CHECK	JJA
REVIEW	PW/M
APPROVE	

**Determining pH of Soil for Use in Corrosion Testing
AASHTO T 289**

PROJECT TITLE

F&ME/I-85 REHAB/SC

SAMPLE ID

B-2

PROJECT NO.

1524908

SAMPLE TYPE

Bag

REMARKS

F&ME Job No. G5439

SAMPLE DEPTH

8.0-10.0'

SAMPLE PREPARATION

Sieved through the #10 Sieve

YES

Air Dry

YES

Type of Water

DISTILLED

Trial	pH	Temperature
1	5.93	21.2

AVERAGE

5.93

21.2

Description CLAYEY SILT; grayish brown.

USCS (ML)

TECH	TJ
DATE	6/25/15
CHECK	DA
REVIEW	AWM
APPROVE	

Determining Minimum Laboratory Soil Resistivity AASHTO T 288

PROJECT TITLE	F&ME/I-85 REHAB/SC	SAMPLE ID	B-5
PROJECT NO.	1524908	SAMPLE TYPE	Bag
REMARKS	F&ME Job No. G5439	SAMPLE DEPTH	25.0-26.5'

SAMPLE PREPARATION Sieved through the #10 Sieve Yes

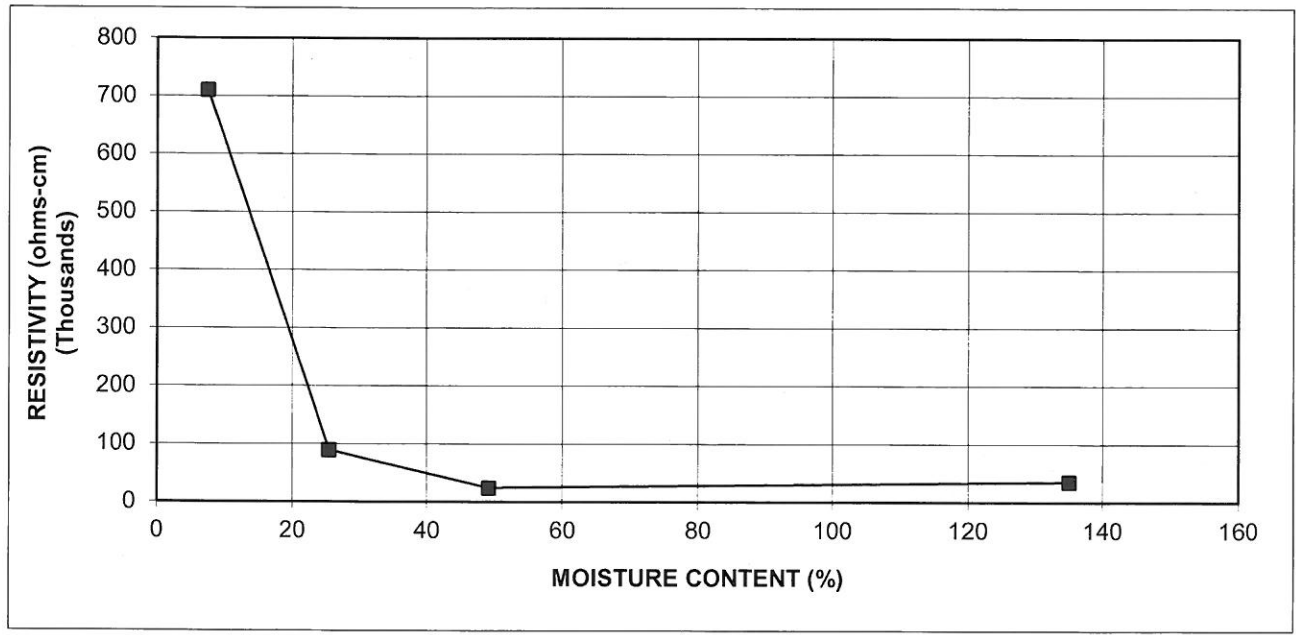
TEST APPARATUS Miller Soilbox and Nilsson 400 Soil Resistance Meter.

Identification: Lowest resistivity

SPECIMEN (Point)	1	2	3	4	
RESISTIVITY (ohms-cm)		710,000	89,000	24,000	35,000

MOISTURE CONTENT

	As-Received Moisture				
WET WEIGHT & TARE	210.63	113.86	119.21	134.95	284.54
DRY WEIGHT & TARE	189.88	108.81	105.35	107.55	150.47
TARE WEIGHT	79.84	41.29	50.90	51.76	51.17
WEIGHT OF MOISTURE (gm)	20.75	5.05	13.86	27.40	134.07
WEIGHT OF DRY SOIL (gm)	110.04	67.52	54.45	55.79	99.30
MOISTURE CONTENT (%)	18.86	7.48	25.45	49.11	135.02



Description

USCS

TECH	TJ
DATE	6/25/15
CHECK	<i>DA</i>
REVIEW	<i>AWY</i>
APPROVE	

**Determining pH of Soil for Use in Corrosion Testing
AASHTO T 289**

PROJECT TITLE

F&ME/I-85 REHAB/SC

SAMPLE ID

B-5

PROJECT NO.

1524908

SAMPLE TYPE

Bag

REMARKS

F&ME Job No. G5439

SAMPLE DEPTH

25.0-26.5'

SAMPLE PREPARATION

Sieved through the #10 Sieve

YES

Air Dry

YES

Type of Water

DISTILLED

Trial	pH	Temperature
1	4.60	21.4

AVERAGE

4.60

21.4

Description CLAYEY SILT; brown.

USCS (ML)

TECH TJ

DATE 6/25/15

CHECK DA

REVIEW WLM

APPROVE



ACCESS
ANALYTICAL, INC.

ANALYTICAL REPORT

CLIENT

F&ME Consultants
3112 Devine St.
Columbia SC 29205

ATTENTION

John Hamilton

PROJECT ID

G5439 I-85 Rehab

LABORATORY REPORT NUMBER

1505070

DATE

May 11, 2015

Primary Data Review By

Chantelle Kanhai
Project Manager, AES

Secondary Data Review By

Ashley Amick

Project Manager, Access Analytical
aamick@axs-inc.com

PLEASE NOTE:

- Unless otherwise noted, all analysis on this report performed at Analytical Environmental Services Inc. (AES Inc), 3080 Presidential Drive, Atlanta, GA 30340.
- AES is SCDHEC certified laboratory # 98016, NCDENR certified lab # 562, GA certified lab # FL-E87582, NELAP certified laboratory # E87582
- Local support services for this project are provided by Access Analytical, Inc. Access Analytical is a representative of AES serving client in the SC/NC/GA areas. All questions regarding this report should be directed to your local Access Analytical representative at 803.781.4243 or toll free at 883.315.4243

Access Analytical - Chain of Custody Record

LAB USE ONLY

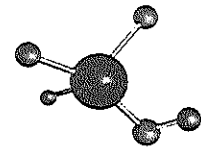
Project Work Order # **1505070**
 Laboratory ID: _____

Sales Order # _____ PO # **G5439** Access Quote # _____

Company Name: **F+ME Consultants**
 Report To: **John Hamilton**
 Address: **3112 Devine St.**
 City: **Columbia** State: **SC** Zip: **29205**
 Phone: **803-254-4540** Fax: **803-254-4542**
 Email: **jhamilton@fmecol.com**
 Project ID: **G5439 I-85 Rehab**
 Sampled By: **Jeff Leary**

Preservative: (*see codes)
 Container Type: (*see codes)

P P P
 Ph sulfate chloride



ACCESS ANALYTICAL, INC.

7478 Carlisle Street Phone: (803) 781-4243
 Irmo, SC 29063 Fax: 781-4303
 www.axs-inc.com

***Preservative Codes (place corresponding # in block above analysis field):**
 0 = None, 1 = HCL, 2 = HNO₃, 3 = H₂SO₄, 4 = NaOH, 5 = Na₂S₂O₈,
 6 = Method 5035 set w/ NaHSO₃ & CH₃OH, 7 = NaOH/ZnOAC, 8 = H₃PO₄.
***Matrix Codes (place corresponding code in matrix column):**
 GW = ground water, WW = waste water, DW = drinking water, S = soil,
 SL = sludge, A = air, IW = industrial waste, WO = waste oil, OT = other
 (specify in comments section)
***Program Area Codes: CWA = Clean Water Act (for wastewaters), SDWA = Safe Drinking Water Act (for drinking waters), SHW = Solid and Hazardous Wastes (for soils, ground waters and waste samples)**
***Container Type: G = Glass, P = Plastic**

↓ REQUESTED LAB ANALYSIS: ↓

Sample ID/Description	Date Collected	Time Collected	Type (grab or composite)	Matrix (see codes)	Program Area (see codes)	TOTAL # of containers	# of containers analyzed	# of containers collected	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed	# of containers analyzed
B-1 (17.5'-19.0')	4/27/15			S		1											
15-0620A									X								
15-0620C										X							
15-0620D											X						
B-3 (6.0'-8.0')	4/28/15			S		1											
15-0617A									X								
15-0617C										X							
15-0617D											X						

NOTES / COMMENTS

(if sample is a composite please use space below to note start/finish times & dates)

Turnaround Time: <input checked="" type="checkbox"/> Standard <input type="checkbox"/> RUSH* *Date Required: _____ (For rush work, results emailed/faxed by end of business day on date required)	Project Location: <input checked="" type="checkbox"/> SC <input type="checkbox"/> NC <input type="checkbox"/> Other (specify) _____	Relinquished By: Jeff Leary	Received By: J. H. Sub Katie Johnson	Date (mm-dd-yy) 4/30/15 5/1/15	Time (24HR) 13:45 10:30	Samples Rec'd on Ice ___Y___N <input checked="" type="checkbox"/> Y ___N	Sample Temp. Upon Receipt (°C): ___(°C)___(N/A) 3.4°C ___(N/A)___(N/A)		
							___Y___N	___(°C)___(N/A)	
								___Y___N	___(°C)___(N/A)
								___Y___N	___(°C)___(N/A)

Client: F&ME Consultants
Project: G5439 I-85 Rehab
Lab ID: 1505070

Case Narrative

pH Analysis by Method SW9045D:

Samples for pH analysis by Method SW9045D were received and analyzed outside holding time requirement of "immediate or 15 minutes."

Analytical Environmental Services, Inc

Date: 11-May-15

Client: F&ME Consultants	Client Sample ID: B-1 (17.5'-19.0') 15-0620 A,C,D
Project Name: G5439 I-85 Rehab	Collection Date: 4/27/2015
Lab ID: 1505070-001	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
Laboratory Hydrogen Ion (pH) SW9045D					(SW9045D)			
pH	5.88	0.01	H	pH Units	206878	1	05/05/2015 09:00	JS
ION SCAN SW9056A					(SW9056A)			
Chloride	BRL	13		mg/Kg-dry	206989	1	05/07/2015 11:03	JW
Sulfate	BRL	13		mg/Kg-dry	206989	1	05/07/2015 11:03	JW
PERCENT MOISTURE D2216								
Percent Moisture	24.4	0		wt%	R291343	1	05/07/2015 10:00	PF

Qualifiers:

- * Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- NC Not confirmed
- < Less than Result value
- J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 11-May-15

Client: F&ME Consultants	Client Sample ID: B-3 (6.0'-8.0') 15-0617 A,C,D
Project Name: G5439 I-85 Rehab	Collection Date: 4/28/2015
Lab ID: 1505070-002	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst	
Laboratory Hydrogen Ion (pH) SW9045D		(SW9045D)							
pH	4.88	0.01	H	pH Units	206878	1	05/05/2015 09:00	JS	
ION SCAN SW9056A		(SW9056A)							
Chloride	25	13		mg/Kg-dry	206989	1	05/07/2015 11:18	JW	
Sulfate	BRL	13		mg/Kg-dry	206989	1	05/07/2015 11:18	JW	
PERCENT MOISTURE D2216									
Percent Moisture	23.3	0		wt%	R291343	1	05/07/2015 10:00	PF	

Qualifiers:	* Value exceeds maximum contaminant level	E Estimated (value above quantitation range)
	BRL Below reporting limit	S Spike Recovery outside limits due to matrix
	H Holding times for preparation or analysis exceeded	Narr See case narrative
	N Analyte not NELAC certified	NC Not confirmed
	B Analyte detected in the associated method blank	< Less than Result value
	> Greater than Result value	J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc

Date: 11-May-15

Client: F&ME Consultants	Client Sample ID: B-4 (4.0'-6.0') 15-0618 A,C,D
Project Name: G5439 I-85 Rehab	Collection Date: 4/28/2015
Lab ID: 1505070-003	Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst	
Laboratory Hydrogen Ion (pH) SW9045D		(SW9045D)							
pH	4.67	0.01	H	pH Units	206878	1	05/05/2015 09:00	JS	
ION SCAN SW9056A		(SW9056A)							
Chloride	180	12		mg/Kg-dry	206989	1	05/07/2015 12:02	JW	
Sulfate	28	12		mg/Kg-dry	206989	1	05/07/2015 12:02	JW	
PERCENT MOISTURE D2216									
Percent Moisture	13.8	0		wt%	R291343	1	05/07/2015 10:00	PF	

Qualifiers:	* Value exceeds maximum contaminant level	E Estimated (value above quantitation range)
	BRL Below reporting limit	S Spike Recovery outside limits due to matrix
	H Holding times for preparation or analysis exceeded	Narr See case narrative
	N Analyte not NELAC certified	NC Not confirmed
	B Analyte detected in the associated method blank	< Less than Result value
	> Greater than Result value	J Estimated value detected below Reporting Limit

Analytical Environmental Services, Inc.

Sample/Cooler Receipt Checklist

Client Access Analytical

Work Order Number 1505070

Checklist completed by Kentie Joann Smith
Signature Date

Carrier name: FedEx UPS Courier Client US Mail Other

Shipping container/cooler in good condition? Yes No Not Present

Custody seals intact on shipping container/cooler? Yes No Not Present

Custody seals intact on sample bottles? Yes No Not Present

Container/Temp Blank temperature in compliance? (0°≤6°C)* Yes No

Cooler #1 3.4°C Cooler #2 _____ Cooler #3 _____ Cooler #4 _____ Cooler #5 _____ Cooler #6 _____

Chain of custody present? Yes No

Chain of custody signed when relinquished and received? Yes No

Chain of custody agrees with sample labels? Yes No

Samples in proper container/bottle? Yes No

Sample containers intact? Yes No

Sufficient sample volume for indicated test? Yes No

All samples received within holding time? Yes No

Was TAT marked on the COC? Yes No

Proceed with Standard TAT as per project history? Yes No Not Applicable

Water - VOA vials have zero headspace? No VOA vials submitted Yes No

Water - pH acceptable upon receipt? Yes No Not Applicable

Adjusted? _____ Checked by _____

Sample Condition: Good Other(Explain) _____

(For diffusive samples or AIHA lead) Is a known blank included? Yes No

See Case Narrative for resolution of the Non-Conformance.

* Samples do not have to comply with the given range for certain parameters.

Client: F&ME Consultants
 Project Name: G5439 I-85 Rehab
 Lab Order: 1505070

Dates Report

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
1505070-001A	B-1 (17.5'-19.0') 15-0620 A,C,I	4/27/2015 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		5/5/2015 9:00:00AM	05/05/2015
1505070-001A	B-1 (17.5'-19.0') 15-0620 A,C,I	4/27/2015 12:00:00AM	Soil	ION SCAN		5/6/2015 12:25:00PM	05/07/2015
1505070-001A	B-1 (17.5'-19.0') 15-0620 A,C,I	4/27/2015 12:00:00AM	Soil	PERCENT MOISTURE			05/07/2015
1505070-002A	B-3 (6.0'-8.0') 15-0617 A,C,D	4/28/2015 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		5/5/2015 9:00:00AM	05/05/2015
1505070-002A	B-3 (6.0'-8.0') 15-0617 A,C,D	4/28/2015 12:00:00AM	Soil	ION SCAN		5/6/2015 12:25:00PM	05/07/2015
1505070-002A	B-3 (6.0'-8.0') 15-0617 A,C,D	4/28/2015 12:00:00AM	Soil	PERCENT MOISTURE			05/07/2015
1505070-003A	B-4 (4.0'-6.0') 15-0618 A,C,D	4/28/2015 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		5/5/2015 9:00:00AM	05/05/2015
1505070-003A	B-4 (4.0'-6.0') 15-0618 A,C,D	4/28/2015 12:00:00AM	Soil	ION SCAN		5/6/2015 12:25:00PM	05/07/2015
1505070-003A	B-4 (4.0'-6.0') 15-0618 A,C,D	4/28/2015 12:00:00AM	Soil	PERCENT MOISTURE			05/07/2015

Client: F&ME Consultants
 Project Name: G5439 I-85 Rehab
 Workorder: 1505070

ANALYTICAL QC SUMMARY REPORT

BatchID: 206878

Sample ID: LCS-206878	Client ID:	Units: pH Units	Prep Date: 05/05/2015	Run No: 291146							
SampleType: LCS	TestCode: Laboratory Hydrogen Ion (pH) SW9045D	BatchID: 206878	Analysis Date: 05/05/2015	Seq No: 6194201							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

pH 7.030 0.01 7.000 100 90 110

Sample ID: 1505218-004ADUP	Client ID:	Units: pH Units	Prep Date: 05/05/2015	Run No: 291146							
SampleType: DUP	TestCode: Laboratory Hydrogen Ion (pH) SW9045D	BatchID: 206878	Analysis Date: 05/05/2015	Seq No: 6194207							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

pH 0.3300 0.01 0.3000 9.52 10 H

Qualifiers:	> Greater than Result value	< Less than Result value	B Analyte detected in the associated method blank
	BRL Below reporting limit	E Estimated (value above quantitation range)	H Holding times for preparation or analysis exceeded
	J Estimated value detected below Reporting Limit	N Analyte not NELAC certified	R RPD outside limits due to matrix
	Rpt Lim Reporting Limit	S Spike Recovery outside limits due to matrix	

Client: F&ME Consultants
Project Name: G5439 I-85 Rehab
Workorder: 1505070

ANALYTICAL QC SUMMARY REPORT

BatchID: 206989

Sample ID: MB-206989	Client ID:	Units: mg/Kg	Prep Date: 05/06/2015	Run No: 291356							
SampleType: MBLK	TestCode: ION SCAN SW9056A	BatchID: 206989	Analysis Date: 05/07/2015	Seq No: 6199425							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloride BRL 10
 Sulfate BRL 10

Sample ID: LCS-206989	Client ID:	Units: mg/Kg	Prep Date: 05/06/2015	Run No: 291356							
SampleType: LCS	TestCode: ION SCAN SW9056A	BatchID: 206989	Analysis Date: 05/07/2015	Seq No: 6199426							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloride 104.7 10 100.0 105 90 110
 Sulfate 230.6 10 250.0 92.3 90 110

Sample ID: 1505070-002AMS	Client ID: B-3 (6.0'-8.0') 15-0617 A,C,D	Units: mg/Kg-dry	Prep Date: 05/06/2015	Run No: 291356							
SampleType: MS	TestCode: ION SCAN SW9056A	BatchID: 206989	Analysis Date: 05/07/2015	Seq No: 6199429							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloride 158.1 13 129.6 25.27 102 80 120
 Sulfate 227.2 13 324.1 70.1 80 120 S

Sample ID: 1505070-002AMSD	Client ID: B-3 (6.0'-8.0') 15-0617 A,C,D	Units: mg/Kg-dry	Prep Date: 05/06/2015	Run No: 291356							
SampleType: MSD	TestCode: ION SCAN SW9056A	BatchID: 206989	Analysis Date: 05/07/2015	Seq No: 6199430							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

Chloride 156.5 13 129.6 25.27 101 80 120 158.1 1.03 20
 Sulfate 231.3 13 324.1 71.4 80 120 227.2 1.81 20 S

Qualifiers: > Greater than Result value < Less than Result value B Analyte detected in the associated method blank
 BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded
 J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix
 Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

APPENDIX D: DISPOSAL MANIFESTS

Regulatory Solutions Non-Hazardous Waste Manifests

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number

2. Page 1 of 1

3. Emergency Response Phone

803-926-0099

4. Waste Tracking Number

2 1 4 4 0

5. Generator's Name and Mailing Address

F& ME Consultants
3112 Devine Street
803-254-4540 Columbia, SC

Generator's Site Address (if different than mailing address)

SCDOT (1-85 Rehab.)
955 Park Street
Columbia, SC 29201

6. Transporter 1 Company Name

Regulatory Solutions, Inc

803-926-0099

U.S. EPA ID Number

7. Transporter 2 Company Name

U.S. EPA ID Number

8. Designated Facility Name and Site Address

Regulatory Solutions, Inc.
40 Paxon Court
Gaston, SC, 29053-
803-926-0099

U.S. EPA ID Number

Facility's Phone:

9. Waste Shipping Name and Description

10. Containers

No.

Type

11. Total Quantity

12. Unit Wt./Vol.

1. NON-RCRA, NON-DOT REGULATED MATERIAL
10785 - 1260 Water Drums

2

D M

110

5 Gallons

2. NON-RCRA, NON-DOT REGULATED MATERIAL
10785 - 1261 Soil Cuttings Drums

2

D M

4,722

1 Pounds

3.

4.

13. Special Handling Instructions and Additional Information

14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offor's Printed/Typed Name

CLYNN M. KLEIN

Signature

[Signature]

Month Day Year

7 15 15

15. International Shipments

Import to U.S.

Export from U.S.

Port of entry/exit:

Date leaving U.S.:

Transporter Signature (for exports only):

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name

CHRIS WILLIAMS

Signature

[Signature]

Month Day Year

7 14 15

Transporter 2 Printed/Typed Name

Signature

Month Day Year

17. Discrepancy

17a. Discrepancy Indication Space

Quantity

Type

Residue

Partial Rejection

Full Rejection

Manifest Reference Number:

17b. Alternate Facility (or Generator)

U.S. EPA ID Number

Facility's Phone:

17c. Signature of Alternate Facility (or Generator)

Month Day Year

18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a

Printed/Typed Name

Justin Conley

Signature

[Signature]

Month Day Year

7 14 15

regulatory solutions, inc.

13462

P.O. Box 877 • Chapin, South Carolina 29036
 40 Pascon Court • Gaston, South Carolina 29053
 803.926.0089 • 803.926-7574 (fax)

Work Order

Customer Name F+ME Consultants	PO#	Manifest# 21440	Date 7-14-15
Billing Address 312 Devine Street	Service Address I-85 South MM 89 Rest Area		
City, State, ZIP Columbia SC 29201	City, State, ZIP Gaffney SC		
Contact Jeff Leary	Telephone 803-309-8680		

Job Time Start: 11:30 am pm Job Time End: 4:30 am pm Total Job Hours: 5

On-Site Time Start: 1:30 am pm On-Site Time End: 2:30 am pm Total Hours On-Site: 1

Round Trip Travel: 4 Hours or Miles Job Status: Completed In-Process

Work Description: Pick up 11 drums from Gaffney I-85 South

Personnel	
Name	Hrs.
Chris Williams	5
Corey Morris	5

Equipment	
Description	Hrs.
BT-01	5
Drum dolly	5

Supplies	
Description	Qty.
Gloves - pair	2

Customer Comments: _____

Customer Signature: 

Date: 7/15/15

Supervisor Signature: 

Date: 7-14-15

04:58PM 07/14/2015
ID 345 21890 lb INBOUND

ID 345
GROSS 21890 lb RECALLED
TARE 15800 lb
NET 6090 lb
07/14/2015 05:20PM

regulatory solutions, inc.

CUSTOMER NAME: F+me B

GENERATOR: I-85 Rehab

TRUCK/CONTAINER #: BT-01

MANIFEST #: 21440

WEIGHER (INITIALS): BB

4345

APPENDIX E: FOI DOCUMENTS

SCDHEC Freedom of Information Request (January 19, 2015)

SCDHEC Historical Data (DVD)

January 19, 2015

Ms. Karla York, Director
Freedom of Information
SC Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Re: Request for information pertaining to environmental problems
Former Auriga/KOSA/Hoechst Celanese Site
Spartanburg County, South Carolina
BoW Site ID# 00225, VCC 13-5841-RP

Dear Ms. York:

This is a request for information pertaining to any environmental information that has been registered with you for the above referenced site.

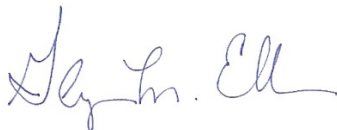
Any information pertaining to environmental problems may consist of the following:

- 1) Information pertaining to the removal or installation of above ground and underground storage tanks;
- 2) Issuance of any environmentally related permit and well record;
- 3) Issuance of any license (or complaints against) to store hazardous substances and/or petroleum products on the subject properties or adjacent properties and any action taken;
- 4) Issuance of any license (or complaints) regarding waste disposal on the subject properties or adjacent properties; and
- 5) Brownfield site on the subject properties or adjacent properties.
- 6) Ongoing Voluntary Cleanup Contract(s) (VCC)

If you have any questions, please do not hesitate to contact us. We would appreciate your response as soon as is convenient.

Regards,

F&ME CONSULTANTS



Glynn M. Ellen
Environmental Manager



South Carolina Department of Health
and Environmental Control

Freedom of Information Center / Sims/Aycock Building
2600 Bull St, Columbia, SC 29201

Ms. Glynn Ellen
F&ME CONSULTANTS
3112 DEVINE ST
COLUMBIA, SC 29205

1/22/2015

Request Number: 1501228

Re: Former Auriga/KOSA/Hoechst Celanese Site
Spartanburg, SC

Dear Ms. Glynn Ellen,

Your request for the above referenced information has been received by the Freedom of Information Center. The Freedom of Information staff are currently researching and compiling this information. You will be notified by our office when the research process is complete. DHEC will make the requested information available for review and copying to the extent it is not protected from disclosure pursuant to section 30-4-30 of the Freedom of Information Act.

If we are unable to locate files on a facility, based on the information submitted, you will be notified by mail.

Further inquiries regarding your request should include your above mentioned Freedom of Information Request Number. We can be reached at (803) 898 - 3882.

Sincerely,

Karla York, Director
Freedom of Information Office

South Carolina Department of Health and Environmental Control

2600 Bull Street ~ Columbia, SC 29201 ~ Phone (803) 898-3432 ~www.scdhec.gov

APPENDIX F: VOLUNTARY CLEANUP CONTRACT

Voluntary Cleanup Contract #13-5841-RP (March 12, 2013)

BOARD:
Allen Amsler
Chairman
Mark S. Lutz
Vice Chairman



Catherine B. Templeton, Director

Promoting and protecting the health of the public and the environment

BOARD:
R. Kenyon Wells
L. Clarence Batts, Jr.
Ann B. Kirol, DDS
John O. Hutto, Sr., MD

March 12, 2013

CERTIFIED MAIL - 9171999991703137207266

Phillip L. Conner
McNair Law Firm, P.A.
P.O. Box 477
Greenville, SC 29602

**Re: Responsible Party Voluntary Cleanup Contract;
Former Auriga/KOSA/Hoechst Celanese Site;
Spartanburg County.**

Dear Mr. Conner:

Please find enclosed a Certified As True And Correct Copy of Responsible Party Voluntary Cleanup Contract 13-5841-RP which was executed on March 12, 2013.

Please note the reimbursement requirement in the Cost of Response section on page 10, item 9.

Thank you so much for your patience and cooperation in this matter. The Department looks forward to working with CNA Holdings, LLC to address this Site under the South Carolina Voluntary Cleanup Program. Should you wish to further discuss the terms of the contract, please telephone either Keith Collinsworth at (803) 896-4181, or myself at (803) 896-4168.

Yours very truly,

David Wilkie, Environmental Health Manager
Division of Site Assessment, Remediation & Revitalization
Bureau of Land and Waste Management

Enclosure

cc: Ken Taylor, L&WM
Keith Collinsworth, L&WM
John Cresswell, L&WM
Susan Turner, Director, EQC Region 2
Addie Walker, L&WM
Pat Vincent, L&WM
Shawn Reed, L&WM
Linda Jackson, L&WM
BLWM File 400225

**VOLUNTARY CLEANUP CONTRACT
13-5841-RP**

**IN THE MATTER OF
FORMER AURIGA/KOSA/HOECHST CELANESE SITE,
SPARTANBURG COUNTY
and
CNA HOLDINGS LLC**

This Contract is entered into by the South Carolina Department of Health and Environmental Control and CNA Holdings LLC, pursuant to the Brownfields/Voluntary Cleanup Program, S.C. Code Ann. §§ 44-56-710 to 760, as amended, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. §§ 9601 to 9675, as amended, and the South Carolina Hazardous Waste Management Act (HWMA), S.C. Code Ann. §§ 44-56-10 to 850, as amended, with respect to the Facility known as the Former Auriga/KoSa/Hoechst Celanese Site ("Site"). The facility property is located at 1550 Dewberry Lane, Spartanburg, South Carolina ("Property"). The Property includes approximately 300 acres and is bounded generally to the north by the Cherokee Creek; on the east by the Pacolet River; on the south by Interstate 85; and on the west by various industrial properties beyond which is Gossett Road. The Property is more specifically identified by the County of Spartanburg as Tax Map Serial Numbers 3-06-00-027.00 (to the extent that parcel 3-06-00-027.00 is located west of the Pacolet River, east of parcel 3-06-00-027.04, and south of the Cherokee Creek); and 3-06-00-051.00; and a legal description of the Property and Figure showing the Property are attached to this Contract as Appendix A.

DEFINITIONS

1. Unless otherwise expressly provided, terms used in this Contract shall have the meaning assigned to them in CERCLA, the HWMA, and in regulations promulgated under the foregoing statutes, or the Brownfields/Voluntary Cleanup Program.

- A. "CNA" shall mean CNA Holdings LLC. CNA is a Delaware corporation authorized to do business in South Carolina with its principal place of business located at 222 W. Las Colinas Blvd.,



Suite 900N, Irving, Texas 75039. CNA Holdings LLC is a subsidiary of Celanese Corporation.

- B. "Contract" shall mean this Responsible Party Voluntary Cleanup Contract.
- C. "Department" shall mean the South Carolina Department of Health and Environmental Control or a successor agency of the State of South Carolina that has responsibility for and jurisdiction over the subject matter of this Contract.
- D. "Pollutant" or "Contaminant" includes, but is not limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions, including malfunctions in reproduction, or physical deformations, in organisms or their offspring; "Contaminant" does not include petroleum, including crude oil or any fraction of crude oil, which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (i) through (vi) of Paragraph (D) of CERCLA § 101, 42 U.S.C. §§ 9601, as amended, and does not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality or mixtures of natural gas and such synthetic gas.
- E. "Contamination" shall mean impact by a Contaminant or hazardous substance.
- F. "Property," as described in the legal description attached as Appendix A, shall mean that portion of the Site, which is subject to ownership, prospective ownership, or possessory or contractual interest of CNA or its related companies. CNA and its related companies no longer own any portion of parcel 3-06-00-027.00.

CNA currently owns parcel 3-06-00-051.00.

- G. "Response Action" shall mean any assessment, cleanup, inspection, or closure of a site as necessary to remedy actual or potential damage to public health, public welfare, or the environment.
- H. "The Site" shall mean the Property and all areas where a Contaminant has been released, deposited, stored, disposed of, or placed, or otherwise comes to be located; "Site" does not include any consumer product in consumer use or any vessel, as defined in CERCLA.
- I. "Voluntary Cleanup" shall mean a response action taken under and in compliance with the Brownfields/Voluntary Cleanup Program, S.C. Code Ann. §§ 44-56-710 to 760, as amended.
- J. "Work Plan" shall mean the plan for additional response actions to be conducted at the Site as described in Paragraph 3 of this Contract.

FINDINGS

2. Based on the information known by or provided to the Department, the following findings are asserted for purposes of this Contract:

- A. The Property was the location of various manufacturing facilities from the 1960's to present. Past and/or Owners/Operators include Hercules, Inc., Hystron Fibers, Inc., American Hoechst, Messer Greishiem, Inc., Hoechst Celanese, KoSa, Arteva Specialties, Invista, Johns Mansville, and Auriga Polymers, Inc.
- B. Based on historical documentation and interviews, the Property was first industrially developed by Hercules, Inc. in 1966 when they built a Dimethyl Terephthalate (DMT) production facility on the southeast portion of the Property. The DMT facility was closed in 1978 and

has been dismantled. Hystron Fibers Inc. leased a portion of the property from Hercules starting in approximately October 1967 and constructed a fiber production area west of the DMT facility. In May 1970, Hystron Fibers Inc. purchased the DMT facility from Hercules, Inc., and Farbwerke Hoechst A.G., a West German corporation, acquired 100% of the stock ownership of Hystron Fibers Inc. (and subsequently renamed it Hoechst Fibers, Inc.). In 1971, Farbwerke Hoechst became American Hoechst. In 1987, American Hoechst acquired Celanese Corporation in a stock purchase and formed Hoechst Celanese. Messer Greishiem, Inc. (MGI) leased an area in the southeast portion of the Property (part of the former DMT area) in 1986. The MGI area became part of Hoechst Celanese when they merged in 1987. The polyester business was divested by Hoechst Celanese in 1998 to Arteva Specialties who operated as KoSa. Celanese (as HNA Holdings) also sold a portion of the Property to Johns Mansville. Arteva Specialties (KoSa) and INVISTA merged in 2004 and subsequently changed its name to Invista. Invista sold 384 acres to Auriga Polymers in 2011. Auriga is presently operating at the Property. CNA Holdings LLC is the legal successor to HNA Holdings.

- C. In 1988, while reviewing routine groundwater monitoring for indicator parameters around a wastewater lagoon at the site, the Department discovered abnormalities in the groundwater data. Two monitoring wells were installed during this investigation. Subsequently, assessment of the groundwater, soil, surface water and sediments was initiated by CNA. Since 1990, CNA has conducted extensive activities to identify, delineate, and address Contamination that has been found at the Site. A partial description of those activities is as follows:
- i. Phase I and phase IA Site investigations that included the construction of approximately 21 monitoring wells, soil

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- sampling, and soil gas sampling;
- ii. Phase II Site investigation that included the construction of approximately 16 monitoring wells, soil sampling, and groundwater investigation;
 - iii. Phase III Site investigation that included the construction of approximately 39 monitoring wells and 25 groundwater extraction wells to remove Contamination;
 - iv. Construction of approximately 8 monitoring wells and an additional extraction well;
 - v. Phase IV Site investigation that included the construction of 45 monitoring wells, 27 extraction wells, and soil sampling;
 - vi. Removal of in-ground wastewater treatment plant (WWTP) process units and the construction of above ground tank based WWTP with secondary containment;
 - vii. Construction of groundwater treatment system;
 - viii. Installation of 2 monitoring wells off of Site near I-85;
 - ix. Implementation of Enhanced Reductive Dechlorination for groundwater treatment;
 - x. Three sampling events at private well located at 611 Bruckner Road for chloroform (results were non-detect);
 - xi. Sampling of two additional private wells located near Bruckner Road for chloroform (results were non-detect); and
 - xii. Ongoing sampling of surface water in the Pacolet River, downstream of Outfall 004, and Cherokee Creek.
- D. All of the above activities have been or are being conducted voluntarily and under oversight by the Department. Pursuant to the above activities, groundwater flow direction has been extensively evaluated and is understood. Areas of soil and groundwater degradation have been delineated. Contaminants including 1,4 dioxane, 1,1 biphenyl, biphenyl ether, chloroform and low concentrations of other constituents have been identified.

Chloroform is the only constituent known to have migrated offsite in groundwater. Monitoring and further assessment are continuing at the Site to date.

- E. Sources for various Contaminants have been identified as the former DMT site, wastewater treatment plant sludge impoundments and basins, and the DowTherm Heater area. In 1978, prior to Celanese's involvement at the Site, the DMT facility from which chloroform releases occurred, was closed. In the mid-1990's, the wastewater treatment plant sludge impoundments were closed and sludge was excavated. Process and other improvements were made to the DowTherm Heater area to prevent potential releases of constituents. Celanese continues to perform remedial activities along with continued monitoring and further assessment at the Site. The Department has conducted additional private well sampling, which confirmed that the private wells are not impacted by the Site. The Department has also conducted two public meetings on August 2, 2011 and November 28, 2011. In August 2011, the Department performed a cancer cluster study, which concluded that there were no increases in cancer incidences or mortality among residents of the 29307 zip codes between 1996 and 2007. The ATSDR concurred with these conclusions in a letter dated October 21, 2011.
- F. In performing the above-described work, CNA, or its contractors, have developed numerous work plans, investigation reports and other documents focused on determining the extent of soil and groundwater contamination and remedial activities at the Site. Where appropriate, the Department has provided responses to documents submitted by CNA. See Appendix B for a partial list of documents submitted by CNA.
- G. As a mechanism for continuing with the work being done by CNA, DHEC invited CNA to enter the DHEC's Voluntary Cleanup Program (VCP) in order to reach a CERCLA-quality cleanup at the Site and,

on June 15, 2012, Celanese voluntarily agreed to enter the VCP.

- H. CNA agrees to provide the necessary information and/or additional investigation if so requested by DHEC in order for CNA to conduct and obtain a CERCLA-quality response action pursuant to the provisions of CERCLA §104, 42 U.S.C. §9604.
- I. As of September 30, 2012 the Department has incurred approximately one hundred six thousand ninety-seven dollars and seventy-three cents (\$106,097.73) in past costs of response at the Site. DHEC is aware that additional costs have been incurred and that this figure is based on information available to the Department and reserves its right to amend, change and/or update the figure.

RESPONSE ACTIONS

3. CNA agrees to submit to the Department for review and written approval within forty-five (45) days (unless otherwise agreed to by DHEC) of the execution date of this Contract a Work Plan for the Site that is consistent with the technical intent of the National Contingency Plan. The Work Plan shall be implemented upon written approval from the Department. The parties to this Contract acknowledge that a substantial amount of investigation work and remediation work has been performed at this Site over the past 24 years. This past work may wholly or substantially satisfy some of the requirements for the Work Plan. Therefore, it is agreed that any response actions that have been completed and that meet the conditions of this Contract shall be deemed to satisfy the applicable elements of the Work Plan provided for in this Paragraph 3. The Work Plan shall include the names, addresses, and telephone numbers of the consulting firm, the analytical laboratory certified by the Department, and CNA's contact person for matters relating to this Contract. CNA will notify the Department in writing of changes in the contractor or laboratory. The Department will review the Work Plan and related documents and will notify CNA in writing of any deficiencies in the Work Plan or other documents, and CNA will respond in writing within forty-five (45) days to the Department's comments. The Work Plan and all associated reports shall be prepared in accordance with industry standards and endorsed by a Professional Engineer (P.E.)

and/or Professional Geologist (P.G.) duly-licensed in South Carolina and shall set forth methods and schedules for accomplishing the following tasks:

- A. Update the 2010 Remedial Effectiveness Report using current data to establish the current Remedial Investigation (RI) status on each of the operable units and describing the administrative path forward (including schedules) through the remedial process.
- B. Submit to the Department an RI Report (to include a Preliminary Risk Evaluation or other assessment of risk to human health and the environment) in accordance with the schedule in the approved Work Plan. The Department shall review the report for determination of completion of the RI and sufficiency of the documentation. If the Department determines that the field investigation is not complete, it will send written notification of such to CNA, and CNA shall subsequently conduct additional field investigation to further determine the source, nature, and extent of contamination. If the Department determines that the field investigation is complete but the report is incomplete, the Department shall send to CNA a letter indicating that revision of the report is necessary. Unless otherwise agreed to by DHEC, within forty-five (45) days of receipt of such letter from the Department, CNA shall submit a revised report addressing the Department's comments.
- C. If remediation of the Contamination at the Site is determined necessary by the Department, conduct an appropriate Feasibility Study to evaluate remedial alternatives for addressing contamination at the Site.

4. CNA shall prepare and submit under separate cover from the Work Plan, a Health and Safety Plan that is consistent with Occupational Safety and Health Administration regulations. The Health and Safety Plan is submitted for information purposes only to the Department. The Department expressly disclaims any liability that



may result from implementation of the Health and Safety Plan by CNA.

5. CNA shall inform the Department of field activities by periodically updating the schedule included in the Work Plan as the scope of work or schedule changes. If CNA plans to conduct field activities not included in the written project schedule, CNA shall inform the Department in writing at least five (5) working days in advance of field activities pursuant to this Contract and, if deemed necessary by the Department, shall allow the Department and its authorized representatives to take duplicates of any samples collected by CNA pursuant to this Contract.

6. Within sixty (60) days of the execution date of this Contract and once every six months thereafter, CNA shall submit to the Department a written progress report that must include the following: (A) actions taken under this Contract during the previous reporting period; (B) actions scheduled to be taken in the next reporting period; (C) sampling, test results, and any other environmental data related to the Site, in summary form, generated during the previous reporting period, whether generated pursuant to this Contract or not; and (D) a description of any environmental problems experienced at the Site during the previous reporting period and the actions taken to resolve them.

7. All correspondence required or permitted to be given by either party to the other hereunder shall be in writing and deemed sufficiently given if sent by (A) regular U.S. mail, (B) certified or registered mail, postage prepaid, return receipt requested, (C) overnight delivery service company or (D) by hand delivery to the other party at the address shown below or at such place or to such agent as the parties may from time to time designate in writing.

Unless otherwise directed in writing by either party, all correspondence, work plans, and reports should be submitted to:

The Department: Addie Walker
South Carolina Department Health & Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, South Carolina 29201
walkeras@dhec.sc.gov

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CNA: Steven M. Simpson
Celanese Global Retained Environmental Matters (REM) Manager
1085 Lakeview Road
Salisbury, NC 28147
(704) 450-8402
Steven.Simpson_contractor@Celanese.com

All final work plans and reports shall include three (3) paper copies and one (1) electronic copy on compact disk.

PUBLIC PARTICIPATION

8. Upon execution of this Contract, the Department will seek public participation in accordance with S.C. Code Ann. § 44-56-740(D), as amended, and not inconsistent with the National Contingency Plan. CNA will pay costs of response associated with public participation (e.g., publication of public notice(s), building and equipment rental(s) for public meetings, etc.).

