Final

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station Shelby, Ohio FUDS Property Number: G05OH0972

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CH2M HILL, Inc. and Professional Environmental Engineers, Inc.

Executive Summary

This Feasibility Study (FS) Report for the Shelby Horizons Area of Concern (AOC) at the former Wilkins Air Force Station (AFS) in Shelby, Ohio, documents the development and evaluation of remedial action alternatives relevant to the Shelby Horizons AOC. The Shelby Horizons AOC is a former disposal area at the former Wilkins AFS, which is a Formerly Used Defense Site (FUDS).

The FS Report includes the following elements:

- Background information
- Development of a remedial action objective (RAO)
- Identification of remedial alternatives according to effectiveness, implementability, and cost
- Detailed analysis of the alternatives according to the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) feasibility evaluation criteria

Site Characteristics

Wilkins AFS operated from 1944 to 1961 on 486 acres located at the north end of the city of Shelby, Ohio, in Richland County. The AFS included 77 acres of warehouse space and 29 acres used for outdoor storage. The U.S. Government used this facility to store medical supplies, airplane parts, clothing, rations, and vehicle parts and supplies. Technical support services at the depot included a motor repair and maintenance shop, several paint shops and paint storage areas, battery shop and service, laboratory supply storage, printing supplies and equipment, service station, wash racks, locomotive maintenance shop, incinerator, and fire station and pump house. In addition, cleaning and preservation of supplies was conducted to ensure that supplies and equipment would survive storage and transportation. After closure, the former AFS was sold to various businesses, local government entities, the Shelby County Board of Education, and individuals. The property is zoned heavy industrial and serviced by public water.

The Shelby Horizons AOC is located in an open, level, maintained grassy area in the western portion of the former Wilkins AFS on the Shelby Horizons Inc. property. The AOC consists of an area of approximately 0.5 acre and a smaller adjacent area approximately 0.03 acre, which were defined based on a geophysical survey conducted in 2000. According to interviews with a former depot employee conducted as part of the preliminary assessment (PA) (Plexus Scientific Corporation [Plexus], 2000), a former disposal area that reportedly consisted of trenches about 12 feet wide, 4 to 5 feet deep, and about 40 feet long was located along the western portion of the current Shelby Horizons property, in the location of the AOC. Waste placed in the trenches consisted of rubbish from former Wilkins AFS operations that was crushed with a bulldozer before being covered with soil. The interviewee also reported that waste was burned in this location for several years (Plexus, 2000).

Investigation Results

Between 2000 and 2012, the United States Army Corps of Engineers (USACE) conducted several investigations, including a PA, a site inspection (SI), a remedial investigation (RI), and an FS data gap evaluation. These investigations included a geophysical survey, surface and subsurface soil sampling, gas sampling, groundwater sampling, methane and mercury vapor sampling, and test pitting/trenching activities.

The buried debris/waste materials disposed at the Shelby Horizons AOC were assumed to be primarily solid waste based on disposal practices described in Army manuals (TM 5-634, 1946 and 1958) for the period. However, characterization of a heterogeneous waste and confirmation that no CERCLA hazardous materials or hazardous substances from various depot support activities were disposed of at the AOC were not practical due to cost and safety concerns. Therefore, the SI and RI were focused on addressing potential migration of contaminants beyond the limits of the buried debris/waste.

As part of the PA, historical aerial photos were reviewed that indicated disturbed areas in the western portion of the property now owned by Shelby Horizons. A geophysical survey was subsequently performed during the SI to identify the presence of anomalies in the areas of disturbed soil identified by the aerials. The geophysical survey identified two anomalies as possible disposal areas. The “larger anomaly” is approximately 22,000 square feet (ft^2) in area and the “smaller anomaly” located immediately north of the larger anomaly is approximately 1,350 ft^2. The area of these two anomalies defined the Shelby Horizons AOC.

Soil was sampled from 27 surface locations (0 to 0.8 foot below ground surface [bgs]) and 5 subsurface locations (2 to 4 feet bgs) during the SI and RI. Metals and polynuclear aromatic hydrocarbons (PAHs) were detected at concentrations above the December 2009 United States Environmental Protection Agency (USEPA) industrial soil Regional Screening Levels (RSLs; hereafter referred to as “industrial RSLs”) in the surface and subsurface soil. Arsenic was detected above industrial RSLs at all sampling locations. The arsenic in the surface soil may be naturally occurring, as all detected concentrations at the Shelby Horizons property were at or near potential background conditions for Ohio (Ohio Environmental Protection Agency [Ohio EPA], 2009) and the Wilkins AFS background concentrations. One subsurface soil sample also contained lead and mercury at concentrations exceeding the industrial RSLs; this sample was collected from within the larger anomaly. Benzo(a)pyrene was detected in five surface soil samples and one subsurface soil sample at concentrations exceeding the industrial RSL; these samples were collected from within the anomalies. One sample collected from within the larger anomaly also contained dibenz(a,h)anthracene and benzo(b)fluroanthacene at concentrations exceeding the industrial RSLs.

Groundwater was sampled quarterly for one year from three wells installed around the AOC during the RI. Dissolved levels of arsenic (MW-13) and antimony (in one of four sampling events [January 2009] for MW-12) were detected in excess of Maximum Contaminant Levels (MCLs), which were used as the primary screening levels for groundwater contamination. Given antimony was only detected once (January 2009) out of four events, the presence above the screening level is likely an isolated occurrence. Arsenic was also detected in background wells. Given arsenic occurs naturally in soil in Ohio and was detected in background wells, it is possible that arsenic in groundwater is naturally occurring.

The results of the human health risk assessment (HHRA) indicated that for current land use, no unacceptable risks were identified for exposure to surface soils. Potable use of groundwater is not a complete exposure pathway since the Shelby Horizons property and surrounding area are connected to city water. In addition, the fine-grained glacial deposits that make up the shallow aquifer potentially impacted by buried debris at the Shelby Horizons property would not be a suitable source of potable or non-potable water due to the low yield of only 3 to 10 gallons per minute. For future construction worker exposure to shallow groundwater beyond the limits of the fill, no unacceptable risks were identified. However, the risk assessment did not address potential risks associated with exposure to the waste itself or water in contact with the waste, which could not be characterized due to the heterogeneity and volume of buried material. The ecological risk assessment (ERA) was performed to evaluate the actual or potential ecological effects from exposures to the site. The ERA concluded that the site does not pose unacceptable risk to ecological receptors.

A soil gas survey was conducted during the RI in the upper 2 feet of soil along the Shelby Horizons property fence line north, west, and south of the anomalies. Using field instruments, methane was not detected at the property edge; however, methane was detected in the casings of two site monitoring wells. The source of methane was further investigated during the 2012 FS data gap investigation when seven vapor probes for methane vapor sampling were installed in the larger anomaly. Methane was detected at 0.1 to 1.2 percent using field instrumentation, but not detected in laboratory samples. Methane was detected at above 90 percent inside the casings of two site groundwater wells, as well as in groundwater samples. Based on these field measurements, laboratory results, and comparison with regional studies, the methane in the monitoring wells appears to have migrated to the shallow subsurface from deeper hydrocarbon source rocks and is not related to the buried debris or previous Department of Defense (DoD) activities.

Mercury vapor was detected using field instrumentation in the subsurface soil in an area approximately 800 ft^2 at the southern end of the larger anomaly during the SI. A subsequent mercury vapor investigation was conducted in 2012 where seven vapor probe locations for sampling mercury vapor were installed in and around the historic detection area. Potential risks were evaluated by comparing the mercury vapor laboratory results (both detected and qualified non-detected) to ambient air and hypothetical indoor air risk-based screening levels. Based upon this evaluation, mercury in the subsurface is not expected to pose risks above USEPA target levels to current/future industrial workers and hypothetical future residents.

Test pitting/trenching activities further refined the lateral and vertical extent of buried debris/waste materials. The bulk of the debris was encountered in the northern two-thirds of the AOC footprint and as a result of observations made during the test pitting/trenching, the footprint of the area of buried debris is smaller than the AOC extent defined by the 2000 geophysical survey. Types of waste observed included ash, glass, metal, partially burnt wood, paper, and concrete. The waste was covered with 0.5 to 4 feet of soil cover. The volume of waste was estimated to be at least 1,600 cubic yards (yd^3).

Remedial Action Objectives

The remedial investigation confirmed the presence and approximate limits of debris/waste buried at the Shelby Horizons AOC. The investigation also confirmed that there are no complete exposure pathways based on current land use (vacant land with soil cover over waste). However, a full characterization of chemicals of concern and identification of all potential risks associated with direct contact with buried debris/waste was not evaluated in the RI given the heterogeneity and volume of fill material. The following RAO was developed to provide a basis for evaluating remedial alternatives that would be protective of possible future receptors that might come in contact with the waste should land use change (removal of soil cover or excavation):

- Eliminate or reduce the potential risks to future receptors associated with direct contact with landfill contents

Once the RAO was defined, potential applicable or relevant and appropriate requirements (ARARs) were identified for remedy development.

Development of Remedial Alternatives

The remedial action alternatives considered for the Shelby Horizons AOC are driven by the presence of buried debris/waste materials. Because technologies involving treatment to change chemical or physical characteristics of landfill material is not feasible due to the heterogeneity of the buried debris/waste, a complete technology screening was not conducted. Therefore, the general response actions (GRAs) were used to screen remedial alternatives.

A No Action Alternative was evaluated as baseline alternative, as required by the National Oil and Hazardous Substances Pollution Contingency Plan.

Containment is the most-practicable remedial alternative for landfills. A Containment Alternative would evaluate the need for a cap to limit exposure to landfill contents and generation of leachate, control and treatment of landfill gas, and land use controls (LUCs). Observations made during test pitting/trenching activities and vapor probe installation at the AOC indicated there was generally 0.5 to 4 feet of soil overlying the buried debris/waste material, thereby eliminating the need for installation of a cap to limit exposure to landfill contents. Based on an evaluation of field measurements, laboratory analysis, and review of regional studies, the waste does not appear to be generating landfill gas. Leachate does not appear to be migrating beyond the footprint of the fill. As a result, containment alternatives for applying additional soil cover to serve as a cap, and treatment of landfill gas or leachate were not evaluated.

Based upon the results of remedial investigations and in consideration of the GRAs, the following alternatives were identified for the Shelby Horizons AOC for detailed evaluation:

- Alternative 1 – No Action
- Alternative 2 – LUCs
- Alternative 3 – Excavation and Offsite Disposal

Alternative 1 – No Action

Under the No Action Alternative, there would be no activities completed at the Shelby Horizons AOC to change the current conditions. Additionally, no action would be taken to restrict potential exposures to buried debris and waste if excavation were to occur within the AOC. This alternative does not provide for LUCs restricting future site use, such as an environmental covenant or a deed restriction. Alternative 1 was retained as a baseline alternative, as required by the National Oil and Hazardous Substances Pollution Contingency Plan.

Alternative 2 – LUCs

The LUCs Alternative would rely upon the existing cover material and an environmental covenant to eliminate or reduce the potential risks associated with direct contact with landfill contents by prohibiting intrusive activities that do not follow protocols established by the covenant.

Alternative 3 – Excavation and Offsite Disposal

The Excavation and Offsite Disposal Alternative consists of excavating the buried debris/waste from the AOC and transporting it to a facility permitted to accept the material. Upon completion of excavation activities, the site would be backfilled and restored to existing grade. Long-term site management would not be required.

Analysis of Remedial Alternatives

The remedial alternatives were evaluated against the following nine CERCLA feasibility evaluation criteria:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements (ARARs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume (TMV) through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. Community acceptance
9. State acceptance

Alternative 1 does not meet the RAO because it does not eliminate or reduce the potential risks associated with direct contact with landfill contents. The results of the detailed analysis indicate that Alternatives 2 and 3 meet the RAO, comply with the ARAR, provide long-term effectiveness and permanence, have minimal short-term effects, and are implementable. Neither Alternatives 2 nor 3 reduces the TMV through treatment; treatment is not associated with the alternatives. Alternative 2 is the least-cost alternative that meets the RAO.

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Acronyms and Abbreviations

^{13}C	carbon-13
^{14}C	carbon-14
δ	Delta
µg/L	microgram(s) per liter
µg/m³	microgram(s) per cubic meter
AUL	activity and use limitation
AFS	Air Force Station
amsl	above mean sea level
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
C_2	Ethane
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COEPC	constituent of potential ecological concern
COIP	Central Ohio Industrial Park, Inc.
COPC	constituent of potential concern
D	hydrogen-2
DO	dissolved oxygen
DoD	Department of Defense
ELCR	excess lifetime cancer risk
ERA	ecological risk assessment
FS	feasibility study
ft^2	square foot (feet)
ft^3	cubic foot (feet)
FUDS	Formerly Used Defense Site
GRA	general response action
GSA	General Services Administration
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient

LUC	land use control
MCL	Maximum Contaminant Level
mg/kg	milligram(s) per kilogram
mg/m^3	milligram(s) per cubic meter
NCP	National Contingency Plan
O&M	operation and maintenance
OAC	Ohio Administrative Code
ODGS	Ohio Division of Geological Society
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
ORP	oxidation-reduction potential
PA	preliminary assessment
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCTC	Pioneer Career and Technology Center
PE	Professional Environmental Engineers
Plexus	Plexus Scientific Corporation
pMC	percent modern carbon
PRG	preliminary remediation goal
QAPP	Quality Assurance Project Plan
RAO	remedial action objective
RI	remedial investigation
RME	reasonable maximum exposure
RSL	Regional Screening Level
SI	site inspection
SVOC	semivolatile organic compound
TAL	target analyte list
TMV	toxicity, mobility, or volume
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VISL	vapor intrusion screening level
VOC	volatile organic compound
yd^3	cubic yard(s)

1 Introduction

This Feasibility Study (FS) Report was prepared by Professional Environmental Engineers, Inc. (PE) and subcontractor CH2M HILL on behalf of the United States Army Corps of Engineers (USACE), Louisville District, under Contract Number W912QR-08-D-0025, Delivery Order 0014. The report documents the development and evaluation of remedial alternatives associated with the Shelby Horizons Area of Concern (AOC) located in the town of Shelby, Ohio (Figure 1-1).

The Shelby Horizons AOC is a former disposal area associated with the former Wilkins Air Force Station (AFS), a Formerly Used Defense Site (FUDS) (hereafter referred to as "site") designated as G05OH0972. Under the FUDS program, the United States (U.S.) Department of Defense (DoD) is responsible for environmental restoration of properties that were formerly owned by, leased to, or otherwise possessed by the U.S under the jurisdiction of the Secretary of Defense. Environmental response actions at a FUDS conform to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 U.S. Code 9601 et seq., the National Oil and Hazardous Substance Pollution Contingency Plan, commonly called the National Contingency Plan (NCP), and Engineer Regulation 200-3-1, as applicable. This FS Report has been performed in general accordance with United States Environmental Protection Agency (USEPA) guidance titled *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988).

The purpose of this FS is to develop, screen, and evaluate remedial alternatives that provide protection from risks associated with direct contact with the buried debris/waste in the future. The scope of this FS is to summarize the prior studies conducted at the Shelby Horizons AOC, including the FS data gap field investigation activities performed in the summer of 2012; summarize risks associated with the disposal area; discuss applicable or relevant and appropriate requirements (ARARs); and, develop remedial objectives relevant for AOC. The FS Report then identifies and screens remedial technologies, identifies and provides a detailed analysis of remedial alternatives, and provides comparative analyses of selected alternatives. The comparative analysis serves as a basis for recommendations on an appropriate remedial action.