COSTS OF RESPONSE

9. CNA shall, within forty five (45) days after receipt of an invoice and after the execution of this Contract, pay to the Department by certified or cashier's check the sum of one hundred six thousand ninety-seven dollars and seventy-three cents (\$106,097.73) to reimburse estimated past costs of response incurred by the Department through September 30, 2012 ("Past Costs") relating to the Site. CNA's payment for Past Costs should be submitted to:

The Department: John K. Cresswell
South Carolina Department of Health & Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

In accordance with §§ 44-56-200 and 44-56-740, CNA shall, on a quarterly basis, reimburse the Department for Oversight Costs of activities required under this Contract. Oversight Costs include, but are not limited to, the direct and indirect costs of negotiating the terms of this Contract, reviewing Work Plans and reports, supervising corresponding work and activities and costs associated with public participation.



Payments will be due within thirty (30) days of the receipt of Department's invoice. The Department shall provide an invoice with documentation of its Oversight Costs in sufficient detail so as to show the personnel involved, amount of time spent on the project for each person, expenses, and other specific costs. Unless otherwise directed in writing by CNA, invoices shall be submitted to:

CNA/Celanese: Ms Karen Brice
Celanese Global Retained Environmental Matters
1601 West LBJ Freeway
Dallas, TX 75234
(972) 443-4531
Karen.Brice@Celanese.com

All of CNA's payments should reference the Contract number on page 1 of this Contract and made payable to:

The South Carolina Department of Health & Environmental Control

If complete payment of the past costs of response or of the quarterly billing of Oversight Costs is not received by the Department by the due date, the Department may bring an action to recover the amount owed and all costs incurred by the Department in bringing the action including, but not limited to, attorney's fees, Department personnel costs, witness costs, court costs, and deposition costs.

ACCESS

10. CNA shall not deny the Department, its authorized officers, employees, representatives, and all other persons performing response actions access to the Site during normal business hours or at any time work under this Contract is being performed or during any environmental emergency or imminent threat situation, as determined by the Department (or as allowed by applicable law). CNA shall ensure that a copy of this Contract is provided to any lessee or successor or other transferee of the Property, to any owner (or such owner's legal counsel) of other property that is currently part of the Site, and to any owner (or such owner's legal counsel) of property that may become part of the Site in the future based upon the work performed under this

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Contract. If CNA is unable to obtain access upon reasonable terms from the Property owner, the Department may obtain access and perform response activities. All of the Department's costs associated with access and said response actions will be reimbursed by CNA.

RESTRICTIVE COVENANT

11. If hazardous substances in excess of residential standards exist at the Property after CNA has completed the actions required under this Contract, a covenant placing necessary and appropriate restrictions on use of the Property shall be executed and recorded upon any portion of the Site owned by CNA or over which CNA has authority to require such restrictive covenants. Upon the Department's approval of the items outlined therein, the restrictive covenant shall be signed by the Department and representatives of CNA, and witnessed, signed, and sealed by a notary public. CNA shall file this restrictive covenant with the Register of Mesne Conveyance or Deeds in the county in which the Property is located. The signed covenant shall be incorporated into this Contract as an Appendix. A Certificate of Completion shall not be issued by the Department until the Restrictive Covenant, if required, is executed and recorded as to the portion of the Site owned by CNA or over which CNA has authority to require such Restrictive Covenant. With the approval of the Department, the restrictive covenant may be modified in the future if additional remedial activities are carried out which meet appropriate clean-up standards at that time or circumstances change such that the restrictive covenant would no longer be applicable. The Department may require CNA or subsequent owners of the Property to modify the restrictive covenant if a significant change in law or circumstances requiring remediation occurs. CNA or subsequent owners of the Property shall file an annual report with the Department by May 31st of each year detailing the current land uses and compliance with the restrictive covenants for as long as the restrictive covenant remains in effect on the Property. The report must be submitted in a manner prescribed by the Department.

OBLIGATIONS AND BENEFITS

12. The obligations of this Contract apply to CNA and this Contract inures to the

benefit of CNA's signatories, parents, successors, assigns, and subsidiaries.

13. Subject to Paragraph 16, nothing in this Contract is intended to be, or shall be construed as, a release or covenant not to sue for any claim or cause of action, past or future, that the Department may have against any person, firm, or corporation not a signatory of this Contract or a signatory's parent, successor, assign, or subsidiary.

14. Subject to Paragraph 16, nothing in this Contract is intended to limit the right of the Department to undertake future response actions at the Site or to seek to compel parties to perform or pay for costs of response actions at the Site. Nothing in this Contract shall in any way restrict or limit the nature or scope of response actions that may be taken or be required by the Department in exercising its authority under State and Federal law.

15. Subject to Paragraph 16, nothing in this Contract is intended to be or shall be construed as a release or covenant not to sue for any claim or cause of action that the Department may have against CNA for any matters not expressly included in this Contract.

16. Upon successful completion of the terms of this Contract and the approved Work Plan as referenced in Paragraph 3 above, CNA shall submit to the Department a written notice of completion.

Once the Department determines that CNA has successfully and completely complied with this Contract, the Department, pursuant to S.C. Code Ann. § 44-56-740(A)(5) and (B)(1), shall issue CNA a Certificate of Completion that provides a covenant not to sue to CNA, its signatories, parents, successors, assigns, and subsidiaries, for the work done in completing the response actions specifically covered in the Contract and completed in accordance with the approved Work Plans and reports. The covenant not to sue is contingent upon the Department's determination that the responsible party successfully and completely complied with the Contract.

In consideration of the Department's covenant not to sue, CNA its signatories,

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parents, successors, assigns, and subsidiaries agree not to assert any claims or causes of action against the Department arising out of activities undertaken at the Site or to seek other costs, damages, or attorney's fees from the Department arising out of activities undertaken at the Site, except for those claims or causes of action resulting from the Department's intentional or grossly negligent acts or omissions.

17. CNA and the Department each reserve the right to unilaterally terminate this Contract. Termination may be accomplished by giving a thirty-(30)-day advance written notice of the election to terminate this Contract to the other party. Should CNA or subsequent owners of the Site elect to terminate, it must submit to the Department all data generated pursuant to this Contract, and certify to the Department's satisfaction that any environmental or physical hazard shall be stabilized and/or mitigated such that the Site does not pose a hazard to human health or the environment that did not exist prior to any initial response action addressing contamination identified in this Contract.

18. The Department may terminate this Contract only for cause, which may include but is not limited to, the following:

- A. Events or circumstances at the Site that are inconsistent with the terms and conditions of this Contract;
- B. Failure to complete the terms of this Contract or the Work Plan;
- C. Failure to submit timely payments for Past Costs and/or for Oversight Costs as defined in Paragraph 9 above;
- D. Additional contamination or releases or consequences at the Site caused by CNA its parents, successors, assigns, and subsidiaries;
- E. Providing the Department with false or incomplete information or knowingly failing to disclose material information;
- F. Change in CNA's or its parents, successors, assigns, and subsidiaries business activities on the Property or use of the Property that are inconsistent with the terms and conditions of this Contract; or
- G. Failure by CNA to obtain the applicable permits from the

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Department for any response actions or other activities undertaken at the Property.

19. Upon termination of the Contract, the covenant not to sue will be null and void. Termination of this Contract by CNA or the Department does not end the obligations of CNA to pay Oversight Costs already incurred by the Department and payment of such costs shall become immediately due.

20. The parties to this Contract agree that this Contract governs CNA's liability to the Department for administrative and civil sanctions arising from the matters set forth herein and constitutes the entire agreement between the Department and CNA with respect to this Contract. The parties are not relying upon any representations, promises, understandings or agreements except as expressly set forth in this Contract.

21. The signatories below hereby represent they are authorized to and enter into this Contract on behalf of their respective parties.

sw

APPENDIX A
Legal Description of the Property

County of Spartanburg
Tax Map Serial Numbers 3-06-00-027.00 and 3-06-00-051.00

Property North of I-85

ALL THAT CERTAIN PIECE, PARCEL OR TRACT OF LAND SITUATED, LYING AND BEING IN THE COUNTY OF SPARTANBURG, STATE OF SOUTH CAROLINA, CONTAINING TWO HUNDRED SEVENTY SIX AND 96/100 (276.93) ACRES MORE OR LESS AND HAVING THE FOLLOWING METES AND BOUNDS TO WIT:

BEGINNING AT A CONCRETE MONUMENT LOCATED AT THE INTERSECTION OF THE NORTHERN RIGHT-OF-WAY OF DEWBERRY ROAD (S-42-754) AND THE EASTERN RIGHT-OF-WAY OF HOECHST DRIVE (S800), HAVING SOUTH CAROLINA STATE PLANE COORDINATES OF N: 1164800.39, E:1741043.64; THENCE ALONG THE RIGHT OF WAY OF HOECHST DRIVE THE FOLLOWING CALLS: N10°21'17"W A DISTANCE OF 20.04 FEET TO AN IRON PIN; THENCE N17°39'48"E A DISTANCE OF 232.38 FEET TO A POINT; THENCE ALONG A CURVE WITH A RADIUS OF 691.97 FEET, A CHORD BEARING OF N40°15'06"E, A CHORD DISTANCE OF 532.45 FEET TO A POINT; THENCE N62°41'29"E A DISTANCE OF 76.47 FEET TO A POINT; THENCE ALONG A CURVE WITH A RADIUS OF 708.00 FEET, A CHORD BEARING OF N55°15'51"E, A CHORD LENGTH OF 183.04 FEET TO A POINT; THENCE N47°50'14"E A DISTANCE OF 374.76 FEET TO A POINT; THENCE N45°13'39"E A DISTANCE OF 83.80 FEET TO A POINT; THENCE ALONG A CURVE WITH A RADIUS OF 169.52 FEET, A CHORD BEARING OF N30°34'34"E, A CHORD DISTANCE OF 86.10 FEET TO A NAIL; THENCE N75°12'27"W A DISTANCE OF 65.81 FEET TO AN IRON PIN; THENCE ALONG A CURVE WITH A RADIUS OF 103.52 FEET, A CHORD BEARING OF S31°09'37"W, A CHORD LENGTH OF 51.51 FEET TO A POINT; THENCE S45°13'39"W A DISTANCE OF 82.30 FEET TO A POINT; THENCE S47°50'14"W A DISTANCE OF 373.25 FEET TO A POINT; THENCE ALONG A CURVE WITH A RADIUS OF 642.00 FEET, A CHORD BEARING S55°15'51"W, A CHORD DISTANCE OF 165.98 FEET TO A POINT; THENCE S64°07'05"W A DISTANCE OF 85.02 FEET TO AN IRON PIN; THENCE ALONG RONALD V. WHITLOCK N34°38'21"W A DISTANCE OF 1051.03 FEET TO AN IRON PIN; THENCE TURNING AND RUNNING ALONG AURIGA POLYMERS N75°10'15"E 1559.80 FEET TO A MONUMENT; THENCE TURNING AND RUNNING ALONG JOHNS MANVILLE INTERNATIONAL THE FOLLOWING CALLS: N30°24'48"E A DISTANCE OF 230.47 FEET TO A MONUMENT, THENCE S59°50'38"E A DISTANCE OF 60.72 FEET TO A POINT; THENCE N31°19'38"E A DISTANCE OF 16.25 FEET TO A NAIL; THENCE S57°57'07"E A DISTANCE OF 25.18 FEET TO A NAIL; THENCE N30°30'13"E A DISTANCE OF 14.89 FEET TO A NAIL; THENCE S58°57'29"E A DISTANCE OF 9.30 FEET TO A MONUMENT; THENCE N30°09'57"E A DISTANCE OF 146.84 FEET TO A MONUMENT; THENCE S58°48'55"E A DISTANCE OF 2.10 FEET TO A MONUMENT; THENCE N30°30'48"E A DISTANCE OF 384.10 FEET TO A MONUMENT; THENCE N59°05'30"W A DISTANCE OF 14.85 FEET TO A MONUMENT; THENCE N28°53'36"E A DISTANCE OF 68.49 FEET TO A MONUMENT; THENCE N59°41'51"W A DISTANCE OF 98.54 FEET TO A MONUMENT; THENCE N10°52'23"E A DISTANCE OF 41.59 FEET TO A MONUMENT; THENCE N30°32'57"E A DISTANCE OF 312.21 FEET TO AN IRON PIN; THENCE N56°32'32"W A DISTANCE OF 132.65 FEET TO A POINT; THENCE TURNING AND RUNNING ALONG AURIGA POLYMERS, INC. N36°40'49"E A DISTANCE OF 474.21 FEET TO A POINT; THENCE TURNING AND RUNNING ALONG THE SOUTHERN BANK OF CHEROKEE CREEK THE FOLLOWING CALLS: S46°46'31"E A DISTANCE OF 61.53 FEET TO A POINT; THENCE S57°03'27"E A DISTANCE OF 99.52 FEET TO A POINT; THENCE S49°02'03"E A DISTANCE OF 148.44 FEET TO A POINT; THENCE N77°11'59"E A DISTANCE OF 91.52 FEET TO A POINT; THENCE N85°47'55"E FOR A DISTANCE OF 73.00 FEET TO A POINT; THENCE S84°41'06"E A DISTANCE OF 137.75 FEET TO A POINT; THENCE S81°11'51"E A DISTANCE OF 113.54 FEET TO A POINT; THENCE S51°09'52"E A DISTANCE OF 34.61 FEET TO A POINT; THENCE S83°47'29"E A DISTANCE OF 126.63 FEET TO A POINT; THENCE S58°26'52"E A DISTANCE OF 14.60 FEET TO A POINT; THENCE N89°45'02"E A DISTANCE OF 97.74 FEET TO A POINT; THENCE S79°08'57"E A DISTANCE OF 81.56 FEET TO A POINT; THENCE S87°46'53"E A DISTANCE OF 44.31 FEET TO A POINT; THENCE S68°14'45"E A DISTANCE OF 78.72 FEET TO A POINT; THENCE S83°02'01"E A DISTANCE OF 86.34 FEET TO A POINT; THENCE S87°36'23"E A DISTANCE OF 101.86 FEET TO A POINT; THENCE N87°30'40"E A DISTANCE OF 113.34 FEET TO A POINT;

THIS IS CERTIFIED AS A TRUE
AND CORRECT COPY

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THENCE S62°22'01"E A DISTANCE OF 94.78 FEET TO A POINT; THENCE S46°18'17"E A DISTANCE OF 54.00 FEET TO A POINT; THENCE S64°11'21"E A DISTANCE OF 103.56 FEET TO A POINT; THENCE S71°10'59"E A DISTANCE OF 157.26 FEET TO A POINT; THENCE S77°58'58"E A DISTANCE OF 70.54 FEET TO A POINT; THENCE N85°00'56"E A DISTANCE OF 81.04 FEET TO A POINT; THENCE N72°54'06"E A DISTANCE OF 51.11 FEET TO A POINT; THENCE N04°15'10"W A DISTANCE OF 112.38 FEET TO A POINT; THENCE N76°33'55"E A DISTANCE OF 45.06 FEET TO A POINT; THENCE S48°35'57"E A DISTANCE OF 93.86 FEET TO A POINT; THENCE S64°07'29"E A DISTANCE OF 105.85 FEET TO A POINT; THENCE S22°23'00"E A DISTANCE OF 52.04 FEET TO A POINT; THENCE S04°57'04"E A DISTANCE OF 108.59 FEET TO A POINT; THENCE S54°05'20"E A DISTANCE OF 105.79 FEET TO A POINT; THENCE S64°11'44"E A DISTANCE OF 97.07 FEET TO A POINT; THENCE S68°43'08"E A DISTANCE OF 61.07 FEET TO A POINT; THENCE N81°31'44"E A DISTANCE OF 101.26 FEET TO A POINT; THENCE N70°23'39"E A DISTANCE OF 84.21 FEET TO A POINT; THENCE N89°44'56"E A DISTANCE OF 111.41 FEET TO A POINT; THENCE S68°23'27"E A DISTANCE OF 102.69 FEET TO A POINT; THENCE S76°56'27"E A DISTANCE OF 86.54 FEET TO A POINT; THENCE TURNING AND RUNNING ALONG THE WESTERN BANK OF THE PACOLET RIVER THE FOLLOWING CALLS: S46°34'35"E A DISTANCE OF 57.41 FEET TO A POINT; THENCE S53°40'16"E A DISTANCE OF 94.50 FEET TO A POINT; THENCE S54°08'58"E A DISTANCE OF 57.17 FEET TO A POINT; THENCE S27°17'25"E A DISTANCE OF 78.52 FEET TO A POINT; THENCE S13°04'24"E A DISTANCE OF 69.44 FEET TO A POINT; THENCE S01°23'21"E A DISTANCE OF 73.93 FEET TO A POINT; THENCE S07°36'36"W A DISTANCE OF 76.47 FEET TO A POINT; THENCE S25°59'58"W A DISTANCE OF 144.98 FEET TO A POINT; THENCE S26°42'13"W A DISTANCE OF 202.04 FEET TO A POINT; THENCE S24°34'05"W A DISTANCE OF 175.10 FEET TO A POINT; THENCE S23°27'54"W A DISTANCE OF 86.27 FEET TO A POINT; THENCE S23°48'39"W A DISTANCE OF 107.84 FEET TO A POINT; THENCE S34°23'54"W A DISTANCE OF 76.50 FEET TO A POINT; THENCE S37°51'11"W A DISTANCE OF 121.00 FEET TO A POINT; THENCE S50°45'42"W A DISTANCE OF 73.78 FEET TO A POINT; S34°55'42"W A DISTANCE OF 82.17 FEET TO A POINT; S36°02'17"W A DISTANCE OF 114.57 FEET TO A POINT; THENCE S36°14'43"W A DISTANCE OF 112.40 FEET TO A POINT; THENCE S32°43'15"W A DISTANCE OF 263.47 FEET TO A POINT; THENCE S20°36'27"W A DISTANCE OF 111.36 FEET TO A POINT; THENCE S08°31'46"W A DISTANCE OF 115.44 FEET TO A POINT; THENCE S05°59'21"E A DISTANCE OF 148.93 FEET TO A POINT; THENCE TURNING AND RUNNING ALONG THE NORTHERN RIGHT OF WAY OF INTERSTATE 85 THE FOLLOWING CALLS: S73°53'36"W A DISTANCE OF 244.16 FEET TO AN IRON PIN; THENCE S16°23'20"E A DISTANCE OF 16.42 FEET TO AN IRON PIN; THENCE S73°53'52"W A DISTANCE OF 636.56 FEET TO AN IRON PIN; THENCE S16°18'02"E A DISTANCE OF 39.78 FEET TO AN IRON PIN; THENCE S73°53'18"W A DISTANCE OF 1669.99 FEET TO A MONUMENT; THENCE CROSSING THE RIGHT OF WAY OF CSX RAILWAY S73°54'43"W A DISTANCE OF 216.69 FEET TO A POINT; THENCE CONTINUING ALONG THE NORTHERN RIGHT OF WAY OF INTERSTATE 85 S74°01'18"W A DISTANCE OF 803.08 FEET TO A MONUMENT; THENCE TURNING AND RUNNING ALONG BARBRA C. POTEAT THE FOLLOWING CALLS: N04°39'13"E A DISTANCE OF 285.51 FEET TO A MONUMENT; THENCE N82°06'04"W A DISTANCE OF 932.68 FEET TO A MONUMENT, SAID MONUMENT BEING THE TRUE POINT AND PLACE OF BEGINNING, CONTAINING 276.93 ACRES, MORE OR LESS.

THIS BEING THE SAME AS THE BOUNDARY SHOWN ON A PLAT BY TRIAD SURVEYORS, INC. TITLED "BOUNDARY SURVEY FOR AURIGA POLYMERS, INC." DATED NOVEMBER 29, 2012.

PROVIDED BY: TRIAD SURVEYORS, 38 GRANDE AVE, GREENVILLE, SC 29607. 864-552-1492

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AND CORRECT COPY

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Property South of I-85

BEGINNING at a point in the center of Pacolet River on the southern edge of the right-of-way of U. S. Highway I-85, thence with the center of the Pacolet River as the Line S. 64-14 E. 382.7 feet to a point in the middle of said River; thence S. 36-58 W. 810 feet to a point in the center of a branch; thence with the branch as the line the following courses and distances, N. 47-05 W. 110.5 feet, S. 70 W. 120 feet, N. 5 E. 120 feet, N. 63 W. 130 feet, N. 15 W. 135 feet, N. 66 W. 150 feet, S. 53 W. 120 feet, N. 65 W. 200 feet, N. 89-55 W. 321.5 feet to an old iron pin in the center of a paved road; thence N. 75-18 W. 68 feet to an iron pin; thence N. 18-30 W. 185.3 feet to an iron pin on the southern edge of the right-of-way of U.S. Highway I-85; thence along the edge of said right-of-way N. 75-43 E. 1690.6 feet to a point in the middle of the Pacolet River, the point of beginning.

This property is more recently shown and delineated on plat of survey made for Bruckner Machinery Corporation by John Robert Jennings, P.L.S., Surveyor, dated June 16, 2004, and recorded herewith in the Office of the Register of Deeds for Spartanburg County, S. C.

This being the identical property heretofore conveyed unto Vernon K. Suzuki by deed of Bruckner Trockentechnik, GmbH & Co. KG. dated August 23, 2004 and recorded in the Office of the Register of Deeds for Spartanburg County, S. C. in Deed Book 81A at Page 651.

APPENDIX B

SIGNATURE *DW*

**Partial listing of key documents that have been
provided to the Department for review.**

Title	Date	Prepared By
Phase I and IA Site Assessment Status Report Textile Fibers Group Facility Spartanburg, SC	Jul-90	AECOM and Predecessors
SCDHEC Re: Preliminary Engineering Report	Aug-90	SCDHEC
SCDHEC Re: Groundwater Monitoring Review	Sep-90	SCDHEC
Proposed Well Installation	Sep-90	AECOM and Predecessors
Permit Requests for Packer Tests and HydroPunch Sampling	Sep-90	AECOM and Predecessors
SCDHEC Monitoring Well Approval	Oct-90	SCDHEC
SCDHEC Re: Meeting and Presentation of Hydrogeologic Information (10/1/90); Phase I and I-A Site Assessment Status Report (9/17/90); Well Installation Proposal (9/7/90); Revised Well Installation Proposal (10/2/90); Request Packer Tests and As-built Hydropunch Borings (9/28/90)	Oct-90	SCDHEC
Hydrogeologic Investigation of the Hoechst Celanese Facility Phase II	Apr-91	AECOM and Predecessors
Request Approval for Well Construction	Sep-91	AECOM and Predecessors
SCDHEC Approval and Comments on Sludge Characterization Borehole Locations and Sampling Plan	Oct-91	SCDHEC
SCDHEC Monitor Well/Packer Test Request (9/16/91) Approval	Oct-91	SCDHEC
Well Permit Application	Nov-91	AECOM and Predecessors
Re: Hoechst Celanese Fibers Plant Request to Install Monitor Wells (11/8/91) Spartanburg County	Dec-91	SCDHEC
Preliminary Sludge Impoundment Characterization Report	Feb-92	AECOM and Predecessors
Addendum to Preliminary Sludge Pond Characterization Report	Apr-92	AECOM and Predecessors
SCDHEC Re: Sludge Disposal Feasibility Study Report per Rust International Corporation	Jun-92	SCDHEC
Response to Comments from SCDHEC Dated June 16, 1992 on the Sludge Disposal Feasibility Study Report	Jul-92	AECOM and Predecessors
Request for Well Construction Approval	Aug-92	AECOM and Predecessors
Addendum to Well Construction Application	Oct-92	AECOM and Predecessors
Monitor Well MW-9 Abandonment and Replacement HCC/Spartanburg	Apr-93	AECOM and Predecessors
Preliminary Engineering Report to South Carolina Department of Health and Environmental Control for Groundwater Remediation Project	May-93	AECOM and Predecessors
SCDHEC Re: Initial Hydrogeologic Characterization, Dated March 23, 1993 Proposed Ash Landfill	May-93	SCDHEC

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Title	Date	Prepared By
Phase IV - Site Characterization Health and Safety Plan and Amendment for HCC/Spartanburg Facility	Jun-93	AECOM and Predecessors
Submittal of Preliminary Engineering Report- Groundwater Remediation- Phase I	Jun-93	Hoechst Celanese
Request for Well Construction Approval	Jul-93	AECOM and Predecessors
Application for Permit to Discharge Process Wastewater - New Source Hoechst Celanese Corporation Groundwater Remediation - Phase I Projects Cover Letter	Jul-93	Hoechst Celanese
Phase I Extraction Start / Groundwater Treatment Plant Construction	1993	Milestone
Wastewater Treatment Plant Construction	1994	Milestone
SCDHEC approval of Lagoon Closure Plan	May-94	SCDHEC
SCDHEC approval of "Revised Preliminary Engineering Report, Wastewater Sludge Disposal" (Phase I)	May-94	SCDHEC
Presentation of Site Characterization Report HCC/Spartanburg to SCDHEC	May-94	AECOM and Predecessors
Well Permit Application	Jul-94	AECOM and Predecessors
Completed Application for Construction Permit (3/28/1994) and Construction Permit Issued (7/13/1994)	Jul-94	SCDHEC
SCDHEC Re: Hoechst Celanese Spartanburg Plant Well Installation Request (07/08/94)	Aug-94	SCDHEC
Submittal of Application for Permit to Discharge Process Wastewater- New Source & Preliminary Engineering Report for Groundwater Remediation-Phase II	Apr-95	Hoechst Celanese
Health and Safety Plan HCC/Spartanburg	May-95	AECOM and Predecessors
Request for Permit to Operate (4/17/1995) and Permit to Operate for Groundwater Treatment System Issued 5/15/1995	May-95	SCDHEC
Well Permit Application	May-95	AECOM and Predecessors
Submittal of Construction Permit Application for Groundwater Remediation Project - Phase II	Jul-95	Hoechst Celanese
DHEC Approval of Preliminary Engineering Report	Aug-95	SCDHEC
Phased Dowtherm Characterization Report	Oct-95	AECOM and Predecessors
DHEC Comments on Plans and Specification for Groundwater Remediation Project - Phase II for Hoechst Celanese Corporation	Oct-95	SCDHEC
Construction Permit for Groundwater Phase II	Oct-95	SCDHEC
Phased DowTherm Characterization Report	May-96	AECOM and Predecessors
Monitor Well MW-4 Plug and Abandonment HCC/Spartanburg	May-96	AECOM and Predecessors
SCDHEC Re: Hoechst Celanese, Spartanburg Plant Well Abandonment Proposal (5/24/95)	Jun-96	SCDHEC
DHEC Notification that Screened Interval Response (10/16/95) Has Been Reviewed	Sep-96	SCDHEC
Request for DHEC to Inspect in order to obtain Permit to Operate	Sep-96	Hoechst Celanese

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Title	Date	Prepared By
Perimeter Groundwater Extraction / Outfall 010 (dedicated treated groundwater outfall)	Oct-96	Milestone
Monitor Well MW-4 Plug and Abandonment HCC/Spartanburg Plant	Nov-96	AECOM and Predecessors
Construction Permit Application for Phased DOWtherm Remediation System	Dec-96	AECOM and Predecessors
Permit to Operate for Groundwater Recovery Phase II	Jul-97	SCDHEC
DHEC Notification of Monitoring Well Approval for Hoechst Celanese Facility	Jun-98	James Ellis, SCDHEC
Submittal of Completed Application Package for NPDES Permit	Mar-01	Celanese
Groundwater Monitoring Status Report for KoSa, Spartanburg Facility	Jun-01	AECOM and Predecessors
Preliminary Risk Evaluation	Dec-01	Milestone
Operating Strategy Report for KoSa, Spartanburg Facility	Dec-01	AECOM and Predecessors
DHEC Approval of Monitoring Well-Request Received 1/28/2002	Jan-02	SCDHEC
SCDHEC Re: KoSa Facility Site ID #00225 Access Request for 611 Bruckner Road, Spartanburg, SC	Feb-02	Jan T. Cooke, SCDHEC
DHEC Concurrence with Recommendations of Operating Strategy Report for KoSa, Spartanburg Facility	Feb-02	Jan T. Cooke, DHEC
December 2001 Groundwater Report for KOSA, Spartanburg Facility	Mar-02	AECOM and Predecessors
USPS Certified Mail Notification to SCDHEC of results of sampling of private well located at 611 Bruckner Road in Spartanburg, SC	Apr-02	Steve Olp, Celanese
DHEC Notification of Review of Groundwater Monitoring Report Received 3/27/02, Request that Next Results be Submitted by 10/28/02	Apr-02	Jan T. Cooke, DHEC
Technical Memorandum for KoSa Spartanburg-March 2002 Perimeter Sampling	May-02	AECOM and Predecessors
NPDES Permit No. SC0048241 to Discharge to Surface Waters Issued July 23, 2002	Jul-02	SCDHEC
June 2002 Groundwater Report for KoSa, Spartanburg Facility	Sep-02	AECOM and Predecessors
Technical Memorandum for KoSa Spartanburg-September 2002 Perimeter Sampling	Nov-02	AECOM and Predecessors
DMT Area Remedial Alternative Recommendation KoSa Facility	Dec-02	AECOM and Predecessors
December 2002 Groundwater Report for KOSA, Spartanburg Facility	Mar-03	AECOM and Predecessors
SCDHEC Re: Underground Injection Control Permit #689 KoSa Spartanburg Facility	Mar-03	SCDHEC
SCDHEC Re: Underground Injection Control Permit #689 KoSa Spartanburg Site	Apr-03	SCDHEC
First Round of Enhanced Reductive Dechlorination (ERD) Injections	May-03	Milestone
Technical Memorandum for KoSa Spartanburg-March 2003 Perimeter Sampling	May-03	AECOM and Predecessors
Lactate Injection Report for KoSa Facility	Jun-03	AECOM and Predecessors

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Title	Date	Prepared By
June 2003 Groundwater Report for KoSa, Spartanburg Facility	Aug-03	AECOM and Predecessors
December 2003 Groundwater Report for KoSa Spartanburg Facility	Mar-04	AECOM and Predecessors
Technical Memorandum Invista Spartanburg - March 2001 Perimeter Sampling BoW Site ID #00225	May-04	AECOM and Predecessors
Addendum to UIC Permit Application #689 KoSa Spartanburg Facility	May-04	AECOM and Predecessors
Technical Memorandum Invista Spartanburg - March 2004 Perimeter Sampling BoW Site ID #00225	May-04	AECOM and Predecessors
SCDHEC Re: Underground Injection Control Permit #689M KoSa Spartanburg Facility	Jun-04	SCDHEC
June 2004 Groundwater Report for Invista, Spartanburg Facility	Aug-04	AECOM and Predecessors
Technical Memorandum Invista Spartanburg - September 2004 Perimeter Sampling BoW Site ID #00225	Nov-04	AECOM and Predecessors
December 2004 Groundwater Report	Apr-05	AECOM and Predecessors
Technical Memorandum Invista Spartanburg - March 2005 Perimeter Sampling BoW Site ID #00225	May-05	AECOM and Predecessors
DHEC Concurrence with Recommendations of Corrective Action Monitoring Report Received 3/29/2005 for KoSa, Spartanburg Facility	May-05	Jan T. Cooke, DHEC
June 2005 Groundwater Report for Invista, Spartanburg Facility	Sep-05	AECOM and Predecessors
December 2005 Groundwater Report	Mar-06	AECOM and Predecessors
SCDHEC Re: Underground Injection Control Permit #689M KoSa Spartanburg Facility Site	Jul-06	SCDHEC
June 2006 Groundwater Report	Sep-06	AECOM and Predecessors
December 2006 Groundwater Report	Feb-07	AECOM and Predecessors
Addendum to UIC Permit Application #689 KoSa Spartanburg Facility	Aug-07	AECOM and Predecessors
SCDHEC Re: Underground Injection Control Permit #689M2 KoSa Spartanburg Site	Aug-07	SCDHEC
June 2007 Groundwater Report	Sep-07	AECOM and Predecessors
December 2007 Groundwater Report	Mar-08	AECOM and Predecessors
June 2008 Groundwater Report INVISTA, Spartanburg Facility	Sep-08	AECOM and Predecessors
December 2008 Groundwater Report INVISTA, Spartanburg Facility South Carolina BoW Site ID# 00225 AECOM Project 79748	Feb-09	AECOM and Predecessors
June 2009 Groundwater Report INVISTA, Spartanburg Facility	Sep-09	AECOM and Predecessors
February 2, 2010 Presentation to DHEC	Feb-10	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Meeting February 2, 2010	Feb-10	SCDHEC
Response to the Tasks and Schedule Proposed in February 2nd Meeting on March 5, 2010	Mar-10	AECOM and Predecessors

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Title	Date	Prepared By
Sampling and Analysis Plan	Apr-10	AECOM and Predecessors
Receptor Survey	May-10	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Response to the Tasks and Schedule...received March 26, 2010; Sampling and Analysis Plan received April 19, 2010; Receptor Survey received May 18, 2010	Jun-10	SCDHEC
INVISTA Spartanburg Site Assessment Report	Jun-10	AECOM and Predecessors
June 2010 Groundwater Report INVISTA, Spartanburg Facility	Sep-10	AECOM and Predecessors
INVISTA Spartanburg Remedial Effectiveness Report	Nov-10	AECOM and Predecessors
December DMT Area Supplemental Monitoring 2010	Feb-11	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Site Assessment Report received September, 2010; Remedial Effectiveness Report dated November, 2010	Apr-11	SCDHEC
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 DMT Area Supplemental Monitoring dated February 28, 2011 Response to Comments dated May 31, 2011	Jul-11	SCDHEC
Auriga Spartanburg Groundwater and Surface Water Monitoring Report	Aug-11	AECOM and Predecessors
SCDHEC Memorandum: Hoechst Celanese / Auriga Cherokee Creek Sampling Spartanburg County, July 15, 2011	Aug-11	SCDHEC
Auriga Spartanburg Off-Site DPT Work Plan	Sep-11	AECOM and Predecessors
SCDHEC Memorandum: An Aquatic Macroinvertebrate Bioassessment of the Pacolet River between Lake Blalock and Interstate I-85 (Spartanburg County, SC) Technical Report 8A 19-11	Sep-11	James Glover, SCDHEC
Injection Plan for Existing Wells	Oct-11	AECOM and Predecessors
SCDHEC Re: Invista/KoSa/Auriga (Hoechst Celanese Textile) Site ID #00225 Aquatic Macroinvertebrate Bioassessment of the Pacolet River performed by SCDHEC on 7-11-2011; Cherokee Creek Sampling performed by SCDHEC 7-15-2011	Oct-11	SCDHEC
Groundwater and Surface Water Monitoring Report August 2011	Nov-11	AECOM and Predecessors
DHEC Letter responding to on-site injection well plan	Nov-11	SCDHEC
Bio-Assessment proposal for Pacolet River	Dec-11	AECOM and Predecessors
Off-site assessment report	Jan-12	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Bio-Assessment Proposal for the Pacolet River dated 12/1/2011	Jan-12	SCDHEC
Auriga Spartanburg Revised On-Site Characterization and Remediation Plan	Mar-12	AECOM and Predecessors
Ecological Study Workplan	Mar-12	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Temporary Well Installation Request Dated March 2, 2012	Mar-12	SCDHEC

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Title	Date	Prepared By
December DMT Area Supplemental Monitoring 2011	Mar-12	AECOM and Predecessors
MW-99 Investigation Plan	Apr-12	AECOM and Predecessors
Supplement to MW-99 Investigation Plan	Apr-12	AECOM and Predecessors
Invitation to VCC	May-12	SCDHEC
Ecological Study Approval	Jun-12	SCDHEC
DHEC Invitation to enter VCC	Jun-12	Milestone
SCDHEC Re: Auriga/Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Off-Site Direct Push Investigation dated January 2012; Off-Site Groundwater Results dated April 26, 2012	Jun-12	SCDHEC
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #0025 Auriga Spartanburg Groundwater and Surface Water Monitoring Report August 2011; Revised On-Site Characterization and Remediation Plan Dated March 2012; DMT Area Supplemental Monitoring December 2011, dated March 20, 2012; Direct Push Supplemental Plan for the MW-99 Area dated April 27, 2012	Jun-12	SCDHEC
McNair Re: Invitation to Participate in South Carolina Voluntary Clean-Up Program for Auriga/KoSa/Hoechst Celanese Site; Spartanburg County; Site #5841	Jun-12	McNair Attorneys
Update to Auriga Spartanburg Revised On-Site Characterization and Remediation Plan	Jul-12	AECOM and Predecessors
Off-site investigation plan	Aug-12	AECOM and Predecessors
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Correspondence from AECOM dated July 3, 2012; Revised On-Site Characterization and Remediation Plan updated July, 2012	Aug-12	SCDHEC
Draft VCC and request to provide information	Aug-12	SCDHEC
SCDHEC Re: Invista/KoSa (Hoechst Celanese Textile) Site ID #00225 Off-Site Plan	Aug-12	SCDHEC

APPENDIX G: VOLUNTARY CLEANUP CONTRACT PROGRESS REPORT

Voluntary Cleanup Contract #13-5841-RP Progress Report #4 (September 2014)
(excluding Appendix A)

400225



AECOM
1360 Peachtree St.
Suite 500
Atlanta, GA 30309

Phone 404.965.9600
Fax 404.965.9605

Ms. Addie Walker
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

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**SITE ASSESSMENT,
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Dear Ms. Walker,

**Subject: VCC Progress Report #4
Auriga, Spartanburg Facility
BoW Site ID# 00225, VCC 13-5841-RP
AECOM Project No. 60280417**

Please find enclosed the above referenced report. As indicated in the Voluntary Cleanup Contract and your request, two hard copies and one electronic copy on CD are included.

If you have questions, please contact me at 404.965.9657.

Sincerely,

Bryon Dahlgren, PE
Project Manager

70



Environment

Prepared for:
CNA Holdings LLC
Dallas, TX

Prepared by:
AECOM
Atlanta, GA
60280417
September 2014

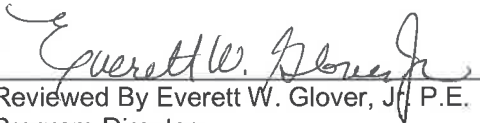
Auriga Spartanburg Voluntary Cleanup Contract 13-5841-RP Progress Report #4 September 2014



Auriga Spartanburg Voluntary Cleanup Contract 13-5841-RP Progress Report #4 September 2014



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Project Manager



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Program Director

Contents

1.0 Introduction.....	1-1
2.0 Chloroform in Groundwater.....	2-1
2.1 Actions Completed during Reporting Period.....	2-1
2.2 Actions Scheduled for Next Reporting Period	2-1
3.0 1,4-Dioxane in Groundwater	3-1
3.1 Actions Completed during Reporting Period.....	3-1
3.2 Actions Scheduled for Next Reporting Period	3-2
4.0 DOWTHERM™ A in Groundwater	4-1
4.1 Actions Completed during Reporting Period.....	4-1
4.2 Actions Scheduled for Next Reporting Period	4-1
5.0 DOWTHERM™ A Phase Material.....	5-1
5.1 Actions Completed during Reporting Period.....	5-1
5.2 Actions Scheduled for Next Reporting Period	5-1
6.0 Other Chlorinated Solvents in Groundwater	6-1
6.1 Actions Completed during Reporting Period.....	6-1
6.2 Actions Scheduled for Next Reporting Period	6-1
7.0 Cherokee Creek and Sediments and Ecological Habitat	7-1
7.1 Actions Completed during Reporting Period.....	7-1
7.2 Actions Scheduled for Next Reporting Period	7-1
8.0 Other Site-Wide Activities	8-1
8.1 Actions Completed during Reporting Period.....	8-1
8.2 Actions Scheduled for Next Reporting Period	8-1
9.0 Problems Encountered and Responses	9-1

List of Tables

Table

- 1 Annual Monitoring Plan – June
- 2 Chloroform Monitoring Plan – December
- 3 Summary of Groundwater Analytical Results, June 2014
- 4 Summary of Surface Water Analytical Results, June 2014
- 5 Summary of Baseline Performance Monitoring Results, April 2014

List of Figures

Figure

- 1 Work Plan Schedule – Updated
- 2 Sample Location Map, June 2014
- 3 Saprolite Potentiometric Map, June 2014
- 4 Bedrock Potentiometric Map, June 2014
- 5 Saprolite Chloroform, June 2014
- 6 Bedrock Chloroform, June 2014
- 7 Saprolite Dissolved Oxygen Isoconcentration Map, June 2014
- 8 Bedrock Dissolved Oxygen Isoconcentration Map, June 2014
- 9 Saprolite ORP Isoconcentration Map, June 2014
- 10 Bedrock ORP Isoconcentration Map, June 2014
- 11 Saprolite 1,4-Dioxane Isoconcentration Map, June 2014
- 12 Bedrock 1,4-Dioxane Isoconcentration Map, June 2014
- 13 Saprolite Diphenyl Ether Isoconcentration Map, June 2014
- 14 Bedrock Diphenyl Ether Isoconcentration Map, June 2014
- 15 Other Organic Detections in Saprolite, June 2014
- 16 Other Organic Detections in Bedrock, June 2014

List of Appendices

Appendix

- A Laboratory Analytical Results

1.0 Introduction

The purpose of this document is to provide to the South Carolina Department of Health and Environmental Control (SCDHEC) an update of activities at the Auriga facility in Spartanburg, South Carolina (SC) (site) under Voluntary Cleanup Contract 13-5841-RP (VCC) signed March 12, 2013. Activity to be completed at the site was defined in the VCC work plan submitted April 26, 2013, and approved January 21, 2014. This progress report covers the period of March 1, 2014 through August 31, 2014.

A schedule of activities was presented in the VCC work plan. An updated version of the schedule is presented as Figure 1.

Two annual monitoring events are defined in the VCC work plan. The site-wide event is scheduled for completion in June of each year. The scope of the June event is presented in Table 1. Table 1 of this report has been expanded from the VCC annual monitoring plan to include the additional performance monitoring wells. A smaller event focused on the chloroform plume area, scheduled for completion in December of each year, is presented in Table 2. Table 2 also includes the performance monitoring well added subsequent to the VCC work plan.

The annual groundwater monitoring event was completed in June. Samples were collected between June 9 and June 18, 2014. Surface water locations were also sampled along Cherokee Creek, the Pacolet River, and Bruckner Creek. The monitoring locations are presented on Figure 2. The complete laboratory analytical results are provided as Appendix A. A summary of groundwater results is presented in Table 3. A summary of surface water results is presented in Table 4. Potentiometric maps based on the groundwater elevations measured during the June sampling event are presented on Figures 3 and 4. These summary tables and figures are referenced in the following discussions of operable units (OU) as defined in the VCC work plan.

2.0 Chloroform in Groundwater

Chloroform at the site is identified as an aqueous plume extending south-southeast from the DMT area. No remaining or ongoing source was identified. Continued delineation and remediation activities were established in the VCC work plan and separate documents.

2.1 Actions Completed during Reporting Period

Installation of performance monitoring wells was completed on March 31, 2014. Baseline samples were collected from the new performance monitoring wells between March 31 and April 3, 2014. The results of the baseline sampling were submitted to SCDHEC on May 15, 2014. The baseline data was consistent with the previously established chloroform concentrations identified in recent direct push technology (DPT) sampling events. The data summary table presented in the May 15 report is reprinted as Table 5 of this progress report.

Injection activities were completed between April 21 and May 30, 2014. The injection completion report was submitted to SCDHEC on June 26, 2014.

The June monitoring event was completed shortly after injection activities were finished. Chloroform results were consistent with recent historic data. The chloroform data are included in summary Tables 3 and 4. The chloroform results are presented on Figures 5 and 6 for saprolite and bedrock, respectively.

No significant changes were noted in the chloroform results for wells or areas. The injection activities are expected to result in declines, but the samples were collected just after the completion of injection. Based on historic remediation in nearby areas, the results of the recent injection are not expected to be observed yet and several quarters may be required before significant changes are noted.

The results of dissolved oxygen and ORP analyses are presented in Table 3 and on Figures 7 through 10. The lactate injection activities are expected to demonstrate changes to these parameters over the next several quarters, creating conditions that will facilitate *in situ* destruction of chloroform.

2.2 Actions Scheduled for Next Reporting Period

Performance monitoring is scheduled to continue in the next quarter. The first quarterly event will be completed during the month of September. All performance monitoring wells will be sampled for volatile organics (VOCs), included chloroform, as well as other indicator parameters.

Activity is also anticipated west of Bruckner Road. The schedule of activities in this area is dependent on final approval from SCDHEC.

The semiannual chloroform groundwater monitoring event will be completed in December 2014. This event will include monitoring of the wells in the December sampling plan, as well as the performance monitoring wells. The complete chloroform monitoring plan is presented in Table 2, which has been revised from the VCC annual monitoring plan to include the performance monitoring wells.

3.0 1,4-Dioxane in Groundwater

1,4-Dioxane has been identified in site groundwater. Several known sources of 1,4-dioxane impact to groundwater were removed in the mid to late 1990's, including the in-ground basins associated with the wastewater treatment system and the sludge holding and sludge drying lagoons. Continued monitoring and evaluation was established as the course of action in the VCC work plan.

3.1 Actions Completed during Reporting Period

Analysis for 1,4-dioxane was included in the June annual sampling event, as indicated in Table 1. The 1,4-dioxane groundwater results are presented in Table 3. In addition, the 1,4-dioxane results for the saprolite and bedrock wells are presented on Figures 11 and 12, respectively.

Minor changes in concentration were noted for several wells in the area between Outfall 001 and Cherokee Creek. Historically, the highest concentration in the area has been in samples collected from well EW-14. The samples from this well have consistently reported concentrations at approximately 0.160 milligrams per liter (mg/L). In the June 2014 sample, this result was 0.0357 mg/L. Another decrease in 1,4-dioxane concentrations was reported in the sample from well EW-28 located near Cherokee Creek. The June 2014 result at EW-28 was 0.0858 mg/L, compared to historic results at approximately 0.15 mg/L.

The largest increase in the Outfall 001 and Cherokee Creek area was at well EW-02. The June 2014 sample result for EW-02 was 0.190 mg/L, compared to historic concentrations of approximately 0.1 mg/L. Samples from a few other wells in this area also showed slight increases in concentration compared to historic results. These wells include MW-97, EW-17, and EW-27. The concentration at each of these locations is below 0.050 mg/L and within historic values for the area. The overall extent and magnitude of concentrations within the area remains unchanged, though some fluctuation has been observed in this event.

Increased concentrations of 1,4-dioxane were noted at a few wells in the central plant vicinity. Concentrations of 1,4-dioxane were first noted in this area centered around well MW-53. The concentrations at well MW-53 remain below the high of 9.54 mg/L noted in 2011, but this well remains the center of the plume. Increases were noted at nearby wells RW-80, RW-86, and RW-91 (6.76, 7.28, and 3.23 mg/L, respectively). A smaller increase was also noted at downgradient well MW-05, which reported a result of 1.35 mg/L. These results suggest that the plume has moved slightly in the past 4 years, but the plume remains closest to MW-53.

Decreasing concentrations were noted at three wells on the west side of the former DMT area. The 1,4-dioxane concentration reported for samples from wells MW-99 and EW-52 declined to 0.0022 mg/L. The result for nearby well MW-98 also declined slightly to 0.0423 mg/L. The results over several years suggest that the plume may be declining in this small area.

South of Bruckner Creek, there was a detection of 1,4-dioxane in the sample from well RW-110. The result of 0.0049 mg/L is similar to the prior reported detection of 0.0036 mg/L in early 2013. Three other samples collected in 2013 and 2014 were non-detected (<0.002 mg/L). Well RW-110 is located directly adjacent to Bruckner Creek. Samples collected from nearby downgradient well RW-111 have consistently remained below the Method 8260 SIM reporting limit of 0.002 mg/L. The sample collected in June was again non-detect (<0.002 mg/L). A second sample was collected from RW-111

on July 11, 2014, tested by Method M522, and reported a result of 0.0000998 mg/L. This result is similar to the M522 result measured from this well in December 2013 of 0.000123 mg/L. These results demonstrate that the groundwater directly adjacent to the creek may report measurable quantities; however, the flow of water from the south into the creek limits the migration of compounds, and the concentrations and range are limited beyond the creek.

In addition to the routine annual sampling (Table 1), one sample was collected from well MW-95 located across the Pacolet River and north of I-85. This sample was analyzed for 1,4-dioxane by Method M522 and reported a detection of 0.0000404 mg/L (40.4 parts per trillion). The reporting limit for this method is 40 parts per trillion. The result is more than an order of magnitude below the groundwater quality standard.

Detections of 1,4-dioxane were reported in a few surface water samples, as presented on Table 4. A detection of 0.0119 mg/L was reported at location SW-05, located near the conflux of Cherokee Creek and the Pacolet River. Lower concentrations were reported at nearby locations SW-04 and SW-06 (0.0021 and 0.0022 mg/L, respectively). This is the first reported detection of 1,4-dioxane at location SW-05. 1,4-Dioxane was also detected in the sample from location SW-10 at a concentration of 0.017 mg/L and at nearby location SW-09 at 0.0024 mg/L. The detection at SW-10 is consistent with periodic fluctuations seen at this location.

1,4-Dioxane was not detected (<0.002 mg/L) at all surface water locations south of I-85.

3.2 Actions Scheduled for Next Reporting Period

Well MW-95 will be resampled for additional analysis by Method M522. In addition, wells located south of I-85 will be analyzed for 1,4-dioxane as part of the December monitoring event.

4.0 DOWTHERM™ A in Groundwater

DOWTHERM™ A (DOWTHERM) is comprised of approximately 27% 1,1-biphenyl and 73% diphenyl ether. The presence of DOWTHERM™ A in groundwater is interpreted to be residual impact from events prior to enhancements in plant operations and housekeeping. Continued monitoring and evaluation was established as the course of action in the VCC work plan.

4.1 Actions Completed during Reporting Period

Monitoring of DOWTHERM™ A, as described in the VCC work plan, is included in the June annual sampling event. The results for 1,1-biphenyl and diphenyl ether are included in Table 3. Diphenyl ether is the primary component of DOWTHERM™ A. In addition, 1,1-biphenyl is more readily degraded than diphenyl ether. Therefore, diphenyl ether is more frequently detected as presented on Figures 13 and 14, which show the extent of DOWTHERM™ A for the saprolite and bedrock wells, respectively.

In general, the concentrations of diphenyl ether are stable with declines noted at a few locations. Three wells along Cherokee Creek reported declining concentrations, including EW-14, EW-16, and EW-28. A declining concentration was also noted at well MW-07. Well MW-07 is in the area of extraction discussed in the following section.

No increasing concentration trends were noted.

As noted in Table 3, the diphenyl ether results for a few wells were rejected during the validation process. The diphenyl ether result for one surface water sample was also rejected. The locations with rejected results are EW-22, EW-27, EW-43, EW-52, MW-97, and SW-04. The validation was the result of poor laboratory control sample recovery. Only results that reported non-detect (<0.010 mg/L) on the preliminary data were rejected by this validation. For the listed locations, except for well EW-22, a result of non-detect (<0.010 mg/L) would be consistent with recent data. At EW-22, the diphenyl ether results for the past three years have ranged from 0.0119 to 0.0163 mg/L. Slightly higher results have been noted in older samples from EW-22. The rejected data are considered to provide no information for the 2014 assessment, but these data gaps do not impact the assessment for this compound.

4.2 Actions Scheduled for Next Reporting Period

No monitoring actions are scheduled for DOWTHERM™ A in groundwater for the next reporting period. The phase DOWTHERM™ investigation is described in the next section.

5.0 DOWTHERM™ A Phase Material

Separate phase DOWTHERM™ A has been removed in the area of wells MW-07 and MW-39 downgradient of the former Fiber 1 EQ basin since startup of an extraction and decanting system in August 2001.

5.1 Actions Completed during Reporting Period

Extraction activities continued during the reporting period. The system was decanted on May 23, 2014. Approximately 1 gallon of phase DOWTHERM™ material was removed from the system, in addition to approximately 1,000 gallons of water. The total volume of product extracted since the system was started is estimated to be 86 gallons.

The investigation of phase DOWTHERM™ A in the vicinity of well MW-7 started in August 2014. AECOM began installation of the temporary wells during the week of August 25, 2014. All wells will be completed early in the next reporting period. The study will be completed over a period of two months once the wells are complete. The temporary wells will be abandoned in accordance with SCDHEC guidance once the study is complete.

5.2 Actions Scheduled For Next Reporting Period

The phase DOWTHERM™ investigation will continue into the next reporting period.

6.0 Other Chlorinated Solvents in Groundwater

Detection of other chlorinated compounds in groundwater have been identified in isolated areas. Detections consist primarily of tetrachloroethene (PCE) and trichloroethene (TCE), and their degradation product cis-1,2-dichloroethene (cDCE). These compounds are primarily noted near well MW-99 west of the DMT area and north of the plant between well MW-40 and Lake Patrick. 1,1-Dichloroethene (1,1-DCE) has also been noted at isolated locations. Continued monitoring and evaluation was established as the course of action in the VCC work plan.

6.1 Actions Completed during Reporting Period

Monitoring of VOCs, as described in the VCC work plan, is included in the June annual sampling event. The results for detected VOCs are included in Table 3. Detections of VOCs other than chloroform and 1,4-dioxane are presented on Figures 15 and 16.

No significant changes were noted for any other VOCs. All detections are consistent with historic values for the locations. A few new detections are noted in new performance monitoring wells, but these results are consistent with the known results for other wells in the area. The concentrations of VOCs at well MW-99 were all lower than recent results. This is consistent with the decline observed in 1,4-dioxane concentrations in the same area. Further data will be needed to determine if this is a trend or a fluctuation.

6.2 Actions Scheduled for Next Reporting Period

The September performance monitoring and December semiannual monitoring will include VOCs analysis for all wells in the sampling plans.

7.0 Cherokee Creek and Sediments and Ecological Habitat

In 2011, SCDHEC completed a macroinvertebrate study of the Pacolet River, including work along Cherokee Creek near the site. In response to the findings of that study, SCDHEC requested additional actions, including an ecological assessment and potential source evaluation. These activities were previously completed and the results submitted to and accepted by SCDHEC. Continued surface water monitoring and evaluation was established as the course of action in the VCC work plan.

7.1 Actions Completed during Reporting Period

The annual monitoring program as approved in the VCC work plan was completed in June. The results for site parameters are summarized in the previous sections of this progress report.

7.2 Actions Scheduled for Next Reporting Period

The next annual sampling event will not occur until after the next reporting period.

8.0 Other Site-Wide Activities

Because the June and December monitoring events encompass multiple operable units, they were defined in the VCC work plan as distinct operable units. Details of these events, specific to each operable unit, are provided in the previous sections.

8.1 Actions Completed during Reporting Period

The VCC work plan includes the June and December monitoring events as shown in Tables 1 and 2. The June 2014 results are summarized in Tables 3 and 4. Complete laboratory results are provided as Appendix A. The results are discussed further in previous sections of this report.

8.2 Actions Scheduled for Next Reporting Period

The December 2014 sampling event will be completed during the next reporting period.

9.0 Problems Encountered and Responses

No problems were encountered.

Tables

**Table 1
Annual Monitoring Plan**

Sample Location	VOCs (8260)	1,4-Dioxane	DowTherm A TM (1)	Natural Attenuation Parameters
Groundwater				
EW-01		X	X	
EW-02		X	X	
EW-07		X		
EW-14	X	X	X	
EW-15		X		
EW-16		X	X	
EW-17		X	X	
EW-20	X	X		
EW-22		X	X	
EW-26		X	X	
EW-27		X	X	
EW-28		X	X	
EW-30	X			X
EW-31		X		X
EW-32		X	X	
EW-36	X			X
EW-37	X	X		X
EW-38	X	X		
EW-39	X			X
EW-40	X			X
EW-41	X	X		X
EW-43		X	X	
EW-47	X	X		
EW-49	X	X	X	X
EW-50	X			X
EW-52	X	X	X	X
EW-53	X	X	X	X
MW-03	X	X		
MW-05		X	X	
MW-07		X	X	
MW-09A		X		
MW-26		X		
MW-39		X	X	
MW-40R		X	X	
MW-41		X		
MW-42		X	X	
MW-45	X			X
MW-46	X			X
MW-53		X	X	
MW-57		X		
MW-81		X	X	
MW-96		X	X	
MW-97		X	X	

**Table 1
Annual Monitoring Plan**

Sample Location	VOCs (8260)	1,4-Dioxane	DowTherm A™ (1)	Natural Attenuation Parameters
MW-98	X	X		
MW-99	X	X	X	X
MW-102		X	X	
MW-103	X	X	X	X
MW-105	X	X	X	X
MW-106	X	X	X	X
MW-107	X	X	X	X
MW-109	X	X	X	X
RW-08		X	X	
RW-24		X	X	
RW-29	X	X	X	X
RW-43		X	X	
RW-47	X			X
RW-48	X	X	X	X
RW-56		X		
RW-65	X	X	X	X
RW-79		X	X	
RW-80		X	X	
RW-82		X	X	
RW-83A		X	X	
RW-84		X	X	
RW-85		X	X	
RW-86		X	X	
RW-87		X	X	
RW-91		X	X	
RW-92		X	X	
RW-108	X	X	X	X
RW-110	X	X		X
RW-111	X	X		X
MW-112	X	X		X
RW-113	X	X		X
MW-114	X	X		X
RW-115	X	X		X
MW-116	X	X		X
MW-118	X	X		X
RW-119	X	X		X
MW-120	X	X		X
RW-121	X	X		X
MW-122	X			X
RW-123	X			X
MW-124	X			X
MW-126	X			X
RW-127	X			X
MW-128	X			X
RW-129	X			X
MW-130	X			X
MW-132	X			X
RW-133	X			X
MW-134	X			X

**Table 1
Annual Monitoring Plan**

Sample Location	VOCs (8260)	1,4-Dioxane	DowTherm A™ (1)	Natural Attenuation Parameters
MW-136	X			X
RW-137	X			X
MW-138	X			X
RW-139	X			X
Surface Water				
SW-01	X	X	X	
SW-02	X	X	X	
SW-03	X	X	X	
SW-04	X	X	X	
SW-05	X	X	X	
SW-06	X	X	X	
SW-07	X	X	X	
SW-08	X	X	X	
SW-09	X	X	X	
SW-10	X	X	X	
SW-11	X	X	X	
SW-12	X	X	X	
SW-13	X	X		
SW-14	X	X		

NA Parameters - Temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), ortho phosphate, sulfate, sulfide, alkalinity, chloride, nitrate, nitrite, dissolved ferrous iron, dissolved manganese, and total organic carbon (TOC).

(1) - DowTherm A™ components are 1,1-biphenyl and Diphenyl Ether

Table 2
December Chloroform Monitoring Plan

Sample Location	VOCs	NA Params
Groundwater		
EW-31	X	X
EW-37	X	X
EW-41	X	X
EW-49	X	X
EW-52	X	X
EW-53	X	X
MW-99	X	X
MW-103	X	X
MW-105	X	X
MW-106	X	X
MW-107	X	X
MW-109	X	X
RW-29	X	X
RW-48	X	X
RW-65	X	X
RW-108	X	X
RW-110	X	X
RW-111	X	X
MW-112	X	X
RW-113	X	X
MW-114	X	X
RW-115	X	X
MW-116	X	X
MW-118	X	X
RW-119	X	X
MW-120	X	X
RW-121	X	X
MW-122	X	X
RW-123	X	X
MW-124	X	X
MW-126	X	X
RW-127	X	X
MW-128	X	X
RW-129	X	X
MW-130	X	X
MW-132	X	X
RW-133	X	X
MW-134	X	X
MW-136	X	X
RW-137	X	X
MW-138	X	X
RW-139	X	X
Surface Water		
SW-12	X	
SW-13	X	
SW-14	X	

NA Params - Natural Attenuation Parameters:
 Temperature, pH, dissolved oxygen (DO), ORP, alkalinity, chloride,
 dissolved ferrous iron, manganese, and total organic carbon (TOC)

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	EW-01 6/17/2014	EW-02 6/12/2014	EW-07 6/13/2014	EW-14 6/17/2014	EW-15 6/17/2014	EW-16 6/17/2014	EW-17 6/13/2014	EW-20 6/17/2014	EW-22 6/17/2014	EW-26 6/18/2014	EW-27 6/17/2014	EW-28 6/12/2014	EW-30 6/12/2014
Volatile Organics & 1,4-Dioxane														
acetone	mg/L	NA	NA	NA	0.0254	NA	NA	NA	<0.025	NA	NA	NA	NA	<0.025
2-butanone	mg/L	NA	NA	NA	<0.01	NA	NA	NA	<0.01	NA	NA	NA	NA	<0.01
chloroform	mg/L	NA	NA	NA	0.0076	NA	NA	NA	<0.005	NA	NA	NA	NA	0.0925
1,1-dichloroethane	mg/L	NA	NA	NA	0.0714	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
1,1-dichloroethene	mg/L	NA	NA	NA	0.0135	NA	NA	NA	0.0162	NA	NA	NA	NA	<0.005
cis-1,2-dichloroethene	mg/L	NA	NA	NA	0.143	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
trans-1,2-dichloroethene	mg/L	NA	NA	NA	0.022	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
1,4-dioxane	mg/L	0.0324	0.19	0.114	0.0357	0.0365	1.63	0.031	0.016	0.604	0.0398	0.0466	0.0858	NA
methylene chloride	mg/L	NA	NA	NA	<0.005	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
1,1,2,2-tetrachloroethane	mg/L	NA	NA	NA	0.334	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
tetrachloroethene	mg/L	NA	NA	NA	0.0054	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
trichloroethene	mg/L	NA	NA	NA	0.235	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
vinyl chloride	mg/L	NA	NA	NA	0.0211	NA	NA	NA	<0.005	NA	NA	NA	NA	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	<0.01	0.141	NA	0.0491	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	0.0264	NA
diphenyl ether	mg/L	0.0131	0.91	NA	0.653	NA	0.0446	<0.01	NA	R**	<0.01	R**	0.167	NA
Field & Natural Attenuation Parameters														
alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	56.2
chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.6
dissolved oxygen	mg/L	0.73	0.76	0.51	1.2	0.58	0.39	0.34	0.45	0.44	0.44	2.82	0.54	0.43
ferrous Fe	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.4
groundwater elevation	feet MSL	676	666.52	641.29	680.55	652.62	646.55	679.51	685.25	648.73	644.97	665.07	666.43	678.18
manganese (dissolved)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.74
nitrate nitrogen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1
ORP	mV	55	-13	-60.7	74.2	-80	-41.9	-129.7	16.8	-45.5	-79.6	79.4	-31.5	-49.2
orthophosphate phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.05
pH	su	5.71	6.14	7.2	4.81	6.65	6.07	7.45	5.73	6.09	6.28	5.35	6.57	6.44
specific conductance	umhos/cm	176	0.132	0.12	161	244	811.9	143	156	781.7	274	0.083	162	0.18
sulfate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1
temperature	degrees C	17.42	18.82	16.47	19.15	16.5	18.04	21.4	17.31	17.82	16.96	19.47	20.42	21.57
total organic carbon	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1
turbidity	NTU	21.8	3.08	8.39	5.24	121.8	35.4	8.6	35.8	40	5.08	60	9.98	8.31

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	EW-31 6/12/2014	EW-32 6/18/2014	EW-36 6/12/2014	EW-37 6/12/2014	EW-38 6/13/2014	EW-39 6/12/2014	EW-40 6/17/2014	EW-41 6/12/2014	EW-43 6/12/2014	EW-47 6/13/2014	EW-49 6/11/2014	EW-50 6/11/2014	EW-52 6/12/2014
Volatiles Organics & 1,4-Dioxane														
acetone	mg/L	NA	NA	<0.025	<0.025	<0.025	<0.025	5.6	<0.025	NA	<0.025	<0.025	<0.025	<0.025
2-butanone	mg/L	NA	NA	<0.01	<0.01	<0.01	<0.01	1.84	<0.01	NA	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	0.0185	0.021	NA	<0.005	<0.005	<0.005	<0.005
1,1-dichloroethane	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,1-dichloroethene	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
cis-1,2-dichloroethene	mg/L	NA	NA	0.0183	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	0.0096	<0.005	0.0569
trans-1,2-dichloroethene	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	0.0125	1.06	NA	<0.002	0.0397	NA	NA	<0.002	0.067	0.0242	0.0042	NA	0.0022
methylene chloride	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
trichloroethene	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
vinyl chloride	mg/L	NA	NA	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	NA	<0.01	NA	NA	NA	NA	NA	NA	<0.01	NA	<0.01	NA	R**
diphenyl ether	mg/L	NA	0.0504	NA	NA	NA	NA	NA	NA	R**	NA	<0.01	NA	R**
Field & Natural Attenuation Parameters														
alkalinity	mg/L	114	NA	36.7	89.9	NA	705	11400	22.6	NA	NA	103	588	44.1
chloride	mg/L	7.7	NA	2.8	10.5	NA	12.9	8.6	2.9	NA	NA	1.8	3.1	2.9
dissolved oxygen	mg/L	0.24	0.7	0.34	0.53	0.44	0.68	0.67	0.34	0.65	5.78	0.43	0.44	0.39
ferrous Fe	mg/L	0.8	NA	4.4	1.2	NA	1	7	4.2	NA	NA	0.2	1	3.6
groundwater elevation	feet MSL	672.5	651.25	726.69	723.61	670.73	710.99	672.15	672.43	673.37	671.1	729	727.32	724.19
manganese (dissolved)	mg/L	1.54	NA	0.147	6.43	NA	1.25	0.28	0.445	NA	NA	0.0512	0.0098	0.21
nitrate nitrogen	mg/L	<0.1	NA	0.1	<0.1	NA	<0.1	3.2	0.14	NA	NA	<0.1	<0.1	<0.1
ORP	mV	-104	93.7	-41.8	136.4	-46	-58.8	-98.2	102.5	-94.1	193.1	-79.6	22.3	-62.9
orthophosphate phosphorus	mg/L	0.073	NA	0.05	NA	NA	0.2	0.17	0.054	NA	NA	<0.1	0.91	<0.1
pH	su	7.09	5.26	6.4	5.53	7.1	6.31	7.3	5.64	6.83	5.24	7.78	8.05	6.33
specific conductance	umhos/cm	0.254	239	0.129	0.123	0.125	1307	22611	0.072	0.22	0.065	0.23	1.082	0.176
sulfate	mg/L	<1	NA	<1	<1	NA	<1	5.3	<1	NA	NA	8.9	3.6	<1
temperature	degrees C	19.92	19.79	19.9	21.1	16.72	21.39	19.11	20.02	19.2	16.5	20.76	22.64	19.3
total organic carbon	mg/L	<1	NA	<1	43.3	NA	5.8	8570	<1	NA	NA	1.2	6.2	<1
turbidity	NTU	9.42	6.41	129	41.4	17.2	17.1	11.1	80.2	8.06	22.3	1.31	21	94.1

Notes:

- NA – Not Analyzed
- degrees C – degrees Celsius
- feet MSL – feet above mean sea level
- mg/L – milligrams per liter
- mV – millivolts
- NTU – nephelometric turbidity units
- su – standard units
- umhos/cm – micromhos/cm
- * – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
- R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	EW-53 6/12/2014	EW-53 Dup 6/12/2014	MW-03 6/13/2014	MW-05 6/11/2014	MW-07 6/11/2014	MW-09A 6/10/2014	MW-26 6/13/2014	MW-39 6/10/2014	MW-40R 6/13/2014	MW-41 6/10/2014	MW-42 6/10/2014	MW-45 6/12/2014	MW-46 6/12/2014
Volatile Organics & 1,4-Dioxane														
acetone	mg/L	<0.025	<0.025	<0.025	NA	NA	NA	NA	NA	NA	NA	NA	<0.025	<0.025
2-butanone	mg/L	<0.01	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	<0.01	<0.01
chloroform	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1-dichloroethane	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1-dichloroethene	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	0.0137
cis-1,2-dichloroethene	mg/L	0.0057	0.0059	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
trans-1,2-dichloroethene	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,4-dioxane	mg/L	<0.002	0.0027	0.0046	1.35	0.0813	0.0515	0.102	0.554	1.32	0.0124	0.0163	NA	NA
methylene chloride	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.005	0.009	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
trichloroethene	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
vinyl chloride	mg/L	<0.005	<0.005	<0.005	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	<0.01	<0.01	NA	0.0239	1.07	NA	NA	1.14	0.553	NA	<0.01	NA	NA
diphenyl ether	mg/L	<0.01	<0.01	NA	0.142	4.16	NA	NA	3.71	1.71	NA	0.0249	NA	NA
Field & Natural Attenuation Parameters														
alkalinity	mg/L	66.3	64.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.2	6.9
chloride	mg/L	9.5	9.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.3	14.3
dissolved oxygen	mg/L	0.65	NA	0.65	0.75	0.84	3.92	2.15	0.4	1.19	1.29	3.43	6.38	5.69
ferrous Fe	mg/L	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
groundwater elevation	feet MSL	699.44	NA	752.08	750.07	745.46	752.49	680.94	741.75	726.7	750.22	741.13	711.29	695.1
manganese (dissolved)	mg/L	1.36	1.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0115	0.0561
nitrate nitrogen	mg/L	<0.1	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	1.8
ORP	mV	58.1	NA	175.4	204.7	-23.8	193.2	237.8	-78.9	104.9	-61.4	44.8	154.4	264.8
orthophosphate phosphorus	mg/L	0.053	0.091	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.068	0.081
pH	su	5.05	NA	3.73	4.93	6.34	4.54	5.31	6.46	4.66	6.67	6.63	5.06	5.15
specific conductance	umhos/cm	245	NA	43	0.08	0.217	56	60	0.156	128	0.158	0.079	48	163
sulfate	mg/L	<1	<1	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	27.4
temperature	degrees C	19.75	NA	21.04	22.8	22.61	24	21.3	24.86	19.62	23.69	22.19	25.53	19.51
total organic carbon	mg/L	14.7	15.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.7	<1
turbidity	NTU	48.3	NA	15.4	2.08	1.59	3.98	3.34	5.56	9.17	15.6	115	9.64	2.13

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	MW-53 6/11/2014	MW-57 6/13/2014	MW-81 6/10/2014	MW-95 6/17/2014	MW-96 6/17/2014	MW-97 6/17/2014	MW-98 6/12/2014	MW-99 6/12/2014	MW-102 6/10/2014	MW-103 6/12/2014	MW-105 6/11/2014	MW-106 6/11/2014	MW-107 6/17/2014
Volatile Organics & 1,4-Dioxane														
acetone	mg/L	NA	NA	NA	NA	NA	NA	<0.025	<0.025	NA	<0.025	<0.025	<0.025	<0.025
2-butanone	mg/L	NA	NA	NA	NA	NA	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	NA	NA	NA	NA	NA	NA	<0.005	0.0066	NA	<0.005	0.129	0.0215	0.186
1,1-dichloroethane	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,1-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
cis-1,2-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	0.162	0.108	NA	<0.005	0.0105	<0.005	<0.005
trans-1,2-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	8.94	0.0128	0.0834	0.0000404	0.0253	0.0261	0.0423	0.0022	0.113	<0.002	0.0071	<0.002	<0.002
methylene chloride	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	NA	NA	NA	NA	NA	NA	0.0296	0.127	NA	<0.005	<0.005	<0.005	<0.005
trichloroethene	mg/L	NA	NA	NA	NA	NA	NA	0.0149	0.0262	NA	<0.005	<0.005	<0.005	<0.005
vinyl chloride	mg/L	NA	NA	NA	NA	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	<0.005	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	0.144	NA	1.07	NA	<0.01	<0.01	NA	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
diphenyl ether	mg/L	0.543	NA	4.11	NA	0.0327	R**	NA	<0.01	0.0216	<0.01	<0.01	<0.01	R**
Field & Natural Attenuation Parameters														
alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	<5	NA	<5	9.9	<5	25.8
chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	1.4	NA	2.2	6.9	4.1	1.9
dissolved oxygen	mg/L	1.08	5.99	0.64	NA	5.27	9.42	2.49	2.37	0.7	6.61	8.58	7.96	6.44
ferrous Fe	mg/L	NA	NA	NA	NA	NA	NA	NA	0	NA	0	0	0	0
groundwater elevation	feet MSL	761.18	733.41	762.08	NA	688.68	689.34	734.29	732.93	746.4	693.15	718.38	719.19	689.71
manganese (dissolved)	mg/L	NA	NA	NA	NA	NA	NA	NA	0.0372	NA	0.0413	<0.005	0.011	0.0087
nitrate nitrogen	mg/L	NA	NA	NA	NA	NA	NA	NA	0.92	NA	2.4	1.7	0.83	1.2
ORP	mV	127.5	283.2	-23.1	NA	262.3	317	172.2	231.3	210.8	312.5	185.3	202.7	197.5
orthophosphate phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	NA	<0.1	<0.1	<0.1
pH	su	4.88	4.97	6.21	NA	3.91	2.77	5.71	5.14	4.87	4.86	5.48	4.92	5.48
specific conductance	umhos/cm	2440	28	0.124	NA	0.042	0.034	56	31	0.164	49	10	0.032	76
sulfate	mg/L	NA	NA	NA	NA	NA	NA	NA	<1	NA	<1	<1	<1	<1
temperature	degrees C	23.8	17.82	25.88	NA	16.93	17.93	19.74	21.12	25.19	18.23	21.21	22.4	18.69
total organic carbon	mg/L	NA	NA	NA	NA	NA	NA	NA	<1	NA	<1	<1	<1	<1
turbidity	NTU	8.41	9.78	8.72	NA	3.56	1.68	7.2	6.9	5.41	8.9	5.45	2.3	9.67

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	MW-109 6/11/2014	MW-112 6/10/2014	MW-114 6/10/2014	MW-114 Dup 6/10/2014	MW-116 6/10/2014	MW-118 6/11/2014	MW-120 6/11/2014	MW-122 6/9/2014	MW-124 6/9/2014	MW-126 6/9/2014	MW-128 6/9/2014	MW-130 6/12/2014	MW-132 6/11/2014
Volatile Organics & 1,4-Dioxane														
acetone	mg/L	<0.025	<0.25	<0.25	<0.025	<0.025	<0.1	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
2-butanone	mg/L	<0.01	<0.1	<0.1	<0.01	<0.01	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	0.722	1.47	1.28	1.22	0.919	0.507	0.193	0.0236	0.55	1.7	0.0052	0.0424	<0.005
1,1-dichloroethane	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-dichloroethene	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,2-dichloroethene	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	0.0157	<0.005	<0.005	<0.005	<0.005	<0.005
trans-1,2-dichloroethene	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	0.0046	NA	NA	NA	NA	NA	NA
methylene chloride	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trichloroethene	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
vinyl chloride	mg/L	<0.005	<0.05	<0.05	<0.005	<0.005	<0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
diphenyl ether	mg/L	<0.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field & Natural Attenuation Parameters														
alkalinity	mg/L	20.4	20.3	11.8	12.1	23.2	10.5	11	21.6	<5	5.6	<5	9.2	11.3
chloride	mg/L	2.8	2.2	6.8	6.8	4.2	2.6	2.5	3.4	7.1	12.8	<1	<1	4.6
dissolved oxygen	mg/L	5.36	4.8	6.69	NA	2.97	6.33	4.02	3.69	5.59	5.98	9.97	3.93	0.58
ferrous Fe	mg/L	0	0	0	NA	0	0	0	NA	0.6	0	0	0	0
groundwater elevation	feet MSL	677.43	686.79	683.08	NA	678.94	674.36	664.82	726.663	725.55	717.95	717.86	699.15	697.93
manganese (dissolved)	mg/L	<0.005	<0.005	0.0072	0.0073	0.124	0.0271	0.0372	0.569	0.0231	0.124	0.0167	0.0516	0.11
nitrate nitrogen	mg/L	1.2	1.8	1.4	1.4	0.75	0.8	0.46	1.3	3.2	2.8	2	0.19	<0.1
ORP	mV	194.5	158.1	188.1	NA	117.2	195	182.6	75	201.2	215.4	293.1	217.4	295.3
orthophosphate phosphorus	mg/L	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	<0.1
pH	su	4.05	5.85	5.74	NA	4.85	4.1	3.76	5.88	5.02	5.19	3.07	4.37	5.16
specific conductance	umhos/cm	64	76	72	NA	79	53	40	0.085	0.069	0.088	36	30	45
sulfate	mg/L	<1	<1	<1	<1	1.8	<1	<1	<1	<1	<1	<1	<1	<1
temperature	degrees C	19.41	18.09	17.63	NA	17.8	17.82	19.24	24.53	24.2	19.83	21.46	20.69	21.11
total organic carbon	mg/L	<1	<1	<1	<1	<1	<1	2.1	<1	<1	<1	<1	<1	<1
turbidity	NTU	146.2	1.9	6.9	NA	2.81	164.5	107.6	1.24	5.96	1.79	6.62	66.9	8.2

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	MW-134 6/11/2014	MW-136 6/9/2014	MW-136 Dup 6/9/2014	MW-138 6/9/2014	RW-08 6/10/2014	RW-24 6/18/2014	RW-29 6/12/2014	RW-29 Dup 6/12/2014	RW-43 6/13/2014	RW-47 6/12/2014	RW-48 6/12/2014	RW-56 6/13/2014	RW-65 6/12/2014
Volatiles Organics & 1,4-Dioxane														
acetone	mg/L	<1	<0.025	<0.025	<0.025	NA	NA	<0.025	<0.025	NA	<0.025	<0.025	NA	<0.025
2-butanone	mg/L	<0.4	<0.01	<0.01	<0.01	NA	NA	<0.01	<0.01	NA	<0.01	<0.01	NA	<0.01
chloroform	mg/L	6.31	<0.005	<0.005	0.169	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
1,1-dichloroethane	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
1,1-dichloroethene	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
cis-1,2-dichloroethene	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
trans-1,2-dichloroethene	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
1,4-dioxane	mg/L	NA	NA	NA	NA	0.105	0.343	<0.002	<0.002	1.26	NA	<0.002	0.0818	<0.002
methylene chloride	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
1,1,2,2-tetrachloroethane	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
tetrachloroethene	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
trichloroethene	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
vinyl chloride	mg/L	<0.2	<0.005	<0.005	<0.005	NA	NA	<0.005	<0.005	NA	<0.005	<0.005	NA	<0.005
DOWTHERM™ A														
1,1-biphenyl	mg/L	NA	NA	NA	NA	0.321	<0.01	<0.01	<0.01	<0.01	NA	<0.01	NA	<0.01
diphenyl ether	mg/L	NA	NA	NA	NA	1.53	0.0351	<0.01	<0.01	<0.01	NA	<0.01	NA	<0.01
Field & Natural Attenuation Parameters														
alkalinity	mg/L	7.4	11.4	11.6	8.2	NA	NA	63.1	63.4	NA	510	105	NA	98.8
chloride	mg/L	1.9	11.7	11.7	2.3	NA	NA	1.2	1.2	NA	2.6	1.8	NA	12
dissolved oxygen	mg/L	1.87	5.07	NA	6.77	0.77	0.68	0.7	NA	0.27	0.49	0.44	2.89	0.55
ferrous Fe	mg/L	0	0	NA	0	NA	NA	0	NA	NA	0.9	1.6	NA	0.2
groundwater elevation	feet MSL	689.33	688.39	NA	676	747.28	663.08	775.1	NA	642.82	691.57	710.86	733.09	687.45
manganese (dissolved)	mg/L	0.0402	0.0738	0.0703	<0.005	NA	NA	0.0112	0.0107	NA	0.145	0.836	NA	1.43
nitrate nitrogen	mg/L	2.7	0.37	0.37	0.82	NA	NA	<0.1	<0.1	NA	<0.1	<0.1	NA	<0.1
ORP	mV	201.6	150	NA	224.1	-82.1	-24.7	40.9	NA	-57.1	-176.4	-44.7	117.4	-97.8
orthophosphate phosphorus	mg/L	<0.1	<0.1	<0.1	<0.1	NA	NA	0.15	0.16	NA	0.15	NA	NA	0.14
pH	su	5.4	5.59	NA	4.17	7.76	5.6	6.51	NA	9.22	8.16	5.88	6.38	7.56
specific conductance	umhos/cm	52	86	NA	40	0.265	599	153	NA	261	919	240	89	252
sulfate	mg/L	<1	<1	<1	<1	NA	NA	10.3	10.3	NA	<1	<1	NA	8.3
temperature	degrees C	20.19	23.48	NA	18.44	24.51	17.7	17.81	NA	15.69	17.52	19.97	20.7	17.4
total organic carbon	mg/L	<1	<1	<1	<1	NA	NA	<1	<1	NA	1.3	<1	NA	<1
turbidity	NTU	6.2	0.8	NA	5.86	3.18	6.94	2.86	NA	8.2	7.1	275.4	5.86	1.8

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	RW-79 6/10/2014	RW-80 6/11/2014	RW-82 6/11/2014	RW-82 Dup 6/11/2014	RW-83A 6/10/2014	RW-84 6/10/2014	RW-85 6/10/2014	RW-85 Dup 6/10/2014	RW-86 6/11/2014	RW-87 6/10/2014	RW-91 6/11/2014	RW-92 6/11/2014	RW-108 6/11/2014	RW-110 6/10/2014
Volatiles Organics & 1,4-Dioxane															
acetone	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.025	<0.025
2-butanone	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.01	<0.01
chloroform	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1-dichloroethane	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
cis-1,2-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
trans-1,2-dichloroethene	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,4-dioxane	mg/L	0.0055	6.76	0.589	0.496	0.0044	0.0203	0.0215	0.0223	7.28	0.0035	3.23	3.46	<0.002	0.0049
methylene chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
tetrachloroethene	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
trichloroethene	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
vinyl chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.005	<0.005
DOWTHERM™ A															
1,1-biphenyl	mg/L	<0.01	0.042	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.353	<0.01	0.0891	0.0211	<0.01	NA
diphenyl ether	mg/L	<0.01	0.312	0.439	0.257	<0.01	<0.01	<0.01	<0.01	1.4	<0.01	0.288	1.76	<0.01	NA
Field & Natural Attenuation Parameters															
alkalinity	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	170	73.7
chloride	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	2.7
dissolved oxygen	mg/L	5.14	0.45	0.39	NA	0.73	1.07	0.77	NA	0.24	1.21	0.49	0.54	0.58	1.25
ferrous Fe	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0	0
groundwater elevation	feet MSL	758.32	764.52	757.21	NA	764.23	761.55	759.03	NA	758.46	764.27	756.87	758.33	676.34	683.91
manganese (dissolved)	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.167	0.0061
nitrate nitrogen	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	1.3
ORP	mV	141.9	82.1	-6.1	NA	178.4	5	102	NA	-115.3	57.5	-35.7	-58	-43.8	31.9
orthophosphate phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.11	<0.1
pH	su	4.66	4.33	5.92	NA	5.56	5.69	4.62	NA	6.73	5.81	5.97	6.28	6.77	7.29
specific conductance	umhos/cm	85	0.769	0.366	NA	0.131	0.126	205	NA	1251	266	271	0.962	321	208
sulfate	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1	9.7
temperature	degrees C	24.94	35.87	25.52	NA	29.03	28.73	24.21	NA	32.49	27.85	22.79	23.98	18.12	18.74
total organic carbon	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1	<1
turbidity	NTU	8.4	3.42	2.18	NA	1.68	1.2	53.9	NA	7.57	4.67	2.4	3.66	16.4	17.2

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 3
Summary of Groundwater Analytical Results
June 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	RW-111 6/10/2014	RW-113 6/10/2014	RW-115 6/10/2014	RW-119 6/12/2014	RW-121 6/11/2014	RW-123 6/9/2014	RW-127 6/9/2014	RW-129 6/11/2014	RW-133 6/10/2014	RW-137 6/9/2014	RW-139 6/9/2014
Volatile Organics & 1,4-Dioxane												
acetone	mg/L	<0.025	<0.025	<0.25	0.24	<0.025	0.0259	<0.025	<0.025	<0.025	<0.025	<0.025
2-butanone	mg/L	<0.01	<0.01	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
chloroform	mg/L	<0.005	<0.005	2.5	0.17	0.114	0.0101	1.09	0.0078	0.0645	0.248	0.899
1,1-dichloroethane	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,1-dichloroethene	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
cis-1,2-dichloroethene	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	0.0051	<0.005	<0.005	<0.005	<0.005	<0.005
trans-1,2-dichloroethene	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	0.0000998*	<0.002	<0.002	0.0339	0.0033	NA	NA	NA	NA	NA	NA
methylene chloride	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	0.0159	<0.005	<0.005	<0.005	<0.005
1,1,2,2-tetrachloroethane	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
trichloroethene	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
vinyl chloride	mg/L	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
DOWTHERM™ A												
1,1-biphenyl	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
diphenyl ether	mg/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Field & Natural Attenuation Parameters												
alkalinity	mg/L	65.4	68.3	47.2	68.5	67.9	87	78.8	223	103	57.1	52.3
chloride	mg/L	1.3	1.6	5.8	2.4	2.2	2.3	10.6	12.9	4.1	5.5	3.5
dissolved oxygen	mg/L	0.72	0.54	3.9	4.49	0.95	1.5	0.89	0.45	0.87	1.43	0.94
ferrous Fe	mg/L	0	0	0	0	0	0.2	0	0	0	0.2	0
groundwater elevation	feet MSL	701.14	683.6	681.46	672.44	664.45	719.73	715.69	709.56	684.77	687.55	672.62
manganese (dissolved)	mg/L	0.0341	0.0401	0.0174	<0.005	0.007	0.0757	0.111	0.189	0.183	0.0221	0.0301
nitrate nitrogen	mg/L	<0.1	<0.1	1.8	0.45	0.17	<0.1	<0.1	<0.1	0.76	0.26	0.66
ORP	mV	-2.9	-97.4	55.9	119.4	117.9	-114.7	11.4	-34.1	91.3	64.8	207.7
orthophosphate phosphorus	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
pH	su	5.87	7.89	6.87	5.77	4.97	7.25	7.02	6.29	6.65	6.2	3.77
specific conductance	umhos/cm	162	162	149	176	146	0.193	0.217	472	225	141	129
sulfate	mg/L	10.5	8.5	2.8	7.2	3.6	4	9.6	6.3	1.8	<1	<1
temperature	degrees C	17.83	18.73	17.46	19.08	18.82	29.16	20.66	21.44	19.43	19.44	17.71
total organic carbon	mg/L	<1	<1	<1	1.3	1.3	4.8	1.2	4.9	<1	<1	<1
turbidity	NTU	3.11	1.03	4.8	308.9	8.67	4.61	2.16	33.9	15.6	1.2	23.1

Notes:

NA – Not Analyzed
degrees C – degrees Celsius
feet MSL – feet above mean sea level
mg/L – milligrams per liter
mV – millivolts
NTU – nephelometric turbidity units
su – standard units
umhos/cm – micromhos/cm
* – 6/10/14 result for 1,4-dioxane = <0.002;
resample on 7/11/14 tested by Method 522
R** – Results not reportable.