The remainder of the FS Report is organized as follows:

- **Section 2, Background Information**—This section presents a summary of background information, including site description, site history, previous environmental investigations, site characteristics, nature and extent of contamination, and a synopsis of human health and ecological risk assessments (ERAs).
- **Section 3, Remedial Action Objectives** —This section presents a discussion of the remedial action objective (RAO) for the AOC based upon potential risks associated with direct contact with the AOC landfill contents and presents the ARAR.

- **Section 4, Development of Remedial Alternatives**—This section discusses applicable remedial alternatives for the AOC and provides an evaluation of their effectiveness, implementability, and cost.
- **Section 5, Detailed Analysis of Alternatives**—This section presents the detailed analysis of the remedial alternatives identified in Section 4.
- **Section 6, Summary**—This section summarizes the conclusions and recommendations of the FS.
- **Section 7, References**—This section presents a list of references consulted in developing the FS Report.

2 Background Information

2.1 Site Description

The former Wilkins AFS site is located at the north end of the City of Shelby, Ohio, in Richland County (Figure 1-1), in an area zoned by the City of Shelby as heavy industrial. The site comprises approximately 486 acres, which were acquired by the U.S. Air Force in 1943 for use as a storage depot. The property is served by public water.

The site topography is relatively flat, with gentle sloping to the northeast and northwest. Ditches have been cut at the site to facilitate surface drainage. Ground surface elevations range from 1,075 to 1,100 feet above mean sea level (amsl).

The Shelby Horizons AOC is located along the northwestern border of the former Wilkins AFS site (Figure 2-1), west of the intersection of Allison Drive and General Road, on property that is currently owned by Shelby Horizons, which operates an industrial business on the property.

Commercial/industrial properties are located to the east and south of the Shelby Horizons property and farmland abuts the property to the west and north. The geographic coordinates of the Shelby Horizons AOC are 40 degrees 54 minutes 15 seconds north latitude and 82 degrees 40 minutes 32 seconds west longitude.

The AOC consists of an area of approximately 0.5 acre and a smaller adjacent area approximately 0.03 acre (Plexus Scientific Corporation [Plexus], 2001) (Figure 2-2). The AOC is located in an open, level, maintained grassy area in the western portion of the Shelby Horizons property. The Shelby Horizons property, including the AOC, is fenced and guarded.

A shallow ditch (a grass-lined drainage swale) exists on the property and cuts through the AOC (Figure 2-2). The ditch conveys stormwater runoff off of the property where the water then likely continues flowing north and enters a north-flowing tributary of Marsh Run (Plexus, 2001; Corrigan et al., 2000). Marsh Run is an east-west-trending creek that flows in a generally northeast direction for approximately 2 miles before discharging to the Black Fork Mohican River (Figure 2-1). The ditch is dry during most of the year and does not support aquatic life.

2.2 Site History

2.2.1 Wilkins AFS

Wilkins AFS was built from 1943 to 1944 on 344 acres and later expanded to 486 acres. The AFS included 77 acres of warehouse space and 29 acres used for outdoor storage. The U.S. Government used this facility to store medical supplies, airplane parts, clothing, rations, and vehicle parts and supplies. As a supply depot, the primary features of the facility were multiple aboveground storage warehouses where various items, such as aircraft parts, vehicles, equipment, and clothing, were stored, maintained, and redistributed to other areas as needed. Maintenance, equipment repair, cleaning, and preservation of supplies occurred in service buildings to a more-limited degree. Shops and services for the stored supplies at the depot included a motor repair and maintenance shop, several paint shops and paint storage areas, battery shop and service, laboratory supply storage, printing supplies and equipment, service station, wash racks, locomotive maintenance shop, incinerator, and fire station and pump house (Plexus, 2000). Depots were designed, constructed, and operated in accordance with standardized military operations reflected in installation reports and technical manuals and periodically inspected for compliance with military standards.

The planned closure of the former Wilkins AFS was announced on October 2, 1957, and in June 1961, the former Wilkins AFS was transferred to the General Services Administration (GSA) to be put up for sale. The former AFS was sold to various businesses, local government entities, the Shelby County Board of Education, and individuals. Currently, the largest property owners are Central Ohio Industrial Park, Inc. (COIP); Shelby Horizons; Pioneer Career and Technology Center (PCTC); and the City of Shelby, Ohio. At the time of the facility closure, there were approximately 60 buildings onsite. Additional discussions of the facility operational history are presented in the Preliminary Assessment (PA) and Site Inspection (SI) documents (Plexus, 2000 and 2001).

2.2.2 Shelby Horizons AOC

According to documentation presented in the September 2000 PA Report (Plexus, 2000), a local resident reported in interviews that as a young boy, he and others used metal detectors in the fields approximately 100 yards west of Building 31 of the former Wilkins AFS (area in the western portion of the current Shelby Horizons property), uncovering various medals dating to World War II, what appeared to be small vials of mercury on several occasions, and what he believed to be full 55-gallon drums on one occasion in a 2- to 3-foot excavation. He did not know how many drums existed or what they contained. In 1999, to verify these claims, USACE conducted a site visit. No visible evidence of burial was observed on the ground surface; however, medals have been found on the ground surface during subsequent site visits (USACE, 2000). The Ohio Environmental Protection Agency (Ohio EPA) conducted a site visit in June 2000 and observed numerous ampoules of possible medical materials in the drainage ditch on the south side of the site (Nabors, 2000).

Based on subsequent interviews conducted in 2000, a former depot/GSA employee indicated that a disposal area was located near the perimeter patrol road. The area consisted of trenches about 12 feet wide, 4 to 5 feet deep, and about 40 feet long. Waste placed in the trenches consisted of rubbish from former Wilkins AFS operations that was crushed with a bulldozer before being covered with soil (Plexus, 2000). The former depot employee also reported that waste was burned in this location for several years. The employee was not aware of any hazardous material being disposed of in this area (Viers, 2000). Based on disposal practices described in Army manuals (TM 5-634, 1946 and 1958), the waste disposed at the Shelby Horizons AOC is assumed to be primarily solid waste.

A detailed review of property-wide aerial photos taken between 1950 and 1995 is included in the PA (Plexus, 2000). The photos indicate ground disturbance in the AOC area in 1958 and trenching in 1959. Plexus determined that widespread scarring in photographs from 1959 was probably to improve drainage conditions and reported that “no evidence of disposal activity is observed." A photograph from 1964 appeared to show the area had been capped with" truck-sized loads of light-toned material" (Plexus, 2000).

2.3 Site Characteristics

The following is a summary of the site characteristics, including geology, hydrogeology, and soils that were presented in the Remedial Investigation (RI) Report (CH2M HILL, 2011) and information from additional site activities in 2012 subsequent to completion of the RI Report. The conceptual site setting figure that was developed for the RI to present generalized concepts for site geologic and hydrogeologic conditions is provided as Figure 2-3. Details on regional geology and hydrology, as well as meteorology, can be found in the RI Report.

2.3.1 Geology

The bedrock in the area of the former Wilkins AFS is the Pleasant Valley Member of the Mississippian Cuyahoga Formation (Totten, 1973; Ohio Division of Geological Society [ODGS], 1995), a thin-bedded gray siltstone and shale. Though the Pleasant Valley Member is the uppermost bedrock over most of the northern half of Richland County, surface exposures are rare because of the covering of glacial drift. Bedrock elevation in the area is approximately 1,000 feet amsl, and bedrock is generally overlain by between 75 and 85 feet of glacial drift.

The site soils are designated as Bennington-Cardington-Cengerburg (Totten, 1973). Native soils encountered at the former Wilkins AFS consist primarily of fine-grained lacustrine silts and clays with some sands and gravels. These materials originated from deposits laid down in glacial Lake Shelby (Plexus, 2006; Totten, 1973). Glacial moraines of the Wisconsinian glaciation occur north of, south of, and within the Lake Shelby deposits.

Soil boring logs from the RI well installation drilling efforts at the AOC indicate that soils are mostly silty clays, with some sand, sand and gravel, and sandy clay deposits to depths of up to 26 feet. Bedrock was not encountered during drilling at the site.

2.3.2 Hydrogeology

The Shelby Horizons AOC is in an area that yields of 3 to 10 gallons of water per minute and may be developed from relatively shallow wells drilled into fine-grained glacial deposits. The shallow aquifer under the Shelby Horizons AOC would not be a viable source for groundwater, potable or non-potable use, due to the low yield of 3 to 10 gallons per minute. However, within the City of Shelby and to the south, shallow sand and gravel deposits may potentially yield up to 100 gallons of water per minute from larger-diameter wells (Ohio Department of Natural Resources [ODNR], 1979, rev. 1994).

In the saturated unconsolidated soils, groundwater flows generally to the north and east toward the Black Fork Mohican River, which ultimately flows to the Charles Mill Lake. However, shallow groundwater flow is affected on a local scale by topography and surface water features, so local groundwater flow directions can vary from regional patterns. Groundwater flow in bedrock in the northern part of Richland County near the former Wilkins AFS also is primarily to the north and east.

Three groundwater monitoring wells exist in the vicinity of the Shelby Horizons AOC (Figure 2-4). Groundwater depths in the three Shelby Horizons monitoring wells are generally less than 10 feet below ground surface (bgs) at elevations ranging from 1,067 feet to 1,078 feet amsl.

The interpretation of groundwater flow at the AOC is based on a limited dataset of three data points; thus, potentiometric contours in the Shelby Horizons AOC area are straight lines based on triangulation of data from these wells, and can only provide an approximate indication of shallow groundwater flow in the area of the AOC. Based on the data, shallow groundwater flows generally to the west at the Shelby Horizons AOC (Figure 2-5).

2.4 Previous Investigations

As noted, the Shelby Horizons AOC was identified during the PA conducted in September 2000 by Plexus (Plexus, 2000). Since the PA, the following investigations have been conducted at Shelby Horizons AOC:

- *Site Inspection, Pioneer and Shelby AOCs* (Plexus, 2001), conducted in 2000
- *Shelby Horizons Remedial Investigation* (CH2M HILL, 2011), conducted in 2008 to 2009
- FS data gap investigation, conducted in July 2012

The buried debris/waste materials disposed at the Shelby Horizons AOC were assumed to be primarily solid waste based on disposal practices described in Army manuals (TM 5-634, 1946 and 1958) for the period. However, characterization of a heterogeneous waste and confirmation that no CERCLA hazardous materials or hazardous substances from various depot support activities were disposed of at the AOC were not practical due to cost and safety concerns. Therefore, the SI and RI were focused on addressing potential migration of contaminants beyond the limits of the buried debris/waste. A summary of the findings for the previous investigations (2000 through 2009) and details associated with the 2012 investigation are presented in the following sections.

2.4.1 Findings of the Preliminary Assessment

The PA included review of available file information, collection and analysis of historical aerial photographs, interviews with former employees, a comprehensive target survey, and a site reconnaissance. The Shelby Horizons AOC was identified as a possible disposal area.

2.4.2 Findings of the Site Inspection

As part of the SI, a geophysical survey was performed to identify the areas of disturbed soil. The geophysical survey identified two anomalies as possible disposal areas within the Shelby Horizons property (Figure 2-6). The “larger anomaly” is approximately 22,000 square feet (ft^2) in area and the “smaller anomaly” located immediately north of the larger anomaly, is approximately 1,350 ft^2. The results of the geophysical survey were used to define the boundaries of the Shelby Horizons AOC.

Soil sampling and mercury vapor measurements in surface soil were collected within or in the vicinity of the larger anomaly; no samples were collected within or near the smaller anomaly. Two surface soil samples and five subsurface samples were collected from within the footprint of the larger anomaly. Surface soil samples SS-09 and SS-10 were collected from depths of 0.3 to 0.8 foot bgs and 0 to 0.5 foot bgs, respectively. Subsurface samples included: SB-09 collected from 2 to 3 feet bgs; SB-10 collected from 2 to 3 feet bgs; SB-11 collected from 2 to 4 feet bgs; SB-12 collected from 2 to 4 feet bgs; and, SB-13 collected from 2 to 3 feet bgs. The sampling locations are shown on Figure 2-7. Soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and target analyte list (TAL) metals. The results of the laboratory analysis are summarized as follows:

- All surface and subsurface samples contained arsenic at concentrations exceeding the USEPA Region 9 preliminary remediation goal (PRG) for industrial soil (hereafter referred to as industrial PRG).
- The two surface samples also contained benzo(a)pyrene above the industrial PRG (SS-09 and SS-10).
- The subsurface sample from SB-09 also contained benzo(a)pyrene, benzo(b)fluoranthracene, dibenz(a,h)anthracene, and lead above the industrial PRGs.

Two surface soil (0 to 0.8 foot bgs) (SS-15 and SS-16) were collected outside the footprint of the buried debris/waste: SS-15 was collected from a location immediately northwest of the larger anomaly; and, SS-16 was obtained to the east. No subsurface soil samples were collected outside the footprint of the buried debris/waste. Both the surface samples contained arsenic at concentrations exceeding the industrial PRG.

It was concluded in the SI that arsenic concentrations may reflect natural levels present in soils of Ohio, disposal activities in the area, or a combination of the two, and the PAHs detected may be related to oiling of roads, fly ash disposal or use on roads, disposal of oily waste, or runoff from vehicle parking.

A soil mercury vapor survey was conducted in the area where numerous vials, with an appearance similar to inoculation vials, were observed by Ohio EPA in June 2000 in the drainage ditch on the south side of the large anomaly (Nabors, 2000). Soil vapor 6 inches below the surface was measured at 26 points (Figure 2-8) using a Jerome 431 mercury vapor meter. The extent of mercury vapor detections was delineated as an area less than 800 ft^2 near the southern portion of the large anomaly immediately south of the drainage ditch.

In light of the PA and SI findings, it was determined that an evaluation of the nature and extent of site-related constituents in soil and groundwater, and the preparation of a human health risk assessment (HHRA) and ERA, were necessary to support a decision regarding the need for further action, if any, at the site. Therefore, an RI was conducted at the Shelby Horizons AOC.

2.4.3 Findings of the Remedial Investigation

The RI activities included installing three groundwater monitoring wells beyond limits of waste, sampling groundwater quarterly for 1 year, and collecting and analyzing 15 surface soil samples and 8 drainage ditch surface soil samples. The locations sampled during the RI are shown on Figure 2-7.

Soil and groundwater samples were analyzed for VOCs, SVOCs, PAHs, and metals. In surface soil, one PAHs (benzo[a]pyrene) was detected above the December 2009 USEPA

Industrial Regional Screening Levels (RSLs) in two sampling locations within the footprint of the large anomaly and one location within the footprint of the small anomaly. Arsenic was detected in all 23 surface soil samples collected within and outside of the AOC at concentrations above the industrial RSLs. It was concluded in the RI that arsenic concentrations detected soil in and around the AOC may be naturally occurring since similar levels were detected in Ohio background soils (Ohio EPA, 2009) and at the Wilkins AFS background sampling locations.