Table 4
Summary of Surface Water Analytical Results
June 2013
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	SW-01 6/11/2014	SW-02 6/11/2014	SW-03 6/11/2014	SW-04 6/11/2014	SW-05 6/11/2014	SW-06 6/11/2014	SW-07 6/11/2014	SW-08 6/11/2014	SW-09 6/11/2014	SW-10 6/11/2014	SW-11 6/11/2014	SW-12 6/10/2014	SW-13 6/11/2014	SW-14 6/11/2014
chloroform	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0127	0.0125	0.0064
1,4-dioxane	mg/L	<0.002	<0.002	<0.002	0.0021	0.0119	0.0022	<0.002	<0.002	0.0024	0.017	<0.002	<0.002	<0.002	<0.002
dissolved oxygen	mg/L	6.98	6.98	7.11	7.69	6.21	6.99	7.69	6.41	6.71	6.69	7.11	8	8.14	8.77
ORP	mV	-58.3	-50.8	-48.2	-32.6	-43.1	-49.3	-49.6	-55.8	-69.8	-37.6	-69.2	94.7	90.7	93.9
pH	su	7.14	7.12	6.98	7.31	7.11	6.91	7.09	7.71	7.86	8.19	6.78	7.02	5.95	5.81
specific conductance	umhos/cm	74	69	69	86	69	58	63	53	52	533	108	159	96	95
turbidity	NTU	12.1	9.2	8.3	6.4	17.4	12.2	12.1	8.4	10.1	9.4	12.6	4.2	5.52	2.97
temperature	degrees C	21.4	21.8	21.1	21	21.7	22.1	22.2	23.2	21.6	29.3	21.1	22.1	22	22.1

NA - Not Analyzed

degrees C - degrees Celsius

mg/L - milligrams per liter

mV - millivolts

NTU = nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Table 5
Summary of Baseline Performance Monitoring Results
April 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	MW-112 4/1/2014	MW-114 4/2/2014	MW-114 Dup 4/2/2014	MW-116 4/1/2014	MW-118 4/1/2014	MW-120 4/2/2014	MW-122 4/3/2014	MW-124 4/3/2014	MW-126 4/3/2014
Volatile Organics and 1,4-Dioxane										
chloroform	mg/L	2.00	1.66	1.49	0.845	0.697	0.149	0.0308	0.798	2.00
cis-1,2-dichloroethene	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0183	<0.005	<0.005
1,4-dioxane	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	0.0023	NA	NA	NA
methylene chloride	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0067	0.0054
Semivolatile Organics										
bis(2-ethylhexyl)phthalate	mg/L	<0.006	<0.006	<0.006	<0.006	0.0068	<0.006	NA	NA	NA
di-n-octyl phthalate	mg/L	<0.01	0.0127	0.0129	<0.01	0.02	<0.01	NA	NA	NA
Field and Natural Attenuation Parameters										
alkalinity	mg/L	21.5	16.3	15.1	23.6	11.7	14.8	15.8	<5	7.9
chloride	mg/L	2.5	7.2	7.2	5.1	3.3	2.8	3.3	7	13.9
dissolved oxygen	mg/L	5.5	6.07	6.07	3.6	6.41	4.51	4.59	5.83	6.52
ferrous Fe	mg/L	0	0.17	0.17	0.06	0.11	0.02	0.08	0.06	0.04
groundwater elevation	feet MSL	687.60	683.20	683.20	680.30	674.05	665.08	727.56	725.74	718.50
manganese (dissolved)	mg/L	<0.005	0.0158	0.015	0.19	0.034	0.0361	0.109	0.0511	0.182
ORP	mV	152.9	153.3	153.3	139.8	149.3	150	219.8	238.4	185.8
pH	su	5.12	4.95	4.95	4.74	4.81	4.88	5.11	4.98	4.15
specific conductance	umhos/cm	0.118	0.123	0.123	0.134	0.074	0.073	0.053	0.062	0.168
temperature	degrees C	15.74	16.95	16.95	18.66	19.11	21.92	20.68	21.8	18.2
total organic carbon	mg/L	1.9	<1	<1	<1	<1	<1	<1	<1	<1
turbidity	NTU	0.17	5.03	5.03	1.68	3.57	4.11	7.03	9.33	0.01

NA - Not Analyzed
degrees C - degrees Celsius
feet MSL - feet above mean sea level
mg/L - milligrams per liter
mV - millivolts
NTU = nephelometric turbidity units
su - standard units
umhos/cm - micromhos/cm

Table 5
Summary of Baseline Performance Monitoring Results
April 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	MW-128 4/2/2014	MW-130 4/1/2014	MW-132 4/2/2014	MW-132 Dup 4/2/2014	MW-134 4/2/2014	MW-136 3/31/2014	MW-138 3/31/2014	RW-113 4/1/2014	RW-115 4/2/2014
Volatile Organics and 1,4-Dioxane										
chloroform	mg/L	0.0077	0.0398	<0.005	<0.005	5.29	<0.005	0.148	<0.005	2.57
cis-1,2-dichloroethene	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	NA	NA	NA	NA	NA	NA	NA	<0.002	<0.002
methylene chloride	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Semivolatile Organics										
bis(2-ethylhexyl)phthalate	mg/L	NA	NA	NA	NA	NA	NA	NA	<0.006	<0.006
di-n-octyl phthalate	mg/L	NA	NA	NA	NA	NA	NA	NA	<0.01	<0.01
Field and Natural Attenuation Parameters										
alkalinity	mg/L	<5	8.7	13.1	12.6	8.3	13.1	8.9	64.8	33.4
chloride	mg/L	1.5	1.2	5.2	5.1	2.3	13.9	2.6	1.9	5.9
dissolved oxygen	mg/L	9.28	2.98	0.25	0.25	2.08	5.85	6.18	1.91	5.5
ferrous Fe	mg/L	0.08	0.04	0.01	0.01	0.02	0	0.05	0.05	0.69
groundwater elevation	feet MSL	717.63	698.93	697.62	697.62	688.53	688.51	676.86	683.78	681.50
manganese (dissolved)	mg/L	0.0208	0.0675	0.116	0.117	0.0538	0.132	0.0067	0.048	0.0125
ORP	mV	280.1	269.8	303.5	303.5	238.1	152.5	170.1	109.5	130.1
pH	su	4.21	5.15	4.62	4.62	4.85	4.89	4.95	7.68	5.95
specific conductance	umhos/cm	0.031	0.029	0.046	0.046	0.047	0.117	0.072	0.252	0.172
temperature	degrees C	23.37	24.28	21.98	21.98	23.13	18.87	15.2	20.64	19.68
total organic carbon	mg/L	<1	<1	1.1	<1	<1	1.1	1.4	1.3	<1
turbidity	NTU	9.73	16.85	4.57	4.57	12.78	1.33	0.46	0	7.38

NA - Not Analyzed
degrees C - degrees Celsius
feet MSL - feet above mean sea level
mg/L - milligrams per liter
mV - millivolts
NTU = nephelometric turbidity units
su - standard units
umhos/cm - micromhos/cm

Table 5
Summary of Baseline Performance Monitoring Results
April 2014
Auriga Spartanburg Facility
AECOM Project No. 60280417

Parameter	Unit	RW-119 4/1/2014	RW-121 4/2/2014	RW-123 4/3/2014	RW-123 Dup 4/3/2014	RW-127 4/3/2014	RW-129 4/2/2014	RW-133 4/2/2014	RW-137 3/31/2014	RW-139 3/31/2014
Volatile Organics and 1,4-Dioxane										
chloroform	mg/L	0.214	0.115	0.0235	0.0224	1.06	0.575	0.0492	0.243	0.958
cis-1,2-dichloroethene	mg/L	<0.005	<0.005	0.0079	0.0074	0.0086	<0.005	<0.005	<0.005	<0.005
1,4-dioxane	mg/L	0.0048	0.0034	NA	NA	NA	NA	NA	NA	NA
methylene chloride	mg/L	<0.005	<0.005	<0.005	<0.005	0.0189	0.0141	<0.005	<0.005	<0.005
tetrachloroethene	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Semivolatile Organics										
bis(2-ethylhexyl)phthalate	mg/L	<0.006	<0.006	NA	NA	NA	NA	NA	NA	NA
di-n-octyl phthalate	mg/L	<0.01	<0.01	NA	NA	NA	NA	NA	NA	NA
Field and Natural Attenuation Parameters										
alkalinity	mg/L	71.7	68.8	85.5	85.8	85.8	242	127	69.6	57.9
chloride	mg/L	3	2.6	2.8	2.7	11.6	13.2	4.9	6.3	4.3
dissolved oxygen	mg/L	8.2	1.95	0.47	0.47	1.17	0.2	2.58	0.84	0.46
ferrous Fe	mg/L	0.12	0	0	0	0	0.08	0.02	0.22	0.12
groundwater elevation	feet MSL	673.15	664.63	720.25	720.25	716.16	709.34	683.24	687.99	673.26
manganese (dissolved)	mg/L	0.0086	<0.005	0.0129	0.0128	0.0647	0.161	0.14	0.0549	0.0349
ORP	mV	127.5	116.4	44.5	44.5	137.2	3.5	158.9	119.8	131.6
pH	su	7.23	6.98	7.41	7.41	6.9	6.49	5.92	5.81	5.39
specific conductance	umhos/cm	0.269	0.232	0.161	0.161	0.369	0.433	0.211	0.217	0.195
temperature	degrees C	15.83	19.67	20.25	20.25	19.81	21.62	18.83	20.99	16.94
total organic carbon	mg/L	<1	2.7	<1	1.1	<1	1.2	1.1	1.9	1.3
turbidity	NTU	257.7	1.79	0.46	0.46	0.44	0.01	23.36	3.65	0.64

NA - Not Analyzed

degrees C - degree Celsius

feet MSL - feet above mean sea level

mg/L - milligrams per liter

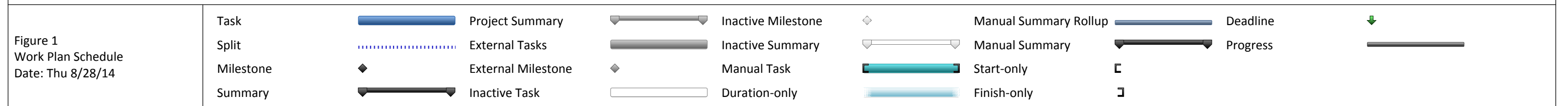
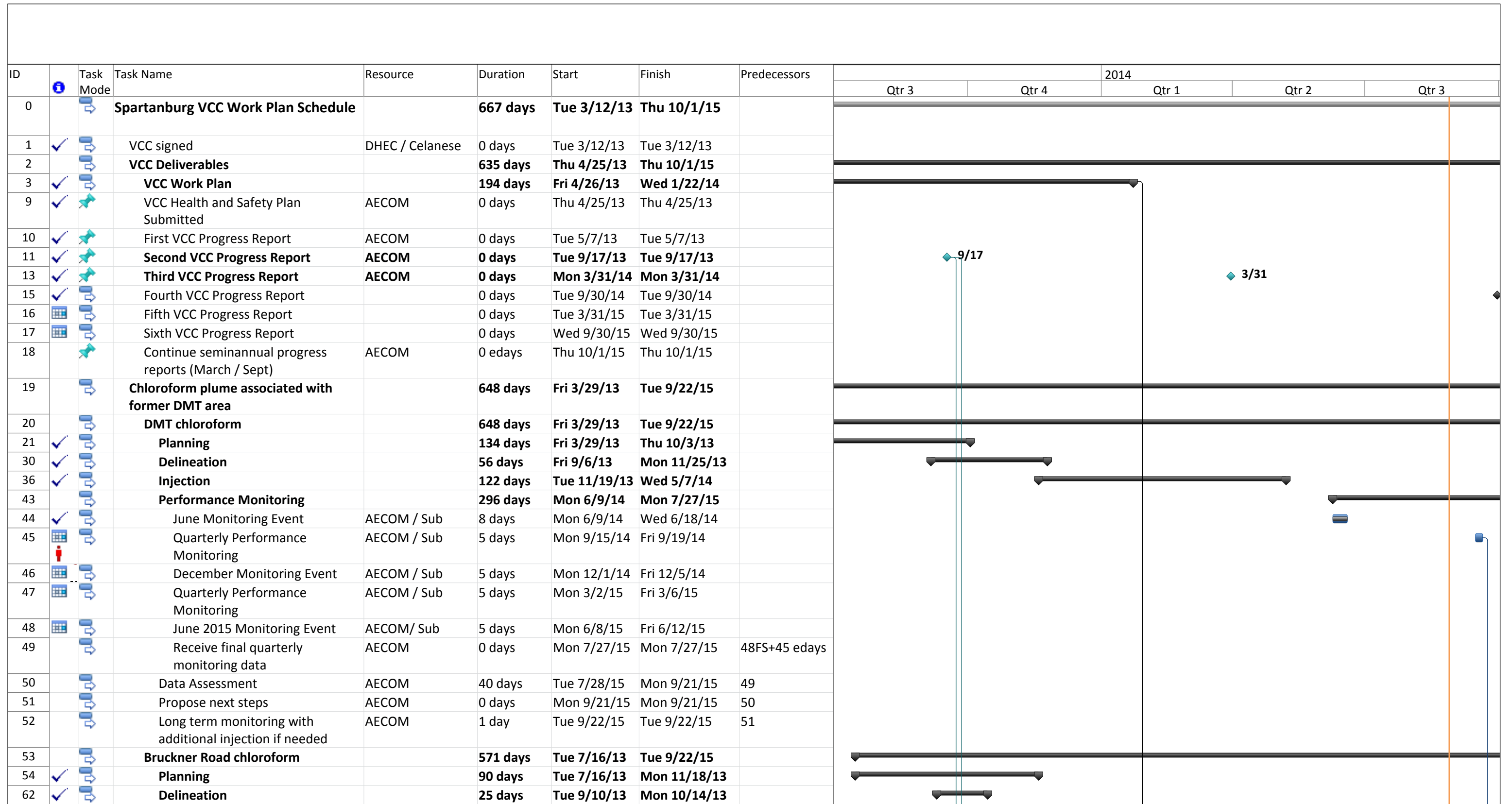
mV - millivolts

NTU = nephelometric turbidity units

su - standard units

umhos/cm - micromhos/cm

Figures



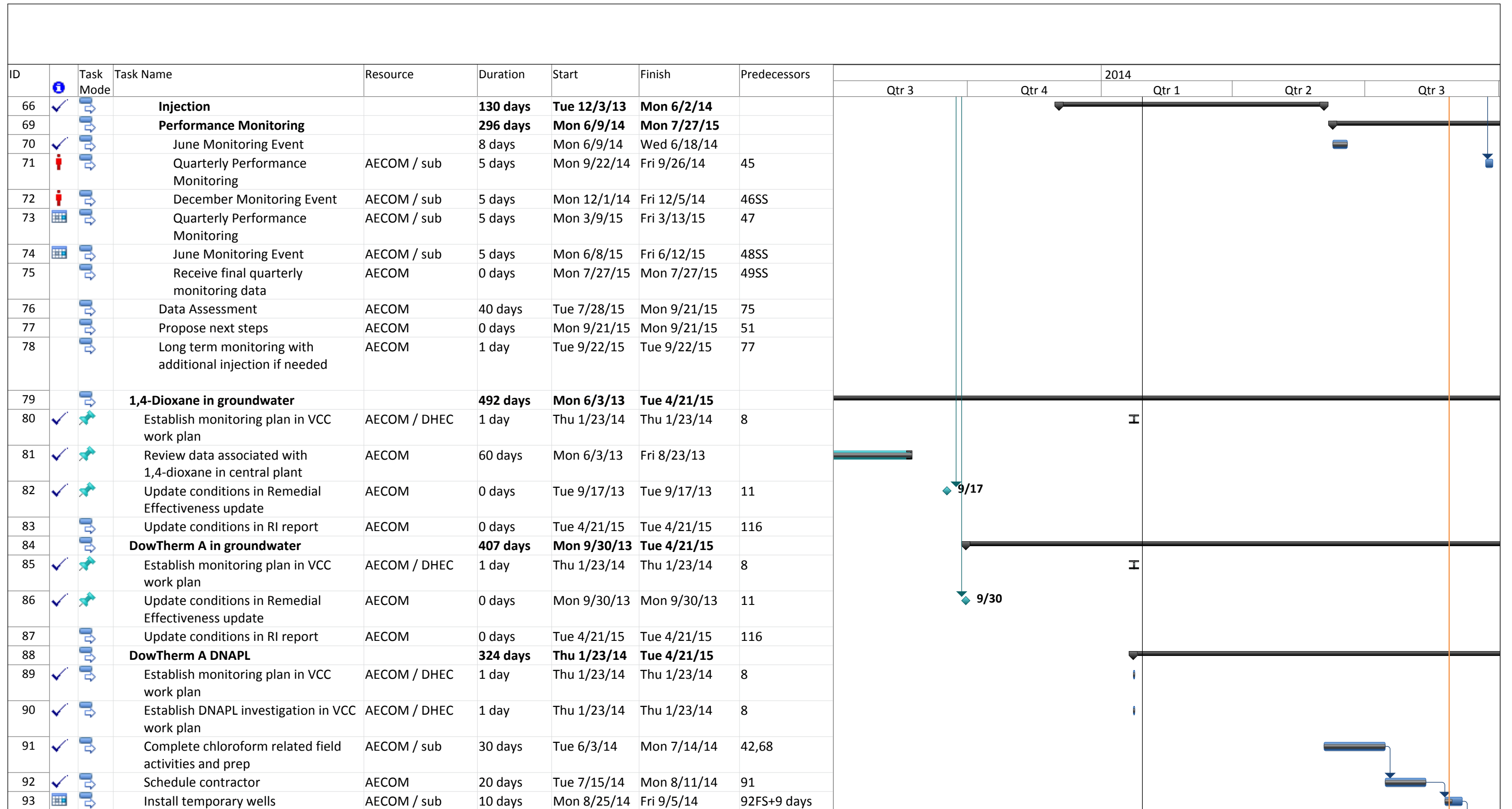
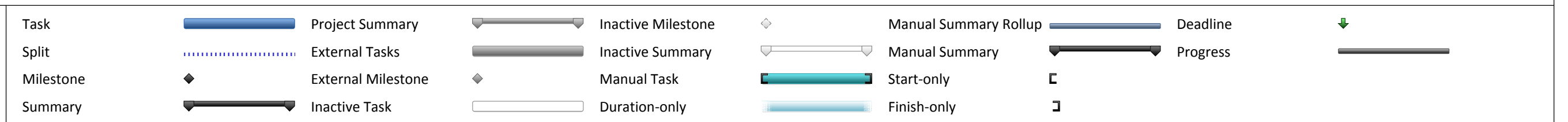


Figure 1
Work Plan Schedule
Date: Thu 8/28/14



ID	Task Mode	Task Name	Resource	Duration	Start	Finish	Predecessors	2014				
								Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3
94		Complete DowTherm A field investigation	AECOM / sub	45 days	Mon 9/8/14	Fri 11/7/14	93					
95		Review results	AECOM	30 days	Mon 11/10/14	Fri 12/19/14	94					
96		Submit recommendations to DHEC in RI Report	AECOM	1 day	Tue 4/21/15	Tue 4/21/15	120,95					
97	✓	Other chlorinated solvents in groundwater		1 day	Thu 1/23/14	Thu 1/23/14						
100		Cherokee Creek sediments and ecological habitat		324 days	Thu 1/23/14	Tue 4/21/15						
101	✓	submit plan forward in VCC work plan	AECOM	1 day	Thu 1/23/14	Thu 1/23/14	3					
102		review recommendations and update in RI	AECOM	1 day	Tue 4/21/15	Tue 4/21/15	120					
103		Site wide activities		482 days	Mon 6/17/13	Tue 4/21/15						
104	✓	June 2013 Annual Sampling		28 days	Mon 6/17/13	Wed 7/24/13						
108	✓	December 2013 Monitoring		28 days	Mon 12/2/13	Wed 1/8/14						
112	✓	June 2014 Annual Sampling		30 days	Mon 6/9/14	Fri 7/18/14						
116		Remedial Investigation Report		87 days	Mon 12/22/14	Tue 4/21/15						
117		Complete work plan investigations	AECOM / DHEC / subs	1 day	Mon 12/22/14	Mon 12/22/14	115,95					
118		draft RI	AECOM	50 days	Tue 12/23/14	Mon 3/2/15	117					
119		review RI	Celanese	25 days	Tue 3/3/15	Mon 4/6/15	118					
120		complete RI	AECOM	10 days	Tue 4/7/15	Mon 4/20/15	119					
121		Submit RI	AECOM	1 day	Tue 4/21/15	Tue 4/21/15	120					
122		Continue Monitoring as established in Work Plan	AECOM / EFM	1 eday	Fri 7/18/14	Sat 7/19/14	112					

Figure 1
Work Plan Schedule
Date: Thu 8/28/14

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			



LEGEND

- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION

NOTE: LOCATION OF MW-40R IS APPROXIMATE - SURVEY PENDING.

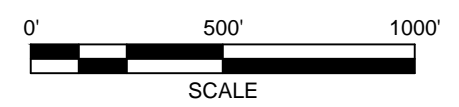
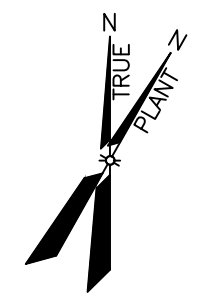
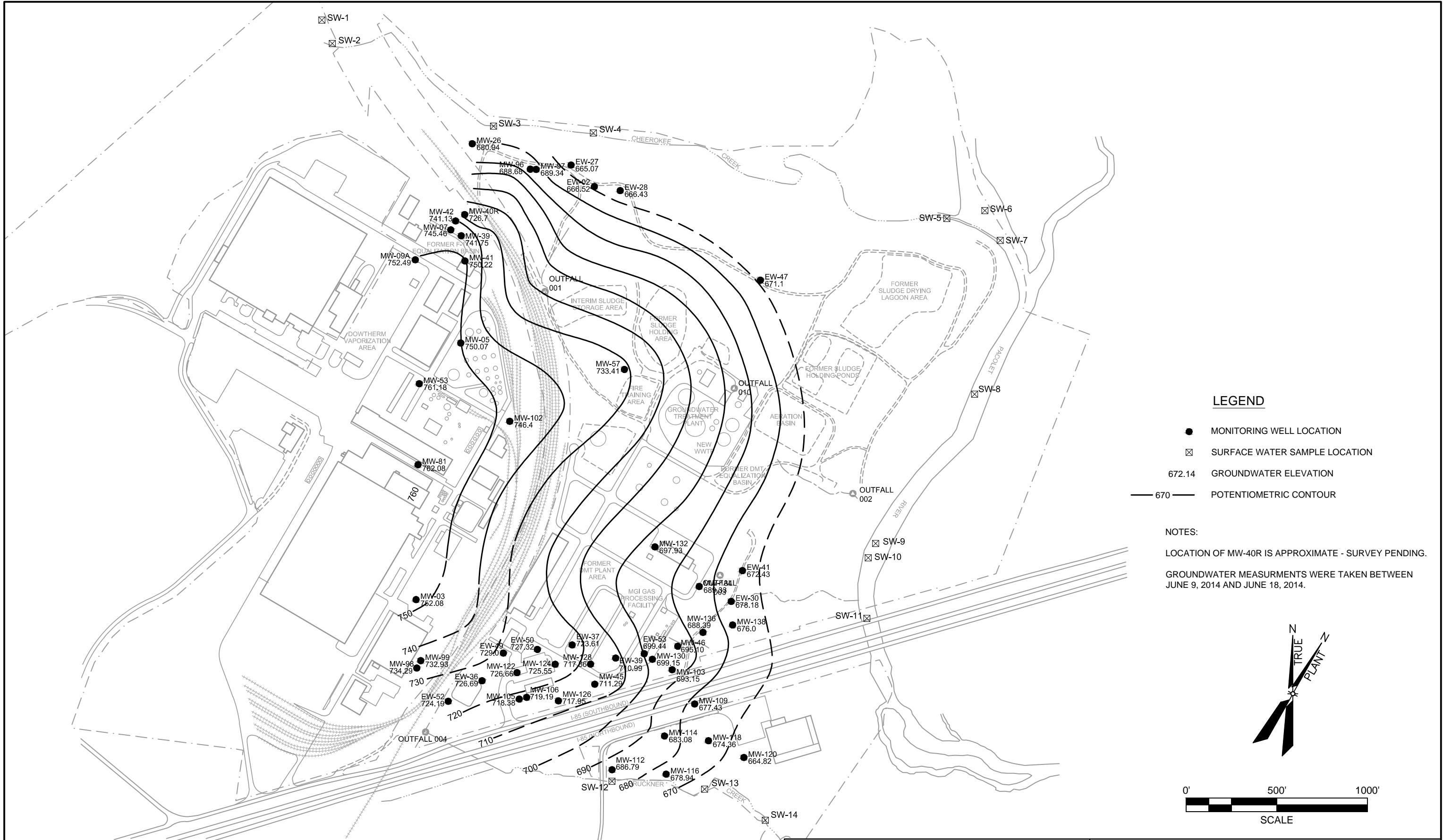


FIGURE 2
SAMPLE LOCATION MAP
JUNE 2014

AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION
- 672.14 GROUNDWATER ELEVATION
- 670 — POTENTIOMETRIC CONTOUR

NOTES:
 LOCATION OF MW-40R IS APPROXIMATE - SURVEY PENDING.
 GROUNDWATER MEASUREMENTS WERE TAKEN BETWEEN JUNE 9, 2014 AND JUNE 18, 2014.

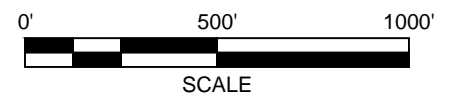
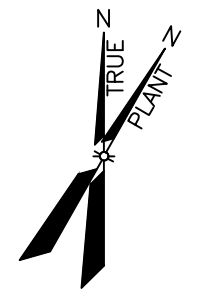
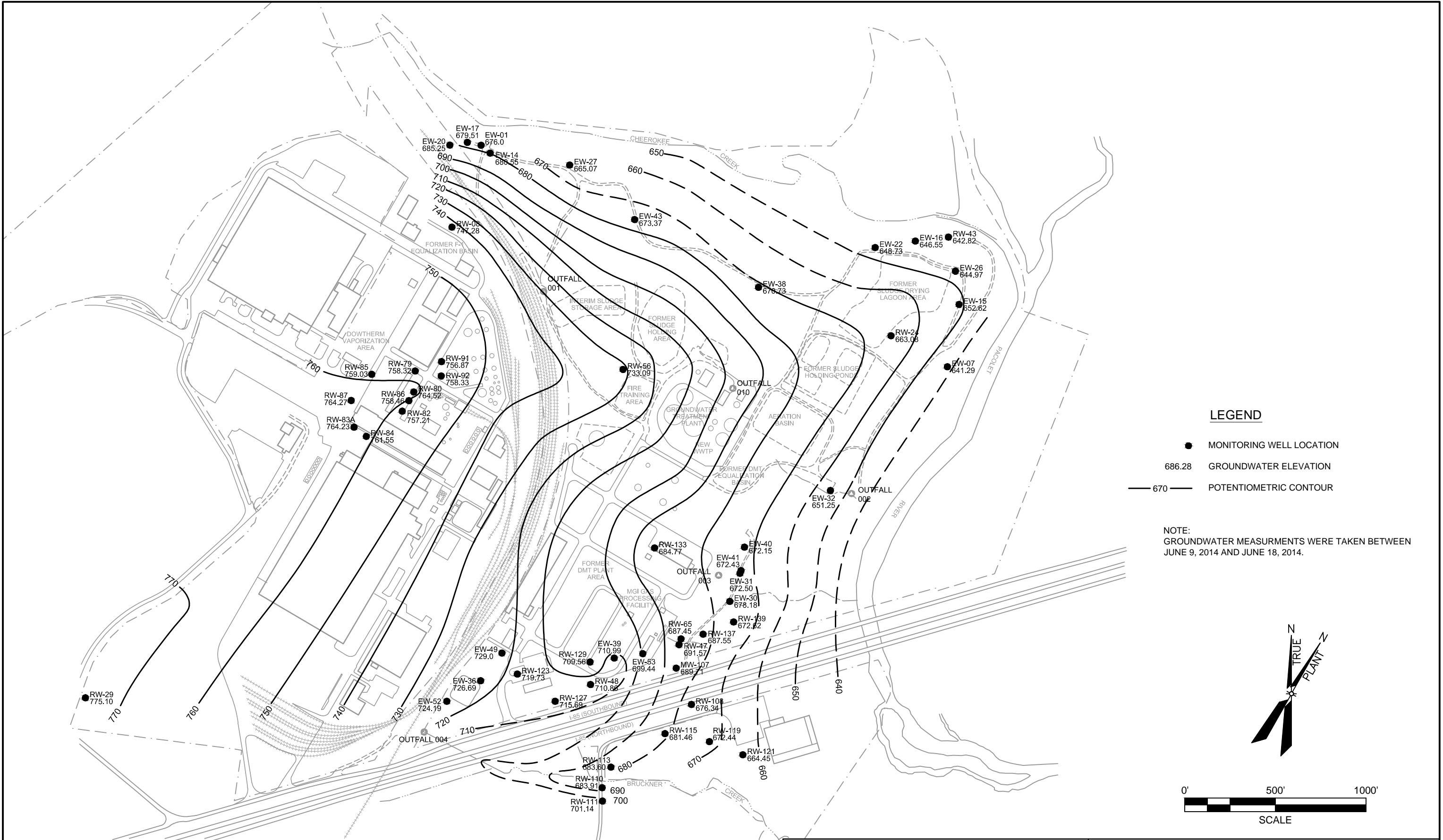


FIGURE 3
SAPROLITE POTENTIOMETRIC MAP
JUNE 2014



LEGEND

- MONITORING WELL LOCATION
- 686.28 GROUNDWATER ELEVATION
- 670 — POTENTIOMETRIC CONTOUR

NOTE:
GROUNDWATER MEASUREMENTS WERE TAKEN BETWEEN
JUNE 9, 2014 AND JUNE 18, 2014.

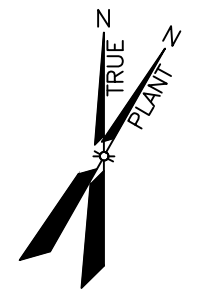
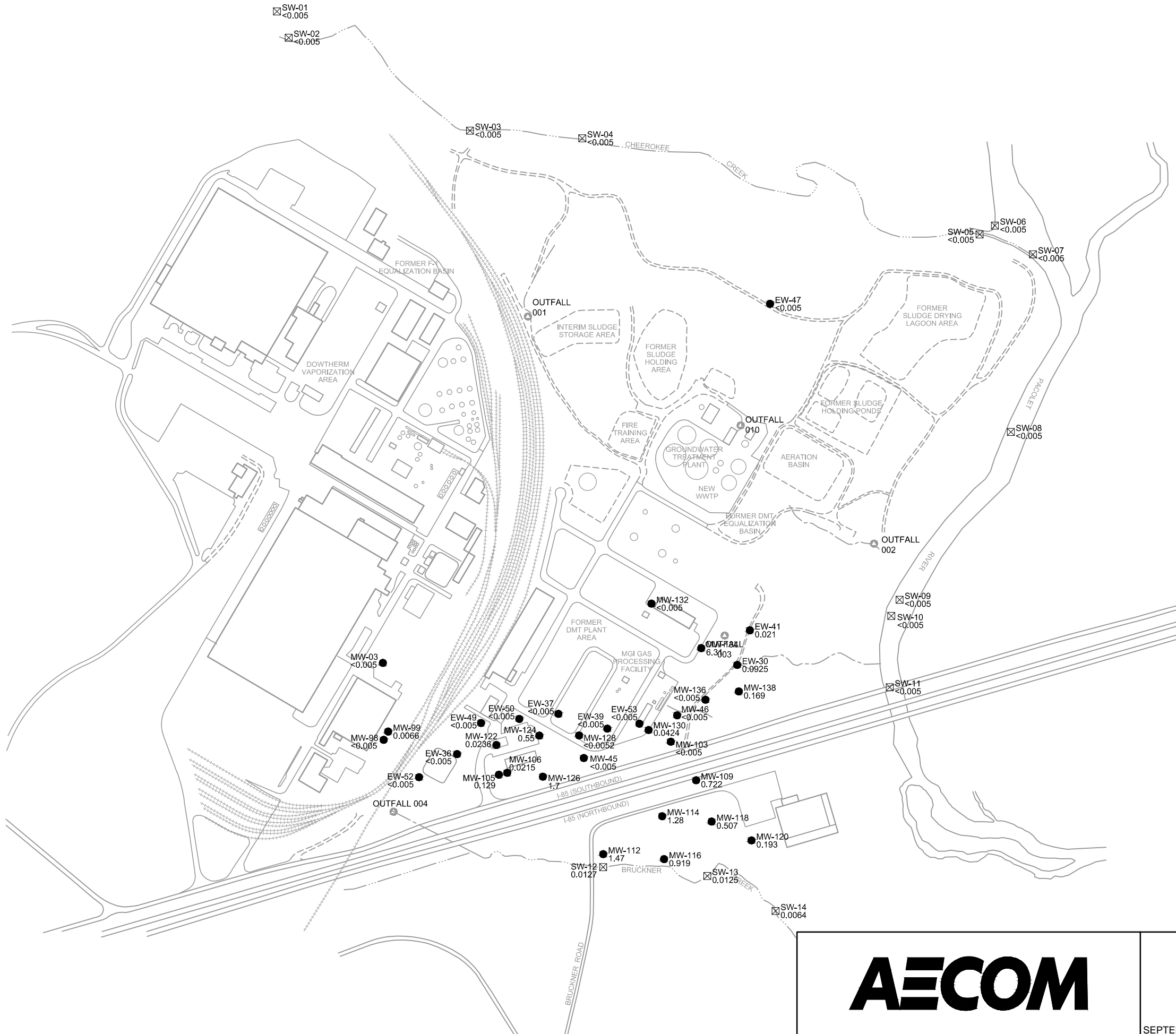


FIGURE 4
BEDROCK POTENTIOMETRIC MAP
JUNE 2014

AURIGA SPARTANBURG FACILITY
SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION
- 0.0075 CHLOROFORM CONCENTRATION (mg/L)

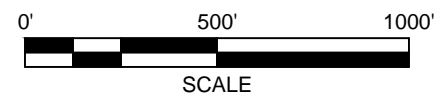
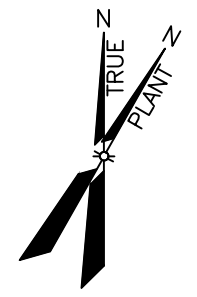
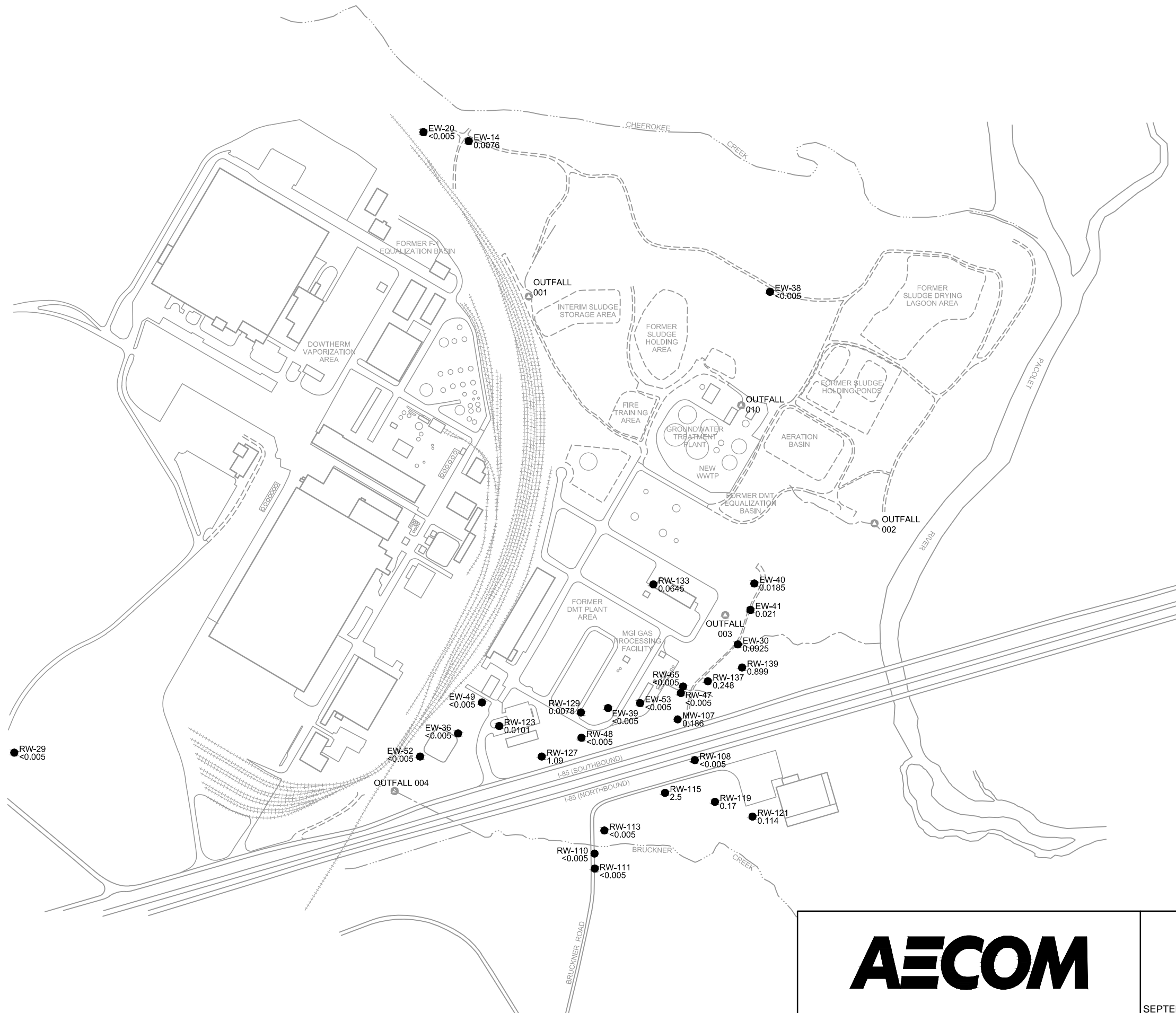


FIGURE 5
SAPROLITE CHLOROFORM
JUNE 2014

AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- <0.00514 CHLOROFORM CONCENTRATION (mg/L)

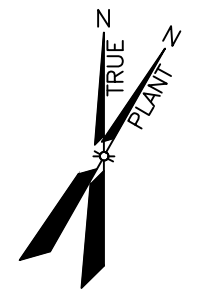
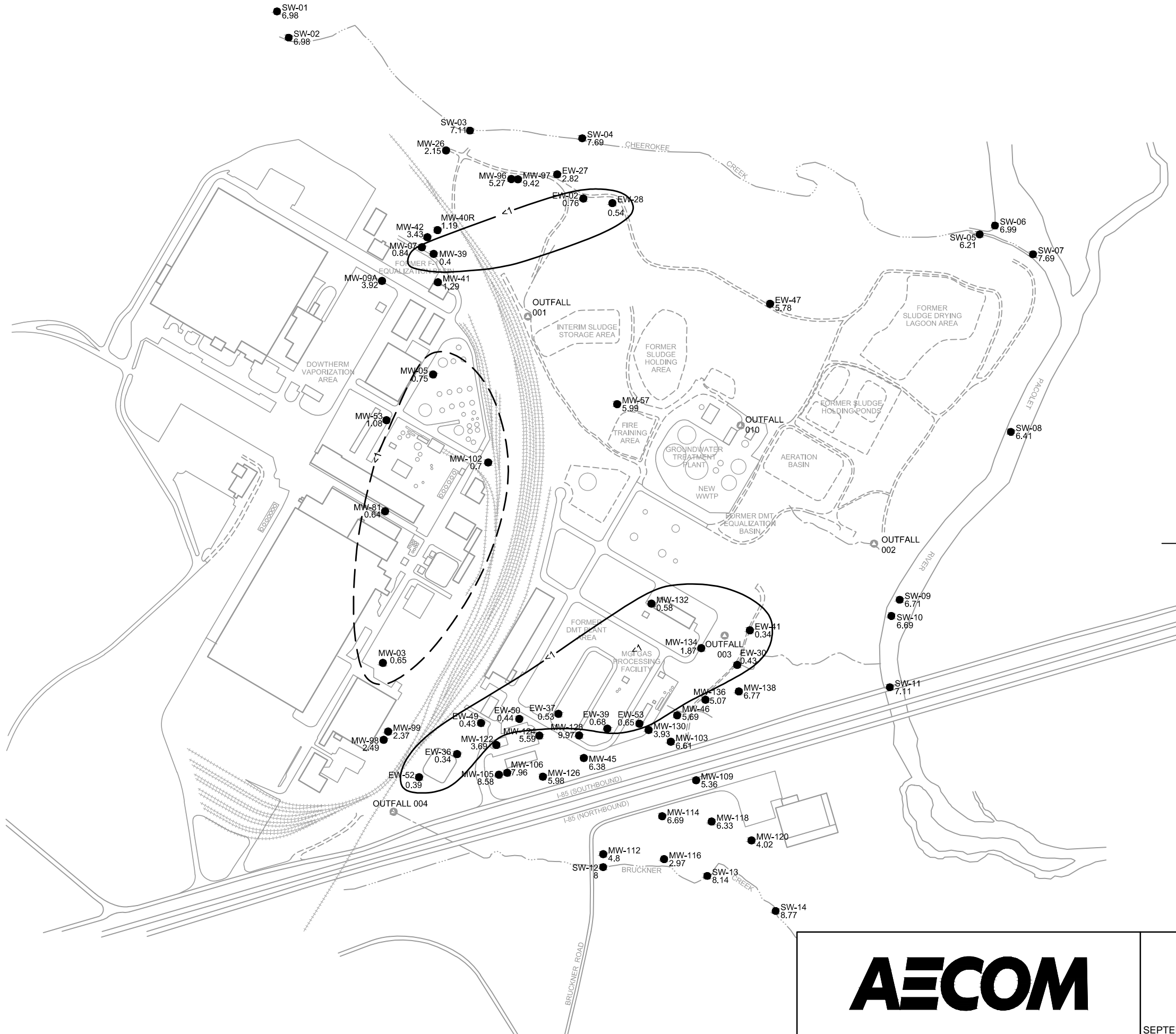


FIGURE 6
BEDROCK CHLOROFORM
JUNE 2014

AURIGA SPARTANBURG FACILITY
SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION
- 0.23 DISSOLVED OXYGEN CONCENTRATION
- <1 — DISSOLVED OXYGEN ISOCONCENTRATION CONTOUR

NOTE: LOCATION OF MW-40R IS APPROXIMATE - SURVEY PENDING.

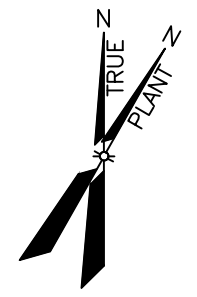
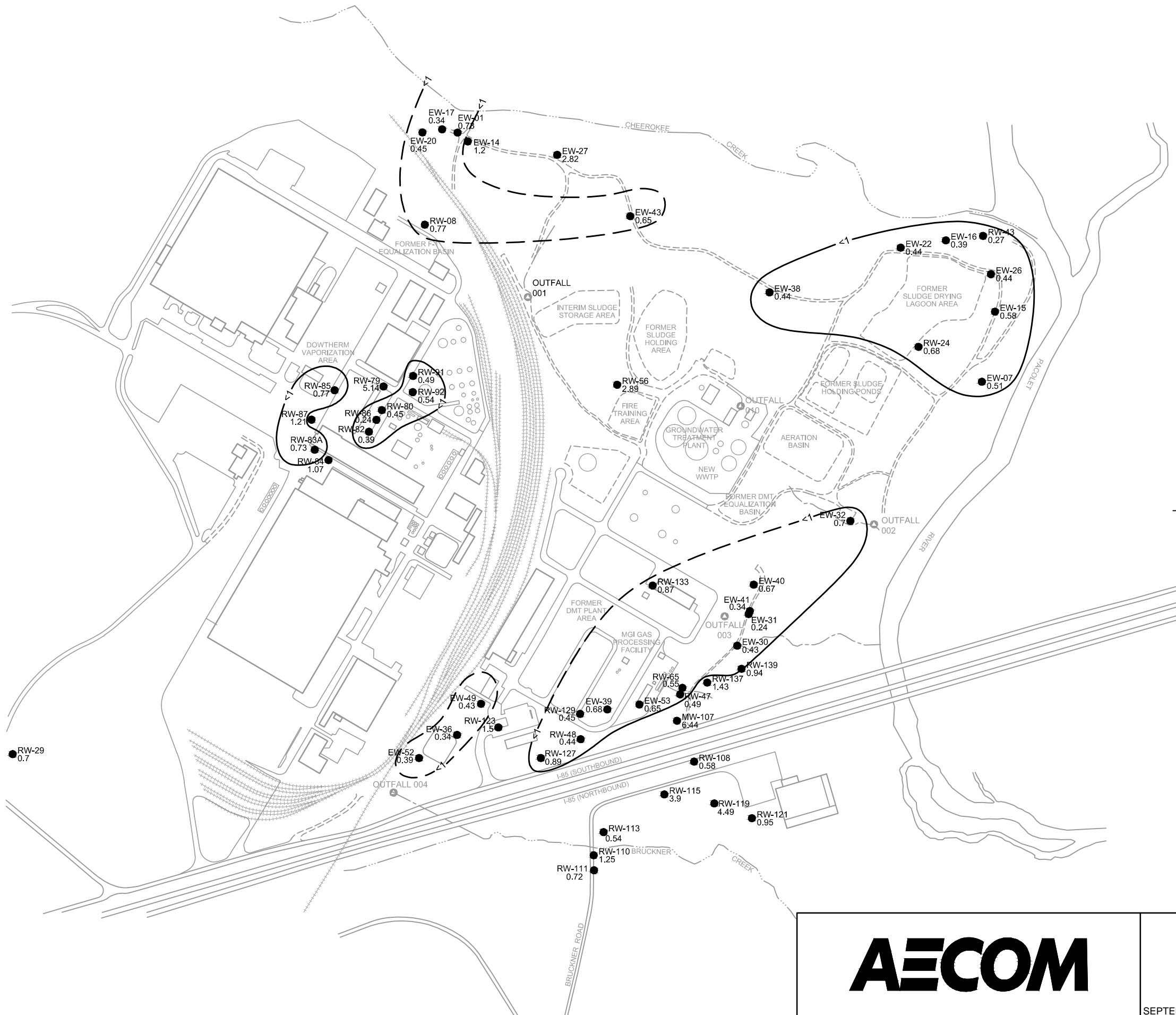


FIGURE 7
SAPROLITE DISSOLVED OXYGEN
ISOCONCENTRATION MAP
JUNE 2014
 AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- 0.14 DISSOLVED OXYGEN CONCENTRATION
- >1 — DISSOLVED OXYGEN ISOCONCENTRATION CONTOUR

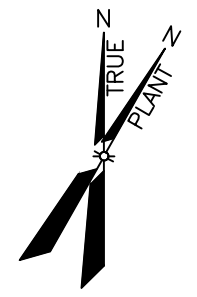
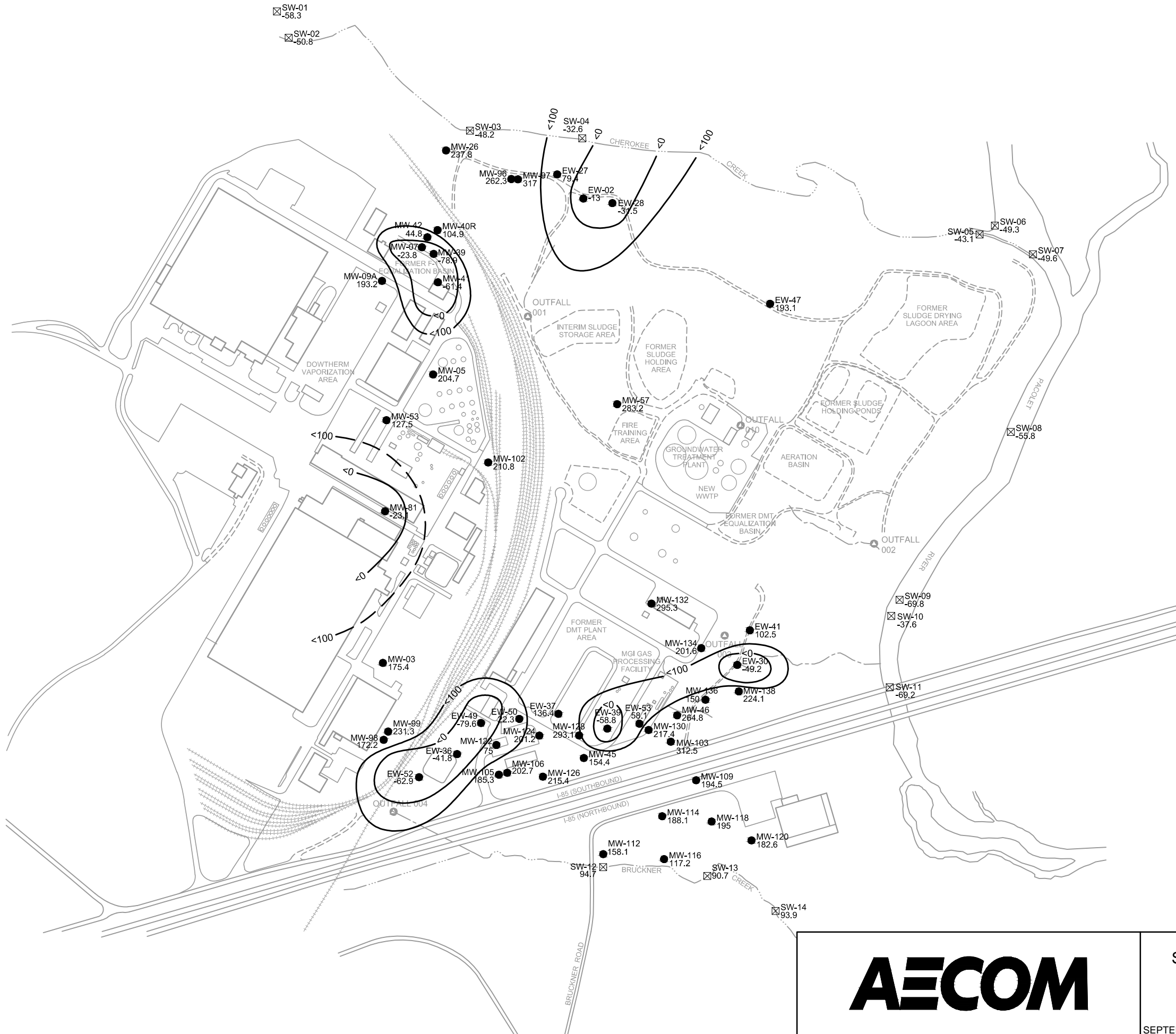


FIGURE 8
BEDROCK DISSOLVED OXYGEN
ISOCONCENTRATION MAP
JUNE 2014
 AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ⊠ SURFACE WATER SAMPLE LOCATION
- 27.5 ORP CONCENTRATION
- <1 — ORP ISOCONCENTRATION CONTOUR

NOTE: LOCATION OF MW-40R IS APPROXIMATE - SURVEY PENDING.

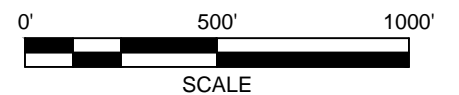
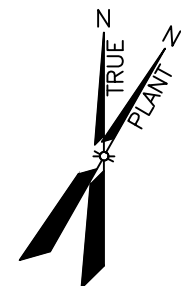


FIGURE 9
SAPROLITE ORP ISOCONCENTRATION MAP
JUNE 2014



- LEGEND**
- MONITORING WELL LOCATION
 - 0.00514 ORP CONCENTRATION
 - - ->0 - - - ORP ISOCONCENTRATION CONTOUR

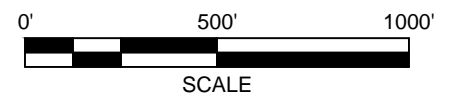
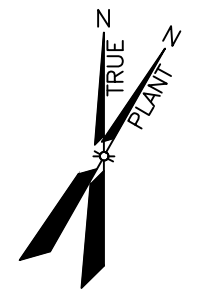
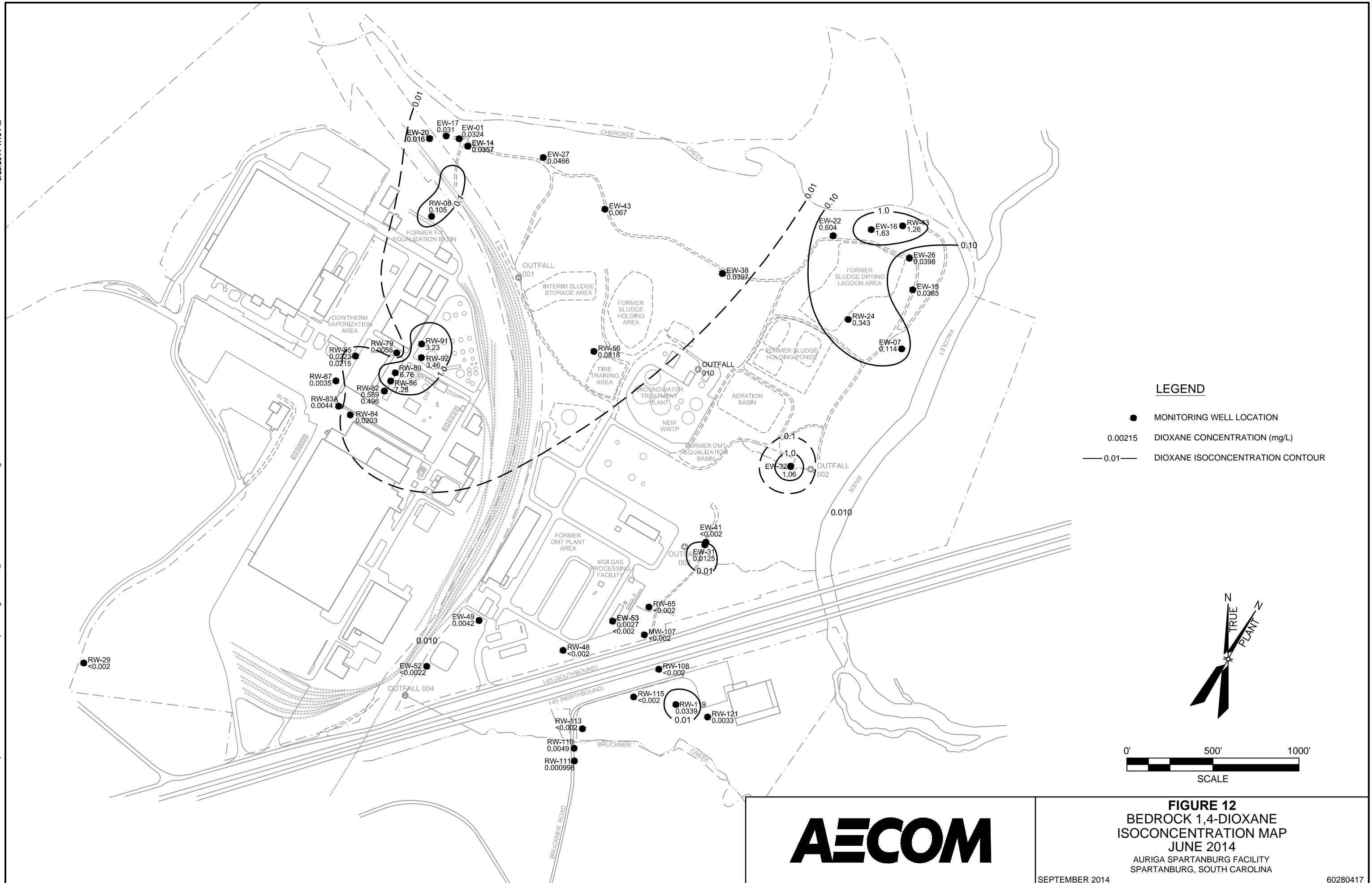


FIGURE 10
BEDROCK ORP ISOCONCENTRATION MAP
JUNE 2014



LEGEND

- MONITORING WELL LOCATION
- 0.00215 DIOXANE CONCENTRATION (mg/L)
- 0.01— DIOXANE ISOCONCENTRATION CONTOUR

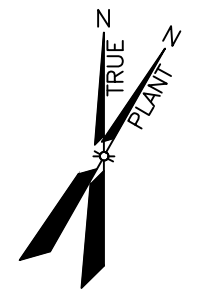
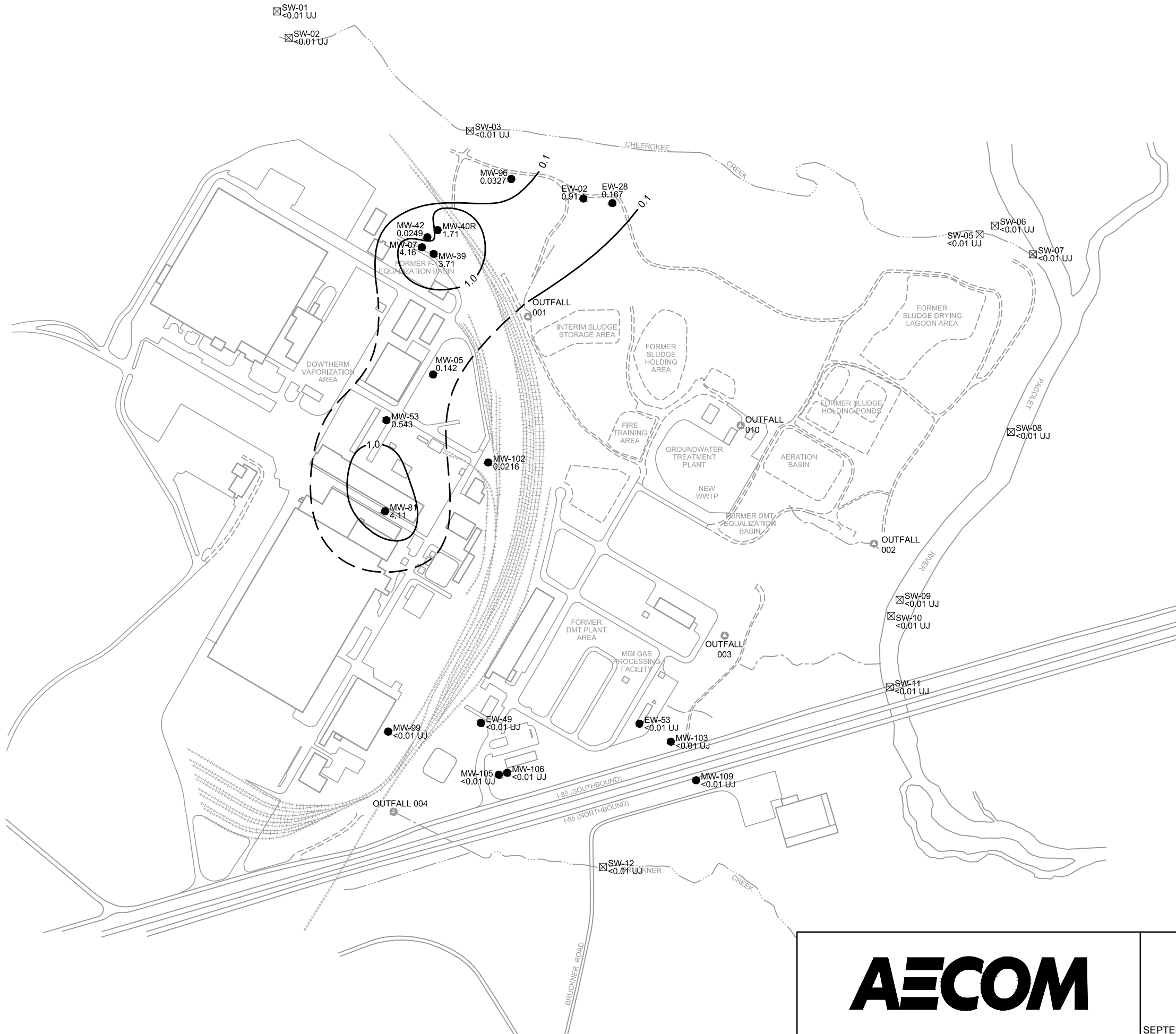


FIGURE 12
BEDROCK 1,4-DIOXANE
ISOCONCENTRATION MAP
JUNE 2014
 AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION
- 0.0401 DIPHENYL ETHER CONCENTRATION (mg/L)
- 0.1 — DIPHENYL ETHER ISOCONCENTRATION CONTOUR

NOTE: LOCATION OF MW-40R IS APPROXIMATE - SURVEY PENDING.

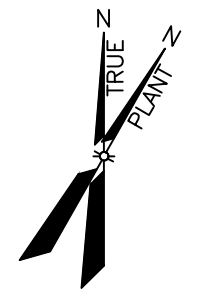
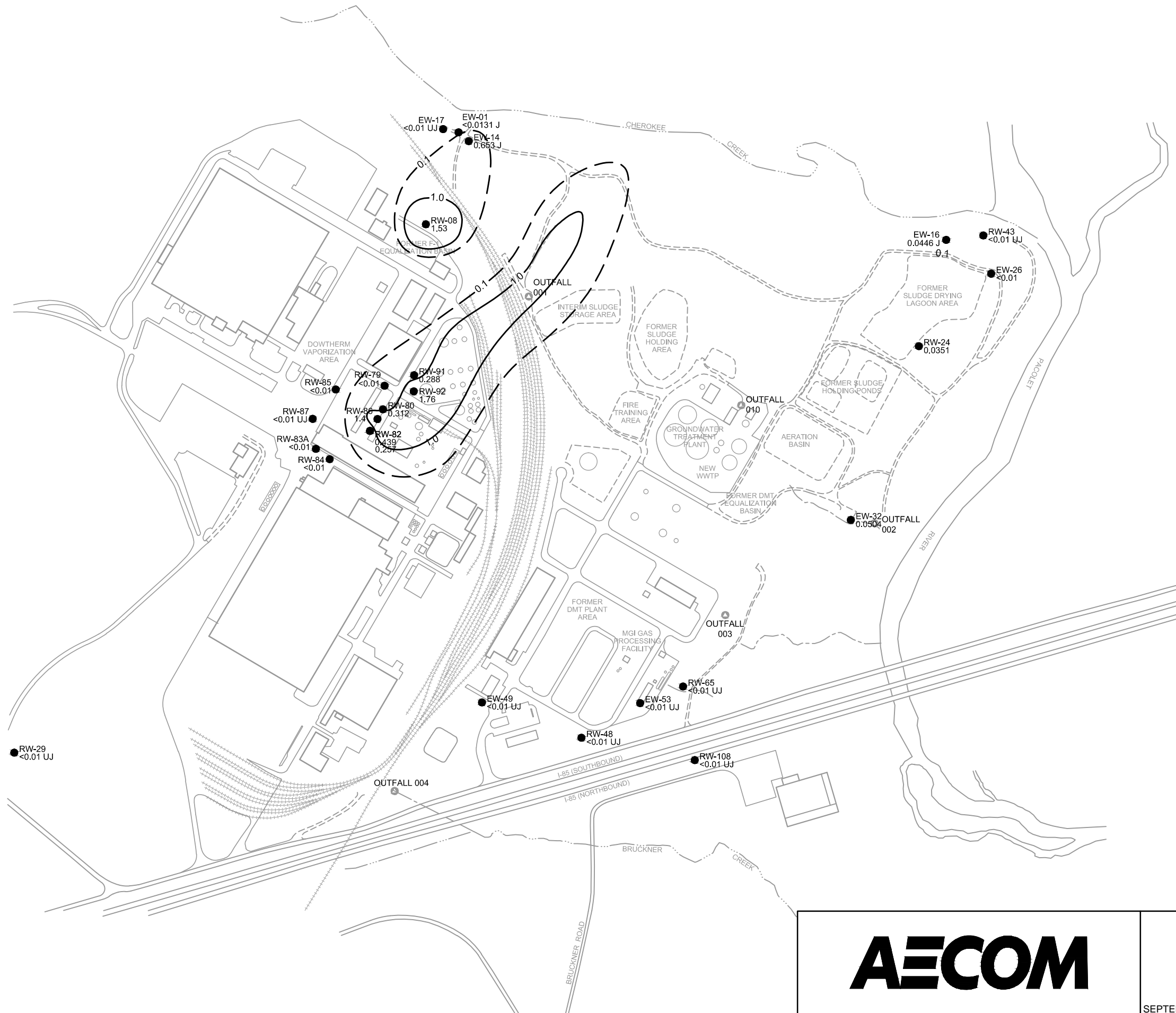


FIGURE 13
SAPROLITE DIPHENYL ETHER
ISOCONCENTRATION MAP
JUNE 2014
 AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- 0.0127 DIPHENYL ETHER CONCENTRATION (mg/L)
- 0.1 — DIPHENYL ETHER ISOCONCENTRATION CONTOUR

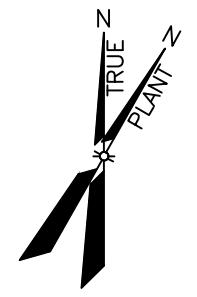
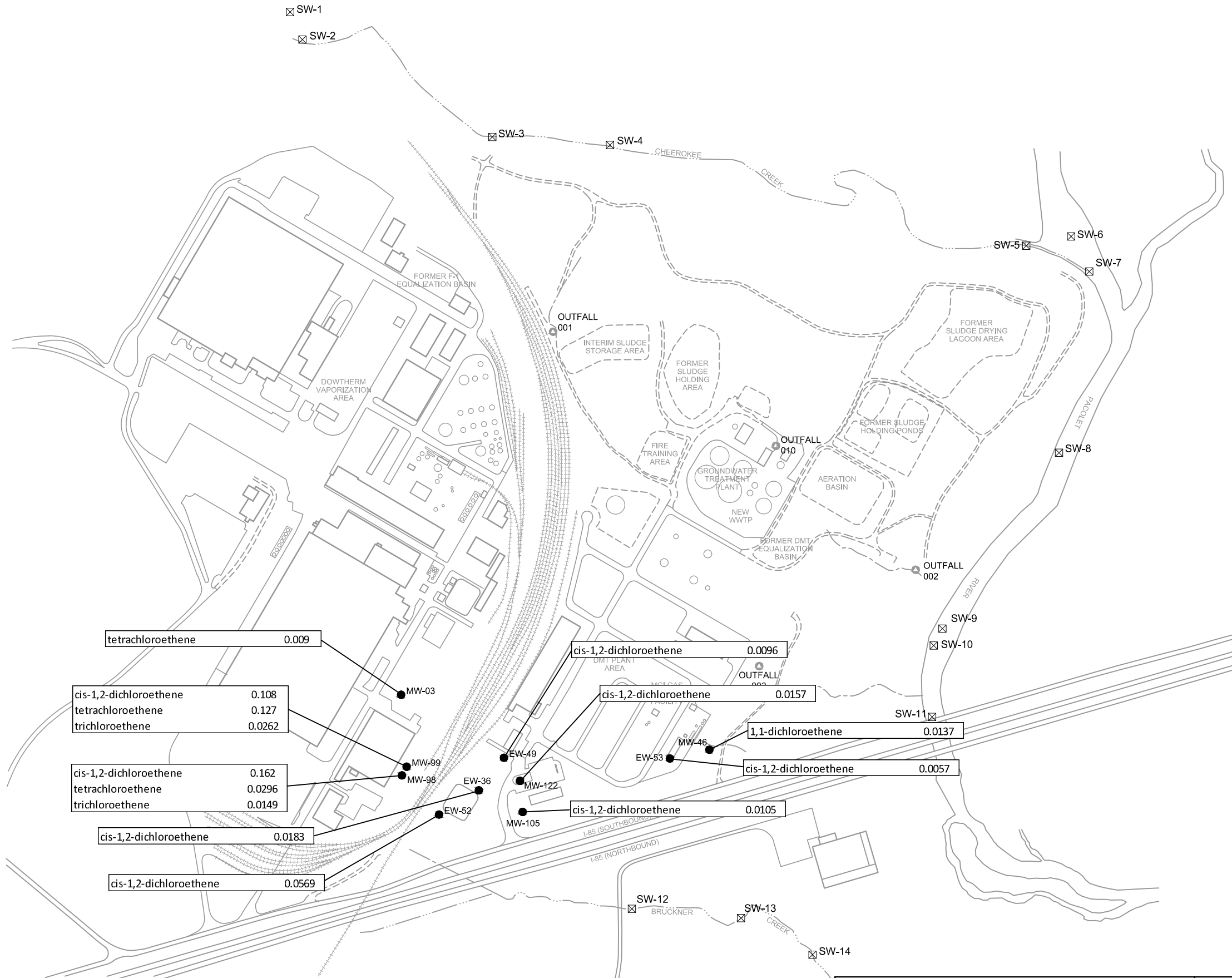


FIGURE 14
BEDROCK DIPHENYL ETHER
ISOCONCENTRATION MAP
JUNE 2014
 AURIGA SPARTANBURG FACILITY
 SPARTANBURG, SOUTH CAROLINA



LEGEND

- MONITORING WELL LOCATION
- ☒ SURFACE WATER SAMPLE LOCATION

NOTE:
CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L).

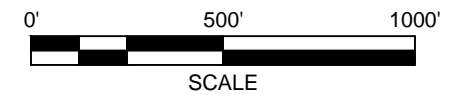
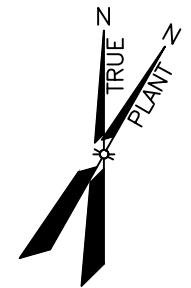
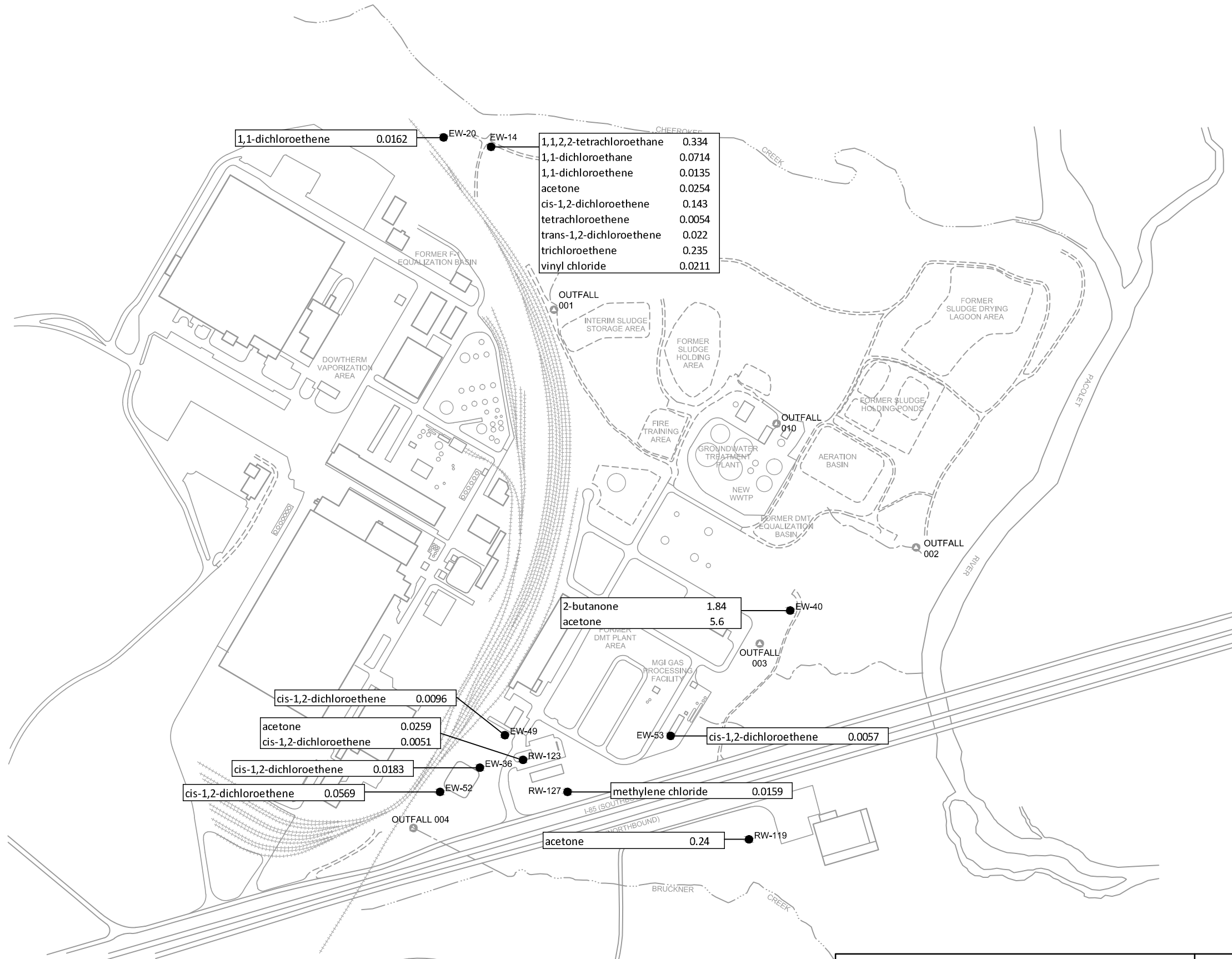


FIGURE 15
OTHER ORGANIC DETECTIONS IN SAPROLITE
JUNE 2014



LEGEND

● MONITORING WELL LOCATION

NOTE:
CONCENTRATIONS IN MILLIGRAMS PER LITER (mg/L).

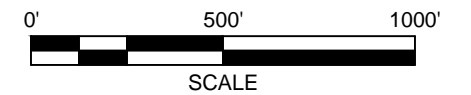
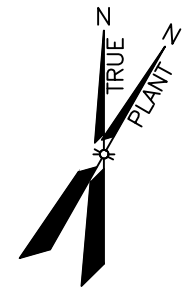


FIGURE 16
OTHER ORGANIC DETECTIONS IN BEDROCK
JUNE 2014

APPENDIX H: TOXICOLOGICAL TECHNICAL SUPPORT DOCUMENTATION

Chloroform

1,4-Dioxane

1,2-Dichloroethylene

Tetrachloroethylene

Trichloroethylene

Acetone

Carbon Disulfide



Technology Transfer Network - Air Toxics Web Site

Chloroform

67-66-3

Hazard Summary-Created in April 1992; Revised in January 2000

Chloroform may be released to the air as a result of its formation in the chlorination of drinking water, wastewater and swimming pools. Other sources include pulp and paper mills, hazardous waste sites, and sanitary landfills. The major effect from acute (short-term) inhalation exposure to chloroform is central nervous system depression. Chronic (long-term) exposure to chloroform by inhalation in humans has resulted in effects on the liver, including hepatitis and jaundice, and central nervous system effects, such as depression and irritability. Chloroform has been shown to be carcinogenic in animals after oral exposure, resulting in an increase in kidney and liver tumors. EPA has classified chloroform as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's [Integrated Risk Information System \(IRIS\)](#), which contains information on oral chronic toxicity and the [RfD](#), and the carcinogenic effects of chloroform including the unit cancer risk for inhalation exposure, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) [Toxicological Profile for Chloroform](#).

Uses

- The vast majority of the chloroform produced in the United States is used to make HCFC-22. The rest is produced for export and for miscellaneous uses. (1)
- Chloroform was used in the past as an extraction solvent for fats, oils, greases, and other products; as a dry cleaning spot remover; in fire extinguishers; as a fumigant; and as an anesthetic. However, chloroform is no longer used in these products. (1)

Sources and Potential Exposure

- Chloroform may be released to the air from a large number of sources related to its manufacture and use, as well as its formation in the chlorination of drinking water, wastewater, and swimming pools. Pulp and paper mills, hazardous waste sites, and sanitary landfills are also sources of air emissions. The background level of chloroform in ambient air in the early 1990s was estimated at 0.00004 parts per million (ppm). (1)
- Human exposure to chloroform may occur through drinking water, where chloroform is formed as a result of the chlorination of naturally occurring organic materials found in raw water supplies. Measurements of chloroform in drinking water during the 1970s and 1980s ranged from 0.022 to 0.068 ppm. (1)
- Chloroform may also be found in some foods and beverages, largely from the use of tap water during production processes. (1)

Assessing Personal Exposure

- Chloroform can be detected in blood, urine, and body tissues. However, these methods are not very reliable because chloroform is rapidly eliminated from the body, and the tests are not specific for chloroform. (1)

Health Hazard Information

Acute Effects:

- The major effect from acute inhalation exposure to chloroform in humans is central nervous system depression. At very high levels (40,000 ppm), chloroform exposure may result in death, with concentrations in the range of 1,500 to 30,000 ppm producing anesthesia, and lower concentrations (<1,500 ppm) resulting in dizziness, headache, tiredness, and other effects. (1,2)
- Effects noted in humans exposed to chloroform via anesthesia include changes in respiratory rate, cardiac effects, gastrointestinal effects, such as nausea and vomiting, and effects on the liver and kidney. Chloroform is not currently used as a surgical anesthetic. (1,2)
- In humans, a fatal oral dose of chloroform may be as low as 10 mL (14.8 g), with death due to respiratory or cardiac arrest. (1,2)
- Tests involving acute exposure of animals have shown chloroform to have low acute toxicity from inhalation exposure and moderate acute toxicity from oral exposure. (3)

Chronic Effects (Noncancer):

- Chronic exposure to chloroform by inhalation in humans is associated with effects on the liver, including hepatitis and jaundice, and central nervous system effects, such as depression and irritability. Inhalation exposures of animals have also resulted in effects on the kidney. (1,2)
- Chronic oral exposure to chloroform in humans has resulted in effects on the blood, liver, and kidney. (1,2)
- EPA has not established a Reference Concentration (RfC) for chloroform. (4)
- The California Environmental Protection Agency (CalEPA) has established a chronic reference exposure level of 0.3 milligrams per cubic meter (mg/m³) for chloroform based on exposures resulting in kidney and liver effects in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. It is not a direct estimator of risk, but rather a reference point to gauge the potential effects. At lifetime exposures increasingly greater than the reference exposure level, the potential for adverse health effects increases. (5)
- ATSDR has established an acute inhalation minimal risk level (MRL) of 0.5 mg/m³ (0.1 ppm) based on exposures resulting in liver effects in mice, an intermediate inhalation MRL of 0.2 mg/m³ (0.05 ppm) based on worker exposures resulting in liver effects in humans, and a chronic inhalation MRL of 0.1 mg/m³ (0.02 ppm) also based on liver effects in humans. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. (1)
- The Reference Dose (RfD) for chloroform is 0.01 milligrams per kilogram per day (mg/kg/d) based on exposures resulting in fatty cyst formation in the livers of dogs. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. (4)
- EPA has medium to low confidence in the RfD due to: medium confidence in the critical study on which the RfD was based because only two treatment doses were used, and a no-observed-effect level (NOEL) was not determined; and medium to low confidence in the database because several studies support the choice of a lowest-observed-adverse-effect level (LOAEL), but a NOEL was not found. (4)

Reproductive/Developmental Effects:

- Little information is available on the reproductive or developmental effects of chloroform in humans, via any route of exposure. A possible association between certain birth outcomes (e.g., low birth weight, cleft palate) and consumption of contaminated drinking water was reported. However, because multiple contaminants were present, the role of chloroform is unclear. (1)
- Animal studies have demonstrated developmental effects, such as decreased fetal body weight, fetal resorptions, and malformations in the offspring of animals exposed to chloroform via inhalation. (1)
- Reproductive effects, such as decreased conception rates, decreased ability to maintain pregnancy, and an increase in the percentage of abnormal sperm were observed in animals exposed to chloroform through inhalation. (1)
- Animal studies have noted decreased fetal weight, increased fetal resorptions, but no evidence of birth defects, in animals orally exposed to chloroform. (1)

Cancer Risk:

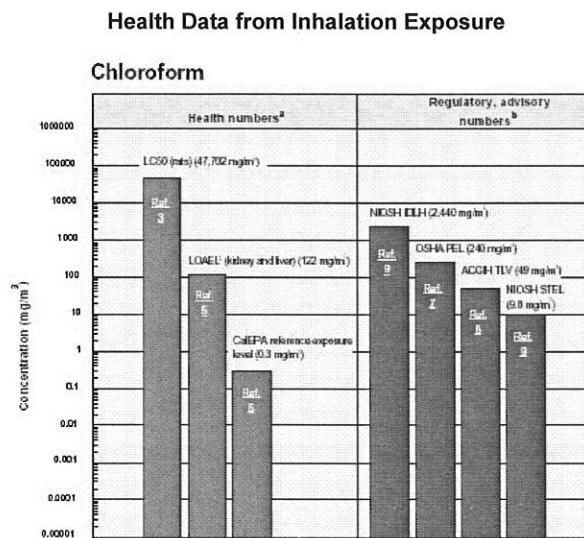
- No information is available regarding cancer in humans or animals after inhalation exposure to chloroform. (1)
- Epidemiologic studies suggest an association between cancer of the large intestine, rectum, and/or bladder and the constituents of chlorinated drinking water, including chloroform. However, there are no epidemiologic studies of water containing only chloroform. (1)
- Chloroform has been shown to be carcinogenic in animals after oral exposure, resulting in an increase in kidney and liver tumors. (1)
- EPA considers chloroform to be a probable human carcinogen and has ranked it in EPA's Group B2. (4)
- EPA has determined that although chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cell death and regrowth in susceptible tissues, chloroform is not likely to cause cancer in humans by any route of exposure under exposure conditions that do not cause cell death and regrowth. Therefore, EPA has not derived either an oral carcinogenic potency slope or an inhalation unit risk for chloroform.