In groundwater, two metals (arsenic and antimony) were detected above Maximum Contaminant Levels (MCLs), which were used as the primary screening levels for groundwater contamination. Although antimony was detected above background levels, it was concluded in the RI that given antimony was only detected once out of four events, the presence above the screening level is likely an isolated occurrence. Since arsenic occurs naturally in soil in Ohio and was detected in background wells, it is possible that arsenic in groundwater is naturally occurring.

A soil gas survey in the upper 2 feet of soil at the Shelby Horizons AOC was also conducted along the property fence line north, west, and south of the anomalies. Using field instruments, methane was not detected at the property edge; however, methane was detected in the casings of two site monitoring wells (MW-11 and MW-13) during two groundwater monitoring events (Figure 2-9).

The RI presented an evaluation of the nature and extent of site-related constituents, a baseline HHRA, and a screening-level ERA. The RI results related to the nature and extent of contamination and migration pathways are further discussed in Section 2.5. A summary of the baseline risk assessments is presented in Section 2.6.

The RI concluded that there was no unacceptable risks associated with exposure to surface soils over the waste. In addition, no unacceptable risks were identified with exposure to surface soils outside the fill material. Since the waste was not sampled during the SI or RI, the risk assessment does not address any potential risks associated with direct contact with the waste. Groundwater was determined to be an incomplete exposure pathway since the Shelby Horizons property and surrounding area are connected to the City water supply. In addition, the fine-grained glacial deposits that make up the shallow aquifer at Shelby Horizons AOC would not be a suitable source of potable or non-potable water due to low yield of only 3 to 10 gallons per minute. For future construction worker exposure to shallow groundwater beyond the limits of the fill, no unacceptable risks were identified. However, the RI recommended further investigation of the methane gas and the mercury vapor measured in the southern area of the AOC during the SI.

2.4.4 Feasibility Study Data Gap Investigation

Investigation activities were conducted in July 2012 to collect data needed to support completion of the FS. The activities consisted of obtaining methane and mercury vapor field measurements and samples for laboratory analysis and test pitting/trenching to assess the volume of the buried debris. Vapor sampling activities were performed accordance with the *Final Quality Assurance Project Plan (QAPP), Methane and Mercury Vapor Investigation at the Shelby Horizons Area of Concern, Former Wilkins Air Force Station, Shelby Ohio* (herein referred to as the "QAPP") (CH2M HILL, 2012a). Test pitting/trenching activities were conducted in accordance with *Final Work Plan for Test Pitting/Trenching at Pioneer and Shelby Horizons*

AOCs, Former Wilkins Air Force Station, FUDS Site Number: G05OH0972 (herein referred to as "Work Plan") (CH2M HILL, 2012b). Each of these field activities are discussed in the following subsections.

2.4.4.1 Methane and Mercury Vapor Investigation

Methane and mercury vapor investigation activities were conducted between July 9, 2012, and July 14, 2012. The planned activities included the following:

- Installing vapor probes to investigate methane inside the AOC boundaries and to investigate mercury vapor in and around the historic mercury vapor detection area
- Obtaining field measurements of methane and mercury from vapor probes
- Collecting an ambient air sample for laboratory analysis of mercury
- Obtaining field measurements of methane from the vapor inside the well casings of the three monitoring wells on the Shelby property
- Collecting vapor samples from selected vapor probes for laboratory analysis of methane (including fixed gases, total reduced sulfur, hydrocarbons, and isotope samples to aid in evaluation of the source of the methane) and/or mercury
- Collecting vapor samples from inside the well casings for laboratory analysis of methane (including fixed gases, total reduced sulfur, hydrocarbons, and isotope samples to aid in evaluation of the source of the methane)
- Collecting groundwater samples from the monitoring wells for laboratory analysis of dissolved methane and carbon dioxide

Table 2-1 summarizes the planned sampling activities and notes deviations from the plans due to field conditions. Details regarding the vapor probe installation and sampling and the groundwater sampling field activities are discussed in the following sections. A photo log of the vapor investigation activities is included in Appendix A.

Vapor Probe Installation. A direct-push rig was used to advance borings at 13 planned locations. Initially, exploratory borings were advanced to 8 feet bgs at each probe location to log the soils and AOC debris, determine depth to groundwater, and determine vapor probe placement. Adjacent to the exploratory boring, a second boring was drilled to install the vapor probes. Soil and debris recovered in plastic sampling core sleeves were logged in accordance with the United States Geological Survey (USGS) at each boring location. Appendix A contains the boring logs.

In accordance with the QAPP (CH2M HILL, 2012a), the vapor probes were planned to be set within the fill at depths greater than 5 feet and above the area water table and capillary fringe. However, perched water was encountered inside the AOC material at depths of 3 to 5 feet bgs, and the vapor probes were installed shallower than planned (installed depths ranged from 2 to 4.5 feet bgs).

Two of the six planned methane probes were not installed. The planned location VP-M1 (in the smaller anomaly) was not installed because AOC debris or fill materials were not encountered. Two attempts were made in at this location to find debris or fill materials;

however, only native clay was encountered. Planned location VP-M3 in the northern portion of the large anomaly was not installed because location VP-M2 had already been moved south to be installed inside AOC materials; therefore, location VP-M2, which is adjacent to location VP-M3, is representative of this area.

In total, 11 of the 13 planned vapor probes were installed as follows:

- Four down the center of the AOC for obtaining methane samples (VP-M locations)
- Three at the southern end inside the AOC and surrounding the historic mercury detection area to allow for collection of both methane and mercury samples (VP-MHD locations)
- Four for collection of mercury samples inside and adjacent to the historic mercury detection area (VP-HD locations)

Figure 2-10 shows the locations where vapor probes were installed. Vapor probe depths and locations where samples were collected are summarized in Table 2-2. Table 2-3 presents the field readings collected at the vapor probes and groundwater monitoring wells. Sample collection procedures and field measurements are discussed as follows, including vapor sample collection at groundwater monitoring wells.

Methane Sampling and Analysis

Vapor Probes. Once the vapor probes were installed, a round of field measurements was collected with a GEM 2000 landfill gas meter to determine levels of methane, carbon dioxide, and oxygen at all 11 probes. These readings were collected by connecting the GEM 2000 meter directly to the vapor probe sample tubing and pulling vapors through the field instrument until readings stabilized.

The following are noted in Table 2-3:

- Field readings could not be collected from location VP-M2 because the probe was set at 3 feet bgs and perched water inside the fill was wicked up, causing water rather than air to be pulled through the tubing.
- Methane was detected in only two of the seven vapor probe sampling locations. Methane was detected at 0.6 and 0.1 percent at locations VP-M4 and VP-M5, respectively.
- Methane was also detected at one of the four planned mercury vapor locations (VP-HD2) at 1.2 percent. However, shortly into collecting the readings and before stabilization, vapors could no longer be pulled through the probe due to a blockage/seal of the probe screen.
- Measured levels of carbon dioxide ranged from 0.0 percent to a high of 10.4 percent at location VP-M6.
- Oxygen ranged from 2.4 percent at VP-HD2 to 17.4 percent at VP-HD3.

Even though none of the seven probes planned for methane sample collection had methane readings above 5 percent, samples were collected from two vapor probes for laboratory analysis (VP-M4 and VP-M6; locations with highest methane and carbon dioxide field readings, respectively) to evaluate the potential source of methane.

In accordance with the QAPP, a helium leak check was performed on the probes selected for sample collection. The two probes passed the helium leak check. The tedlar bag filled from the probe during the leak check was then attached to the GEM 2000 and a MultiRAE to collect pre-sampling field readings from the purged vapor point. Table 2-3 presents the pre-sampling field methane, carbon dioxide, oxygen, and total VOCs readings recorded.

The samples for fixed gases and total reduced sulfur were then collected via vacuum pump, lung box, and collected in tedlar bags. Isotope samples were then collected directly from the probe tubing via Cali-bond bags and a puffer tool. Samples were packed in either boxes or coolers and shipped to the laboratories for analysis of fixed gases, including methane and carbon dioxide, total reduced sulfur compounds, hydrocarbons (C_1 to C_6), stable isotopes of carbon-13 (^{13}C) and hydrogen-2 (D), and carbon-14 (^{14}C). The laboratory data reports for the vapor probe samples are provided in Appendix A. The laboratory data were verified in accordance with the QAPP and the data quality evaluation report is provided in Appendix A.

Vapor samples for tritium analysis were planned to be collected from probes in the AOC. However, methane concentrations at the probe locations were not at concentrations high enough to reasonably obtain samples for tritium analysis. In addition, only one vapor probe (VP-M4), rather than the two planned, was analyzed for total reduced sulfur) due to the low methane levels detected inside the AOC.

Monitoring Wells. A round of initial methane, carbon dioxide, and oxygen readings were obtained from the air in the casings in groundwater monitoring wells MW-11, MW-12, and MW-13 using the GEM 2000 meter. Readings were collected after J-plugs with vapor sampling ports were installed and the air within the casing was allowed to equilibrate for several hours. At each well, the vapor sampling port was attached to the GEM 2000 and initial readings were recorded and then allowed to stabilize. The final readings of methane, carbon dioxide, and oxygen were then recorded.

The field readings are presented in Table 2-3. Methane was not detected at well MW-12. Methane was detected in wells MW-11 and MW-13 (92.8 and 42.9 percent, respectively; refer to Figure 2-9 for well locations). These readings are consistent with the 2009 field readings collected from the wells during the RI sampling (CH2M HILL, 2011).

Air/vapor samples were collected from within the well casings at MW-11 and MW-13 to confirm the presence of methane in the well casings and evaluate the potential source of the methane. Prior to sample collection, the vapor in the well casings was allowed to stabilize for 2 days with the well cap closed. Samples for fixed gases and total reduced sulfur were then collected via vacuum pump, lung box, and collected in tedlar bags. Isotope samples were then collected directly from the probe tubing via Cali-bond bags and a puffer tool. The samples were packed in either boxes or coolers and shipped to the laboratories for analysis of fixed gases, including methane and carbon dioxide, total reduced sulfur compounds, hydrocarbons (C_1 to C_6), stable isotopes of ^{13}C and D, and ^{14}C. The laboratory data reports for the vapor probe samples are provided in Appendix A. The laboratory data were verified in accordance with the QAPP and the Data Quality Evaluation Report is provided in Appendix A.

As previously noted, vapor samples for tritium analysis were planned to be collected from probes in the AOC and from the groundwater monitoring wells for comparison. Since AOC vapor locations did not have high enough concentrations of methane to analyze for tritium, vapor samples collected from the monitoring well were not analyzed for tritium.

Groundwater samples were collected from monitoring wells MW-11, MW-12, and MW-13. The wells were purged and sampled using the low-flow groundwater sampling technique as described in the QAPP. Groundwater samples were collected once the water quality parameters stabilized.

Water quality parameters (pH, specific conductance, turbidity, dissolved oxygen [DO], oxidation-reduction potential [ORP], and temperature), water levels, purge rate, and purge volume were recorded on field logs. Final field water quality parameter readings and the purge logs are presented in Appendix A.

Groundwater samples were packed on ice and shipped to the laboratory for dissolved methane and carbon dioxide analyses. The laboratory data reports for the groundwater samples are provided in Appendix A. The laboratory data were verified in accordance with the QAPP and the Data Quality Evaluation Report is provided in Appendix A.

Mercury Sampling and Analysis. Mercury vapor sampling was conducted to confirm the mercury vapor detections reported in the SI. Prior to mercury vapor sample collection, a helium leak check was performed in accordance with the QAPP. One probe failed the helium leak check and could not be sampled (VP-MHD3). Another probe had to be abandoned during the purge process (VP-HD2) because of negative pressure while purging. The soil logs indicate the subsurface material at this location was clay, which is likely the reason it was difficult to pull and collect soil vapor.

The five remaining mercury probes were purged at a rate of 200 milliliters per minute and field readings were obtained from the tedlar bag used to perform the helium leak check. Table 2-3 summarizes these purged field measurements. The field measurements indicate the following:

- Mercury vapor was detected at all locations except VP-MHD1; field-detected concentrations ranged from 0.01 to 0.019 microgram per cubic meter (μg/m^3).
- Mercury vapor was not detected in the ambient air from the work area (monitored for mercury vapor the day of the sample collection using the Jerome 431 mercury meter).

Mercury vapor samples were collected from five probe locations (VP-MHD1, -MHD2, -HD1, -HD3, and -HD4) and the ambient air. The ambient air laboratory sample was collected on the Shelby Horizons property, approximately 350 feet southeast of the AOC. Samples collected via mercury sorbent tubes and vacuum pump. Flow rates were maintained using a flow calibrator at a rate of 200 milliliters per minute. Sample tubes were put on frozen ice packs, packed, and shipped to the laboratory for mercury analysis. The laboratory data reports for the mercury vapor samples are provided in Appendix A. The laboratory data were verified in accordance with the QAPP and the Data Quality Evaluation Report is provided in Appendix A.

Methane Sample Laboratory Results. As discussed previously, methane vapor samples were collected from inside the casings of two groundwater monitoring wells (MW-11 and MW-13) and from two shallow vapor probes (VP-M4 and VP-M6, located within the AOC) to evaluate the potential source of the methane. Methane gas can be generated by a number of sources, such as bacterial decomposition from landfills, swamps, and buried peats and soils, or thermal decomposition of buried coals and shales.

Landfill gas is produced by bacterial decomposition, which occurs when organic waste (for example, food, textiles, wood, and paper) is broken down by under anaerobic conditions by bacteria naturally occurring in the subsurface. During the later stages of anaerobic degradation, when methanogenesis is prominent, both the composition and production rates of landfill gas begin to stabilize near 45 to 60 percent methane by volume, 40 to 60 percent carbon dioxide, and 2 to 9 percent other gases, such as nitrogen, oxygen, carbon monoxide, hydrogen, and sulfides (Agency for Toxic substances and Disease Registry [ATSDR], 2001). Peak gas production from landfills usually occurs from 5 to 7 years after the waste has been buried (Crawford and Smith, 1985). Since the disposal of FUDS-related materials in the AOCs occurred in the 1950s and early 1960s (Plexus, 2000) over 50 years ago, any methane generation by the FUDS debris would presumably be the result of methanogenetic processes. The fixed gas laboratory results from the two methane probes installed inside the AOC indicate relatively low to non-detectable levels of methane and levels of carbon dioxide less than 0.5 percent (Table 2-4a).

The fixed gas laboratory results for vapor samples from MW-11 and MW-13 did show levels of methane above 90 percent and low levels of carbon dioxide (less than 0.5 percent) (Table 2-4a). The laboratory results of dissolved methane concentrations in the groundwater samples showed dissolved methane present, with levels of methane at well MW-11 near the solubility of methane (between 28,000 and 30,000 micrograms per liter [µg/L]) (Table 2-4b). The levels of methane detected in the groundwater and well casings indicate that methane is present in the water-bearing zone screened by the monitoring wells, which are screened approximately 14 to 24 feet bgs. The fixed gas methane and carbon dioxide data suggest that the methane is not from methanogenetic processes associated with debris in the AOC.

Columbia Gas Transmission Facility in Mansfield, Ohio, supplies gas to the companies now operating at the former Wilkins AFS, including the buildings at the Shelby Horizons property. Levels of carbon dioxide, total reduced sulfur (specifically mercaptans), and hydrocarbons C_1 to C_4 can be used to help identify whether the source of methane found in the monitoring wells is from a natural gas pipeline. Natural gas supplied for fuel contains mostly methane and ethane, but does contain low levels of carbon dioxide and low levels of the higher molecular weight hydrocarbons (C_3 to C_6).