Physical Properties

- Chloroform is a colorless liquid that is not very soluble in water and is very volatile. (1,6)
- Chloroform has a pleasant, nonirritating odor; the odor threshold is 85 ppm. (1)
- The chemical formula for chloroform is CHCl_3 , and it has a molecular weight of 119.38 g/mol. (1)
- The vapor pressure for chloroform is 159 mm Hg at 20 °C, and it has a log octanol/water partition coefficient ($\log K_{ow}$) of 1.97. (1)

Conversion Factors:

To convert concentrations in air (at 25°C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound})/(24.45)$. For chloroform: 1 ppm = 4.88 mg/m^3 . To convert concentrations in air from $\mu\text{g}/\text{m}^3$ to mg/m^3 : $\text{mg}/\text{m}^3 = (\mu\text{g}/\text{m}^3) \times (1 \text{ mg}/1,000 \mu\text{g})$.



ACGIH TLV—American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC₅₀ (Lethal Concentration₅₀)—A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH REL—National Institute of Occupational Safety and Health's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

OSHA PEL—Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^aHealth numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^bRegulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

^cThese cancer risk estimates were derived from oral data and converted to provide the estimated inhalation risk.

^dThe LOAEL is from the critical study used as the basis for the CalEPA chronic reference exposure level.

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Last updated on Friday, October 18, 2013



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Chloroform

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 67-66-3

NIOSH REL: 2 ppm (9.78 mg/m³) 60-minute STEL; NIOSH considers chloroform to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL: 50 ppm (240 mg/m³) CEILING

1989 OSHA PEL: 2 ppm (9.78 mg/m³) TWA

1993-1994 ACGIH TLV: 10 ppm (49 mg/m³) TWA, A2

Description of Substance: Colorless liquid with a pleasant odor.

LEL: . . Noncombustible Liquid

Original (SCP) IDLH: 1,000 ppm

Basis for original (SCP) IDLH: The chosen IDLH is based on the statement by Patty [1963] that 1,024 ppm produced dizziness, intracranial pressure, and nausea after 7 minutes with definite after-effects [Lehmann and Flury 1943]. Also, Lehmann et al. [1936] reported that a 2-minute exposure to 1,107 ppm caused dizziness and vertigo. Because a person may become disoriented at concentrations greater than 1,000 ppm and be unable to escape, 1,000 ppm is chosen as the IDLH.

**Existing short-term exposure guidelines: National Research Council [NRC 1984]
 Emergency Exposure Guidance Levels (EEGLs):**

1-hour EEGL: 100 ppm

24-hour EEGL: 30 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
G. pig	Clayton 1967	-----	20,000	2 hr	32,000 ppm (1.6)	3,200 ppm
Rat	Lehmann and Flury 1943	9,617	-----	4 hr	19,235 ppm (2.0)	1,924 ppm
Cat	Lehmann et al. 1936	-----	7,056	4 hr	14,113 ppm (2.0)	1,411 ppm
Human	Tab Biol Per 1933	-----	25,000	5 min	13,750 ppm (0.55)	1,375 ppm

Other animal data: It has been reported that inhalation of 10,000 ppm has produced clinical anesthesia [NIOSH 1974] and that exposure for 2 minutes to 1,107 ppm has caused dizziness and vertigo [Lehmann et al. 1936]. Workers exposed 4 hours/day to concentrations of 57 to 71 ppm complained of lassitude, loss of appetite, and nausea [Challen et al. 1958]. Exposures to 390 ppm were tolerated for 30 minutes without complaint, whereas 1,030 ppm resulted in dizziness, intracranial pressure, and nausea in 7 minutes, with headache for several hours [Lehmann and Flury 1943].

Revised IDLH: 500 ppm

Basis for revised IDLH: The revised IDLH for chloroform is 500 ppm based on acute inhalation toxicity data in humans [Lehmann and Flury 1943]. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for chloroform at concentrations above 2 ppm.]

REFERENCES:

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Page last reviewed: December 4, 2014

Page last updated: December 4, 2014

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Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA
30329-4027, USA
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Search the NIOSH Pocket Guide

Enter search terms separated by spaces.

<h1>Chloroform</h1>					
Synonyms & Trade Names Methane trichloride, Trichloromethane					
CAS No. 67-66-3	RTECS No. FS9100000 (/niosh-rtecs/FS8ADAEo.html)		DOT ID & Guide 1888 151 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide151/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula CHCl ₃	Conversion 1 ppm = 4.88 mg/m ³		IDLH Ca [500 ppm] See: 67663 (/niosh/idlh/67663.html)		
Exposure Limits NIOSH REL : Ca ST 2 ppm (9.78 mg/m ³) [60-minute] See Appendix A (nengapdx.html) OSHA PEL † (nengapdxg.html) : C 50 ppm (240 mg/m ³)			Measurement Methods NIOSH 1003 (/niosh/docs/2003-154/pdfs/1003.pdf) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless liquid with a pleasant odor.					
MW: 119.4	BP: 143° F	FRZ: -82°F	Sol(77°F): 0.5%	VP: 160 mmHg	IP: 11.42 eV
Sp.Gr: 1.48	Fl.P: NA	UEL: NA	LEL: NA		
Noncombustible Liquid					
Incompatibilities & Reactivities Strong caustics; chemically-active metals such as aluminum or magnesium powder, sodium & potassium; strong oxidizers [Note: When heated to decomposition, forms phosgene gas.]					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]					
Target Organs Liver, kidneys, heart, eyes, skin, central nervous system					

Cancer Site [in animals: liver & kidney cancer]	
<p>Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: No recommendation Provide: Eyewash, Quick drench</p>	<p>First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately</p>
<p>Respirator Recommendations</p> <p>NIOSH</p> <p>At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus</p> <p>Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister Any appropriate escape-type, self-contained breathing apparatus</p> <p><u>Important additional information about respirator selection (pgintrod.html#mustread)</u></p>	
<p>See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0027 (/niosh/ipcsneng/neng0027.html) See MEDICAL TESTS: 0047 (/niosh/docs/2005-110/nmed0047.html)</p>	

Page last reviewed: April 4, 2011
 Page last updated: February 13, 2015
 Content source: [National Institute for Occupational Safety and Health \(NIOSH\) Education and Information Division](#)

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Occupational Safety & Health Administration We Can Help

Chemical Sampling Information / Chloroform

Chloroform

General Description

Synonyms: Trichloromethane**OSHA IMIS Code Number:** 0670**Chemical Abstracts Service (CAS) Registry Number:** 67-66-3**NIOSH Registry of Toxic Effects of Chemical Substances (RTECS) Identification Number:** FS9100000**Department of Transportation Regulation Number (49 CFR 172.101) and Emergency Response Guidebook :** 1888 151**NIOSH Pocket Guide to Chemical Hazards, Chloroform:** chemical description, physical properties, potentially hazardous incompatibilities, and more

Exposure Limits

OSHA Permissible Exposure Limit (PEL):

- **General Industry:** 29 CFR 1910.1000 Table Z-1 - 50 ppm, 240 mg/m³ Ceiling
- **Construction Industry:** 29 CFR 1926.55 Appendix A - 50 ppm, 240 mg/m³ Ceiling
- **Maritime:** 29 CFR 1915.1000 Table Z-Shipyards - 50 ppm, 240 mg/m³ TWA

American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit**Value (TLV):** 10 ppm, 49mg/m³ TWA; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans**National Institute for Occupational Safety and Health (NIOSH) Recommended****Exposure Limit (REL):** 2 ppm, 9.78mg/m³ STEL (60 Minutes); Appendix A - NIOSH Potential Occupational Carcinogens

Health Factors

Carcinogenic Classification:

- **Environmental Protection Agency (EPA):** Group B2, probable human carcinogen
- **International Agency for Research on Cancer (IARC):** Group 2B, possibly carcinogenic to humans
- **National Toxicology Program (NTP):** Group 2, reasonably anticipated to be a human carcinogen (PDF)

NIOSH Immediately Dangerous To Life or Health Concentration (IDLH): 500 ppm**Potential Symptoms:** Dizziness, mental dullness, irritability, confusion, distorted perceptions; loss of appetite, nausea; headaches; fatigue; anesthesia; hepatomegaly, hepatitis, jaundice; eye irritation (tearing, conjunctivitis, permanent eye damage), skin irritation (drying, cracking, redness, dermatitis, pain); [potential occupational carcinogen] Ingestion Acute: abdominal pain, vomiting**Health Effects:** Cumulative liver and kidney damage (HE3); Known animal and suspected human carcinogen (HE2); Narcosis (HE8)**Affected Organs:** Liver, kidneys, heart, eyes, skin, CNS

1. The odor threshold of chloroform (85 ppm) is greater than its PEL.
2. Metabolized to the toxic reactive metabolite, phosgene, by the CYP2E1 and CYP2A6 isozymes of cytochrome P450, with a higher affinity for CYP2E1, an enzyme induced in the liver by chronic ethanol consumption.

Literature Basis:

- NIOSH Pocket Guide to Chemical Hazards: Chloroform.
- International Chemical Safety Cards (WHO/IPCS/ILO): Chloroform.
- EPA Air Toxics Website: Chloroform. U.S. Environmental Protection Agency Technology Transfer Network.
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Date Last Revised: 01/05/2004**Monitoring Methods used by OSHA****Laboratory Sampling/Analytical Method:****Sampling Media**

Charcoal Tube (100/50 mg sections, 20/40 mesh)

maximum volume: 10 Liters**maximum flow rate:** 0.2 L/min (TWA)**maximum volume:** 15 Liters**maximum flow rate:** 0.2 L/min (Ceiling)**current analytical method:** Gas Chromatography; GC/FID**analytical solvent:** Carbon disulfide**alternative solvent:** (99:1) Carbon disulfide/Dimethylformamide**method reference:** OSHA Manual of Analytical Methods (OSHA 5)**method classification:** Fully Validated**On-Site Sampling Techniques/Methods:****Device**

Detector Tube

manufacturer: AUER/MSA**model/type:** Trichloroethane-5, MSA P/N 487343, AUER P/N 5086-834**sampling information:** follow manufacturer's instructions**upper measurement limit:** 100 ppm**detection limit:** approximately 8 ppm**overall uncertainty:** unknown**method reference:** on-site air secondary (manufacturer)**Device**

Detector Tube

manufacturer: Dräger**model/type:** Chloroform 2/a, order no. 67 28861**sampling information:** 10 strokes**upper measurement limit:** 10 ppm**detection limit:** approximately 1 ppm**overall uncertainty:** approximately 33%**method reference:** on-site air secondary (manufacturer)

Device

Detector Tube

manufacturer: Gastec

model/type: 137L

sampling information: 3 or 5 strokes

upper measurement limit: 27 ppm

detection limit: 0.1 ppm

overall uncertainty: 16% for 0.5 to 2 ppm, 8% for 2 to 10 ppm

method reference: on-site air secondary (manufacturer)

Device

Detector Tube

manufacturer: Matheson-Kitagawa

model/type: 8014-152S

sampling information: 2 or 4 strokes

upper measurement limit: 500 ppm

detection limit: approximately 20 ppm

overall uncertainty: unknown

method reference: on-site air secondary (manufacturer)

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Occupational Health Guideline for Chloroform*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CHCl_3
- Synonyms: Trichloromethane
- Appearance and odor: Colorless liquid with a pleasant, sweet odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chloroform is a ceiling level of 50 parts of chloroform per million parts of air (ppm). This may also be expressed as 240 milligrams of chloroform per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be reduced to a ceiling level of 2 ppm averaged over a one-hour period, and that chloroform be regulated as an occupational carcinogen. The NIOSH Criteria Document for Chloroform should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Chloroform can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Chloroform vapor may cause headache, drowsiness, vomiting, dizziness, unconsciousness, irregular heart beat, and death. Liver and kidney damage may also result from exposure to chloroform vapor. When splashed in the eye, chloroform causes pain and irritation. Swallowing chloroform is

followed immediately by severe burning of the mouth and throat, pain in the chest and abdomen, and vomiting. Depending on the amount swallowed, loss of consciousness and liver damage may follow.

2. Long-term Exposure: Prolonged exposure to chloroform may cause liver and kidney damage. Prolonged or repeated skin contact with the liquid may produce skin irritation.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to chloroform.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to chloroform at potentially hazardous levels:

1. Initial Medical Examination:

— A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. A history of, or physical signs consistent with, chronic alcoholism probably constitutes such an increased risk. Examination of liver, kidneys, and heart should be stressed. The skin should be examined for evidence of chronic disorders.

— Liver function tests: A profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

— Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Chloroform vapor is a central nervous system depressant and is toxic to the liver and kidneys. It has been largely abandoned as an anesthetic agent because of the frequency of cardiac arrest during surgery and of

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

delayed death due to hepatic injury. An increased incidence of cardiac arrhythmias has been demonstrated during surgery in patients anesthetized with chloroform, as compared with other anesthetic agents; vapor concentrations were of the order of 22,500 ppm. Animals showed minor and reversible injury of liver and kidneys after repeated 7-hour exposures to concentrations of chloroform as low as 25 ppm, while 50 to 85 ppm produced more severe injury. Experimental human exposures showed that 14,000 to 16,000 ppm caused rapid loss of consciousness in man; 4100 ppm or less caused serious disorientation, while single exposures of 1000 ppm caused dizziness, nausea, and after-effects of fatigue and headache. Prolonged exposure to 80 to 240 ppm caused lassitude, digestive disturbances, and mental dullness, while 20 to 70 ppm produced milder symptoms. Of 68 chemical workers exposed regularly to concentrations of 2 to 205 ppm for 1 to 4 years, some 25% had hepatomegaly. This group of 68 exposed workers were found to be more susceptible to viral hepatitis than the general population. The hepatotoxicity of several chlorinated hydrocarbons has been shown to be potentiated by prior exposure to some aliphatic alcohols. This phenomenon has been demonstrated in mice exposed first to isopropyl alcohol by gavage and then to chloroform by intraperitoneal injection. A potentiating effect of ethyl alcohol ingestion on the toxicity of chloroform vapor in the occupational setting is suspected, but has not been proven in industrial practice. High concentrations of vapor cause conjunctival irritation and blepharospasm. Liquid chloroform splashed in the eye causes immediate burning pain and conjunctival irritation; the corneal epithelium may be injured, but regeneration is prompt, and the eye returns to normal in 1 to 3 days. The liquid has a defatting effect on the skin and may produce chronic irritation with drying and cracking. Liver tumors have been reported in animals.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 119.4
2. Boiling point (760 mm Hg): 61 C (142 F)
3. Specific gravity (water = 1): 1.49
4. Vapor density (air = 1 at boiling point of chloroform): 4.1
5. Melting point: -63.5 C (-82 F)
6. Vapor pressure at 20 C (68 F): 160 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.8
8. Evaporation rate (butyl acetate = 1): 11.6

• Reactivity

1. Conditions contributing to instability: In the presence of air and light, chloroform slowly reacts to form toxic phosgene and hydrogen chloride gases.

2. Incompatibilities: Chloroform reacts with strong caustics and chemically active metals such as aluminum, magnesium powder, sodium, or potassium.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, chlorine, phosgene, and carbon monoxide) may be released when chloroform decomposes.

4. Special precautions: Liquid chloroform will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

1. Odor Threshold: Patty reports that the odor threshold of chloroform is approximately 200 to 300 ppm, and May reports an odor threshold of 200 ppm. The *Hygienic Guide*, however, gives an odor threshold of 50 ppm and states that "olfactory fatigue" occurs upon exposure.

2. Eye Irritation Level: Grant states that "in conscious individuals high concentrations of vapors of chloroform cause moderate sensation of stinging and irritation of the eyes, automatically inducing protective closure of the lids." The concentrations causing eye irritation are not mentioned. However, Patty does not give any indication that eye irritation occurs at concentrations even as high as 4096 ppm.

3. Evaluation of Warning Properties: Since there are no quantitative data relating the irritant effects of chloroform to air concentrations, and since olfactory fatigue occurs during exposure to chloroform, this material is treated as a substance with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• One-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average one-hour exposure is based on a single one-hour sample. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of chloroform. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure chloroform may be used. An

analytical method for chloroform is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with liquid chloroform, where skin contact may occur.
- Clothing wet with liquid chloroform should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chloroform from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chloroform, the person performing the operation should be informed of chloroform's hazardous properties.
- Non-impervious clothing which becomes wet with liquid chloroform should be removed promptly and not reworn until the chloroform is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid chloroform may contact the eyes.
- Where there is any possibility that employees' eyes may be exposed to chloroform, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes wet with liquid chloroform should be promptly washed or showered with soap or mild detergent and water to remove any chloroform.

- Eating and smoking should not be permitted in areas where liquid chloroform is handled, processed, or stored.
- Employees who handle liquid chloroform should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.
- Areas in which exposure to chloroform may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to chloroform may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of fluorocarbons for refrigerant propellants; manufacture of fluorocarbon resins	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as an extractant solvent in manufacture of pharmaceuticals, rubber, essential oils and flavors, sterols and alkaloids, and in the recovery of fat from waste products	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in chemical analysis and assays; veterinary uses, and in standard solutions as preservative and bactericide	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a general solvent in plastics, dyes, oils, waxes, rubber, cleaning and dry cleaning industries	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a chemical intermediate in dye, drug, and pesticide industries	Process enclosure; local exhaust ventilation; general dilution ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**
If chloroform gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If burning is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If chloroform gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If chloroform soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of chloroform, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When chloroform has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.
- If chloroform is spilled or leaked, the following steps should be taken:
 1. Ventilate area of spill or leak.
 2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

ADDITIONAL INFORMATION

To find additional information on chloroform, look up chloroform in the following documents:

- Medical Surveillance for Chemical Hazards
- Respiratory Protection for Chemical Hazards
- Personal Protection and Sanitation for Chemical Hazards
- NIOSH Criteria Document for Chloroform (Revised June 1976)

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 1, 1972.

RESPIRATORY PROTECTION FOR CHLOROFORM

Condition	Minimum Respiratory Protection* Required Above 50 ppm
Vapor Concentration	
500 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 1000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.



Technology Transfer Network - Air Toxics Web Site

1,4-Dioxane (1,4-Diethyleneoxide)

123-91-1

Hazard Summary-Created in April 1992; Revised in January 2000

1,4-Dioxane is used as a solvent. Acute (short-term) inhalation exposure to high levels of 1,4-dioxane has caused vertigo, drowsiness, headache, anorexia and irritation of the eyes, nose, throat, and lungs in humans. It may also irritate the skin. Damage to the liver and kidneys has been observed in rats chronically (long-term) exposed in their drinking water. In three epidemiologic studies on workers exposed to 1,4-dioxane, the observed number of cancer cases did not differ from the expected cancer deaths. Tumors have been observed in orally exposed animals. EPA has classified 1,4-dioxane as a Group B2, probable human carcinogen.

Please Note: The main source of information for this fact sheet is EPA's [Integrated Risk Information System](#) (IRIS), which contains information on the carcinogenic effects of 1,4-dioxane including the unit cancer risk for oral exposure. Other secondary sources include the [Hazardous Substances Data Bank](#) (HSDB), a database of summaries of peer-reviewed literature, and the [Registry of Toxic Effects of Chemical Substances](#) (RTECS), a database of toxic effects that are not peer reviewed.

Uses

- 1,4-Dioxane is used as a solvent for cellulose acetate, ethyl cellulose, benzyl cellulose, resins, oils, waxes, some dyes, and other organic and inorganic compounds. (2,4)

Sources and Potential Exposure

- Occupational exposure to 1,4-dioxane is the most likely route of exposure. (1)
- 1,4-Dioxane has been detected in both surface water and groundwater. (2)

Assessing Personal Exposure

- No information was located regarding the measurement of personal exposure to 1,4-dioxane.

Health Hazard Information

Acute Effects:

- Acute inhalation exposure to high levels of 1,4-dioxane has caused vertigo and irritation of the eyes, nose, throat, and lungs in humans. It may also irritate the skin. (3,4)
- Some symptoms of poisoning include the irritation of the upper respiratory passages, coughing, irritation of eyes, drowsiness, vertigo, headache, anorexia, stomach pains, nausea, vomiting, coma, and death; these symptoms were observed in workers, but length of exposure was unknown. (5)
- In a fatal case of acute 1,4-dioxane poisoning by inhalation, hepatic and renal lesions, and demyelination and edema of the brain were observed in the individual. (2)
- Convulsions, collapse, and effects to the kidneys and liver were observed in rabbits injected with 1,4-dioxane. (2)
- Acute animal tests in rats, mice, rabbits, and guinea pigs, have demonstrated 1,4-dioxane to have moderate acute toxicity by inhalation or dermal exposure, and low to moderate acute toxicity by ingestion. (6)

Chronic Effects (Noncancer):

- Damage to the liver and kidneys has been observed in rats chronically exposed in their drinking water. (2,11)
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for 1,4-dioxane. (7)
- The [California Environmental Protection Agency](#) (CalEPA) has calculated a chronic reference exposure level of 3 milligrams per cubic meter (mg/m³) based on no effects on the liver, kidney, or blood in rats. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the reference exposure level, the potential for adverse health effects increases. (11)

Reproductive/Developmental Effects:

- No information is available on the reproductive and developmental effects of 1,4-dioxane in humans. (2)
- No evidence of gross, skeletal, or visceral malformations was found in the offspring of rats exposed via gavage (experimentally placing the chemical in the stomach). Embryotoxicity was observed only at the highest dose. (3)

Cancer Risk:

- In three epidemiologic studies on workers exposed to 1,4-dioxane, the observed number of cancer cases did not differ from the expected cancer deaths. (7)
- A study by the National Cancer Institute (NCI) of rats and mice exposed to 1,4-dioxane in their drinking water reported increased incidences of liver carcinomas and adenomas and nasal cavity squamous cell carcinomas. (9)
- Liver carcinomas and gallbladder carcinomas were observed in mice and guinea pigs, respectively. (7)
- No treatment-related lesions resulted from exposure to 1,4-dioxane vapor in rats. (7)
- EPA has classified 1,4-dioxane as a Group B2, probable human carcinogen. (7)
- EPA uses mathematical models, based on human and animal studies, to estimate the probability of a person developing cancer from drinking water containing a specified concentration of a chemical. EPA calculated an oral unit risk estimate of 3.1×10^{-7} ($\mu\text{g/L}$)⁻¹. EPA estimates that, if an individual were to continuously drink water containing 1,4-dioxane at an average of 3.0 $\mu\text{g/L}$ (3×10^{-3} milligrams per liter (mg/L)) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of drinking water containing this chemical. Similarly, EPA estimates that drinking water containing 30.0 $\mu\text{g/L}$ (3×10^{-2} mg/L) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and water containing 300.0 $\mu\text{g/L}$ (3×10^{-1} mg/L) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency factors, please see IRIS. (7)
- EPA has calculated an oral cancer slope factor of 0.011 (mg/kg/d)⁻¹. (7)

- The CalEPA has calculated an inhalation unit risk factor of 7.7×10^{-6} ($\mu\text{g}/\text{m}^3$)⁻¹. (12)

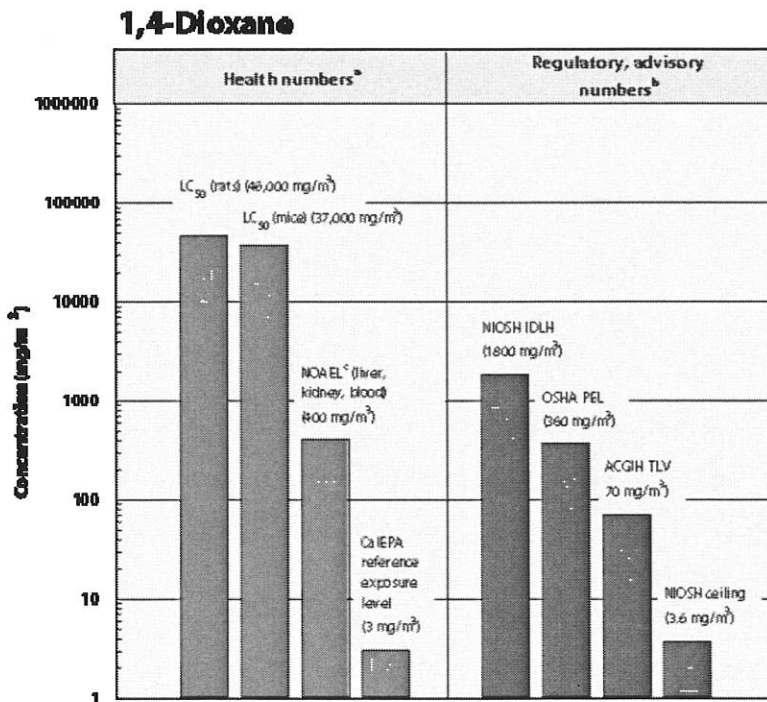
Physical Properties

- The chemical formula of 1,4-dioxane is $\text{C}_4\text{H}_8\text{O}_2$, and its molecular weight is 88.10 g/mol. (4)
- 1,4-Dioxane occurs as a colorless flammable liquid that is miscible in water. (2,4)
- 1,4-Dioxane has a faint pleasant odor, with an odor threshold of 24 parts per million (ppm). (4,10)
- The vapor pressure for 1,4-dioxane is 30 mm Hg at 20 °C. (2)
- 1,4-Dioxane is also called 1,4-diethyleneoxide.

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m^3 : $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound})/(24.45)$. For 1,4-dioxane: 1 ppm = 3.6 mg/m^3 .

Health Data from Inhalation Exposure



ACGIH TLV—American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC₅₀ (Lethal Concentration₅₀)—A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH IDLH—National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL ceiling—NIOSH's recommended exposure limit ceiling; the concentration that should not be exceeded at any time.

NOAEL—No-observed-adverse-effect level.

OSHA PEL—Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

^c This NOAEL is from the critical study used as the basis for the CalEPA reference exposure level.

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Last updated on Friday, October 18, 2013



Search the NIOSH Pocket Guide

Enter search terms separated by spaces.

Dioxane					
Synonyms & Trade Names Diethylene dioxide; Diethylene ether; Dioxan; p-Dioxane; 1,4-Dioxane					
CAS No. 123-91-1	RTECS No. JG8225000 (/niosh-rtecs/JG7D80E8.html)		DOT ID & Guide 1165 127 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide127/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula C ₄ H ₈ O ₂	Conversion 1 ppm = 3.60 mg/m ³	IDLH Ca [500 ppm] See: 123911 (/niosh/idlh/123911.html)			
Exposure Limits NIOSH REL : Ca C 1 ppm (3.6 mg/m ³) [30-minute] See Appendix A (nengapdxa.html) OSHA PEL † (nengapdxg.html): TWA 100 ppm (360 mg/m ³) [skin]		Measurement Methods NIOSH 1602 (/niosh/docs/2003-154/pdfs/1602.pdf); OSHA 7 (http://www.osha.gov/dts/sltc/methods/organic/org007/org007.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)			
Physical Description Colorless liquid or solid (below 53°F) with a mild, ether-like odor.					
MW: 88.1	BP: 214°F	FRZ: 53°F	Sol: Miscible	VP: 29 mmHg	IP: 9.13 eV
Sp.Gr: 1.03	FLP: 55°F	UEL: 22%	LEL: 2.0%		
Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.					
Incompatibilities & Reactivities Strong oxidizers, decaborane, triethynyl aluminum					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]					
Target Organs Eyes, skin, respiratory system, liver, kidneys					
Cancer Site [in animals: lung, liver & nasal cavity tumors]					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Provide: Eyewash, Quick drench			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Water wash promptly Breathing: Respiratory support Swallow: Medical attention immediately		

Respirator Recommendations

NIOSH**At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:**

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0041 \(/niosh/ipcsneng/neng0041.html\)](#) See MEDICAL TESTS: [0090 \(/niosh/docs/2005-110/nmed0090.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

Content source: [National Institute for Occupational Safety and Health \(NIOSH\)](#) Education and Information Division

Centers for Disease Control and Prevention 1600 Clifton Road Atlanta, GA 30329-4027, USA
800-CDC-INFO (800-232-4636) TTY: (888) 232-6348 - [Contact CDC-INFO](#)



Occupational Health Guideline for Dioxane*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$
- Synonyms: Diethylene dioxide; diethylene ether; dioxan; p-dioxane; 1,4-dioxane
- Appearance and odor: Colorless liquid with a mild ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dioxane is 100 parts of dioxane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 360 milligrams of dioxane per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be reduced to a ceiling level of 1 ppm averaged over a 30-minute period, and that dioxane be regulated as an occupational carcinogen. The NIOSH Criteria Document for Dioxane should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Dioxane can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

• Effects of overexposure

Overexposure to dioxane may cause irritation of the eyes, nose, and throat. It may also cause drowsiness, dizziness, loss of appetite, headache, nausea, vomiting, stomach pain, and liver and kidney damage. Prolonged skin exposure to the liquid may cause drying and

cracking. Dioxane has been shown to induce tumor formation in experimental animals.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to dioxane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to dioxane at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the upper respiratory system, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Dioxane may cause liver damage. A profile of liver function should be performed by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

—Skin disease: Dioxane is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—14" x 17" chest roentgenogram: Dioxane causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Dioxane is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Center for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

• Summary of toxicology

Dioxane vapor is a mucous membrane irritant, and on prolonged exposure is toxic to the liver and kidneys. Repeated exposure of several animal species to 1000 ppm produced damage to kidneys and liver, and the repeated inhalation of 800 ppm over 30 days resulted in fatal kidney injury in some rabbits. Human volunteers exposed for 15 minutes to 300 ppm reported mild transient irritation of the eyes, nose, and throat. There is significant absorption of the liquid through the skin, adding to the inhalation hazard. Prolonged or repeated skin contact may also result in drying and cracking due to defatting action. Fatal intoxication due to liver necrosis and severe kidney damage has been reported in workers after two months of heavy exposure to dioxane vapor; the onset of poisoning was marked by drowsiness and headache, nausea, vomiting, and irritation of the eyes and respiratory passages. In one fatal case there was significant damage to the brain as well as to liver and kidney. Due to its mild odor, serious or fatal exposures have been experienced without forewarning. Tumors of the nose, liver, and lungs have been reported in animals following ingestion of high concentrations of dioxane. Immersion of chick embryos in dioxane has been reported to cause possible mutagenic effects. The significance of these findings in humans is unknown.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 88
2. Boiling point (760 mm Hg): 101 C (214 F)
3. Specific gravity (water = 1): 1.03
4. Vapor density (air = 1 at boiling point of dioxane): 3.0
5. Melting point: 11.8 C (53 F)
6. Vapor pressure at 20 C (68 F): 29 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

Miscible in all proportions

8. Evaporation rate (butyl acetate = 1): 2.7

• Reactivity

1. Conditions contributing to instability: Heat, long exposure to moisture.
2. Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving dioxane.
4. Special precautions: Dioxane is hygroscopic and will produce peroxides in the presence of moisture. Dioxane containing peroxides should not be distilled to dryness because of the potential explosion of non-volatile peroxides.

• Flammability

1. Flash point: 12 C (54 F) (closed cup)
2. Autoignition temperature: 180 C (356 F)
3. Flammable limits in air, % by volume: Lower: 2.0; Upper: 22.0
4. Extinguishant: Dry chemical, alcohol foam,

carbon dioxide

• Warning properties

1. Odor Threshold: Summer reports an odor threshold of 170 ppm; May reports 2.7 and 170 ppm.

2. Eye Irritation Level: Grant states that "in human beings, irritation of the eye is noted only at concentrations greater than 220 ppm of vapor in air." Patty states that at 300 ppm, dioxane "caused irritation of the eyes, nose, and throat; and at 500 ppm, it was objectionable. Even at higher concentrations, the initial irritation to eyes and respiratory passages is transitory"

3. Evaluation of Warning Properties: Patty states that the initial irritation produced by exposure to dioxane is transitory and that the "warning properties of dioxane are completely inadequate to prevent exposure to toxic amounts." The AIHA *Hygienic Guide* also notes that "the vapor has poor warning properties and can be inhaled in amounts which may cause serious intoxication or death with injury of the liver and kidneys."

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of dioxane vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure dioxane may be used. An analytical method for dioxane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted

are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid dioxane.

- Any clothing which becomes wet with liquid dioxane should be removed immediately and non-impervious clothing which becomes contaminated with dioxane should be removed promptly and such clothing should not be reworn until the dioxane is removed from the clothing.

- Clothing wet with liquid dioxane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of dioxane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the dioxane, the person performing the operation should be informed of dioxane's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where liquid dioxane may contact the eyes.

SANITATION

- Skin that becomes contaminated with dioxane should be promptly washed or showered to remove any dioxane.

- Eating and smoking should not be permitted in areas where liquid dioxane is handled, processed, or stored.

- Employees who handle liquid dioxane should wash their hands thoroughly before eating, smoking, or using toilet facilities.

- Areas in which exposure to dioxane may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to dioxane may occur and control methods which may be effective in each case:

Operation

Use in spray application of natural and synthetic resin-based varnishes, lacquers, and paints

Use in dipping, roller coating, tumbling, knifing, and brushing of natural and synthetic resin-based varnishes, lacquers, and paints

Use as a solvent for fats, oils, waxes, greases, and natural and synthetic resins

Use as a wetting agent in textile processing, dye baths, and stain and printing compositions

Use as a degreaser

Use as a dehydrating agent in preparation of histological slides

Use in manufacture of detergents and cleaning preparations; manufacture of polishing compounds

Use as a stabilizer for chlorinated solvents; use in preparation of cosmetics and deodorants; use in purification of drugs

Use as a working fluid for scintillation counter samples

Use as a solvent in pulping of wood; polishing compounds

Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

General dilution ventilation; personal protective equipment

Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If dioxane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If dioxane gets on the skin, promptly wash the contaminated skin with water. If dioxane soaks through the clothing, remove the clothing promptly and wash the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of dioxane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When dioxane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If dioxane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber equipped with an appropriate effluent

gas cleaning device. Dioxane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

• Waste disposal method:

Dioxane may be disposed of by atomizing in a suitable combustion chamber.

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*. Volume 11, 1976.

RESPIRATORY PROTECTION FOR DIOXANE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
200 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 200 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.



Water: Basic Information about Regulated Drinking Water Contaminants

You are here: [Water](#) » [Drinking Water](#) » [Drinking Water Contaminants](#) » [Basic Information about Regulated Drinking Water Contaminants](#) » Basic Information about cis-1,2-Dichloroethylene in Drinking Water

Basic Information about cis-1,2-Dichloroethylene in Drinking Water

EPA regulates cis-1,2-dichloroethylene in drinking water to protect public health. cis-1,2-Dichloroethylene may cause health problems if present in public or private water supplies in amounts greater than the drinking water standard set by EPA.

- [What is cis-1,2-dichloroethylene?](#)
- [Uses for cis-1,2-dichloroethylene](#)
- [What are cis-1,2-dichloroethylene's health effects?](#)
- [What are EPA's drinking water regulations for cis-1,2-dichloroethylene?](#)
- [How does cis-1,2-dichloroethylene get into my drinking water?](#)
- [How will I know if cis-1,2-dichloroethylene is in my drinking water?](#)
- [How will cis-1,2-dichloroethylene be removed from my drinking water?](#)
- [How do I learn more about my drinking water?](#)

What is cis-1,2-dichloroethylene?

cis-1,2-Dichloroethylene is an odorless organic liquid that has two slightly different forms, a "cis" form and a "trans" form.

Uses for cis-1,2-dichloroethylene.

Both the cis and trans forms — usually as a mixture — are used as a solvent for waxes and resins; in the extraction of rubber; as a refrigerant; in the manufacture of pharmaceuticals and artificial pearls; in the extraction of oils and fats from fish and meat; and in making other organics.

If you are concerned about cis-1,2-dichloroethylene in a private well, please visit:

- [EPA's private drinking water wells website](#)
- [Water Systems Council website](#) (EXIT Disclaimer)

What are cis-1,2-dichloroethylene's health effects?

Some people who drink water containing cis-1,2-dichloroethylene well in excess of the maximum contaminant level (MCL) for many years could experience problems with their liver.

This health effects language is not intended to catalog all possible health effects for cis-1,2-dichloroethylene. Rather, it is intended to inform consumers of some of the possible health effects associated with cis-1,2-dichloroethylene in drinking water when the rule was finalized.

What are EPA's drinking water regulations for cis-1,2-dichloroethylene?

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These non-enforceable health goals, based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals (MCLG). Contaminants are any physical, chemical, biological or radiological substances or matter in water.

The MCLG for cis-1,2-dichloroethylene is 0.07 mg/L or 70 ppb. EPA has set this level of protection based on the best available science to prevent potential health problems. EPA has set an enforceable regulation for cis-1,2-dichloroethylene, called a maximum contaminant level (MCL), at 0.07 mg/L or 70 ppb. MCLs are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. In this case, the MCL equals the MCLG, because analytical methods or treatment technology do not pose any limitation.

The Phase II Rule, the regulation for cis-1,2-dichloroethylene, became effective in 1992. The Safe Drinking Water Act requires EPA to periodically review the national primary drinking water regulation for each contaminant and revise the regulation, if appropriate. EPA reviewed cis-1,2-dichloroethylene as part of the Six Year Review and determined that the 0.07 mg/L or 70 ppb MCLG and 0.07 mg/L or 70 ppb MCL for cis-1,2-dichloroethylene are still protective of human health.

- [More information on the Six Year Review of Drinking Water Standards.](#)

States may set more stringent drinking water MCLGs and MCLs for cis-1,2-dichloroethylene than EPA.

How does cis-1,2-dichloroethylene get into my drinking water?

The major source of cis-1,2-dichloroethylene in drinking water is discharge from industrial chemical factories.

A federal law called the Emergency Planning and Community Right to Know Act (EPCRA) requires facilities in certain industries, which manufacture, process, or use significant amounts of toxic chemicals, to report annually on their releases of these chemicals. For more information on the uses and releases of chemicals in your state, contact the Community Right-to-Know Hotline: (800) 424-9346.

- [EPA's Toxics Release Inventory \(TRI\) website](#) provides information about the types and amounts of toxic chemicals that are released each year to the air, water, and land.

How will I know if cis-1,2-dichloroethylene is in my drinking water?

When routine monitoring indicates that cis-1,2-dichloroethylene levels are above the MCL, your water supplier must take steps to reduce the amount of cis-1,2-dichloroethylene so that it is below that level. Water suppliers must notify their customers as soon as practical, but no later than 30 days after the system learns of the violation. Additional actions, such as providing alternative drinking water supplies, may be required to prevent serious risks to public health.

cis-1,2-Dichloroethylene at a Glance

Maximum Contaminant Level (MCL) = 0.07 milligrams per Liter (mg/L) or 70 parts per billion (ppb)

Maximum Contaminant Level Goal (MCLG) = 0.07 mg/L or 70 ppb

Health Effects

Some people who drink water containing cis-1,2-dichloroethylene in excess of the MCL over many years could experience problems with their liver.

[Drinking Water Health Advisories](#) provide more information on health effects

Chemical Abstract Service Registry

Number
156-59-2

Sources of Contamination

Discharge from industrial chemical factories

[List of all Regulated Contaminants \(PDF\)](#)

(6 pp, 396 K, [About PDF](#))

- [See EPA's public notification requirements for public water systems.](#)

If your water comes from a household well, check with your health department or local water systems that use ground water for information on contaminants of concern in your area.

- [For more information on wells, go to EPA's website on private wells.](#)

How will cis-1,2-dichloroethylene be removed from my drinking water?

The following treatment method(s) have proven to be effective for removing cis-1,2-dichloroethylene to below 0.07 mg/L or 70 ppb: granular activated carbon in combination with packed tower aeration.

How do I learn more about my drinking water?

EPA strongly encourages people to learn more about their drinking water, and to support local efforts to protect the supply of safe drinking water and upgrade the community water system. Your water bill or telephone book's government listings are a good starting point for local information.

Contact your water utility. EPA requires all community water systems to prepare and deliver an annual consumer confidence report (CCR) (sometimes called a water quality report) for their customers by July 1 of each year. If your water provider is not a community water system, or if you have a private water supply, request a copy from a nearby community water system.

- [The CCR summarizes information regarding sources used \(i.e., rivers, lakes, reservoirs, or aquifers\), detected contaminants, compliance and educational information.](#)
- [Some water suppliers have posted their annual reports on EPA's website.](#)

Other EPA websites

- Find an answer or ask a question about drinking water contaminants on [EPA's Question and Answer website](#) or call [EPA's Safe Drinking Water Hotline](#) at (800) 426-4791
- [EPA's Integrated Risk Information System](#)
- [EPA's Substance Registry System](#)

Last updated on Friday, December 13, 2013



1,2-Dichloroethylene

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 540-59-0

NIOSH REL: 200 ppm (790 mg/m³) TWA

Current OSHA PEL: 200 ppm (790 mg/m³) TWA

1989 OSHA PEL: Same as current PEL

1993-1994 ACGIH TLV: 200 ppm (790 mg/m³) TWA

Description of Substance: Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor.

LEL: . . 5.6% (10% LEL, 5,600 ppm)

Original (SCP) IDLH: 4,000 ppm

Basis for original (SCP) IDLH: Patty [1963] reported that rats exposed to the cis-isomer of dichloroethylene for 4 hours at 8,000 ppm were neither killed nor anesthetized, but at 16,000 ppm, anesthesia occurred in 8 minutes and death occurred in 4 hours [Smyth 1956]. Because Patty [1963] also reported that the trans-isomer was twice as toxic and anesthetic as the cis-isomer, an IDLH of 4,000 ppm is chosen.

Short-term exposure guidelines: None developed

ACUTE TOXICITY DATA

Lethal concentration data:

Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived value
trans-isomer Mouse	ATSDR 1990	21,723	-----	6 hr	130,338 ppm (2.3)	13,034 ppm
cis-isomer Rat	Smyth 1956	-----	16,000	6 hr	32,000 ppm (2.0)	3,200 ppm

Lethal dose data:

Species	Reference	Route	LD ₅₀ (mg/kg)	LD _{Lo} (mg/kg)	Adjusted LD	Derived value

Rat	USDA 1966	oral	770	-----	1,337 ppm	134 ppm
trans-isomer						
Rat	Freudt et al. 1977	oral	1,275	-----	8,925 ppm	893 ppm

Human data: It has been reported that exposure to the trans-isomer at 2,200 ppm caused burning of the eyes, vertigo, and nausea [von Oettingen 1955]. An exposure to the trans-isomer at 819 ppm for 30 minutes has been reported to cause no untoward effects, while inhalation of either 1,687 to 2,184 ppm for 5 minutes or 1,191 ppm for 10 minutes has resulted in vertigo, pressure in the head, and somnolence [von Oettingen 1937].

Revised IDLH: 1,000 ppm
Basis for revised IDLH: The revised IDLH for 1,2-dichloroethylene is 1,000 ppm based on acute inhalation toxicity data in humans [von Oettingen 1937, 1955].

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Page last reviewed: December 4, 2014
 Page last updated: December 4, 2014
 Content source: [National Institute for Occupational Safety and Health](#) Education and Information Division

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Search the NIOSH Pocket Guide

Enter search terms separated by spaces.

1,2-Dichloroethylene					
Synonyms & Trade Names Acetylene dichloride, cis-Acetylene dichloride, trans-Acetylene dichloride, sym-Dichloroethylene					
CAS No. 540-59-0	RTECS No. KV9360000 (/niosh-rtecs/KV8ED280.html)		DOT ID & Guide 1150 13OP (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide130/poly/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula ClCH=CHCl	Conversion 1 ppm = 3.97 mg/m ³		IDLH 1000 ppm See: 540590 (/niosh/idlh/540590.html)		
Exposure Limits NIOSH REL : TWA 200 ppm (790 mg/m ³) OSHA PEL : TWA 200 ppm (790 mg/m ³)			Measurement Methods NIOSH 1003 (/niosh/docs/2003-154/pdfs/1003.pdf); OSHA 7 (http://www.osha.gov/dts/sltc/methods/organic/org007/org007.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acid, chloroform-like odor.					
MW: 97.0	BP: 118-140°F	FRZ: -57 to -115°F	Sol: 0.4%	VP: 180-265 mmHg	IP: 9.65 eV
Sp.Gr (77°F): 1.27	FL.P: 36-39°F	UEL: 12.8%	LEL: 5.6%		
Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.					
Incompatibilities & Reactivities Strong oxidizers, strong alkalis, potassium hydroxide, copper [Note: Usually contains inhibitors to prevent polymerization.]					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, respiratory system; central nervous system depression					
Target Organs Eyes, respiratory system, central nervous system					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately		

Respirator Recommendations

NIOSH/OSHA**Up to 1000 ppm:**

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode²

(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)²

(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0436 \(/niosh/ipcsneng/nengo436.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

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Technology Transfer Network - Air Toxics Web Site Tetrachloroethylene (Perchloroethylene)

127-18-4

Hazard Summary-Created in April 1992; Revised in December 2012

Tetrachloroethylene is widely used for dry-cleaning fabrics and metal degreasing operations. Effects resulting from acute (short term) high-level inhalation exposure of humans to tetrachloroethylene include irritation of the upper respiratory tract and eyes, kidney dysfunction, and neurological effects such as reversible mood and behavioral changes, impairment of coordination, dizziness, headache, sleepiness, and unconsciousness. The primary effects from chronic (long term) inhalation exposure are neurological, including impaired cognitive and motor neurobehavioral performance. Tetrachloroethylene exposure may also cause adverse effects in the kidney, liver, immune system and hematologic system, and on development and reproduction. Studies of people exposed in the workplace have found associations with several types of cancer including bladder cancer, non-Hodgkin lymphoma, multiple myeloma. EPA has classified tetrachloroethylene as likely to be carcinogenic to humans.

Please Note: The main sources of information for this fact sheet are EPA's *Integrated Risk Information System (IRIS)* (2), which contains information on inhalation chronic toxicity and the RfC, oral chronic toxicity and the RfD, and the carcinogenic effects of tetrachloroethylene; and the Agency for Toxic Substances and Disease Registry's (ATSDR's) *Toxicological Profile for Tetrachloroethylene*. (1)

Uses

- Tetrachloroethylene is used for dry cleaning and textile processing, as a chemical intermediate, and for vapor degreasing in metal-cleaning operations. (1)

Sources and Potential Exposure

- Over the past few decades, concentrations of tetrachloroethylene detected in ambient air have declined with reductions in the use of tetrachloroethylene. (2)
- Tetrachloroethylene has also been detected in drinking water supplies from contaminated groundwater sources. (2)
- Occupational exposure to tetrachloroethylene primarily occurs in industries using the chemical (e.g., many dry cleaning facilities) and at industries manufacturing the chemical. New dry cleaning technologies and practices introduced over the past couple of decades result in substantially reduced occupational exposure (1, 2)

Assessing Personal Exposure

- Tetrachloroethylene can be measured in the breath, and breakdown products of tetrachloroethylene can be measured in the blood and urine. (1)

Health Hazard Information

Acute Effects:

- Effects resulting from acute, inhalation exposure of humans to tetrachloroethylene vapors include irritation of the upper respiratory tract and eyes, kidney dysfunction, and at lower concentrations, neurological effects, such as reversible mood and behavioral changes, impairment of coordination, dizziness, headache, sleepiness, and unconsciousness. (1, 2)
- Animal studies have reported effects on the liver, kidney, and central nervous system (CNS) from acute inhalation exposure to high levels of tetrachloroethylene. (1, 2)
- Acute animal tests in mice have shown tetrachloroethylene to have low toxicity from inhalation and oral exposure. (1)

Chronic Effects (Noncancer):

- The major effects from chronic inhalation exposure to tetrachloroethylene in humans are neurological effects, including sensory symptoms such as headaches, impairments in cognitive and motor neurobehavioral functioning and color vision decrements. Other effects noted in humans, generally at higher exposures, include liver damage, kidney effects, immune and hematologic effects, and on development and reproduction. (1, 2)
- Animal studies have reported effects on the liver, kidney, and CNS from chronic inhalation exposure to tetrachloroethylene. (1, 2)
- EPA has calculated a Reference Concentration (RfC) of 0.04 milligrams per cubic meter (0.04 mg/m³) based on neurotoxicity in occupationally-exposed adults. The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not an estimator of risk but rather a reference point to gauge the potential for effects. At exposures increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse effect would necessarily occur. (2)
- The Reference Dose (RfD) for tetrachloroethylene is 0.006 milligrams per kilogram body weight per day (mg/kg/d) based on neurotoxicity in occupationally-exposed adults. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk, but rather a reference point to gauge the potential for effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (2)
- EPA has medium confidence in both the RfC and RfD values overall. Although EPA's confidence in the evidence of neurotoxicological hazard is high, EPA has medium rather than high confidence in the study estimates they were based on because they were derived from a LOAEL rather than a NOAEL and data were insufficient for dose-response modeling; additionally, the studies focus on occupational subjects and lack data to characterize potential susceptibility and variability across humans. EPA has medium confidence in the database due to limitations in both the available human and animal database (4)

Reproductive/Developmental Effects:

- Some adverse reproductive effects, such as menstrual disorders, altered sperm structure, and reduced fertility, have been reported in studies of workers occupationally exposed to tetrachloroethylene. However, the evidence is inconclusive. (2)

- Some studies of residents exposed to drinking water contaminated with tetrachloroethylene and other solvents during pregnancy suggest an association of tetrachloroethylene exposure with birth defects, however firm conclusions cannot be drawn due to several limitations of these studies. (2)
- Increased fetal resorptions and effects to the fetus have been reported in animals exposed to high levels of tetrachloroethylene by inhalation. (2)

Cancer Risk:

- Studies of dry cleaning workers exposed to tetrachloroethylene have shown associations between exposure to tetrachloroethylene and several types of cancer, specifically bladder cancer, non-Hodgkin lymphoma and multiple myeloma. There is also limited evidence suggestive of associations with esophageal, kidney, cervical and breast cancer. (2)
- Animal studies have reported an increased incidence of liver tumors in mice, from inhalation and gavage (experimentally placing the chemical in the stomach) exposure, and kidney and mononuclear cell leukemias in rats, via inhalation exposure. (1,2)
- EPA has classified tetrachloroethylene as likely to be carcinogenic to humans by all routes of exposure based on suggestive evidence in epidemiological studies and conclusive evidence in rats (mononuclear cell leukemia) and mice (increased incidence of liver tumors). The International Agency for Research on Cancer (IARC) has classified tetrachloroethylene as probably carcinogenic to humans (Group 2A).
- EPA uses mathematical models, based on animal or human studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of $2.6 \times 10^{-7} (\mu\text{g}/\text{m}^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing tetrachloroethylene at an average of $4 \mu\text{g}/\text{m}^3$ ($4 \times 10^{-3} \text{ mg}/\text{m}^3$) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that continuously breathing air containing $40 \mu\text{g}/\text{m}^3$ ($4 \times 10^{-2} \text{ mg}/\text{m}^3$) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing $400 \mu\text{g}/\text{m}^3$ ($4 \times 10^{-1} \text{ mg}/\text{m}^3$) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS.
- EPA calculated an oral cancer slope factor of 0.0021 (mg/kg/d)⁻¹ based on extrapolation from inhalation dose-response data. (2)

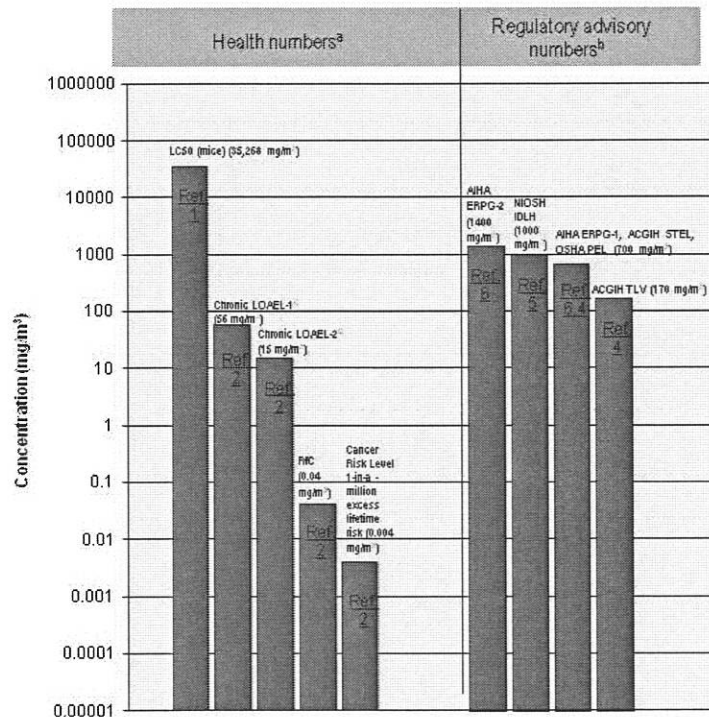
Physical Properties

- Tetrachloroethylene is a nonflammable colorless liquid with a sharp sweet odor; the odor threshold is 1 ppm. (1)
- The chemical formula for tetrachloroethylene is C₂Cl₄, and the molecular weight is 165.83 g/mol. (1)
- The vapor pressure for tetrachloroethylene is 18.47 mm Hg at 25 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of 3.40. (1)

Conversion Factors:

To convert concentrations in air (at 25 °C) from ppm to mg/m³: $\text{mg}/\text{m}^3 = (\text{ppm}) \times (\text{molecular weight of the compound}) / (24.45)$. For tetrachloroethylene: 1 ppm = 6.78 mg/m³. To convert concentrations in air from μg/m³ to mg/m³: $\text{mg}/\text{m}^3 = (\mu\text{g}/\text{m}^3) \times (1 \text{ mg}/1,000 \mu\text{g})$.

Health Data from Inhalation Exposure



AIHA ERPG - American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

ACGIH TLV - American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC50 (Lethal Concentration50) - A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LOAEL - Lowest-observed-adverse-effect level.

NIOSH IDLH - National Institute of Occupational Safety and Health's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

ACGIH STEL - American Conference of Governmental and Industrial Hygienists' recommended short-term exposure limit; a 15-minute TWA exposure which should not be exceeded at any time during a workday.

OSHA PEL - Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in 2012.

^a Health numbers are toxicological numbers from human studies, animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

^c The LOAELs for neurological effects are from the two principal studies on which the RfC is based.

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1. Agency for Toxic Substances and Disease Registry (ATSDR). *Toxicological Profile for Tetrachloroethylene (Update)*. U.S. Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1997.
2. U.S. Environmental Protection Agency. *Integrated Risk Information System (IRIS) on Tetrachloroethylene*. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 2012.
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5. National Institute for Occupational Safety and Health (NIOSH). *Pocket Guide to Chemical Hazards*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 2007.
6. American Industrial Hygiene Association (AIHA). *The AIHA 2011 Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook*. 2011.

Last updated on Thursday, April 09, 2015



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Tetrachloroethylene

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 127-18-4

NIOSH REL: Minimize workplace exposure concentrations; NIOSH considers tetrachloroethylene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL: 100 ppm TWA, 200 ppm CEILING,
 300 ppm 5-minute MAXIMUM PEAK IN ANY 3 HOURS

1989 OSHA PEL: 25 ppm (170 mg/m³) TWA

1993-1994 ACGIH TLV: 25 ppm (170 mg/m³) TWA, 100 ppm (685 mg/m³) STEL, A3

Description of substance: Colorless liquid with a mild, chloroform-like odor.

LEL: . . Noncombustible Liquid

Original (SCP) IDLH: 500 ppm

Basis for original (SCP) IDLH: The chosen IDLH is based on the statement by Negherbon [1959] that a 95-minute exposure to 1,000 ppm produces slight drunkenness, but no narcosis [Rowe et al. 1952]. Negherbon [1959] also reported that a 20- to 30-minute exposure to 206 to 235 ppm causes dizziness in humans (along with eye irritation, sinus congestion, nasal discharge, and sleepiness) [Rowe et al. 1952]. An IDLH of 500 ppm is used to prevent disorientation during escape.

Short-term exposure guidelines: None developed

ACUTE TOXICITY DATA:

Lethal concentration data:

Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Rat	Carpenter et al. 1949	4,000	-----	4 hr	11,320 ppm (2.83)	1,132 ppm
Mouse	Friberg et al. 1953	5,200	-----	4 hr	14,716 ppm (2.83)	1,472 ppm
Rat	Pozzani et al. 1959	4,964	-----	8 hr	19,856 ppm (4.0)	1,986 ppm

*Note: Conversion factor (CF) was determined with "n" = 2.0 [ten Berge et al. 1986].

Human data: It has been reported that 2,000 ppm caused slight narcosis in 5 minutes; 930-1185 ppm caused irritation of the eyes and throat, and marked dizziness after 2 minutes; 1,000

ppm caused slight drunkenness, but no narcosis after 95 minutes; 513-690 ppm caused eye, throat, and nose irritation, dizziness, loss of inhibition, and some incoordination after 10 minutes; 500 ppm for 2 hours caused slight discomfort; 206-356 ppm for 2 hours caused headache, burning of the eyes, sinus congestion, impaired coordination, and nausea; 206-235 ppm for 20-30 minutes caused eye irritation, sinus congestion, dizziness, and sleepiness; and 106 ppm caused only slight eye irritation [Negherbon 1959; Rowe et al. 1952].

Revised IDLH: 150 ppm

Basis for revised IDLH: The revised IDLH for tetrachloroethylene is 150 ppm based on acute inhalation toxicity data in humans [Negherbon 1959; Rowe et al. 1952] [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for tetrachloroethylene at any detectable concentration.]

REFERENCES:

1. Carpenter CP, Smyth HF Jr, Pozzani UC [1949]. The assay of acute vapor toxicity and the grading and interpretation of results on 96 chemical compounds. *J Ind Hyg Toxicol* 31:343-346.
2. Friberg L, Kylin B, Nystrom A [1953]. Toxicities of trichloroethylene and tetrachloroethylene and Fujiwara's pyridine-alkali reaction. *Acta Pharmacol Toxicol* 9:303-312.
3. Negherbon WO [1959]. Handbook of toxicology. Vol. III. Insecticides, a compendium. Wright-Patterson Air Force Base, OH: U.S. Air Force, Air Research and Development Command, Wright Air Development Center, Aero Medical Laboratory, WADC Technical Report 55-16, p. 737.
4. Pozzani UC, Weil CS, Carpenter CP [1959]. The toxicological basis of threshold limit values:
5. The experimental inhalation of vapor mixtures by rats, with notes upon the relationship between single dose inhalation and single dose oral data. *Am Ind Hyg Assoc J* 20:364-369.
5. Rowe VK, McCollister DD, Spencer HC, Adams EM, Irish DD [1952]. Vapor toxicity of tetrachloroethylene for laboratory animals and human subjects. *AMA Arch Ind Hyg Occup Med* 5:566-579.
6. ten Berge WF, Zwart A, Appelman LM [1986]. Concentration-time mortality response relationship of irritant and systematically acting vapours and gases. *J Haz Mat* 13:301-309.

Page last reviewed: December 4, 2014

Page last updated: December 4, 2014

Content source: [National Institute for Occupational Safety and Health](#) Education and Information Division

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Tetrachloroethylene					
Synonyms & Trade Names Perchloroethylene, Perchloroethylene, Perk, Tetrachlorethylene					
CAS No. 127-18-4	RTECS No. KX3850000 (/niosh-rtecs/KX3ABF10.html)		DOT ID & Guide 1897 160 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide160/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula Cl₂C=CCl₂	Conversion 1 ppm = 6.78 mg/m³		IDLH Ca [150 ppm] See: 127184 (/niosh/idlh/127184.html)		
Exposure Limits <small>NIOSH REL</small> : Ca Minimize workplace exposure concentrations. See Appendix A (nengapdx.html) <small>OSHA PEL</small> † (nengapdxg.html): TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm			Measurement Methods NIOSH 1003 (/niosh/docs/2003-154/pdfs/1003.pdf); OSHA 1001 (http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless liquid with a mild, chloroform-like odor.					
MW: 165.8	BP: 250°F	FRZ: -2°F	Sol: 0.02%	VP: 14 mmHg	IP: 9.32 eV
Sp.Gr: 1.62	FLP: NA	UEL: NA	LEL: NA		
Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene.					
Incompatibilities & Reactivities Strong oxidizers; chemically-active metals such as lithium, beryllium & barium; caustic soda; sodium hydroxide; potash					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]					
Target Organs Eyes, skin, respiratory system, liver, kidneys, central nervous system					
Cancer Site [in animals: liver tumors]					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash promptly		

Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0076 \(/niosh/ipcsneng/neng0076.html\)](#) See MEDICAL TESTS: [0179 \(/niosh/docs/2005-110/nmed0179.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

Content source: [National Institute for Occupational Safety and Health \(NIOSH\) Education and Information Division](#)

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Occupational Health Guideline for Tetrachloroethylene*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CCl}_2 = \text{CCl}_2$
- Synonyms: Perchloroethylene; perchlorethylene; tetrachlorethylene; perk
- Appearance and odor: Colorless liquid with an odor like chloroform or ether.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetrachloroethylene is 100 parts of tetrachloroethylene per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 200 ppm and a maximum acceptable peak of 300 ppm for 5 minutes in any three-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 50 ppm (339 mg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 100 ppm (678 mg/m³) averaged over a 15-minute period. The NIOSH Criteria Document for Tetrachloroethylene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Tetrachloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Tetrachloroethylene may cause headache, nausea, drowsiness, dizziness, incoordination, and unconsciousness. It may also cause irritation of

the eyes, nose, and throat and flushing of the face and neck. In addition, it might cause liver damage with such findings as yellow jaundice and dark urine. The liver damage may become evident several weeks after the exposure.

2. Long-term Exposure: Prolonged or repeated overexposure to liquid tetrachloroethylene may cause irritation of the skin. It might also cause damage to the liver and kidneys.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetrachloroethylene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to tetrachloroethylene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver and the cardiovascular and neurological systems should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Tetrachloroethylene may cause liver damage. A profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Tetrachloroethylene vapor is a narcotic. Rats did not survive when exposed for longer than 12-18 minutes to 12,000 ppm; when exposed repeatedly to 470 ppm they showed liver and kidney injury. Cardiac arrhythmias

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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attributed to sensitization of the myocardium to epinephrine have been observed with certain other chlorinated hydrocarbons, but exposure of dogs to concentrations of 5000 and 10,000 ppm tetrachloroethylene did not produce this phenomenon. Four human subjects were unable to tolerate 5000 ppm in a chamber for 6 minutes. They experienced vertigo, nausea, and mental confusion during the 10 minutes following cessation of exposure. In an industrial exposure to an average concentration of 275 ppm for 3 hours, followed by 1100 ppm for 30 minutes, a worker lost consciousness; there was apparent clinical recovery 1 hour after exposure but the monitored concentration of tetrachloroethylene in the patient's expired air diminished slowly over a 2-week period. Long-term industrial exposures have been reported to cause various neuropathies, such as numbness, trembling, neuritis, and defects of memory. During the second and third post-exposure weeks, the results of liver function tests became abnormal, suggesting that acute exposure had had a significant effect upon the liver. Other instances of liver injury following industrial exposure have been reported. Other effects on humans of inhalation of various concentrations are as follows: 2000 ppm, mild narcosis within 5 minutes; 600 ppm, sensation of numbness around the mouth, dizziness, and some incoordination after 10 minutes. In human experiments, 7-hour exposures at 100 ppm resulted in mild irritation of the eyes, nose, and throat; flushing of the face and neck; headache; somnolence; and slurred speech. Exposure of the skin to the liquid for 40 minutes resulted in a progressively severe burning sensation beginning within 5 to 10 minutes; the result was marked erythema, which subsided after 1 to 2 hours. The liquid sprayed into rabbits' eyes produced immediate pain and blepharospasm; patches of epithelium were lost, but the eyes recovered completely within 2 days.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 165.85
2. Boiling point (760 mm Hg): 121.2 C (250 F)
3. Specific gravity (water = 1): 1.62
4. Vapor density (air = 1 at boiling point of tetrachloroethylene): 5.83
5. Melting point: -22.4 C (-8 F)
6. Vapor pressure at 20 C (68 F): 14 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.015
8. Evaporation rate (butyl acetate = 1): 2.8

• Reactivity

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Tetrachloroethylene reacts with strong oxidizers and chemically active metals such as barium, lithium, and beryllium.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released when tetrachloroethylene decomposes.

oethylene decomposes.

4. Special precautions: Liquid tetrachloroethylene will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Not combustible

• Warning properties

1. Odor Threshold: Both May and Stern state that 50 ppm is the odor threshold for tetrachloroethylene.

2. Eye Irritation Level: Grant reports that "exposure to high concentrations of (tetrachloroethylene) vapor causes mild sensation of irritation to the eyes, but serious injury is not likely." The exact concentrations producing irritation are not mentioned by Grant.

Spector, however, reports that after a 20- to 30-minute exposure to 206 to 235 ppm, eye irritation occurs in humans.

Patty reports "very slight irritation of the eyes" among humans at 106 ppm.

3. Other Information: Spector reports that a 10-minute exposure to 513 to 690 ppm produces nose and throat irritation.

4. Evaluation of Warning Properties: Since the odor threshold of tetrachloroethylene is below the permissible exposure limit, and since eye irritation occurs at a concentration only twice the permissible exposure limit, its warning properties are considered to be adequate.

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of tetrachloroethylene. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Peak Above Ceiling Evaluation

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of tetrachloroethylene. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of

three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tetrachloroethylene may be used. An analytical method for tetrachloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid tetrachloroethylene.

• Non-impervious clothing which becomes contaminated with liquid tetrachloroethylene should be removed promptly and not reworn until the tetrachloroethylene is removed from the clothing.

• Clothing wet with liquid tetrachloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetrachloroethylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetrachloroethylene, the person performing the operation should be informed of tetrachloroethylene's hazardous properties.

• Employees should be provided with and required to use splash-proof safety goggles where liquid tetrachloroethylene may contact the eyes.

SANITATION

• Skin that becomes contaminated with liquid tetrachloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any tetrachloroethylene.

• Employees who handle liquid tetrachloroethylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetrachloroethylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as dry cleaning solvent; as degreasing and metal cleaning agent; in vapor degreasing of metal parts	Local exhaust ventilation; general dilution; personal protective equipment
Use as chemical intermediate in production of fluorocarbons, pesticides, and trichloroacetic acid	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as scouring, sizing, desizing, solvent and greaser remover in processing and finishing of textiles	Local exhaust ventilation; general dilution; personal protective equipment
Use as general industrial solvent in rubber, textile, printing, soap, and paint remover industries	Local exhaust ventilation; general dilution; personal protective equipment
Use as extraction agent for vegetable and mineral oils and in pharmaceutical industry; as vermifuge; as laundry treatment for presoaking and as drying medium in metal and wood industries	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If tetrachloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If tetrachloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If tetrachloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of tetrachloroethylene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When tetrachloroethylene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If tetrachloroethylene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Tetrachloroethylene may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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* SPECIAL NOTE

Tetrachloroethylene appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980). The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 20, 1979.

RESPIRATORY PROTECTION FOR TETRACHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.



Water: Basic Information about Regulated Drinking Water Contaminants

You are here: [Water](#) » [Drinking Water](#) » [Drinking Water Contaminants](#) » [Basic Information about Regulated Drinking Water Contaminants](#) » [Basic Information about Trichloroethylene in Drinking Water](#)

Basic Information about Trichloroethylene in Drinking Water

EPA regulates trichloroethylene in drinking water to protect public health. Trichloroethylene may cause health problems if present in public or private water supplies in amounts greater than the drinking water standard set by EPA.

- [What is trichloroethylene?](#)
- [Uses for trichloroethylene.](#)
- [What are trichloroethylene's health effects?](#)
- [What are EPA's drinking water regulations for trichloroethylene?](#)
- [How does trichloroethylene get into my drinking water?](#)
- [How will I know if trichloroethylene is in my drinking water?](#)
- [How will trichloroethylene be removed from my drinking water?](#)
- [How do I learn more about my drinking water?](#)

What is trichloroethylene?

Trichloroethylene, a volatile organic chemical, is a colorless or blue liquid with a chloroform-like odor.

Uses for trichloroethylene.

Trichloroethylene is primarily used to remove grease from fabricated metal parts and in the production of some textiles.

If you are concerned about trichloroethylene in a private well, please visit:

- [EPA's private drinking water wells website](#)
- [Water Systems Council website](#) EXIT Disclaimer

What are trichloroethylene's health effects?

Some people who drink water containing trichloroethylene well in excess of the maximum contaminant level (MCL) for many years could experience problems with their liver and may have an increased risk of getting cancer.

This health effects language is not intended to catalog all possible health effects for trichloroethylene. Rather, it is intended to inform consumers of some of the possible health effects associated with trichloroethylene in drinking water when the rule was finalized.

What are EPA's drinking water regulations for trichloroethylene?

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur. These non-enforceable health goals, based solely on possible health risks and exposure over a lifetime with an adequate margin of safety, are called maximum contaminant level goals (MCLG). Contaminants are any physical, chemical, biological or radiological substances or matter in water.

The MCLG for trichloroethylene is zero. EPA has set this level of protection based on the best available science to prevent potential health problems. EPA has set an enforceable regulation for trichloroethylene, called a maximum contaminant level (MCL), at 0.005 mg/L or 5 ppb. MCLs are set as close to the health goals as possible, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

The Phase I Rule, the regulation for trichloroethylene, became effective in 1989. The Safe Drinking Water Act requires EPA to periodically review the national primary drinking water regulation for each contaminant and revise the regulation, if appropriate. EPA reviewed trichloroethylene as part of the second Six Year Review and determined that it is appropriate to revise the regulation based on changes in analytical feasibility.

- [More information on the Six Year Review of Drinking Water Standards.](#)

States may set more stringent drinking water MCLGs and MCLs for trichloroethylene than EPA.

How does trichloroethylene get into my drinking water?

The major source of trichloroethylene in drinking water is discharge from metal degreasing sites and other factories. Wastewater from metal finishing, paint and ink formulation, electrical components, and rubber processing industries may also contain trichloroethylene.

A federal law called the Emergency Planning and Community Right to Know Act (EPCRA) requires facilities in certain industries, which manufacture, process, or use significant amounts of toxic chemicals, to report annually on their releases of these chemicals. For more information on the uses and releases of chemicals in your state, contact the Community Right-to-Know Hotline: (800) 424-9346.

- [EPA's Toxics Release Inventory \(TRI\) website provides information about the types and amounts of toxic chemicals that are released each year to the air, water, and land.](#)

How will I know if trichloroethylene is in my drinking water?

When routine monitoring indicates that trichloroethylene levels are above the MCL, your water supplier must take steps to reduce the amount of trichloroethylene so that it is below that level. Water suppliers must notify their customers as soon as practical, but no later than 30 days after the system learns of the violation. Additional actions, such as providing alternative drinking water supplies, may be required to prevent serious risks to public health.

- [See EPA's public notification requirements for public water systems.](#)

Trichloroethylene at a Glance

Maximum Contaminant Level (MCL) = 0.005 milligrams per Liter (mg/L) or 5 parts per billion (ppb)

Maximum Contaminant Level Goal (MCLG) = zero

Health Effects

Some people who drink water containing trichloroethylene in excess of the MCL over many years could experience problems with their liver and may have an increased risk of getting cancer.

[Drinking Water Health Advisories provide more information on health effects](#)

Chemical Abstract Service Registry Number

79-01-6

Sources of Contamination

Discharge from metal degreasing sites and other factories

[List of all Regulated Contaminants \(PDF\)](#)

(6 pp, 396 K, [About PDF](#))

If your water comes from a household well, check with your health department or local water systems that use ground water for information on contaminants of concern in your area.

- [For more information on wells, go to EPA's website on private wells.](#)

How will trichloroethylene be removed from my drinking water?

The following treatment method(s) have proven to be effective for removing trichloroethylene to below 0.005 mg/L or 5 ppb: granular activated carbon in combination with packed tower aeration.

How do I learn more about my drinking water?

EPA strongly encourages people to learn more about their drinking water, and to support local efforts to protect the supply of safe drinking water and upgrade the community water system. Your water bill or telephone book's government listings are a good starting point for local information.

Contact your water utility. EPA requires all community water systems to prepare and deliver an annual consumer confidence report (CCR) (sometimes called a water quality report) for their customers by July 1 of each year. If your water provider is not a community water system, or if you have a private water supply, request a copy from a nearby community water system.

- [The CCR summarizes information regarding sources used \(i.e., rivers, lakes, reservoirs, or aquifers\), detected contaminants, compliance and educational information.](#)
- [Some water suppliers have posted their annual reports on EPA's website.](#)

Other EPA websites

- Find an answer or ask a question about drinking water contaminants on [EPA's Question and Answer website](#) or call EPA's Safe Drinking Water Hotline at (800) 426-4791
- [EPA's Integrated Risk Information System](#)
- [EPA's Air Toxics Technology Transfer Network, Trichloroethylene](#)

Other Federal Departments and Agencies

- [Agency for Toxic Substances and Diseases Registry, ToxFAQs, Trichloroethylene](#)

Last updated on Wednesday, February 05, 2014



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Trichloroethylene

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 79-01-6

NIOSH REL: 2 ppm 60-minute CEILING during usage as an anesthetic agent and 25 ppm TWA during all other exposures; NIOSH considers trichloroethylene to be a potential occupational carcinogen as defined by the OSHA carcinogen policy [29 CFR 1990].

Current OSHA PEL: 100 ppm TWA, 200 ppm CEILING,
 300 ppm 5-minute MAXIMUM PEAK IN ANY 2 HOURS

1989 OSHA PEL: 50 ppm (270 mg/m³) TWA, 200 ppm(1,080 mg/m³) STEL

1993-1994 ACGIH TLV: 50 ppm (269 mg/m³) TWA, 100 ppm(537 mg/m³) STEL, A5

Description of substance: Colorless liquid (unless dyed blue)with a chloroform-like odor.

LEL (@77°F) : 8% (10% LEL(@77°F), 8,000 ppm)

Original (SCP) IDLH: 1,000 ppm

Basis for original (SCP) IDLH: The chosen IDLH is based on the results of experimental 2-hour exposures by Vernon and Ferguson [1969] of 8 young male volunteers (aged 21 to 30) to concentrations of 0, 100, 300, and 1,000 ppm. On the basis of a number of psychophysiological tests, decrements in performance were reported statistically at only 1,000 ppm. Because the exposure time was 2 hours at 1,000 ppm, a person should be able to escape within 30-minutes without injury or irreversible health effects.

Existing short-term exposure guidelines: National Research Council [NRC 1988] Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 200 ppm

24-hour EEGL: 10 ppm

ACUTE TOXICITY DATA:

Lethal concentration data:

Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF*)	Derived value
Human	Bell 1951	-----	2,900	?	?	?

G. pig	Davis et al. 1959	-----	37,200	40 min	53,196 ppm (1.43)	5,320 ppm
Mouse	Friberg et al. 1953	8,450	-----	4 hr	114,075 ppm (13.5)	11,408 ppm
Cat	Lehmann et al. 1936	-----	5,952	2 hr	33,688 ppm (5.66)	3,369 ppm
Rat	NRC 1988	-----	8,000	4 hr	108,000 ppm (13.5)	10,800 ppm
Rat	Vernot et al. 1977	26,300	-----	1 hr	62,594 ppm (2.38)	6,259 ppm
Rabbit	WHO 1970	-----	11,000	?	?	?

*Note: Conversion factor (CF) was determined with "n" = 0.8 [ten Berge et al. 1986].

Other human data: Exposure of eight volunteers for 2 hours to 1,000 ppm resulted in decrements in visual perception and motor skills, but 2-hour exposures to 100 and 300 ppm did not [Vernon and Ferguson 1969]. Tachypnea and ventricular arrhythmias have been equated with inhaled concentrations greater than 15,000 ppm during usage as an anesthetic [Vernon and Ferguson 1969].

Revised IDLH: 1,000 ppm [Unchanged]
 Basis for revised IDLH: Based on acute inhalation toxicity data in volunteers [Vernon and Ferguson 1969], the original IDLH for trichloroethylene (1,000 ppm) is not being revised at this time. [Note: NIOSH recommends as part of its carcinogen policy that the "most protective" respirators be worn for trichloroethylene at concentrations above 25 ppm.]

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Page last reviewed: December 4, 2014

Page last updated: December 4, 2014

Content source: [National Institute for Occupational Safety and Health](#) Education and Information Division

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Search the NIOSH Pocket Guide

Enter search terms separated by spaces.

Trichloroethylene					
Synonyms & Trade Names Ethylene trichloride, TCE, Trichloroethene, Trilene					
CAS No. 79-01-6	RTECS No. KX4550000 (/niosh-rtecs/KX456D70.html)		DOT ID & Guide 1710 160 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide160/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula ClCH=CCl ₂	Conversion 1 ppm = 5.37 mg/m ³		IDLH Ca [1000 ppm] See: 79016 (/niosh/idlh/79016.html)		
Exposure Limits NIOSH REL : Ca See Appendix A (nengapdx.html) See Appendix C (nengapdxc.html) OSHA PEL † (nengapdxg.html): TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)			Measurement Methods NIOSH 1022 (/niosh/docs/2003-154/pdfs/1022.pdf), 3800 (/niosh/docs/2003-154/pdfs/3800.pdf); OSHA 1001 (http://www.osha.gov/dts/sltc/methods/mdt/mdt1001/1001.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless liquid (unless dyed blue) with a chloroform-like odor.					
MW: 131.4	BP: 189°F	FRZ: -99° F	Sol: 0.1%	VP: 58 mmHg	IP: 9.45 eV
Sp.Gr: 1.46	FLP: ?	UEL(77° F): 10.5%	LEL(77° F): 8%		
Combustible Liquid, but burns with difficulty.					
Incompatibilities & Reactivities Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]					
Target Organs Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system					
Cancer Site [in animals: liver & kidney cancer]					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash promptly		

Wash skin: When contaminated
Remove: When wet or contaminated
Change: No recommendation
Provide: Eyewash, Quick drench

Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0081 \(/niosh/ipcsneng/neng0081.html\)](#) See MEDICAL TESTS: [0236 \(/niosh/docs/2005-110/nmedo236.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

Content source: [National Institute for Occupational Safety and Health \(NIOSH\)](#) Education and Information Division

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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR TRICHLOROETHYLENE POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about trichloroethylene for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- **Formula:** C_2HCl_3
- **Structure:** $CCl_2 = CHCl$
- **Synonyms:** Acetylene trichloride, ethylene trichloride, TCE
- **Identifiers:** CAS 79-01-6; RTECS KX455000; DOT 1710, label required: "St. Andrew's Cross (X)"
- **Appearance and odor:** Colorless liquid with a sweet odor like chloroform

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
 1. Molecular weight: 131.38
 2. Boiling point (at 760 mmHg): 87.1°C (188°F)
 3. Specific gravity (water = 1): 1.46
 4. Vapor density (air = 1 at boiling point of trichloroethylene): 4.54
 5. Melting point: -86.4°C (-123°F)
 6. Vapor pressure at 25°C (77°F): 74.3 mmHg
 7. Solubility in water, g/100 g water at 25°C (77°F): 0.00011
 8. Evaporation rate (butyl acetate = 1): 6.2
 9. Saturation concentration in air (approximate) at 25°C (77°F): 10.1% (101,000 ppm)
 10. Ionization potential: 9.47 eV
- **Reactivity**
 1. Incompatibilities: Trichloroethylene may react violently with chemically active metals such as barium, lithium, sodium, magnesium, and titanium. Aluminum may react with the free hydrogen chloride in trichloroethylene to produce aluminum

chloride, which catalyzes a violent self-accelerating polymerization reaction. Contact with strong caustics may cause the formation of dichloroacetylene, a toxic and flammable gas.

2. Hazardous decomposition products: Toxic vapors and gases (e.g., phosgene, hydrogen chloride, and carbon monoxide) may be released in a fire involving trichloroethylene.

- **Flammability**

1. Flash point: 32°C (90°F) (closed cup)
2. Autoignition temperature: 788°C (420°F)
3. Flammable limits in air, % by volume: Lower, 12.5; Upper, 90
4. Extinguishant: Alcohol foam, dry chemical, or carbon dioxide
5. Class IC Flammable Liquid (29 CFR 1910.106), Flammability Rating 1, Practically Nonflammable (NFPA)

- **Warning properties**

1. Odor threshold: 21.4 ppm
2. Eye irritation level: 400 ppm
3. Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for trichloroethylene per million parts of air (ppm) as a time-weighted average (TWA) concentration over an 8-hour workshift; the acceptable ceiling concentration is 200 ppm; and the maximum peak concentration above the acceptable ceiling (maximum duration of 5 minutes in any 2-hour period) is 300 ppm. The National Institute for Occupational Safety and Health (NIOSH) recommends that trichloroethylene be controlled and handled as a potential human carcinogen in the workplace and that exposure be minimized to the lowest feasible limit. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 50 ppm (270 mg/m³) as a TWA for a normal 8-hour workday and a 40-hour workweek; the ACGIH short-term exposure limit (STEL) is 200 ppm (1,080 mg/m³) (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Table 1.—Occupational exposure limits for trichloroethylene

	Exposure limits	
	ppm	mg/m ³
OSHA PEL TWA	100	—
Acceptable ceiling	200	—
Maximum ceiling (5 min in 2 h)	300	—
NIOSH REL TWA (Ca)*	25	—
ACGIH TLV® TWA	50	270
STEL	200	1,080

* (Ca): NIOSH recommends treating as a potential human carcinogen.

HEALTH HAZARD INFORMATION

• Routes of exposure

Trichloroethylene may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

• Summary of toxicology

1. *Effects on animals*: Acute inhalation of trichloroethylene by multiple species of animals caused depressed brain function, brain damage, liver and kidney injury, and death due to respiratory failure or cardiac arrest. In rats, rabbits, guinea pigs, and gerbils, chronic inhalation of trichloroethylene caused toxic effects on the nerves, increases in liver and kidney weights, and suppression of growth. Chronic oral administration of trichloroethylene to mice produced cancers of the liver and lungs, and chronic inhalation by female mice produced cancers of the lymph system and lungs.

2. *Effects on humans*: Acute inhalation or ingestion of trichloroethylene has caused reversible peripheral nerve degeneration, injury to the liver and kidneys and to the cardiovascular and gastrointestinal systems, depression of the central nervous system, coma, and sudden death due to respiratory failure, cardiac arrhythmia, or liver or kidney failure. Chronic exposure to trichloroethylene has caused damage to the liver, kidneys, and nervous system. The ingestion of alcohol, caffeine, and some prescription drugs has been found to potentiate the effects of trichloroethylene intoxication. A dermal response seen as a reddening of the face, neck, back, and shoulders (degreaser's flush) has occurred in chronically exposed workers following the ingestion of alcohol. Repeated immersion of the hands into liquid trichloroethylene has caused paralysis of the fingers.

• Signs and symptoms of exposure

1. *Short-term (acute)*: Inhalation exposure to trichloroethylene can cause drowsiness, dizziness, headache, blurred vision, incoordination, mental confusion, flushed skin, tremors, nausea, vomiting, fatigue, and cardiac arrhythmia. Irritation of the skin, mucous membranes, and eyes can also occur.

2. *Long-term (chronic)*: Exposure can cause headache, cough, double vision, impaired coordination and senses of touch and smell, anxiety, dizziness, giddiness, weakness, tremor, slowness of heartbeat, and intolerance to alcohol. Dryness of the skin, blisters, and dermatitis can also occur.

RECOMMENDED MEDICAL PRACTICES

• Medical surveillance program

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, and morbidity and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

• Preplacement medical evaluation

Prior to placing a worker in a job with a potential for exposure to trichloroethylene, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, liver, kidneys, and cardiovascular, nervous, and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to trichloroethylene at or below the NIOSH REL. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include chronic diseases of the skin or liver. The physician should obtain baseline values for liver function tests.

• Periodic medical screening and/or biologic monitoring

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that

may be attributed to exposure to trichloroethylene. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the integrity and physiologic function of the eyes, skin, liver, kidneys, and cardiovascular, nervous, and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population.

The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS: standardized questionnaires and tests of lung function.