Gas companies also seed the gas supply with mercaptans, which are sulfur-containing organic compounds added to assist with detecting pipeline leaks. Table 2-5a shows approximate levels of mercaptans seeded in the local gas supply.

The laboratory results from the vapor sample analysis for hydrocarbons and detected total reduced sulfur compounds (mercaptans) are presented in Tables 2-6 and 2-5b, respectively. Although methane was detected at high concentrations in the vapor samples from the groundwater monitoring wells, only trace amounts of ethane (C_2) were detected. Levels of carbon dioxide and the higher molecular weight hydrocarbons (C_3 to C_6) were either not detected or detected at low concentrations (less than 0.5 percent) (Table 2-6). Mercaptans were not detected in any of the vapor samples. However, hydrogen sulfide was detected in the vapor samples from the monitoring wells only, indicating naturally reducing conditions are present at the monitoring wells. The presence of naturally reducing conditions in the groundwater at these two wells is supported by the groundwater field parameters collected from these wells during the monitoring well sampling in July 2012 (DO concentrations less than 0.8 milligram per liter and negative ORPs near -185 millivolts) (Table 2-6). Overall, the hydrocarbon data and the lack of mercaptans suggest that the source of the methane in the monitoring wells at Shelby Horizons property is not from a natural gas pipeline.

The isotope analysis was performed on the vapor samples from the two monitoring wells and two vapor probes to distinguish if the source of methane is from a biogenic or thermogenic source. Biogenic gas is produced by the microbial decomposition of organic material (such as landfills, wetlands, swamps, and glacial sediments with an organic-rich composition). Biogenic gas from landfills, swamps, and wetlands are composed primarily of methane and carbon dioxide, sometimes at near equal amounts (Coleman et al., 1995). Biogenic gases generally have delta (δ) ^{13}C concentrations ranging from -50 to -90 (Hackley et al., 1996). Thermogenic gas is a naturally occurring source of methane. This gas is produced by thermal decomposition of organic material through high temperatures and pressures. This process occurs in deep burials over millions of years, typically associated with gas and coal deposits. Most commercial natural gas deposits are mined from these thermogenic sources. Thermogenic gas generally contains less than 0.1 percent carbon dioxide and has δ ^{13}C concentrations ranging from -25 to -60 (Coleman, et al., 1995; Hackley et al., 1996).

Analysis of the ^{13}C and D of methane are used to evaluate the path by which the gas formed. Plotting the δ D relative to the δ ^{13}C shows the typical isotopic composition ranges for microbial near surface (landfill, swamps, marshes), microbial deep surface (drift gas), and thermogenic origins (Schoell, 1980). Figure 2-11 shows the general ranges for the gas origins and plots the isotopic methane results from the two monitoring wells and AOC vapor probe location VP-M4. The samples from Shelby Horizons AOC plot between thermogenic and near-surface biogenic.

Thermogenic gas from low-maturity source rocks, such as the Devonian and Mississippian source rocks in Richland County, Ohio, can have a more-negative stable isotopic composition than the typical range for thermogenic gas, and plot into the near-surface biogenic range (Laughery and Baldassare, 1998). Methane $\delta^{13}C$ ratios of -54 percent were measured from Devonian shale gas in central Ohio (Claypool et al., 1978). The δ ^{13}C concentrations of the methane from the vapor samples from the groundwater wells and vapor probe VP-M4 were approximately -54 and -52, respectively. Figure 2-11 shows a dashed line extending from the typical thermogenic range to include gas produced from low-maturity source rocks. The Shelby Horizons samples plot within the range of low-maturity source rock methane, indicating that the methane detected at Shelby is from a low-maturity thermogenic source.

^{14}C analysis is used to distinguish between thermogenic and biogenic sources. Levels of ^{14}C spiked in the 1950s and 1960s due to the atmospheric testing of thermonuclear devices. Organic material growing at that time would have elevated ^{14}C concentrations. Therefore, gases produced from recently buried refuse buried since the 50s would have enriched ^{14}C content, typically between 110 to 150 percent modern carbon (pMC). Since the organic material from which thermogenic gas or deeper subsurface biogenic is produced comes from the remains of plants and animals that lived millions of years ago, thermogenic or subsurface biogenic methane has no remaining ^{14}C activity (Hackley et al., 1996).

As indicated in Table 2-7, the ^{14}C levels from methane in the vapor samples from Shelby Horizons had very low or no detections of pMC indicating that the methane found in the vapor from the groundwater wells and AOC vapor probes is from an old source. The ^{14}C level from carbon dioxide in vapor sample VP-M6 has high pMC, indicating the carbon dioxide detected in the vapor probe was from a modern source, likely from the respiration of plants. Overall, the ^{14}C of methane has a low pMC showing that the methane from the groundwater wells and AOC vapor probes is from a thermogenic source.

The analyses performed on the methane samples indicate the following conclusions regarding the origin of the methane:

- Low to non-detect levels of methane found in the AOC materials indicates the AOC is not the source.
- High concentrations of methane found in the groundwater and groundwater well casings indicate that methane is present in water bearing zone.
- Landfill gas typically contains 40 to 60 percent carbon dioxide and 2 to 9 percent other gases, such as nitrogen, oxygen, carbon monoxide, hydrogen, and sulfides (ATSDR, 2001). The low concentrations of carbon dioxide, oxygen, and nitrogen found in the groundwater well casings indicate the methane is not landfill gas.
- The lack of mercaptans in the methane indicates the methane is not leaking from a natural gas pipeline.
- The methane ^{13}C and D analyses suggest that the methane originated from low-maturity hydrocarbon source rocks that are present in northeast Ohio.
- The methane ^{14}C analyses indicate the methane has a thermogenic source, which support the low-maturity source rock origin of the methane indicated by the ^{13}C and D analyses.

Since the methane occurs in the monitoring wells (that is, the water-bearing zone beneath the AOC), and since the methane was either not detected or detected at low concentrations in the vapor probes set inside the AOC material, the methane appears to have migrated to the shallow subsurface from deeper hydrocarbon source rocks and is not related to the AOC or previous DoD activities.

2.4.4.2 Mercury Investigation Results

Mercury vapor was detected using field instrumentation at all vapor probe locations except VP-MHD1; detected concentrations ranged from 0.01 to 0.019 $\mu g/m^3$. The ambient air (monitored for mercury vapor the day of the sample collection using the Jerome 431 mercury meter) did not detect mercury vapor in the ambient air.

Samples for laboratory analysis were collected during the FS data gap investigation to assess risks posed by any mercury detected in vapor at the AOC. Potential risks were evaluated by comparing mercury vapor laboratory results to ambient air and hypothetical indoor air risk-based screening levels.

Table 2-8 presents the validated analytical results. Because the laboratory results were provided in nanograms per sample, the results were converted to $\mu g/m^3$ by dividing by the total volume of air sampled. The total volume of air sampled was derived from the field sampling flow rates and times. The laboratory data report is provided in Appendix A.

The laboratory data were validated in accordance with the QAPP and the Data Quality Evaluation Report is provided in Appendix A. The pre-validated laboratory results indicate the presence of mercury in all samples (except ambient air), including the trip blank where mercury vapor was detected at a concentration of 0.103 $\mu g/m^3$. The detection of mercury in the trip blank was near the reporting limit for this method. As this is an extremely sensitive method with low detection limits, minute levels of mercury from background contamination, such as particles of dust, can be detected. The trip blank may have become contaminated when the tube was opened briefly in the field per the QAPP. However, mercury vapor was not detected in the sample collected from the ambient air (collected using a vacuum pump). Sample results from the vapor probes were flagged as non-detect due to the presence of mercury in the trip blank (refer to Data Quality Evaluation Report in Appendix A for additional information). The validated laboratory results for mercury vapor are presented in Table 2-8.

A conservative approach was taken with respect to risk screening and all of the data results (detected or validated non-detect) were compared against the RSLs for ambient air (Table 2-9). This comparison shows that all data (detected or validated non-detect) are below both the industrial (1.3 milligrams per cubic meter [mg/m^3]) and the residential (0.31 $\mu g/m^3$) RSLs. Details of the risk screening conducted are discussed in Section 2.6.1.

2.4.4.3 Test Pitting/Trenching Field Activities

Test pitting/trenching activities occurred on July 16 and 17, 2012. In accordance with the Work Plan, test pits were excavated to native material, the depth of the water table, or until the limits of the excavating equipment, whichever was shallower. No test pit/trench was excavated deeper than 10 feet bgs. Materials in and excavated from the test pits/trenches were described in accordance with the Work Plan (CH2M HILL, 2012b). Appendix B contains photographs from test pitting/trenching activities and the test pit logs.

Test pit/trench depths, lengths, and widths were measured using a tape measure and walking wheel, respectively. Excavated materials containing debris or materials otherwise suspected to be waste were placed on plastic sheeting; plastic sheeting was not used for visually clean fill. Test pits/trenches were backfilled with the excavated material and compacted in 1- to 2-foot lifts with the excavator bucket and original overlying soil replaced before the end of each work day.

Test pits/trenches were planned as follows:

- **Initial Shallow Locations.** Focused on potential individual disposal areas as indicated by the geophysical survey results. The objectives were to provide initial understanding and coverage of subsurface conditions across the AOCs and to locate potential buried debris, which would then be further refined with supplemental locations.

- **Supplemental Locations.** These locations were to be selected based on the findings of the initial shallow locations.

Table 2-10 lists the depth intervals and waste types encountered at each test pit/trench location. Figure 2-12 shows the locations of the planned and completed test pits/trenches.

Seven test pits/trenches were excavated at the Shelby Horizons AOC. At initial test pits TP-1 and TP-2, visually clean fill and minor amounts of debris were observed in the upper portions of the excavations and native soil (lean clay) was observed below 1.5 feet. One strip of metal (approximately 1 foot wide by 6 feet long) was observed in the upper foot at TP-1. Trace amounts of glass, concrete, and metal mixed with soil were observed in the upper 1.5 feet at TP-2 and boring logs for the vapor probes completed the week before in that area indicated only the presence of trace debris (coal, metal, and glass) in this portion of the AOC. At TP-3, when black burnt debris was initially noted at the 2-foot depth, excavation was extended in depth to identify the vertical extent. Due to the observations in TP-3, initial planned test pits were excavated until native soil was identified (beyond the initial test pit depth of 2 feet bgs).

Debris/waste was encountered in TP-3 through TP-6. TP-6 was a supplemental location added to identify the north-south extent. Debris/waste encountered varied in depth from as shallow as 0.5 to 4 feet bgs. The bottom depth of the debris generally varied from 1 to 8 feet bgs. However, a pocket of debris was identified in TP-5 to extend at least to 10 feet bgs without the bottom being confirmed. No debris was encountered in TP-7, which was located in the area of the small anomaly. Only visually clean fill material in the upper 1 foot and native soil were observed at TP-7. Each test pit except TP-5 extended until native cohesive soils were encountered. The cohesive soils consisted of brown lean clay to sandy lean clay.

The findings of the test pitting/trenching efforts indicate that, in general, 1 to 2 feet of soil are present overlying the buried debris/waste materials. However, TP-6 had approximately 0.5 foot of soil cover. TP-6 is located in the main area where the stockpiled soil pile was removed prior to the data gap investigations and scraping of the ground surface may have locally removed some of the soil cover near this test pit. In the southern portion of the AOC, only trace amounts of glass, concrete, and metal mixed with soil were observed in the upper 1.5 feet of soil at TP-2 and from approximately 5 to 6 feet bgs (in soil core during vapor probe installation at VP-MHD3). Buried debris was identified in one location (TP-5) to extend to at least 10 feet bgs. Debris/waste encountered consisted of burnt materials containing ash, glass, metal, paper, partially burnt wood, and concrete. Discolored soils were also observed. Based upon these findings, only the northern portion of the AOC contains buried debris/waste materials. The extent and volume of buried debris/waste is further discussed in Section 3.1.

2.5 Nature and Extent of Contamination

This section summarizes the nature and extent of contamination using soil, groundwater, and vapor sample results collected during the SI, RI, and subsequent July 2012 FS data gap investigation. The RI Report evaluated the analytical results from both the SI and RI events;

therefore, further details on the SI and RI samples can be found in the RI Report (CH2M HILL, 2011).

2.5.1 Fill Material

- Waste material was disposed of at the AOC during the years of operation of the Wilkins AFS (1943 until 1961). The exact types and quantities are unknown.
- Test pitting was conducted in 2012 and the buried materials observed consisted of ash, glass, metal, partially burnt wood, paper, and concrete.
- The bulk of the debris was encountered in the northern two-thirds of the AOC geophysical footprint.
- The fill material is covered by 0.5 to 4 feet of soil material. The bottom depth of debris varied from 1 to 8 feet bgs. A pocket of debris was identified in TP-5 to extend at least to 10 feet bgs, without the bottom being identified.

2.5.2 Surface Soil and Subsurface Soil

During the SI, surface (0 to 0.8 foot bgs) and subsurface (2 to 4 feet bgs) soil sampling was conducted within the larger geophysical anomaly based on historical aerial photographs. During the RI, surface soil samples (0 to 0.5 foot bgs) were collected in and around both of the geophysical anomalies and the drainage ditch running through and adjacent to the larger anomaly. In addition, background surface soil samples were collected during the Pioneer AOC RI (Plexus, 2006) and were referenced during the RI to evaluate if concentrations may be naturally occurring or related to the AOC. Figure 2-7 shows the SI and RI soil sampling locations.

Soil samples were analyzed for VOCs, SVOCs, PAHs, and metals; in addition, SI samples were also analyzed for pesticides and PCBs. The SI and RI soil data were compared to the December 2009 USEPA industrial RSLs in the RI based on current and planned future land use and the tabulated analytical results are provided in the RI (CH2M HILL, 2011).

2.5.2.1 Surface Soil Results

- Surface soil samples were collected from locations within and outside the footprint of the larger and smaller anomalies.
- Arsenic was detected above the industrial soil RSL (1.6 milligrams per kilogram [mg/kg]) at all 23 RI soil sampling locations. Arsenic was the only metal detected above industrial soil RSLs. The highest concentration of arsenic detected in the surface soil was 17 mg/kg (SI-SS-16 located outside of the footprint of the large anomaly) and the average detected concentration for surface soil was 9.2 mg/kg. Ohio EPA guidance suggests that arsenic soil concentrations of 13 mg/kg or less may be naturally occurring (Ohio EPA, 2009). Arsenic detected in the Wilkins AFS background surface soil samples had an average concentration of 11.06 mg/kg, which is similar to the AOC soil arsenic concentrations suggesting that arsenic in the cover soil at the AOC may be naturally occurring.
- No mercury results exceeded the industrial RSL.

- Benzo(a)pyrene exceeded the industrial soil RSL of 0.21 mg/kg at five sampling locations within the footprint of the large and small anomalies (concentrations ranged from 0.22 to 0.62 mg/kg); PAHs were detected in the Wilkins AFS background surface soil samples; however, all detections were below industrial soil RSLs. The most-likely potential source(s) of PAHs in surface soil would be runoff from the site parking areas and occasional past use of the AOC for parking vehicles.
- SVOCs, VOCs, pesticides, or PCBs in the surface soil samples were either not detected or if detected did not exceed industrial soil RSLs.

2.5.2.2 Subsurface Soil

- All subsurface soil samples were collected within the footprint of the larger anomaly.
- All five subsurface samples contained arsenic at concentrations exceeded the industrial RSL of 1.6 mg/kg; sample concentrations ranged from 9.2 to 21.8 mg/kg.
- One subsurface soil sample (SI-SB-09) contained lead, mercury, and the PAHs benzo(a)pyrene, dibenz(a,h)anthracene, and benzo(b)fluoranthracene at concentrations that exceeded the industrial soil RSL.
- SVOCs, VOCs, pesticides, or PCBs in the subsurface soil samples were either not detected, or if detected, did not exceed industrial soil RSLs.

2.5.3 Groundwater

As part of the RI activities, three monitoring wells (MW-11, MW-12, and MW-13) were installed around the geophysical anomalies and sampled for four quarters between November 2008 and July 2009. Figure 2-7 shows the locations of the wells. Groundwater samples were analyzed for VOCs, SVOCs, PAHs, and metals. Groundwater results were compared to the USEPA MCL or, if no MCL existed, then the December 2009 tap water RSLs were used. Tabulated analytical results are provided in the RI (CH2M HILL, 2011).

- Dissolved levels of arsenic (MW-13) and antimony (in one of four sampling events [January 2009] for MW-12) were detected in excess of MCLs.
- Organic compounds detected in groundwater did not exceed screening levels.
- Dissolved methane was detected at wells MW-11 and MW-13, which are the same wells that had methane vapor detected in the well casings. The presence of dissolved methane indicates methane is present in the water-bearing zone. Levels of methane dissolved in groundwater were near the solubility for methane (28,000 to 30,000 μg/L) at well MW-11. As discussed in Section 2.4.4.1, the methane appears to have originated from a deep thermogenic source and is not related to any DoD activity at the AOC.

2.5.4 Methane Vapor

- Methane was not detected at along the north, west, and south fence line at the property edge in the upper 2 feet of soil.
- Methane was detected at low concentrations (below 1.5 percent) during field screenings and non-detect in laboratory analyses of the vapor probes installed inside the AOC. Methane has been detected in the casings of monitoring wells MW-11 and MW-13 at

concentrations of above 90 percent and dissolved in the groundwater (Tables 2-4a and 2-6b).

2.5.5 Mercury Vapor

- Mercury vapor was detected using a field meter during the SI in an area of approximately 800 ft^2 at the southern end of the AOC.
- Additional mercury vapor investigation work was completed in the summer of 2012 to verify the readings detected in 2000. Mercury vapor was detected during the field screen at all locations except VP-MHD1 at concentrations ranging from 0.01 to 0.019 $\mu g/m^3$. Mercury vapor was not detected in the ambient air.
- Although following data validation there was only one detection of mercury vapor (in the trip blank), a conservative approach was taken with respect to risk screening and the data results (detected or validated non-detect) were compared against the RSLs for ambient air (Table 2-9). This comparison shows that the data results (detected or validated non-detect) are all below either the industrial (1.3 $\mu g/m^3$) or the residential (0.31 $\mu g/m^3$) RSL.

2.5.6 Migration Pathways

As previously noted, the Shelby Horizons AOC is an open, relatively level area covered with grass or gravel, and adjacent areas have been used as a semi-tractor trailer parking area. Potential current receptors include industrial workers from nearby buildings and parking areas, and trespasser/visitors. A shallow ditch is present along the south and west sides of the site to facilitate drainage and rainwater runoff drains east toward the western end of the Shelby Horizons building. Potable water supplies for the Shelby Horizons facility and the surrounding area within city limits are provided by the Shelby Water Department.

The migration pathways for the contaminants at the site were identified in the RI-based review of the nature and extent and the physical properties of the detected constituents. Analytes that exceeded background concentrations and risk screening levels were identified as potential constituents of concern in evaluating the migration pathways. These constituents, metals and PAHs, are summarized in Section 2.5.

The following three primary mechanisms can transport these constituents at the Shelby AOC:

- Leaching into groundwater
- Surface runoff
- Wind erosion

Significant factors affecting the transport of metals and PAHs include their chemical and physical properties and that of the surrounding geology/environment. Metals and the high–molecular-weight PAHs have a strong affinity to remain bound to soil. They therefore are not generally mobile in the dissolved phase and migrate primarily by colloidal transport or while sorbed to particulates. These constituents are therefore expected to persist in the soil. The hydraulic conductivity of the site soils and parent geologic materials (sand strata within clayey glacial till) in the shallow subsurface beneath the AOC/buried debris would be expected to be low, possibly in the range of 10^{-6} to 10^{-4} centimeters per second (Fetter, 1994).

During precipitation events, surface runoff can occur and transport constituents in the soil to other areas. However, the AOC and immediate area are relatively level and heavily vegetated in most areas; therefore, runoff is expected to be limited.

Given the surface conditions (grass/gravel) at the AOC, it is unlikely wind erosion would be a significant transport mechanism.

2.6 Baseline Risk Assessment Summary

2.6.1 Human Health Risk Assessment

A HHRA for the Shelby AOC was conducted in 2011 by CH2M HILL as part of the RI. The HHRA evaluated potential exposures associated with soil for commercial/industrial and hypothetical residential land uses. Although not a realistic future use, a residential soil exposure scenario was evaluated in the HHRA as a worst-case scenario to provide upper-bound risk estimates. The risk assessment did not address potential risks associated with direct exposure to the buried debris/waste, which could not be characterized due to the heterogeneity and volume of the buried material. Because there is no current use of groundwater and no reasonably anticipated future uses of groundwater for potable use at the site, the groundwater exposure pathway outside the disposal area was concluded to be incomplete and was not addressed in the HHRA (CH2M HILL, 2011). In addition, the fine-grained glacial deposits that make up the shallow aquifer at Shelby Horizons AOC would not be a suitable source of potable or non-potable water due to low yield of only 3 to 10 gallons per minute. Since only low-level (less than 1 µg/L), single detection of VOCs was observed in groundwater samples, vapor intrusion (into current or future buildings) and inhalation of volatile emissions from groundwater were not considered to be potentially significant or complete exposure pathways.

Cumulative risk estimates were summed for each receptor scenario across the indicated exposure routes and a summary of the reasonable maximum exposure (RME) excess lifetime cancer risks (ELCRs) and non-cancer hazard indices (HIs) were presented in the 2011 HHRA and are presented in Table 2-10. A summary of this information is provided as follows in comparison to USEPA target levels for ELCR ($1x10^{-4}$) and HI (1):

- Current/Future Industrial Workers – Surface soil (ingestion, dermal contact, and inhalation of particulates)
  - ELCR and HI are within target levels.
- Current/Future Trespassers/Visitors (adult and youth) – Surface soil (ingestion, dermal contact, and inhalation of particulates)
  - ELCR and HI are within target levels.
- Future Residents (adult and child) – Surface and subsurface soil (ingestion, dermal contact, and inhalation of particulates)
  - ELCR is within the target level.

  - HI for adult residents is within the target level.
  - HI for child residents exceeds the target level due to cobalt.

- Future Construction Workers – Surface and subsurface soil (ingestion, dermal contact, and inhalation of particulates) and groundwater (dermal contact)
  - ELCR and HI are within target levels.

In summary, risk estimates for potential soil exposures by industrial workers, trespasser/visitors, and construction workers to surface soil and subsurface soil beyond the limits of waste are within USEPA acceptable levels. Although risk estimates for a residential land use scenario were provided to present an upper-bound estimate of potential risks associated with site exposures, future residential land use is unrealistic and therefore results for the other receptor populations represent reasonably foreseeable exposure scenarios for the site.

2.6.1.1 Risk-Based Screening – Mercury Vapor

The analytical data for mercury vapor collected in July 2012 were evaluated to determine if mercury in the subsurface has the potential to pose unacceptable risks from vapor intrusion into buildings and subsequent inhalation of indoor air by current/future industrial workers and hypothetical future residents. Risks were evaluated by comparing mercury vapor laboratory results to ambient air and indoor air risk-based screening levels; the USEPA's RSLs for air and the vapor intrusion screening levels (VISLs), respectively (USEPA, 2012a and 2012b). The screening comparison is provided in Table 2-9.

The residential and industrial RSLs and VISLs for elemental mercury (rather than mercury salts) were used in the screening step based on the assumption that mercury vapors, if present onsite, would be associated with elemental mercury.

The VISLs are the target sub-slab and exterior soil gas concentrations, obtained from the VISL Calculator, Version 2 (USEPA, 2012b) and were derived using the following equation:

$$C_{soil-gas} = \frac{C_{target,\, ia}}{AF_{ss}}$$

where:

Csoil-gas = Target soil gas concentration (µg/m^3)
Ctarget, ia = Target indoor air concentration (USEPA's RSL for air) (µg/m^3)
AFss = Attenuation factor (ratio of indoor air concentration to sub-slab or soil gas concentration; default value is 0.1)

The RSLs and VISLs are based on a hazard quotient (HQ) of 1. The HQ assumes that there is a level of exposure below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level exceeds this threshold, there is the potential for non-cancer health effects to occur (USEPA, 2012c).

Although the detections seen in the vapor probes were considered non-detect after validation due to blank contamination, the highest pre-validation detection was 0.144 µg/m^3, which is also below the RSL and VISL screening criteria (Table 2-9). Therefore, mercury in the subsurface is not expected to pose risks above USEPA target levels to current/future industrial workers and hypothetical future residents.

2.6.2 Ecological Risk Assessment

An ERA was conducted to support the RI (CH2M HILL, 2011). The ERA was performed to evaluate the actual or potential ecological effects from exposures to the site. The risk assessment did not address potential risks associated with direct exposure to the buried debris/waste, which could not be characterized due to the heterogeneity and volume of the buried material. The multi-pathway analysis performed was based on reasonable, protective assumptions about the potential for ecological receptors (lower-trophic [plants and invertebrates] and upper-trophic [birds and mammals] terrestrial and aquatic receptors) to be exposed to and be adversely affected by exposure to constituents of potential ecological concern (COEPCs) found in the site surface soil.

The upper-trophic receptors were selected as surrogate species representing estimated exposure and subsequently risk to other species within comparable feeding guilds. Key wildlife receptors include the deer mouse, American robin, mourning dove, short-tailed shrew, red-tailed hawk, and red fox.

Potential ecological risks were identified with respect to lower-trophic and upper-trophic terrestrial receptors within the site. Refinements to the ERA were then conducted in which COPECs were further evaluated with respect to uncertainties associated with screening thresholds and toxicity reference values.

Based on the results of the refinements to the COPECs identified within the site, it is unlikely that lower-trophic receptors are at risk. Potential ecological risks for upper-trophic receptors via exposure to thallium (all six receptors) may still be present. However, unacceptable risks to local populations of upper-trophic-level receptors are unlikely based on the assumption that all receptors spend 100 percent of their time at the site due to the small size of the AOC. The general home ranges of all the upper-level trophic-level receptors, except the deer mouse, are greater than the extent of the site. Predicted risks would be less than those based on the assumption that 100 percent of receptor time is spent on the site. The site would represent 100 percent of the home range for the deer mouse. However, the site would only support a small number of deer mice and would not pose an unacceptable threat to local populations of deer mice.

Based on the previously presented ERA and subsequent refinements, it was concluded that the site does not pose unacceptable risk to ecological receptors.

3 Remedial Action Objectives

3.1 Development of Remedial Action Objectives

The RI confirmed the presence and approximate limits of debris/waste buried at the Shelby Horizons AOC. The investigation also confirmed that there are no complete exposure pathways based on current land use (vacant land with soil cover over waste). However, a full characterization of chemicals of concern and identification of all potential risks associated with direct contact with buried debris/waste were not evaluated in the RI given the heterogeneity and volume of fill material. The following RAO was developed to provide a basis for evaluating remedial alternatives that would be protective of possible future receptors that might come in contact with the waste should land use change (removal of soil cover or excavation):

- Eliminate or reduce the potential risks to future receptors associated with direct contact with landfill contents

3.2 Areas and Volumes of Media of Concern

The limits of buried waste and debris materials in the AOC, as estimated from the geophysical investigations during the SI, were refined during the 2012 test pitting/trenching activities.

The test pitting/trenching efforts indicate that the buried debris/waste materials are primarily located in the northern half of the AOC in two separate areas (Figure 3-1). The test pitting/trenching in the southernmost anomaly at TP-1 and TP-2 indicated only trace amounts of debris (glass, concrete, and metal mixed with soil) in the upper 1.5 feet. (Figure 2-12). (During exploratory drilling in this area for vapor probe installation, trace amounts of debris were noted from approximately 5 to 6 feet bgs at one location.) The limits of excavation have been defined for the purpose of this FS to be the two areas in the northern portion of the AOC as shown on Figure 3-1. These two areas are estimated to total 7,200 ft^2 (0.17 acre).

Buried debris and waste materials were observed to extend to between 4 and 8 feet bgs in the middle of the AOC based upon test pitting/trenching activities. Water/saturated debris was observed in the excavations at approximately 4 to 5 feet bgs. (Groundwater was measured in the site wells outside of the fill to be at a depth of 7 to 8 feet bgs, suggesting that the water observed in the excavations is a perched water table).

The corresponding volume of buried debris/waste materials is estimated for this FS using the following equations:

Area (ft^2) × *Debris/Waste Thickness (feet) = Volume (cubic feet* [ft^3])

Area 1 (north): 3,200 ft^2 × 4 feet = 12,800 ft^3

Area 2 (middle of AOC): 4,000 ft^2 × 8 feet = 32,000 ft^3

Volume (ft^3)/27 (ft^3/cubic yard [yd^3]) = Volume (yd^3)

32,000 ft^3 + 12,800 ft^3 = 44,800 (ft^3)/27 (ft^3/ *yd^3*) = **1,660 yd^3**

The actual volume is likely to vary.

3.3 General Response Actions

General response actions (GRAs) are broad classes of responses, remedies, or technologies developed to meet the site-specific RAOs and are media specific. Although an action may be capable of meeting the objective for a given medium, combinations of actions may later prove to be more cost effective in meeting all the objectives for the site. To comply with the site-specific RAOs, the GRAs are normally combined to form site-wide remedial alternatives.

Based on the RAOs, the following GRAs have been identified for the Shelby Horizons AOC:

- Land Use Controls (LUCs)
- Containment
- Removal

The *LUCs* relate to legal or administrative tools taken to reduce the potential for exposure to site contaminants and/or control access to, and future use of, a site. LUCs include such activities as establishing an environmental covenant, applying restrictions to limit future uses of the property, or installing a security fence to limit access.

Containment response actions at landfills generally include actions that prevent the migration of and direct contact with waste materials, and include control and treatment of landfill gas, and control and treatment of leachate and contaminated groundwater migrating away from the landfill. These actions may include surface controls and capping. Surface controls include earth grading to control stormwater run-on/run-off and implementing measures to control erosion. Containment technologies may include placing low hydraulic conductivity materials above the buried debris and waste materials, placing a protective soil cover over the buried debris and waste materials, or providing for a composite cap of engineered materials to construct a liner of flexible membrane combined with a soil cover. As noted early, the buried debris/waste is contained, and therefore was not included as part of the evaluation of alternatives.