• **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to trichloroethylene may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

• **Sentinel health events**

1. Acute SHE's include: Contact and/or allergic dermatitis.
2. Delayed-onset SHE's include: Toxic hepatitis.

MONITORING AND MEASUREMENT PROCEDURES

• **TWA exposure evaluation**

Measurements to determine worker exposure to trichloroethylene should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

• **Method**

Sampling and analysis may be performed by collecting trichloroethylene vapors with charcoal adsorption tubes followed by desorption with carbon disulfide and analysis by gas chromatography. Detector tubes or other direct-reading devices calibrated to measure trichloroethylene may also be used if available. A detailed sampling and analytical method for trichloroethylene may be found in the *NIOSH Manual of Analytical Methods* (method number S336).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with trichloroethylene.

SANITATION

Clothing which is contaminated with trichloroethylene should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of trichloroethylene from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of trichloroethylene's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with trichloroethylene should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle trichloroethylene should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to trichloroethylene may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for trichloroethylene

Operations	Controls
During use as a cleaning solvent in cold cleaning and vapor degreasing operations	Process enclosure, local exhaust ventilation, personal protective equipment
During use as a scouring and cleaning agent in textile processing; during use in the extraction and purification of animal and vegetable oils in food and pharmaceutical industries; during use in chemical synthesis	Process enclosure, local exhaust ventilation
During use in the manufacture of adhesives, anesthetics and analgesics, and cleaning and polishing preparations	Process enclosure, local exhaust ventilation
During use as a fumigant and disinfectant for seeds and grains	Local exhaust ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

• Eye exposure

Where there is any possibility of a worker's eyes being exposed to trichloroethylene, an eye-wash fountain should be provided within the immediate work area for emergency use.

If trichloroethylene gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• Skin exposure

Where there is any possibility of a worker's body being exposed to trichloroethylene, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If trichloroethylene gets on the skin, wash it immediately with soap and water. If trichloroethylene penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

• Rescue

If a worker has been incapacitated, move the affected worker from the hazardous exposure. Put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

If trichloroethylene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. For small quantities of liquids containing trichloroethylene, absorb on paper towels and place in an appropriate container.
3. Large quantities of liquids containing trichloroethylene may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.
4. Liquids containing trichloroethylene may be collected by vacuuming with an appropriate system.

WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations.

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should

not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

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Table 3.—Respiratory protection for trichloroethylene

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used.



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Acetone

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 67-64-1

NIOSH REL: 250 ppm (590 mg/m³) TWA

Current OSHA PEL: 1,000 ppm (2,400 mg/m³) TWA

1989 OSHA PEL: 750 ppm (1,800 mg/m³) TWA, 1,000 ppm (2,400 mg/m³) STEL

1993-1994 ACGIH TLV: 750 ppm (1,780 mg/m³) TWA, 1,000 ppm (2,380 mg/m³) STEL

Description of substance: Colorless liquid with a fragrant, mint-like odor.

LEL: 2.5% (10% LEL, 2,500 ppm)

Original (SCP) IDLH: 20,000 ppm

Basis for original (SCP) IDLH: There is no evidence in the available toxicological data that acetone presents an IDLH hazard below the lower explosive limit (LEL) of 25,000 ppm. Because Patty [1963] reported that a 1.5-hour exposure to 20,256 ppm is narcotic for mice, 20,000 ppm has been chosen as the IDLH.

Existing short-term exposure: National Research Council [NRC 1984] guideline

Emergency Exposure Guidance Levels (EEGLs):

1-hour EEGL: 8,500 ppm

24-hour EEGL: 1,000 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

					Adjusted	
					0.5-hr	Derived
Species	Reference	LC ₅₀ (ppm)	LCLo (ppm)	Time	LC (CF)	Value
Mouse	Flury and Wirth, 1933	-----	45,455	1 hr	56,818 ppm (1.25)	5,682 ppm
Rat	Pozzani et al. 1959	20,702	-----	8 hr	51,755 ppm (2.5)	5,176 ppm

Lethal dose data:

				LD ₅₀	LDLo	Derived
--	--	--	--	------------------	------	---------

Species	Reference	Route	(Mg/kg)	(mg/kg)	Adjusted LD	Value
Rat	Freeman and Hayes 1985	oral	5,800	-----	16,777 ppm	1,678 ppm
Mouse	Molodykh et al. 1980	oral	3,000	-----	8,678 ppm	868 ppm
Rabbit	WHO 1980	oral	5,340	-----	15,446 ppm	1,545 ppm

Other animal data: RD50 (mouse), 77,516 ppm [Alarie 1981].

Human data: Volunteers experienced slight irritation at 300 ppm but 500 ppm was tolerated [Nelson et al. 1943]. Eye irritation, headache, lightheadedness, nasal irritation, and throat irritation were noted in workers exposed to concentrations considerably in excess of 1,000 ppm and perhaps as high as 6,500 ppm [Raleigh and McGee 1972]. No indications of toxicity were reported following exposures to 2,100 ppm for 8 hours/day [Haggard et al. 1944].

Revised IDLH: 2,500 ppm [LEL]

Basis for revised IDLH: Based on health considerations and acute inhalation toxicity data in humans [Haggard et al. 1944; Raleigh and McGee 1972] and animals [Flury and Wirth 1933; Pozzani et al. 1959], a value of about 5,000 ppm would have been appropriate for acetone. However, the revised IDLH for acetone is 2,500 ppm based strictly on safety considerations (i.e., being 10% of the lower explosive limit of 2.5%).

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Page last reviewed: December 4, 2014

Page last updated: December 4, 2014

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<h1>Acetone</h1>					
Synonyms & Trade Names Dimethyl ketone, Ketone propane, 2-Propanone					
CAS No. 67-64-1	RTECS No. AL3150000 (/niosh-rtecs/AL3010Bo.html)		DOT ID & Guide 1090 127 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide127/) (http://www.cdc.gov/Other/disclaimer.html)		
Formula (CH₃)₂CO	Conversion 1 ppm = 2.38 mg/m³		IDLH 2500 ppm [10%LEL] See: 67641 (/niosh/idlh/67641.html)		
Exposure Limits <small>NIOSH</small> REL : TWA 250 ppm (590 mg/m³) OSHA PEL † (nengapdxg.html) : TWA 1000 ppm (2400 mg/m³)			Measurement Methods NIOSH 1300 (/niosh/docs/2003-154/pdfs/1300.pdf), 2555 (/niosh/docs/2003-154/pdfs/2555.pdf), 3800 (/niosh/docs/2003-154/pdfs/3800.pdf); OSHA 69 (http://www.osha.gov/dts/sltc/methods/organic/orgo69/orgo69.html) (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless liquid with a fragrant, mint-like odor.					
MW: 58.1	BP: 133° F	FRZ: -140° F	Sol: Miscible	VP: 180 mmHg	IP: 9.69 eV
Sp.Gr: 0.79	Fl.P: 0° F	UEL: 12.8%	LEL: 2.5%		
Class IB Flammable Liquid : Fl.P. below 73°F and BP at or above 100°F.					
Incompatibilities & Reactivities Oxidizers, acids					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis					
Target Organs Eyes, skin, respiratory system, central nervous system					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately		

Remove: When wet (flammable)

Change: No recommendation

Respirator Recommendations

NIOSH

Up to 2500 ppm:

(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)*

(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)*

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

(APF = 10) Any supplied-air respirator*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0087](#)

[\(/niosh/ipcsneng/neng0087.html\)](#) See MEDICAL TESTS: [0002 \(/niosh/docs/2005-110/nmed0002.html\)](#)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

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OSHA comments from the January 19, 1989 Final Rule on Air Contaminants Project extracted from 54FR2332 et. seq. This rule was remanded by the U.S. Circuit Court of Appeals and the limits are not currently in force.

CAS: 67-64-1; **Chemical Formula:** CH₃COCH₃

OSHA's previous Z-table limit for acetone was 1000 ppm as an 8-hour TWA. In the NPRM, the Agency proposed to lower this limit to 250 ppm as an 8-hour TWA. This proposed limit was derived from the NIOSH-recommended limit, which was based on a number of industrial and human volunteer studies reporting irritant and central nervous system effects resulting from exposure to acetone concentrations at levels below 1000 ppm; NIOSH (Ex. 8-47, Table N1) and the AFL-CIO (Ex. 194) concurred with the proposed limit. The ACGIH TLVs for acetone are 750 ppm as an 8-hour TWA and 1000 ppm as a 15-minute STEL. OSHA has carefully reviewed the scientific evidence and comments in the record and has determined that it is appropriate to revise the acetone PEL in the final rule to 750 ppm as an 8-hour TWA and to add a short-term limit of 1000 ppm. Acetone is a colorless, highly volatile, flammable liquid with an aromatic odor.

OSHA's proposed 250-ppm TWA limit for acetone was largely based on controlled human studies conducted by Nelson, Enge, Ross et al. (1943/Ex. 1-66) and Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191), as well as studies in workers conducted by Vigiliani and Zurlo (1955/Ex. 1-164) and Parmeggiani and Sassi (1954/Ex. 1-753). OSHA's reliance on these studies to establish a revised limit for acetone was criticized by Dr. William C. Thomas, Manager of Toxicology for the Hoechst Celanese Corporation, who testified on behalf of the Ketones Program Panel of the Chemical Manufacturers Association (CMA) (Ex. 8-54; Tr. 8/4/88, pp. 6-114 to 6-127; Exs. 149A, 149C). The National Marine Manufacturers Association (Ex. 181) agreed with Dr. Thomas' remarks. Summaries of each of these studies and of OSHA's response to Dr. Thomas' remarks follow.

In a controlled-exposure experiment, Nelson, Enge, Ross et al. (1943/Ex. 1-66) exposed an average of 10 human subjects (both male and female) to a variety of solvents, including acetone, for three to five minutes. Subjects were asked to judge the level of sensory irritation as absent, slightly irritating, or very irritating. Tests were conducted in a 1200-cubic-foot gas cabinet equipped with an anemostat to distribute the air uniformly. Acetone was reported to produce slight irritation on exposure to 300 ppm, but a concentration of 500 ppm produced a degree of eye, nose, and throat irritation that was still described by a majority of the subjects as "tolerable."

Dr. Thomas expressed five criticisms of the Nelson, Enge, Ross et al. (1943/Ex. 1-66) study. These were: (1) the short duration of exposure used; (2) the study's failure to account for adaptation because "naive" subjects who had not had previous acetone exposure were used; (3) the authors' reliance on subjective responses rather than on objective medical examination; (4) the use of nominal (calculated) exposures rather than measured exposures; and (5) the

introduction of potential bias because students who were involved in the experiment were used as test subjects (Tr. 8/4/88, pp. 6-114 to 6-117; Exs. 149A, 149C).

NIOSH addressed some of these issues in its criteria document for ketones (NIOSH 1978f, as cited in ACGIH 1986/Ex. 1-3, p. 6). In its analysis of the Nelson, Enge, Ross et al. (1943/Ex. 1-66) study, NIOSH (1978f) concluded:

- The concentrations of ketones in the exposure chamber were calculated (nominal) rather than measured analytically, so the true concentration may have been lower than reported.... [T]he use of experimenters as subjects was a possible source of bias, and the exposure periods of 3-5 minutes were not long enough to show if adaptation would occur.... The fact that exposure duration did not approach that of a normal workshift is a major limitation of...[this study]. However, the data are useful as a guide to the relative irritating properties of ketones and the concentrations at which these [properties] appear (NIOSH 1978f, p. 31).

Thus, despite these experimental limitations, NIOSH concluded that the Nelson, Enge, Ross et al. (1943/Ex. 1-66) study was useful in identifying ketone concentrations that are irritating, and it relied on this study, at least in part, when recommending a 250-ppm TWA limit for acetone (NIOSH 1978f, as cited in ACGIH 1986/Ex. 1-3, p. 6).

The second paper discussed by Dr. Thomas is the report by Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191). In this study, the authors exposed 25 healthy male subjects to 0, 100, 250, 500, or 1000 ppm acetone. Subjects were exposed for three hours in the morning and three hours in the afternoon, with a 45-minute period between exposures. Irritant responses were scored on a scale from 0 to 12, with a score of 12 representing severe irritation.

Most of the subjects exposed to 500 or 1000 ppm acetone reported irritation (scored between 4 and 5 in severity) during the first 90 minutes of exposure in the morning and the first 60 minutes of exposure in the afternoon. Subjects ceased to report irritation at the 90-minute mark during the afternoon exposure. A lesser degree of irritation was reported to occur among subjects exposed to 100 or 250 ppm acetone; however, this irritation subsided after the first 90 minutes of exposure in each of the two exposure periods. Subjects exposed to 250 ppm or higher reported feeling general weakness and a sense of tension even as long as 24 hours after exposure. Blood and urine samples taken during and after exposure showed increasing blood and urinary acetone levels among subjects exposed to 250 ppm or higher. Following the exposure period, these levels fell to normal values within about 25 to 35 hours after exposure was terminated. The authors also reported an increased leukocyte count in subjects exposed to 500 or 1000 ppm acetone; the increased white cell count persisted for about 24 hours after the cessation of exposure. The authors attributed this increased leukocyte count to acetone's irritant properties (Matsushita, Yoshimune, Inoue et al. 1969/Ex. 1-191).

Dr. Thomas criticized this study because it did not describe the methods used by its authors for measuring acetone exposures, and the blood acetone levels reported by Matsushita and colleagues (1969/Ex. 1-191) were about 2.5 times higher than those reported after similar exposures conducted by DiVincenzo, Yanno, and Astill (1973, as cited in ACGIH 1986/Ex. 1-3, p. 6). After a two-hour exposure to 500 ppm acetone, Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191) found a blood acetone level of 25 mg/L, compared to a level of 10 mg/L reported by DiVincenzo, Yanno, and Astill (1973, as cited in ACGIH 1986/Ex. 1-3, p. 6). Dr. Thomas suggested that the actual exposure levels employed by Matsushita and associates (1969/Ex. 1-191) may actually have been substantially higher than reported by these authors (Tr. 8/4/88, pp. 6-118 to 6-119; Exs. 149A, C).

OSHA has reviewed the report by DiVincenzo, Yanno, and Astill (1973, as cited in ACGIH 1986/Ex. 1-3, p. 6) and finds that the blood acetone results reported in this paper cannot be directly compared, as Dr. Thomas has done, with those reported by Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191), for a number of reasons. First, the subjects studied by DiVincenzo, Yanno, and Astill fasted for eight hours prior to exposure; it is not clear that the subjects studied by Matsushita, Yoshimune, Inoue et al. fasted before they were exposed. Second, the blood acetone values reported by DiVincenzo, Yanno, and Astill were corrected for endogenous acetone (i.e., acetone levels that existed prior to exposure). The authors reported that endogenous acetone levels ranged from 0 to 10 mg/L of blood, or about as high as would occur after a two-hour exposure to 500 ppm of acetone. Whether Matsushita, Yoshimune, Inoue et al. corrected for endogenous blood acetone levels is uncertain; if they did not, their reported blood acetone levels may be as much as two times overstated. The third consideration is that the studies used different methods to measure blood acetone levels. Matsushita, Yoshimune, Inoue et al. used a colorimetric method, while DiVincenzo, Yanno, and Astill used a gas chromatographic approach. The use of different analytical methods by the two investigative groups complicates any comparison of their blood acetone results. Thus, OSHA does not agree that the results by DiVincenzo, Yanno, and Astill (1973, as cited by ACGIH 1986/Ex. 1-3, p. 6) demonstrate that the exposure levels used by Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191) are necessarily understated. In addition to the two controlled-exposure studies discussed above, two industry studies were relied on by OSHA to support the reduction in the acetone PEL. One report by Parmeggiani and Sassi (1954/Ex. 1-759) indicated that six employees exposed to 307 to 918 ppm acetone in a rayon acetate plant experienced eye and throat irritation, dizziness, and inebriation. Five of the employees showed objective signs of pharyngeal irritation, four had lung irritation, and three had conjunctivitis. Although the authors attribute the observed CNS effects to excessive concomitant exposure to carbon disulfide, the irritant effects are more likely to have been the result of exposure to acetone, because carbon disulfide is not a primary irritant by vapor inhalation (Chemical Hazards of the Workplace, 2nd ed., Proctor, Hughes, and Fischman 1988, pp. 120-121). The other report, by Vigliani and Zurlo (1955/Ex. 1-164), found that acetone production workers exposed to 700 ppm acetone for three hours daily for 7 to 15 years experienced inflammation of the respiratory tract, stomach, and duodenum; giddiness; and loss of strength.

Dr. Thomas (Exs. 8-54, 149A, 149C; Tr. 8/4/88, pp. 6-114 to 6-127) criticized these two studies on the basis that the urinary acetone levels reported by Parmeggiani and Sassi (1954/Ex. 1-759) and by Vigliani and Zurlo (1955/Ex. 1-164) indicated that airborne exposures were much higher than the reported values. He stated that, based on these values, the employees observed in both of these studies were likely to have been exposed to acetone levels approximating 5000 ppm. OSHA is not convinced that the exposure levels reported in these two studies are understated. The studies by Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-191) and DiVincenzo, Yanno, and Astill (1973, as cited in ACGIH 1986/Ex. 1-3, p. 6) clearly demonstrate that blood and urinary acetone levels can increase with continued, daily exposure. Furthermore, in its criteria document, NIOSH (1978f, as cited in ACGIH 1986/Ex. 1-3, p. 6) cites a number of studies that demonstrate that skin absorption of acetone can result in elevated blood and urinary acetone levels. OSHA believes that the high urinary acetone levels reported in the workers studied by Parmeggiani and Sassi (1954/Ex. 1-759) and by Vigliani and Zurlo (1955/Ex. 1-164) were most likely the result of an accumulated body burden of acetone brought about by long-term exposure and dermal absorption. Given these considerations, it does not appear appropriate to approximate airborne exposure levels on the basis of the urinary acetone levels reported in these two studies. To summarize, OSHA finds that the studies discussed above show that acetone is capable of producing sensory irritation at

concentrations below 1000 ppm and that long-term exposure to acetone at levels below 1000 ppm can cause CNS disturbances. In addition, the ACGIH (1986/Ex. 1-3, p. 6) reports that chronic exposure to acetone causes respiratory irritation and headaches. Despite the methodological shortcomings of all of these studies, OSHA is impressed with the consistency of their findings. Both the Nelson, Enge, Ross et al. (1943/Ex. 1-66) and the Matsushita, Yoshimune, Inoue et al. (1969/Ex. 1-91) studies demonstrate that exposure to concentrations of acetone below 1000 ppm are associated with eye, nose, and throat irritation. Both industry studies (Parmeggiani and Sassi 1954/Ex. 1-759; Vigliani and Zurlo 1955/Ex. 1-164) report similar signs and symptoms of irritation and CNS disturbances in workers exposed to concentrations of acetone between 700 and 1000 ppm. OSHA is not persuaded by Dr. Thomas' arguments that exposure levels are understated in these reports; OSHA believes that the quantitative relationship between long-term exposure to acetone and urinary acetone levels is not sufficiently established to draw this conclusion. Therefore, OSHA concludes that the findings of these four studies are consistent in demonstrating the acute and long-term effects of acetone exposure at levels below 1000 ppm.

The Ketones Panel of the CMA (Tr. 8/4/88, pp. 6-100 to 6-113; Exs. 149A, 149B, and 179) also presented testimony by Dr. Robert Raleigh, Adjunct Professor of Medicine at the University of Rochester School of Medicine. Dr. Raleigh testified on a study he conducted among filter press operators who were exposed exclusively to acetone (Raleigh and McGee 1972, as cited in Ex. 8-54). In this study, 13 workers were asked about symptoms and were medically examined over a one-week period. Using grab bags, acetone samples were taken at random periods during each workshift. Subjective symptoms were recorded with each grab sample. Samples were analyzed by gas chromatography.

Over the period studied, TWA exposures to acetone varied from 950 to 1060 ppm. Of the 13 workers studied, nine (69 percent) reported eye irritation, five (38 percent) reported nasal irritation, and five (38 percent) reported throat irritation. Three (23 percent) employees reported experiencing lightheadedness. Some employees reported these symptoms more than once during the study period. There were four cases of eye irritation following short-term exposures to acetone concentrations below 1000 ppm. Eye irritation that was reported to be "strong" occurred following short-term exposures to approximately 1800 ppm. Physical examination revealed a few instances of redness of the nasal mucosa and slight infection of the mucosa of the nose and throat.

In his written testimony regarding this study, Dr. Raleigh concluded:

- Considering the number of samples taken, the variability of human response, the slight to mild nature of the response, and the lack of objective evidence of eye irritation as noted by the examining physician, I do not believe... [instances of irritation occurring below 1000 ppm] indicate the need for a safe level being set below 1000 parts per million (Ex. 8-54, p. 9).

Dr. Raleigh also testified that the occurrence of transient dizziness was no cause for concern:

- [T]his symptom is usually very transient and in my experience I have never noted any adverse consequences from an occasional person...who complains of dizziness (Tr. 8/4/88, p. 6-103).

OSHA does not agree with Dr. Raleigh's interpretation of his study or with his view that dizziness, irritation and mild infections of the mucous membranes of the respiratory tract do not constitute material impairments of health. After reviewing the Raleigh and McGee report

(1972, as cited in Ex. 8-54), OSHA notes that more than half the workers studied experienced sensory reactions from exposure to acetone at TWA levels equal to the former 1000-ppm OSHA limit. Furthermore, some of these reactions were characterized as "strong." OSHA believes that this study further demonstrates that the Agency's former 1000-ppm 8-hour TWA limit is insufficiently protective and does not prevent workers from experiencing these sensory effects. In addition, in contrast to Dr. Raleigh, OSHA characterizes transient dizziness in and of itself as an "adverse consequence." Dizziness connotes an effect on the central nervous system; in addition, dizziness is a serious safety hazard in the workplace. For the reasons stated earlier in this section, OSHA finds that such effects constitute material impairments of health. Thus, OSHA finds that the Raleigh and McGee study (1972, as cited in Ex. 8-54) is a recent, well-conducted study that provides additional support for the need to lower the former 1000-ppm TWA limit for acetone. Furthermore, OSHA finds the evidence that adverse effects can result from short-term exposures to levels of acetone at or near 750 ppm convincing; two controlled human studies (Nelson, Enge, Ross et al. 1943/Ex. 1-66; Matsushita, Yoshimune, Inoue et al. 1969/Ex. 1-191) reported sensory irritant effects upon short-term exposure to such levels of acetone, and two industry studies (Parmeggiani and Sassi 1954/Ex. 1-759; Vigliani and Zurlo 1955/Ex. 1-164) reported irritation and CNS effects among employees exposed to acetone levels ranging from 307 to 918 ppm in one instance and about 700 ppm in the other. In addition, two studies (Matsushita, Yoshimune, Inoue et al. 1969/Ex. 1-191; DiVincenzo, Yanno, and Astill 1973, as cited in ACGIH 1986/Ex. 1-3, p. 6) suggest that chronic exposure to acetone on a daily basis leads to the bioaccumulation of acetone. In light of the studies discussed above, OSHA concludes that it is necessary to reduce the limit for acetone to 750 ppm as an 8-hour TWA and 1000 ppm as a STEL to protect workers from the acute and chronic effects of acetone exposure. OSHA finds that the chemically induced sensory irritation associated with acute exposures to acetone can occur at levels only slightly above the 750-ppm level being established as an 8-hour TWA. In the absence of a STEL, the 750-ppm limit would permit excursions to levels as high as 12,000 ppm for brief periods. Such levels "depress the central nervous system, causing dizziness, weakness, and loss of consciousness" (Proctor, Hughes, and Fischman 1988, p. 49). An 8-hour TWA of 750 ppm is necessary to protect workers against the bioaccumulation of acetone, chronic irritation of the respiratory tract, and headaches associated with long-term acetone exposures. OSHA considers both the short-term sensory irritation associated with brief exposures to acetone and the increased blood and urinary accumulation and chronic respiratory irritation characteristic of long-term acetone exposures to be material impairments of health. Accordingly, OSHA is establishing in the final rule an 8-hour TWA PEL of 750 ppm and a STEL of 1000 ppm for acetone.

Page last reviewed: September 28, 2011

Page last updated: September 28, 2011

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Technology Transfer Network - Air Toxics Web Site

Carbon disulfide

75-15-0

Hazard Summary-Created in April 1992; Revised in January 2000

Exposure to carbon disulfide occurs mainly in the workplace. Acute (short-term) inhalation exposure of humans to carbon disulfide has caused changes in breathing and chest pains. Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and convulsions have also been reported in humans acutely exposed by inhalation. Neurologic effects, including behavioral and neurophysiological changes, have been observed in chronic (long-term) human and animal inhalation studies. Reproductive effects, such as decreased sperm count and menstrual disturbances, have been observed in humans exposed to carbon disulfide by inhalation. Animal studies support these findings. EPA has not classified carbon disulfide for human carcinogenicity.

Please Note: The main sources of information for this fact sheet are the Agency for Toxic Substances and Disease Registry's (ATSDR's) *Toxicological Profile for Carbon disulfide* and EPA's *Integrated Risk Information System* (IRIS), which contains information on oral chronic toxicity and the *RfD* and inhalation chronic toxicity and the *RfC*.

Uses

- Carbon disulfide is used predominantly in the manufacture of rayon, cellophane, and carbon tetrachloride. (1,2)
- Carbon disulfide is also used to produce rubber chemicals and pesticides. (1,2)

Sources and Potential Exposure

- The main route of exposure to this compound is in the workplace. Workers in plants that use carbon disulfide in their manufacturing processes have a high degree of exposure potential. (1)
- Releases of carbon disulfide from industrial processes are almost exclusively to the air; individuals in proximity to these sites may be exposed. Concentrations of carbon disulfide in urban/suburban areas were measured at about 65 parts per trillion (ppt) and in rural areas at about 41 ppt. (1,2)
- Carbon disulfide has been detected in some samples of drinking water. (1)
- Low amounts of carbon disulfide may be emitted naturally from volcanoes and marshes. (1)

Assessing Personal Exposure

- Carbon disulfide breaks down into other chemical substances after it enters the body. Medical tests can measure levels of these substances in urine and blood, but the tests are not reliable indicators of total exposure. (1)

Health Hazard Information

Acute Effects:

- Acute inhalation exposure of humans caused changes in breathing and some chest pains during an accidental release of carbon disulfide. (1)
- Nausea, vomiting, dizziness, fatigue, headache, mood changes, lethargy, blurred vision, delirium, and convulsions have also been reported in humans acutely exposed by inhalation. (3)
- Brain chemistry changes and sensory and motor nerve conduction alterations were observed in rats acutely exposed to carbon disulfide by inhalation. (1)
- Animal studies show transitory effects associated with the target organ toxicity (central nervous system (CNS), blood, liver, eyes) seen from chronic exposure. (1)
- Tests involving acute exposure of rats, mice, and rabbits have shown carbon disulfide to have low acute toxicity from inhalation and moderate acute toxicity by ingestion. (4)

Chronic Effects (Noncancer):

- Neurotoxic effects have been observed in chronic human and animal inhalation studies. Behavioral and neurophysiological changes, reduced nerve conduction velocity, peripheral neuropathy, and polyneuropathy have been observed in chronically exposed workers. (1,2,5)
- An increased incidence of coronary heart disease has been observed in an epidemiological study of workers who chronically inhaled carbon disulfide in the workplace. Concomitant exposure to other chemicals and a failure to control for other coronary heart disease risk factors have been noted with this study. An increased incidence of angina has been reported in another occupational study. (1,2)
- Muscle pain, headaches, and general fatigue have been reported by workers chronically exposed to carbon disulfide in the air. (1,3)
- Ocular effects have been observed in chronically exposed workers. (1)
- Workers who handled fibers made from a polymer solution in carbon disulfide developed blisters and eczematous lesions on their hands. (1,3)
- Chronic inhalation exposure has been observed to affect the CNS, blood, liver, and kidneys in animals. (1)
- The Reference Concentration (*RfC*) for carbon disulfide is 0.7 milligrams per cubic meter (mg/m³) based on neurological effects in humans. The *RfC* is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the *RfC*, the potential for adverse health effects increases. Lifetime exposure above the *RfC* does not imply that an adverse health effect would necessarily occur. (5)
- EPA has medium confidence in the study on which the *RfC* was based because it is well designed and conducted, uses adequate numbers of subjects, and is well supported by other occupational studies examining the same effect; however, considerable uncertainty exists regarding the exposure histories of the cohorts examined; medium confidence in the database because a considerable number of well-conducted occupational studies have defined the effects of carbon disulfide in humans; however, a significant question remains regarding the possibility of developmental effects in humans; and consequently medium confidence in the *RfC*. (5)
- The Reference Dose (*RfD*) for carbon disulfide is 0.1 milligrams per kilogram body weight per day (mg/kg/d) based on fetal toxicity/malformations in rabbits. (5)
- EPA has medium confidence in the study on which the *RfD* was based because this study was a well-designed multispecies study that provided adequate toxicologic endpoints; medium confidence in the database because it contains supportive reproductive and epidemiologic studies; and, consequently, medium confidence in the *RfD*. (5)

Reproductive/Developmental Effects:

- Reproductive effects, such as decreased sperm count and decreased libido in men and menstrual disturbances in women, have been reported from occupational settings involving inhalation exposure to carbon disulfide. (1-3)
- Developmental effects, including skeletal and visceral malformations, embryotoxicity, and functional and behavioral disturbances, have been observed in several animal studies across a wide exposure range. (2)
- Pharmacokinetic studies indicate that carbon disulfide and its metabolites cross the placenta and localize in the target organs of the fetus (brain, blood, liver, and eyes). (1)

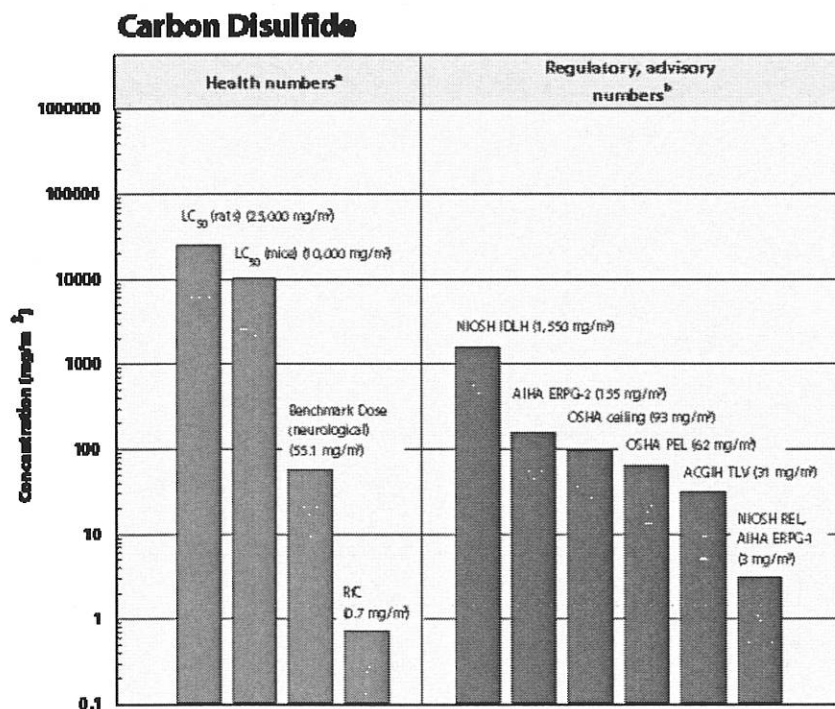
Cancer Risk:

- In a study of workers exposed by inhalation to carbon disulfide and other solvents, an increased incidence of lymphatic leukemia was reported. However, there were many confounding factors in this study, making it difficult to interpret the results. (1,2)
- EPA has not classified carbon disulfide for human carcinogenicity. (5)

Physical Properties

- The chemical formula for carbon disulfide is CS₂, and its molecular weight is 76.14 g/mol. (1,8)
- Pure carbon disulfide occurs as a colorless liquid that is not very soluble in water; impure carbon disulfide is yellowish. Carbon disulfide evaporates rapidly at room temperature and is flammable. (1,8)
- Pure carbon disulfide has a sweet, pleasant, chloroform-like odor, with an odor threshold of 0.05 mg/m³. Commercial grades of carbon disulfide have a foul odor, smelling like rotten eggs. (1)
- The vapor pressure for carbon disulfide is 352.6 mm Hg at 25 °C, and its log octanol/water partition coefficient (log K_{ow}) is 1.84 to 2.16. (1)

To convert concentrations in air (at 25 °C) from ppm to mg/m³: $mg/m^3 = (ppm) \times (\text{molecular weight of the compound}) / (24.45)$. For carbon disulfide: 1 ppm = 3.1 mg/m³. To convert concentrations in air from µg/m³ to mg/m³: $mg/m^3 = (\mu g/m^3) \times (1 mg/1,000 \mu g)$.

Health Data from Inhalation Exposure

ACGIH TLV—American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

AIHA ERPG—American Industrial Hygiene Association's emergency response planning guidelines. ERPG 1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor; ERPG 2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed up to one hour without experiencing or developing irreversible or other serious health effects that could impair their abilities to take protective action.

LC₅₀ (Lethal Concentration₅₀)—A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH IDLH—National Institute of Occupational Safety and Health's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL—NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

OSHA PEL—Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

OSHA PEL ceiling--Occupational Safety and Health Administration's permissible exposure limit ceiling value; the concentration of a substance that should not be exceeded at any time.

The health and regulatory values cited in this factsheet were obtained in December 1999.

^a Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

^b Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH, ACGIH, and AIHA numbers are advisory.

^c This benchmark dose is from the critical study used as the basis for the RfC.

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Last updated on Friday, October 18, 2013



Carbon disulfide

May 1994

Immediately Dangerous to Life or Health Concentrations (IDLH)

CAS number: 75-15-0

NIOSH REL: 1 ppm (3 mg/m³) TWA, 10 ppm (30 mg/m³) STEL [skin]

Current OSHA PEL: 20 ppm TWA, 30 ppm CEILING,
100 ppm 30-minute MAXIMUM PEAK

1989 OSHA PEL: 4 ppm (12 mg/m³) TWA, 12 ppm (36 mg/m³) STEL [skin]

1993-1994 ACGIH TLV: 10 ppm (31 mg/m³) TWA [skin]

Description of Substance: Colorless to faint-yellow liquid with a sweet ether-like odor.

LEL: . . 1.3% (10% LEL, 1,300 ppm)

Original (SCP) IDLH: 500 ppm

Basis for original (SCP) IDLH: The chosen IDLH is based on the statement in Patty [1963] that symptoms occur after 30 minutes of exposure to 420 to 510 ppm [Flury and Zernik 1931]. AIHA [1956] reported that severe symptoms and unconsciousness may occur within 30 minutes at 1,100 ppm [Patty 1963]. Patty [1963] also reported that exposure of humans to 4,800 ppm for 30 minutes causes coma and may be fatal [Flury and Zernik 1931].

Existing short-term exposure guidelines: 1992 American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines (ERPGs):

ERPG-1: 1 ppm (60-minute)

ERPG-2: 50 ppm (60-minute)

ERPG-3: 500 ppm (60-minute)

National Research Council [NRC 1984] Emergency Exposure Guidance Levels (EEGLs):

10-minute EEGL: 200 ppm

30-minute EEGL: 100 ppm

60-minute EEGL: 50 ppm

ACUTE TOXICITY DATA

Lethal concentration data:

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Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived Value
Rat	AIHA 1992	>1,670	-----	1 hr	>2,088 ppm (1.25)	>208 ppm
Rat	AIHA 1992	15,500	-----	1 hr	19,375 ppm (1.25)	1,938 ppm
Rat	AIHA 1992	3,000	-----	4 hr	6,000 ppm (2.0)	600 ppm
Rat	AIHA 1992	3,500	-----	4 hr	7,000 ppm (2.0)	700 ppm
Rat	Izmerov et al. 1982	7,911	-----	2 hr	12,658 ppm (1.6)	1,266 ppm
Mouse	Izmerov et al. 1982	3,165	-----	2 hr	5,063 ppm (1.6)	506 ppm
Human	Lefaux 1968	-----	4,000	30 min	4,000 ppm (1.0)	400 ppm

Other animal data: RD₅₀ (mouse), >81,000 ppm [AIHA 1992].

Other human data: Symptoms have occurred after 30 minutes of exposure to concentrations ranging from 420 to 510 ppm while exposure to 4,800 ppm for 30 minutes causes coma and may be fatal [Flury and Zernik 1931]. Severe symptoms and unconsciousness may occur within 30 minutes at 1,100 ppm [Patty 1963]. It has been reported that 760 ppm causes an immediate headache that lasts for hours [Browning 1953]. It has also been reported that minor symptoms are induced after several hours of exposure to 300 ppm, distinct signs of poisoning at 400 ppm, severe poisoning after 30 minutes at 1,150 ppm, and life-threatening health effects at 3,200 to 3,800 ppm [Bittersohl et al. 1972]. It has been reported that exposure at 2,000 to 3,300 ppm leads to narcosis in 30 minutes, and death occurs after 30 to 60 minutes of exposure at 5,000 ppm [Paluch 1954].

Revised IDLH: 500 ppm [Unchanged]

Basis for revised IDLH: Based on acute inhalation toxicity data in humans [Bittersohl et al. 1972; Browning 1953; Flury and Zernik 1931; Lefaux 1968], the original IDLH for carbon disulfide (500 ppm) is not being revised at this time.

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Page last reviewed: December 4, 2014

Page last updated: December 4, 2014

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Search the NIOSH Pocket Guide

Enter search terms separated by spaces.

Carbon disulfide

Synonyms & Trade Names Carbon bisulfide

CAS No. 75-15-0	RTECS No. FF6650000 (/niosh-rtecs/FF657890.html)	DOT ID & Guide 1131 131 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide131/) (http://www.cdc.gov/Other/disclaimer.html)
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Formula CS ₂	Conversion 1 ppm = 3.11 mg/m ³	IDLH 500 ppm See: 75150 (/niosh/idlh/75150.html)
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<p>Exposure Limits <small>NIOSH REL :</small> TWA 1 ppm (3 mg/m³) ST 10 ppm (30 mg/m³) [skin] <small>OSHA PEL †</small> (nengapdxg.html): TWA 20 ppm C 30 ppm 100 ppm (30-minute maximum peak)</p>	<p>Measurement Methods NIOSH 1600 (/niosh/docs/2003-154/pdfs/1600.pdf), 3800 (/niosh/docs/2003-154/pdfs/3800.pdf) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) (http://www.cdc.gov/Other/disclaimer.html)</p>
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Physical Description Colorless to faint-yellow liquid with a sweet ether-like odor. [Note: Reagent grades are foul smelling.]

MW: 76.1	BP: 116° F	FRZ: -169° F	Sol: 0.3%	VP: 297 mmHg	IP: 10.08 eV
Sp.Gr: 1.26	Fl.P: -22° F	UEL: 50.0%	LEL: 1.3%		

Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.

Incompatibilities & Reactivities Strong oxidizers; chemically-active metals such as sodium, potassium & zinc; azides; rust; halogens; amines [Note: Vapors may be ignited by contact with ordinary light bulb.]

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms dizziness, headache, poor sleep, lassitude (weakness, exhaustion), anxiety, anorexia, weight loss; psychosis; polyneuropathy; Parkinson-like syndrome; ocular changes;

coronary heart disease; gastritis; kidney, liver injury; eye, skin burns; dermatitis; reproductive effects

Target Organs central nervous system, peripheral nervous system, cardiovascular system, eyes, kidneys, liver, skin, reproductive system

Personal Protection/Sanitation ([See protection codes \(protect.html\)](#))
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated
Remove: When wet (flammable)
Change: No recommendation

First Aid ([See procedures \(firstaid.html\)](#))
Eye: Irrigate immediately
Skin: Soap wash immediately
Breathing: Respiratory support
Swallow: Medical attention immediately

Respirator Recommendations

NIOSH

Up to 10 ppm:

(APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)
 (APF = 10) Any supplied-air respirator

Up to 25 ppm:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode
 (APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s)

Up to 50 ppm:

(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)
 (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
 (APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s)
 (APF = 50) Any self-contained breathing apparatus with a full facepiece
 (APF = 50) Any supplied-air respirator with a full facepiece

Up to 500 ppm:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
 (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister
 Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](/niosh/npg/pgintrod.html) See ICSC CARD: [0022 \(/niosh/ipcsneng/neng0022.html\)](/niosh/ipcsneng/neng0022.html) See MEDICAL TESTS: [0039 \(/niosh/docs/2005-110/nmed0039.html\)](/niosh/docs/2005-110/nmed0039.html)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

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Species	Reference	LC ₅₀ (ppm)	LC _{Lo} (ppm)	Time	Adjusted 0.5-hr LC (CF)	Derived Value
Rat	AIHA 1992	>1,670	-----	1 hr	>2,088 ppm (1.25)	>208 ppm
Rat	AIHA 1992	15,500	-----	1 hr	19,375 ppm (1.25)	1,938 ppm
Rat	AIHA 1992	3,000	-----	4 hr	6,000 ppm (2.0)	600 ppm
Rat	AIHA 1992	3,500	-----	4 hr	7,000 ppm (2.0)	700 ppm
Rat	Izmerov et al. 1982	7,911	-----	2 hr	12,658 ppm (1.6)	1,266 ppm
Mouse	Izmerov et al. 1982	3,165	-----	2 hr	5,063 ppm (1.6)	506 ppm
Human	Lefaux 1968	-----	4,000	30 min	4,000 ppm (1.0)	400 ppm

Other animal data: RD₅₀ (mouse), >81,000 ppm [AIHA 1992].

Other human data: Symptoms have occurred after 30 minutes of exposure to concentrations ranging from 420 to 510 ppm while exposure to 4,800 ppm for 30 minutes causes coma and may be fatal [Flury and Zernik 1931]. Severe symptoms and unconsciousness may occur within 30 minutes at 1,100 ppm [Patty 1963]. It has been reported that 760 ppm causes an immediate headache that lasts for hours [Browning 1953]. It has also been reported that minor symptoms are induced after several hours of exposure to 300 ppm, distinct signs of poisoning at 400 ppm, severe poisoning after 30 minutes at 1,150 ppm, and life-threatening health effects at 3,200 to 3,800 ppm [Bittersohl et al. 1972]. It has been reported that exposure at 2,000 to 3,300 ppm leads to narcosis in 30 minutes, and death occurs after 30 to 60 minutes of exposure at 5,000 ppm [Paluch 1954].

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