The *Removal* response action consists of excavating buried debris/waste and disposing of the materials at an approved location. Upon completion of a removal response action, the potential risks associated with direct contact with landfill contents would be eliminated.

3.4 Identification of ARARs

Federal and state ARARs that affect the remedial action have been identified and evaluated. This evaluation is considered the first step in identifying regulations, requirements, and guidance that may be pertinent to actions to be taken at the site. This evaluation also includes an initial determination of whether potential ARARs actually qualify as applicable or relevant and appropriate based on known site conditions and potential remedial options.

A requirement must first be determined to be relevant, then appropriate. In general, this involves a comparison of several site-specific factors, including the characteristics of the remedial action, the nature of the hazardous substance present at the site, and applicable regulatory requirements. When the analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be complied with as if it were applicable.

- *Applicable* requirements are cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental, state environmental, or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial alternative, location, or other circumstance at the site. For a requirement to be applicable, the remedial alternative or the circumstances at the site must satisfy the jurisdictional prerequisites of that requirement. "Applicability" implies that the remedial action or the circumstances at the site satisfy the jurisdictional prerequisites of a requirement. If a requirement is not applicable, one must consider whether it is both relevant and appropriate.
- *Relevant and appropriate* requirements are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting law that, while not legally applicable, address problems or situations sufficiently similar to the particular site conditions that their use may be well suited. A requirement that is judged both relevant and appropriate must be complied with to the same degree as if it was applicable. In some circumstances, a requirement may be relevant to the particular site-specific situation, yet not be appropriate because of differences in the purpose of the requirement, the duration of the regulated activity, or the physical size or characteristic of the situation is intended to address. There is more discretion in the determination of relevant and appropriate requirements than in the determination of applicable requirements.

The three categories of ARARs are chemical, location, and action specific. Chemical-specific ARARs are health- or risk-based concentration limits for specific hazardous substances in various environmental media set by federal and state regulations. Chemical-specific ARARs are numerical standards that establish the acceptable amount or concentration of a chemical that may be found in, or discharged to the environment. Chemical-specific ARARs may be derived from several standards including Safe Drinking Water Act MCLs, and water quality criteria. No chemical-specific ARARs were identified for the surface and subsurface soils or groundwater beyond the limits of the fill.

Location-specific ARARs identify requirements that must be addressed during remedial activities because the activities occur in "special" locations. Location-specific ARARs include activities on and near wetlands and floodplains, archeological and natural resources, historical landmarks, critical habitats of endangered or threatened species, and public drinking water systems. No location-specific ARARs were identified.

Action-specific ARARs are technology-based or activity-based requirements or limitations on actions taken with respect to hazardous substances. These requirements are triggered by the particular remedial activities developed to accomplish a remedy. The following action-specific ARAR was identified for the site:

- 3 Ohio Administrative Code (OAC) 3745-27-13 (H), Sections 7 and 8 – Disturbances Where Hazardous or Solid Waste Facility was Operated. Describes substantive limitations on any proposed filling, grading, excavating, building, drilling, or mining on land where a hazardous waste facility or solid waste facility was operated and how the activities will be accomplished. Specifically the regulation states:
  - (7) If excavation occurs outside the limits of waste at the site, the material used to backfill any excavated areas may not consist of solid or hazardous waste.
  - (8) Filling, grading, excavating, building, drilling, or mining activities shall be performed in a manner that prevents migration of leachate, explosive gas, or toxic gas from the facility.

This ARAR requires submittal of proposed activities and project information (as outlined in the rule) and approval from the Director before filling, grading, excavating, building, drilling or mining activities are performed.

3.5 Technology Screening

Based upon the results of the HHRA and the subsequent FS activities conducted in 2012, the RAO is based on preventing direct contact with the buried debris/waste that was not addressed as a medium in the risk assessment. Potential risks associated with direct contact with the landfill contents if the soil cover was removed or during intrusive work, such as excavation, were not addressed in the RI due to the difficulty in adequately characterizing a heterogeneous waste. Because technologies involving treatment to change chemical or physical characteristics of any media at the AOC are not necessary to meet the RAO, a complete technology screening was not conducted. In addition, USEPA's presumptive remedy guidance (USEPA, 1993) allows for streamlining the evaluation of alternatives. This guidance indicates that for municipal landfills the most-practicable remedial alternative is containment; however, size and volume of the landfill should also be considered. The estimated volume of the buried debris/waste is below the threshold of 100,000 yd^3, beyond which removal of waste is not generally feasible (USEPA, 1996); therefore, excavation was retained for detailed evaluation.

Observations made during test pitting/trenching activities and vapor probe installation at the AOC in July 2012 indicated there was generally 1 to 2 feet of soil overlying the buried debris/waste materials with the exception of one test/pit trench location (where some surface soil may have been scraped off during removal of the stockpiled soil) where the cover was estimated to be 0.5 foot. There was no evidence of debris/waste materials at the surface. As a result, an alternative for applying additional soil cover to serve as a cap (containment) was not evaluated.

Detailed evaluation was performed for the following alternatives:

- Alternative 1 – No Action[1]
- Alternative 2 – LUCs
- Alternative 3 – Excavation and Offsite Disposal

[1] NCP requires that a No Action alternative be developed as a baseline against which other alternatives can be compared.

4 Development of Remedial Alternatives

4.1 Development of Remedial Alternatives

The following subsections describe the remedial alternatives evaluated for the Shelby Horizons AOC and present an evaluation of their effectiveness, implementability, and cost.

Effectiveness is the degree to which an alternative meets RAOs and ARARs, safeguards human health and environment by reducing potential exposure to contaminated media, and protects the environment by preventing further transport of the contaminants. Alternatives that meet the criteria are considered effective; alternatives that are less effective or not effective are not considered further. Effectiveness focuses on the following:

- Potential effectiveness of the remedial alternatives in addressing the estimated areas and volumes of the media of concern
- Ability of the remedial alternatives in meeting the RAOs
- Potential impacts to human health and the environment during the remedial action
- Reliability of the remedial alternatives with respect to the buried debris/waste and the site conditions

Implementability refers to the technical and administrative feasibility of implementing the alternative. Options that are technically or administratively difficult may be eliminated from further consideration.

- *Technical feasibility* refers to the ability of remedial alternatives to be constructed and reliably operated to meet technology-specific remediation regulations for process options until a remedial action is complete. The term also includes operation and maintenance (O&M), replacement, and monitoring (if needed) of technical components after remedial construction is complete.
- *Administrative feasibility* refers to the ability to obtain approvals from federal and state agencies; availability of treatment, storage, and disposal services and capacity; and requirements for, and availability of, specific equipment and technical specialists.

Cost is evaluated relative to construction (capital) and long-term O&M required to operate and maintain a remedial alternative. Cost plays a limited role in the screening of remedial alternatives at this stage.

4.2 Alternative 1 – No Action

4.2.1 Description

The NCP, specifically 40 *Code of Federal Regulations* (CFR) § 300.430(e)(6), requires that a No Action Alternative be evaluated as a baseline in the FS process for comparison to the other approaches. Under the No Action Alternative, there would be no activities completed at the

Shelby Horizons AOC to change the current conditions. Additionally, no action would be taken to restrict potential risks associated with direct contact with landfill contents if excavation or removal of the soil cover were to occur within the AOC. This alternative does not provide for LUCs restricting future site use, such as an environmental covenant or a deed restriction. Alternative 1 is retained as a baseline alternative, as required by the NCP.

4.2.2 Evaluation

Effectiveness. Without restrictions on future site use, the potential for exposure to buried debris/waste materials during intrusive work, such as excavation, or the removal of the soil cover, such as re-grading, would continue. Therefore, this alternative does not meet the RAO.

Implementability. There are no implementability considerations for this alternative.

Cost. This alternative has no associated costs.

4.3 Alternative 2 – Land Use Controls

4.3.1 Description

The LUCs and Long-Term Management Alternative would consist of administrative mechanisms to place activity and use limitations (AULs) within the footprint of the buried debris/waste. Specifically, the AULs would prohibit removal of the soil cover and intrusive activities unless approved by the State of Ohio in accordance with 3 OAC 3745-27-13 (H). Future use of the site by the land owner would be possible, as long as the proposed use is in accordance with the requirements of the environmental covenant.

The primary assumptions for this alternative include the following:

- A deed survey would be conducted to support the establishment of a covenant.
- Surveys would be conducted periodically to confirm compliance with the LUCs.

Five year reviews will be conducted.

4.3.2 Evaluation

Effectiveness. A LUC restricting intrusive activities can be effective in meeting the RAO.

Implementability. An environmental covenant would be established pursuant to Section 3745-24-13 (H) of the Ohio Revised Code. This is an established procedure in the State of Ohio and is readily implementable with approval of the property owner. Access agreements would be required to ensure that surveys completed during 5-year reviews can continue during implementation of the remedy.

Cost. The cost of this alternative would be associated with implementation of an established environmental covenant, including documenting the use restrictions. Costs associated with establishing the covenant and preparation of 5-year reviews (every 5 years for 30 years) are included as part of the evaluation of the cost of this alternative. The present value cost for this alternative is estimated to be $62,800. Appendix C presents the cost details for this alternative.

4.4 Alternative 3 – Excavation and Offsite Disposal

4.4.1 Description

The Excavation and Offsite Disposal Alternative consists of excavating the buried debris and waste materials from the AOC and transporting the excavated materials to a facility permitted to accept them.[2] A non-hazardous characterization for the waste materials is assumed based upon information presented in the RI and observations during test pitting/trenching activities conducted in 2012.

Approximately 2,500 yd^3 (1,660 yd^3 of debris and waste materials, and an additional 800 yd^3 to provide for side-slope material necessary to be removed for excavation stability) is estimated for removal under this alternative; however, the actual volume may vary. Excavation would be conducted in two distinct areas (Figure 3-1). Removal of saturated waste and debris materials would require dewatering/water management. Water that cannot be managed within the excavation would be transported and disposed offsite at a treatment facility. For this FS, it is assumed that the water is non-hazardous and would be transported offsite for treatment. Upon completion of excavation activities, the site would be backfilled and restored to existing grade.

The primary assumptions for this alternative include the following:

- Minimal site preparation is necessary aside from relocation of existing stockpiles of soil/gravel that may be within the limits of excavation.
- Work planning includes the development of an excavation plan to comply with the ARAR, stormwater management plan, dust management, and erosion and sediment control plans.
- Excavation of the buried debris/waste materials with transport to a permitted disposal facility.
- De-watering/water management during excavation with transportation of the water, assumed to be non-hazardous to an offsite treatment facility.
- The AOC will be backfilled with imported clean fill materials to match the surrounding ground surface and seed the area.
- If affected by construction activities, the existing grass drainage swale to the west and south of the AOC would be restored.

Uncertainties do exist and would need to be considered during the design and removal phases, including the potential for waste being deeper than estimated in this feasibility study; the potential for asbestos to be present in the waste material, which would need to be considered in handling and disposal of the excavated waste materials; and potential presence of contaminated soils below the buried debris that may need to be removed as part of the remedial action.

[2] Depending on remedial action implementation schedules for the Shelby Horizons AOC and the nearby Pioneer AOC, consideration should be given to coordinating efforts, as well as consolidating the excavated debris from the Shelby Horizons AOC with the debris at the Pioneer AOC. For FS cost-estimating purposes, it is assumed that remediation activities at the Shelby Horizons AOC will be implemented separately.

4.4.2 Evaluation

Effectiveness. This alternative would meet the RAO by removing the debris/waste materials present within the AOC. No use restrictions/environmental covenants would be required.

Implementability. This alternative is readily implementable using common construction equipment and practices. There would be an increase of traffic on the Shelby Horizons related to hauling materials to and from the site. Excavation of saturated debris/waste would require dewatering and water management within the excavation.

Cost. The cost of this alternative is driven primarily by the quantity of materials that would need to be transported offsite for disposal and imported to the site to provide for clean backfill. The minimal estimated present value cost is $724,000. Appendix C presents the cost details for this alternative.

5 Detailed Analysis of Alternatives

The information presented in this section provides a detailed analysis of the remedial alternatives described in Section 4 and is designed to aid decision makers in evaluating and selecting remedial alternatives to address future potential contact with buried debris and waste materials at the Shelby Horizons AOC. The detailed analysis consists of an assessment of the individual alternatives versus each of the nine evaluation criteria and a comparative analysis of the alternatives against the nine criteria. The detailed analysis of alternatives provides the information necessary for recommending the preferred alternative, to be recommended during the preparation of the Proposed Plan, and ultimately selected for the Decision Document. The preferred alternative in the Proposed Plan will be provided for public comment prior to selection of a remedy, which will then be documented in a Decision Document.

5.1 Evaluation Criteria

Provisions of the NCP require that each alternative be evaluated against nine criteria listed in 40 CFR 300.430(e)(9). These criteria were published in the March 8, 1990, *Federal Register* (55 *FR* 8666) to provide grounds for comparison of the relative performance of the alternatives and to identify their advantages and disadvantages. The evaluation criteria include the following

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume (TMV) through treatment
- Short-term effectiveness
- Implementability
- Cost
- Community acceptance
- State acceptance

The criteria are divided into three groups—*threshold, balancing, and modifying* criteria. *Threshold criteria* must be met by a particular alternative for it to be eligible for selection as a remedial action. There is little flexibility in meeting the *threshold* criteria—either they are met by a particular alternative or the alternative is not considered acceptable. The two threshold criteria are as follows:

- Overall protection of human health and the environment
- Compliance with ARARs

If ARARs cannot be met, a waiver may be obtained when one of the following exceptions listed in the NCP occurs (see 40 CFR 300.430 [f][1][ii][C][1 to 5]):

1. The alternative is an interim measure and will become part of a total remedial action that will attain the ARARs.

2. Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
3. Compliance with the requirement is technically impracticable from an engineering perspective.
4. The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.
5. With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state.

Unlike the threshold criteria, the five *balancing criteria* weigh the tradeoffs between alternatives. A low rating on one *balancing* criterion can be compensated for by a high rating for another. The five balancing criteria include the following:

- Long-term effectiveness and permanence
- Reduction of TMV through treatment
- Short-term effectiveness
- Implementability
- Cost

The *modifying* criteria are community and state acceptance. These are evaluated following public comment and are used to modify the selection of the preferred alternative. Community and state acceptance are not addressed in this FS Report, but will be included in the Decision Document. The criteria are discussed in further detail as follows.

5.1.1 Threshold Criteria

To be eligible for selection, an alternative must meet the two threshold criteria described as follows, or in the case of ARARs, must justify why a waiver is appropriate.

5.1.1.1 Overall Protection of Human Health and the Environment (Criterion 1)

Protectiveness is the primary requirement that remedial actions must meet under CERCLA. A remedy is protective if it adequately eliminates, reduces, or controls current and potential risks posed by the site through each exposure pathway. The assessment against this criterion describes how the alternative achieves and maintains protection of human health and the environment.

5.1.1.2 Compliance with ARARs (Criterion 2)

Compliance with ARARs is a statutory requirement of remedy selection. ARARs are federal and state cleanup standards, standards of control, and other substantive environmental statutes or regulations that are either “applicable” or “relevant and appropriate” to the cleanup action. The assessment against this criterion describes how the alternative complies with ARARs or presents the rationale for waiving an ARAR.

ARARs are discussed in terms of chemical, location, and action specific. An alternative that does not comply with an ARAR may have grounds for invoking a waiver as described in the NCP under paragraph 40 CFR 300.430(f)(1)(ii)(C).

5.1.2 Balancing Criteria

The five balancing criteria for detailed evaluation of alternatives are indicated as follows.

5.1.2.1 Long-Term Effectiveness and Permanence (Criterion 3)

Long-term effectiveness and permanence are measured by how much risk remains after the remedy is completed. Alternatives providing the highest degree of long-term effectiveness and permanence are those that leave little or no waste, have little or no long-term maintenance and monitoring requirements, and minimize or eliminate the need for LUCs. The evaluation for long-term effectiveness includes consideration of the following factors:

- Magnitude of the risk to human and environmental receptors posed by untreated waste or treatment residues after active remedial activities
- Type, degree, and adequacy of long-term management required for untreated waste or treatment residues after active remedial activities
- Long-term reliability of engineering to provide continued protection from untreated waste or treatment residues
- Potential need for replacement of the action and the continuing need for repairs to maintain the performance of the remedy

5.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment (Criterion 4)

The statutory preference is a remedial action that employs treatment to reduce the TMV of hazardous substances. Criterion 4 addresses the anticipated performance of technologies to reduce TMV of hazardous substances. Alternatives that do not include treatment technologies are not considered to reduce TMV. This criterion considers the following:

- Treatment process(es)
- Amount of hazardous substances that will be treated or destroyed
- Degree of expected reduction in TMV through treatment, including how the treatment addresses the principal risk(s)
- Degree to which the treatment will be irreversible
- Type and quantity of residual wastes that will remain following treatment

5.1.2.3 Short-Term Effectiveness (Criterion 5)

This criterion evaluates the effectiveness of alternatives in maintaining protection of human health and the environment until the RAOs are met. Short-term effectiveness is measured by the following factors:

- Short-term risks that may be imposed to the community during implementation of an alternative
- Potential adverse impacts on workers during implementation, and the effectiveness and reliability of protective measures

- Potential for adverse environmental impacts during implementation, and effectiveness and reliability of mitigation measures
- Estimated duration of implementation needed to achieve the remedial objectives

5.1.2.4 Implementability (Criterion 6)

Implementability deals with the difficulties of constructing and operating an alternative and the availability of materials and services required. The following facets are considered:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy
- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain necessary approvals and permits from other agencies (for offsite actions)
- Availability of services and materials necessary for implementing the alternative, including the availability of adequate offsite treatment, storage capacity, and disposal capacity and services; availability of necessary equipment and specialists and provisions to provide necessary additional resources; and availability of prospective technologies

5.1.2.5 Cost (Criterion 7)

Under this criterion, an alternative is assessed in terms of its present worth capital and O&M costs. Preliminary cost estimates were developed for Alternatives 2 and 3 for the Shelby AOC (Appendix C). These estimates are based on available information and are based on information provided by vendors, regulators, and personnel with experience on similar projects. The expected accuracy of these cost estimates is +50 to -30 percent (USEPA, 1991). These cost estimates should not be considered the actual cost of designing and implementing a remedial action, but rather relative costs among the alternatives using consistent assumptions and estimating methods.

Capital costs presented in this report include allowances for a 20 percent contingency project management, remedial design, and construction management. O&M costs include a contingency of 20 percent. The present net worth is based on a 30-year project duration and assumes a 2.0 percent discount rate (Office of Management and Budget, 2011).

5.1.3 Modifying Criteria

State and community acceptance of a proposed remedial action are important elements in remedy selection. Concerns of state regulators and the local community must be addressed during the selection process and are generally termed “modifying criteria.”

5.1.3.1 State Acceptance (Criterion 8)

This evaluation criterion assesses the technical and administrative issues and concerns that the State of Ohio may have about each alternative. Preliminary input has been solicited from Ohio EPA and will be incorporated into the evaluation of the alternatives in this document. Additional consideration will be provided for the state acceptance criterion after receiving comments on the Proposed Plan. This criterion will be fully addressed in the Decision Document.

5.1.3.2 Community Acceptance (Criterion 9)

This evaluation criterion evaluates the issues and concerns that the public may have regarding each of the alternatives. Community input regarding the alternatives will be solicited during the public comment period, during which time the Proposed Plan will be available for public review. A responsiveness summary will be prepared to address comments received during the public comment period. This criterion will be fully addressed in the Decision Document after public comments on the Proposed Plan are received.

5.2 Individual Analysis of Alternatives

Detailed analysis of each of the alternatives for the Shelby Horizons AOC is presented as follows. Evaluation of each alternative against the seven threshold and balancing criteria is the first step in completing the detailed evaluation.

5.2.1.1 Alternative 1—No Action

This alternative is required to be evaluated by the NCP process as a baseline for other alternatives. The No Action Alternative does not provide for LUCs, monitoring, or active remedial activities to be undertaken at the AOC. Table 5-1 contains the detailed evaluation of Alternative 1.

5.2.1.2 Alternative 2—Land Use Controls

The LUC Alternative would rely upon an environmental covenant to restrict the future use of the Shelby AOC, restrict intrusive activities within the AOC and restrict removal of the soil cover over the AOC.

For cost estimating purposes, the Alternative 2 components include the following:

- An environmental covenant is filed with the State of Ohio in accordance with Section 3745-24-13 (H) of the Ohio Revised Code.
- Periodic site inspections will be required to ensure that the use restrictions are being implemented in accordance with the requirements of the environmental covenant.
- Five-year reviews are assumed every 5 years for 30 years.

Table 5-2 contains the detailed evaluation of Alternative 2.

5.2.1.3 Alternative 3— Excavation and Offsite Disposal

Alternative 3 would provide for the excavation of the material and disposal at an approved facility. Imported clean fill materials would be used to establish closure grades for the AOC. Long-term management would not be required as part of this alternative. The area would be re-graded to help prevent the ponding of water and improve overall drainage.

For cost estimating purposes, the Alternative 3 components include the following:

- Work planning will include preparation of an excavation plan to comply with the ARAR and addressing uncertainties presented in Subsection 4.4.1, as well as a stormwater management plan, erosion control plan, and dust management plan.
- The section of the AOC where wastes have been disposed would be cleared and grubbed. Based upon the results of previous investigations and the recent test pitting/trenching activities, the estimated volume to be removed is approximately 2,500 yd^3 (including benching/sloping of the excavation sides). Waste would be placed directly in haul trucks or in roll-off boxes for disposal at a facility permitted to accept them. A non-hazardous characterization for the waste materials is assumed based upon the conclusions drawn from previous reports, as well as from observations during test pitting/trenching activities conducted in 2012. Disposal costs may vary based on disposal location and characterization of the content of the waste materials excavated.
- Dewatering and associated onsite water management plan, which would include sample collection for characterization, would be necessary for the saturated materials requiring excavation.
- Clean soil would be brought onsite to replace the removed material and graded to match the surrounding surface.
- The existing grass swale located to the west and south of the AOC would be repaired if damaged by construction.
- A soil cover would be constructed to match the surrounding grades at the AOC and seeded for to establish a vegetative cover.

Table 5-3 contains the detailed evaluation of Alternative 3.

5.2.2 Comparative Analysis of Alternatives

In the following analysis, the remedial alternatives are evaluated in relation to one another for each of the nine NCP criteria. The purpose of this analysis is to identify the relative advantages and disadvantages of each alternative. Comparative analyses of remedial alternatives are documented as follows. Table 5-4 summarizes this comparative analysis.

5.2.2.1 Protection of Human Health and the Environment

There is no risk to human health or ecological receptors under the current land use. Previous SIs and test pitting/trenching activities indicate there are buried debris/waste materials at the AOC that could be exposed during future intrusive or excavation activities. Potential risks associated with direct contact with the landfill contents were not evaluated; therefore, the RAO provides for protection of possible future receptors that might come in contact with landfill contents should land use change through removal of the soil cover or excavation.

Alternatives 2 and 3 are protective in that they restrict and eliminate, respectively, the potential for exposure to the buried debris. Alternative 2 would be protective as long as the LUCs associated with the environmental covenant are complied with or enforced. However, a disadvantage of Alternative 2 is the need to maintain and enforce the LUCs as long as the buried debris/waste remains in place.

Alternative 1 is not protective because no action would be taken to mitigate the potential exposure to buried material.

5.2.2.2 Compliance with ARARs

One ARAR (3 OAC 3745-27-13 [H], Sections 7 and 8) has been identified and is related to Alternative 2, if the soil cover is disturbed, and Alternative 3 as waste will be excavated.

Specifically, the regulation states the following:

- (7) If excavation occurs outside the limits of waste at the site, the material used to backfill any excavated areas may not consist of solid or hazardous waste.
- (8) Filling, grading, excavating, building, drilling, or mining activities shall be performed in a manner that prevents migration of leachate, explosive gas, or toxic gas from the facility.

This ARAR requires submittal of proposed activities and project information (as outlined in the rule) and approval from the Director before filling, grading, excavating, building, drilling or mining activities are performed. Compliance with this ARAR would be achieved with establishment of an environmental covenant between the property owner and the Ohio EPA.

5.2.2.3 Long-Term Effectiveness and Permanence

Alternative 3 will achieve long-term effectiveness and permanence because the buried waste/debris materials would be removed from the AOC. Alternative 2 will achieve long-term effectiveness and permanence as long as the LUCs are enforced and maintained. Alternative 1 does not meet this criterion because no action would be taken.

5.2.2.4 Reduction in Toxicity, Mobility, and Volume through Treatment

None of the alternatives would reduce the TMV through treatment; treatment is not associated with any of the alternatives due to the heterogeneity and volume of the buried waste. However, Alternative 3 would result in removal of the buried debris/material.

5.2.2.5 Short-Term Effectiveness

Alternative 1 has no short-term risks to the remediation workers or to the community because no activities would be planned under this alternative. The short-term risks associated with the construction activities under Alternative 3, and the limited test pitting under Alternative 2, would be minimized by implementing appropriate health and safety procedures and other pollution prevention measures. Short-term disruptions to the local community during implementation of Alternative 3 may occur from the heavy equipment operations, such as increased traffic of construction trucks in and out of the site, increased noise levels, and dust generation from the heavy equipment during excavation activities. However, these disruptions would be minimized through a proper planning for traffic routing and scheduling, implementation of erosion and sediment controls, and dust suppression. The potential for encountering naturally occurring methane gas during excavation activities should be considered in safety planning for excavation activities.

5.2.2.6 Implementability

This criterion does not apply to Alternative 1 because no action would be implemented. Alternative 2 involves only administrative actions that are readily implementable and are an established procedure in the state of Ohio. Alternative 3 is readily implementable using common construction practices and equipment. Both Alternatives 2 and 3 require a similar level of coordination with state agencies and the property owner; however, upon property owner acceptance, Alternative 2 is easier to implement.

5.2.2.7 Cost

As shown in Table 5-4, Alternative 2 is the least-cost alternative that achieves the RAO.

5.2.2.8 State Acceptance

Alternatives 2 and 3 are likely to acceptable to Ohio EPA because they meet the RAO, and the threshold and balancing criteria. Alternative 1 is not acceptable because it does not meet the RAO, or the threshold criteria.

5.2.2.9 Community Acceptance

Assessment of community acceptance of the proposed alternatives will be addressed in the Decision Document.

6 Summary

This FS has been prepared to develop, screen, and evaluate remedial alternatives to eliminate or prevent potential for human exposure to buried material in the immediate vicinity of the Shelby Horizons AOC.

To develop remedial alternatives specific to the AOC, this report summarizes the prior studies and the FS data gap field investigation activities performed in the summer of 2012, discusses risks associated with the disposal area, considers ARARs, and develops remedial objectives for AOC. Based upon that information, remedial technologies have been identified and screened, a detailed analysis of identified remedial alternatives was conducted, and a comparative analysis of alternatives was completed. The comparative analysis serves as a basis for recommendations on an appropriate remedial action.

The results of the HHRA indicate that for current land use, no unacceptable risks were identified for surface soils. However, because the samples did not include buried debris/materials, the HHRA did not assess contact with the buried debris/materials. Subsequently, the following RAO was established to be protective should excavation into the buried debris occur:

- Eliminate or reduce the potential risks to future receptors associated with direct contact with landfill contents

The following three remedial alternatives have been evaluated for the Shelby Horizons AOC:

- Alternative 1 – No Action
- Alternative 2 – LUCs
- Alternative 3 – Excavation and Offsite Disposal

The No Action Alternative (Alternative 1) was included in accordance with the NCP. Alternative 2 is the least-cost remedy that meets the RAO. Alternative 2 meets the RAO by relying upon the establishment of LUCs to eliminate or prevent potential exposure to buried debris/materials. The protectiveness of the remedy would be evaluated every 5 years for 30 years. Alternative 3 (removal and offsite disposal of buried debris) meets the RAO by removing the buried debris and waste materials. Removal of these materials eliminates the potential contact with the landfill contents.

Following review and acceptance of this report, a Proposed Plan will be prepared in accordance with CERCLA guidance documents. The Proposed Plan will include summaries of the previous investigation activities, as well as the remedial alternatives evaluated for the Shelby Horizons AOC. A recommendation on the preferred remedial alternative will be presented in the Proposed Plan. A Decision Document will be drafted after receiving and addressing public comments on the Proposed Plan. The Decision Document will summarize the RI results, present the remedial alternatives evaluated in the FS, and describe the selected remedy.

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Tables

TABLE 2-1

Vapor Investigation Activities Completed and Deviations from the Final 2012 QAPP

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Planned Event Per Final QAPP (CH2M HILL 2012)	Date Completed	Deviations
AOC Monitoring Wells		
Measure the methane and carbon dioxide concentrations inside the three AOC monitoring well casings.	July 9, 2012	None.
Collect methane vapor samples for laboratory analysis of fixed gases if methane is measured at or above 5 percent in the well casings.	July 13, 2012	None.
Collect additional vapor samples for laboratory analysis of hydrocarbons C1-C4, mercaptans, stable isotopes of hydrogen and carbon, carbon-14 isotope, and tritium isotope analysis from at least two well casings as long as methane was measured at or above 5 percent at these locations.	July 13 and 14, 2012	Although vapor sampels for tritium samples were collected from the wells, they were not analyzed since tritium samples could not be collected from the AOC and the purpose of these samples was to compare results between the AOC and the wells. Tritium samples from the wells alone do not provide information on the methane source.
Collect groundwater samples for laboratory analysis of dissolved methane and carbon dioxide from each of the AOC monitoring wells.	July 10 and 11, 2012	None.
Vapor Probes		
Install 13 temporary shallow soil vapor monitoring probes: six to allow for field measurement of methane concentrations and collection of samples for laboratory analysis; four to allow for field measurements of methane and mercury, and samples for laboratory analysis of mercury; and three to allow for field measurements of methane and mercury and collection of samples for laboratory analysis of methane and mercury.	July 11 and 12, 2012	Two planned vapor sampling locations were not installed. VP-M1 was not installed because AOC debris was not encountered. VP-M3 was not installed because saturated conditions were encountered and because of proximity to another probe that was installed adjacent to VP-M3. Eleven total probes were installed: four for obtaining methane field measurements and samples; four for field measurements of methane and mercury as well as sample collection for laboratory analysis of mercury; and, three to allow for collection of both field measurements and samples for methane and mercury.
Log soil and AOC contents at planned probe locations to evaluate depth of fill and determine probe depth. Install probes inside the AOC contents and above the water table, at approximately 5 feet below ground surface.	July 11 and 12, 2012	Vapor probes were installed between 2 and 4 feet below ground surface due to saturated conditions throughout the AOC. See Table 2 for more details on installed probe depths.
Measure the methane and carbon dioxide concentrations from each vapor probe. If methane is measured at or above 5 percent, collect confirmation laboratory samples for methane (fixed gases).	July 13 and 14, 2012	Although field equipment showed methane detections below 5 percent from all probe locations inside the AOC, methane samples were collected from two of nine planned locations within the AOC (VP-M4 and VP-M6).
Collect additional samples for laboratory analysis of hydrocarbons C1-C4, mercaptans, stable isotopes of hydrogen and carbon, 14C isotope, and 3H isotope analysis from at least four vapor probe points as long as methane was measured at or above 5 percent at these locations.	July 13 and 14, 2012	Only one (VP-M4) of the two AOC location samples was analyzed for total reduced sulfur (mercaptans) due to the low methane levels detected inside the AOC. The purpose of the mercaptan sampling was to determine if the source of methane is from a natural gas supply pipeline. The two AOC methane sampling locations did not have enough methane to analyze for tritium; therefore tritium samples were not collected.
Collect sub-surface mercury vapor laboratory samples (NIOSH 6009) from seven locations in and around the former historical detection area.	July 14, 2012	Mercury samples were collected from five of seven planned locations due to probes failing leak tests (VP-MHD3) or being unable to pull vapors (VP-HD2).
Monitor ambient air for mercury at the start and end of each mercury sample field day.	July 14, 2012	An ambient air reading was only collected at the beginning of the day.
Collect one ambient air sample for laboratory analysis of mercury.	July 14, 2012	None.

TABLE 2-2
Vapor Investigation Probes Installed and Laboratory Samples Collected
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Probe Location	Probe Depth (top of probe in feet bgs)	Notes	Planned Analyses	Laboratory Samples Collected
VP-M1	Not installed	Not installed since only native soils (clay) encountered.	Methane Suite	NA
VP-M2	3	Moved 10 feet south of original location in order to find AOC fill.	Methane Suite	Pulled water through sample tubing, unable to be sampled.
VP-M3	Not installed	Not installed since water encountered at 3.5 feet bgs and VP-M3 nearby at similar depth.	Methane Suite	NA
VP-M4	3.5		Methane Suite	**Methane samples (except tritium) collected since this location had highest level of methane measured in the field.**
VP-M5	2		Methane Suite	Methane not collected due to low levels measured in the field.
VP-M6	4		Methane Suite	**Methane samples (except tritium) collected since this location had highest level of carbon dioxide measured in the field.**
VP-MHD1	2		Methane Suite and Mercury Vapor	**Mercury sample collected.** Methane not collected due to low levels measured in the field.
VP-MHD2	4.5		Methane Suite and Mercury Vapor	**Mercury sample collected.** Methane not collected due to low levels measured in the field.
VP-MHD3	3.5		Methane Suite and Mercury Vapor	Failed leak check, not sampled.
VP-HD1	3.5		Mercury Vapor	**Mercury sample collected.**
VP-HD2	6.5	Location VP-HD02 was advanced through 2.5 feet of surface debris and 4 feet into subsurface. Total probe tubing length was 6.5 feet; however, probe was 4 feet below actual ground surface.	Mercury Vapor	Negative pressure encountered during sampling, unable to pull air, not sampled.
VP-HD3	3.5		Mercury Vapor	**Mercury sample collected.**
VP-HD4	3		Mercury Vapor	**Mercury sample collected.**
MW-11	NA	Monitoring well casing.	Methane Suite	**Methane full suite of samples collected.**
MW-12	NA	Monitoring well casing.	Methane Suite	Not sampled due to low levels of methane measured in the field.
MW-13	NA	Monitoring well casing.	Methane Suite	**Methane full suite of samples collected.**

Notes:

Methane Suite includes fixed gases of methane and carbon dioxide, hydrocarbons C1-C4, mercaptans, stable isotopes of hydrogen and carbon, 14-carbon isotope, and tritium isotope analysis.

bgs = below ground surface

NA = not applicable

TABLE 2-3

Vapor Investigation Field Measurements – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Probe Location	Preliminary GEM Field Readings (directly from vapor probe tubing July 13, 2012 and from well casing on July 9, 2012)	Purged GEM/MultiRAE Field Readings (from purge bag July 13 or 14, 2012)	Purged Jerome Field Readings for Mercury Vapor (from purge bag July 14, 2012)
VP-M2	Pulled water – no readings able to be collected	––	--
VP-M4	CH_4 = 0.6%, CO_2 = 0.5%, O_2 = 14.9%	CH_4 = 0.3%, CO_2 = 1.5%, O_2 = 16.3%, VOCs = 1.4 ppm	Not collected
VP-M5	CH_4 = 0.1%, CO_2 = 9.0%, O_2 = 11.7%	Not purged due to preliminary low levels of methane	Not collected
VP-M6	CH_4 = 0.0%, CO_2 = 10.4%, O_2 = 5.6%	CH_4 = 0.0%, CO_2 = 10.9%, O_2 = 8.0%, VOCs = 0.5 ppm	Not collected
VP-MHD1	CH_4 = 0.0%, CO_2 = 2.5%, O_2 = 17.3%	CH_4 = 0.0%, CO_2 = 2.1%, O_2 = 18.6%, VOCs = 0.4 ppm	0.00 $\mu g/m^3$
VP-MHD2	CH_4 = 0.0%, CO_2 = 0.9%, O_2 = 10.5%	CH_4 = 0.0%, CO_2 = 3.1%, O_2 = 13.1%, VOCs = 1.0 ppm	0.01 $\mu g/m^3$
VP-MHD3	CH_4 = 0.0%, CO_2 = 0.0%, O_2 = 15.4%	Failed leak check, purge data not recorded	--
VP-HD1	CH_4 = 0.0%, CO_2 = 0.8%, O_2 = 16.1%	CH_4 = 0.0%, CO_2 = 2.2%, O_2 = 18.3%, VOCs = 1.2 ppm	0.018 $\mu g/m^3$
VP-HD2	CH_4 = 1.2%, CO_2 = 3.7%, O_2 = 2.4%	Negative pressure while purging, probe obstructed, unable to purge.	--
VP-HD3	CH_4 = 0.0%, CO_2 = 0.6%, O_2 = 17.4%	CH_4 = 0.0%, CO_2 = 1.8%, O_2 = 18.9%, VOCs = 1.4 ppm	0.013 $\mu g/m^3$
VP-HD4	CH_4 = 0.0%, CO_2 = 3.8%, O_2 = 16.0%	CH_4 = 0.0%, CO_2 = 4.0%, O_2 = 17.2%, VOCs = 0.6 ppm	0.019 $\mu g/m^3$
MW-11	CH_4 = 92.8%, CO_2 = 0.1%, O_2 = 0.8%	Not purged	Not collected
MW-12	CH_4 = 0.0%, CO_2 = 0%, O_2 = 19.7%	Not purged	Not collected
MW-13	CH_4 = 42.9%, CO_2 = 0.2%, O_2 = 11.3%	Not purged	Not collected

Notes:

Purged readings are taken prior to sample collection

$\mu g/m^3$ = microgram(s) per cubic meter

ppm = part(s) per million

CH_4 = methane

CO_2 = carbon dioxide

O_2 = oxygen

VOCs = volatile organic compounds

-- = no data

TABLE 2-4a

Vapor Investigation Fixed Gas Laboratory Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location		VP-M4	VP-M6	MW-11	MW-11 (Duplicate)	MW-13
Sample Date		7/13/2012	7/14/2012	7/13/2012	7/13/2012	7/13/2012
Analyte	**Units**					
Analysis by Applied Sciences Laboratory [1]						
Methane	Percent	0.4U	0.4U	**94.5**	**94.5**	**92**
Carbon dioxide	Percent	**3.73**	**10.3**	**0.19J**	**0.192J**	**0.453J**
Carbon monoxide	Percent	0.5U	0.5U	1U	1U	1U
Nitrogen	Percent	**53.9**	**55.3**	**4.55**	**4.58**	**6.66**
Oxygen	Percent	**14.7**	**7.7**	**0.729J**	**0.738J**	**0.922J**
Analysis by Isotech Laboratory [2]						
Methane	Mole Percent	**8.1**	0.0002U	**80.89**	**93.91**	**90.57**
Carbon dioxide	Mole Percent	**3.46**	**8.41**	**0.19**	**0.2**	**0.45**
Nitrogen	Mole Percent	**71.9**	**79.74**	**15.42J**	**5.38J**	**8.19**
Oxygen	Mole Percent	**15.65**	**10.89**	**3.29J**	**0.42J**	**0.59**
Argon	Mole Percent	**0.866**	**0.964**	**0.163J**	**0.0419J**	**0.0894**
Hydrogen	Mole Percent	**0.0017**	0.001U	0.001U	0.001U	0.001U
Helium	Mole Percent	**0.0148**	0.001U	**0.0148**	**0.0169**	**0.0165**

Notes:

[1] Analyzed by Method USEPA 3C. Per the QAPP (CH2M HILL 2012), this is the fixed gas data to be used to determine the presence or absence of fixed gas.

[2] Analyzed by Isotope Labs for compositional gas to screen samples for isotope analysis.

Mole percent is amount of the constituent divided by the amount of all constituents in the mixture

J = estimated results

U = Not detected. The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Bold indicates the analyte was detected

TABLE 2-4b

Vapor Investigation Dissolved Gas in Groundwater Laboratory Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location		MW-11	MW-11(Duplicate)	MW-12	MW-13
Sample Date		7/11/2012	7/11/2012	7/10/2012	7/11/2012
Analyte	**Units**				
Methane	ug/L	**20,800**	**25,900**	37U	**16,000**
Carbon dioxide	ug/L	**9,870**	**10,800**	**48,600**	**22,000**

Notes:

ug/L = micrograms per liter

U = Not detected. The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Bold indicates the analyte was detected

The solubility of methane at 20^{o}C is between 30,000-28,000 ug/L

TABLE 2-5a

Composition of Seeded Mercaptans from Columbia Gas of Ohio, Mansfield Facility*

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

	Percent	**ug/m3**
Isopropyl Mercaptan	16%	1,282
tert-Butyl Mercaptan	75%	6,008
n-Propyl Mercaptan	6%	481
Other mercaptans and decomposition products	3%	240

Notes:

* Reference: Telephone conversation with Mr. Tim Kessler of Columbia Gas, February and September 2012.

Total mass of sulfur spiked is 0.5 lb per 1,000,000 ft3 of gas = 8010 ug/m3

ug/m3 = micrograms per meter cubed calculated from the given % of the total mass spiked.

TABLE 2-5b

Vapor Investigation Total Reduced Sulfur Laboratory Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location **Sample Date** **Analyte**	**Units**	VP-M4 7/13/2012	MW-11 7/13/2012	MW-11 (Duplicate) 7/13/2012	MW-13 7/13/2012	Approximate Concentrations Seeded by Columbia Gas (see Table 2-5a)
2,5-Dimethylthiophene	ug/m3	23U	23U	23U	23U	--
2-Ethylthiophene	ug/m3	23U	23U	23U	23U	--
3-Methylthiophene	ug/m3	20U	20U	20U	20U	--
Carbon Disulfide	ug/m3	**57**	**32**	**26**	**15**	--
Carbonyl Sulfide	ug/m3	**41**	12U	**13**	12U	--
Diethyl Disulfide	ug/m3	12U	12U	12U	12U	--
Diethyl Sulfide	ug/m3	18U	18U	18U	18U	--
Dimethyl Sulfide	ug/m3	13U	13U	13U	13U	--
Ethyl Mercaptan	ug/m3	13U	13U	13U	13U	--
Ethyl Methyl Sulfide	ug/m3	16U	16U	16U	16U	--
Hydrogen Sulfide	ug/m3	7U	**25**	**26**	**230**	--
Isobutyl Mercaptan	ug/m3	18U	18U	18U	18U	--
Isopropyl Mercaptan	ug/m3	16U	16U	16U	16U	1,282
Methyl Disulfide	ug/m3	9.6U	9.6U	9.6U	9.6U	--
Methyl Mercaptan	ug/m3	9.8U	9.8U	9.8U	9.8U	--
n-Butyl Mercaptan	ug/m3	18U	18U	18U	18U	--
n-Propyl Mercaptan	ug/m3	16U	16U	16U	16U	481
tert-Butyl Mercaptan	ug/m3	18U	18U	18U	18U	6,008
Tetrahydrothiophene	ug/m3	18U	18U	18U	18U	--
Thiophene	ug/m3	17U	17U	17U	17U	--

Notes:

ug/m3 = micrograms per meter cubed

U = Not detected. The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Bold indicates the analyte was detected

Per discussion with the lab, carbon disulfide and carbonyl sulfide are common contaminants from the rubber stopper on the sampling container.

TABLE 2-6

Vapor Investigation Hydrocarbon Laboratory Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location		VP-M4	VP-M6	MW-11	MW-11 (Duplicate)	MW-13
Sample Date		7/13/2012	7/14/2012	7/13/2012	7/13/2012	7/13/2012
Analyte	**Units**					
Ethane / C_2	Percent	**0.0097**	0.0001U	**0.0298**	**0.0347**	**0.0984**
Ethene / C_2H_4	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U
Propane / C_3	Percent	0.0001U	0.0001U	0.0001U	0.0001U	**0.0001**
Propene / C_3H_6	Percent	0.0001U	0.0001U	0.0001U	0.0001U	**0.0001**
Hexane (and heavier hydrocarbons) / C_6+	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U
iso-Butane / iC_4	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U
iso-Pentane / iC_5	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U
Butane / nC_4	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U
Pentane / nC_5	Percent	0.0001U	0.0001U	0.0001U	0.0001U	0.0001U

Notes:

U = Not detected. The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Bold indicates the analyte was detected

TABLE 2-7

Vapor Investigation Isotope Laboratory Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Sample Location	Date	CO_2			CH_4			
		$\delta^{13}C$ ‰	**^{14}C**	**Std. Dev.**	**$\delta^{13}C$ ‰**	**δD ‰**	**^{14}C pMC**	**Std. Dev.**
MW-11	7/13/2012	na	na	--	**-54.21**	**-262.9**	0.4U	--
MW11 (Duplicate)	7/13/2012	na	na	--	**-54.31**	**-262.3**	0.3U	--
MW13	7/13/2012	**-29.53**	na	--	**-54.44**	**-259.2**	**0.4**	0.1
VP-M4	7/13/2012	**-22.41**	na	--	**-52.07**	**-251.3**	**1.6**	0.1
VP-M6	7/14/2012	**-23.36**	94.5	0.4	na	na	na	--

Notes:

‰ = molecules per thousand

pMC = percent modern carbon

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Bold indicates the analyte was detected

na = not analyzed

δ = delta

^{13}C = carbon-13

^{14}C = carbon-14

D = deuterium

Std. Dev. = Standard Deviation

CH_4 = methane

CO_2 = carbon dioxide

TABLE 2-8

Vapor Investigation Mercury Laboratory Analytical Results – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location ID	Date	Validated Lab Result (ng)	Validation Qualifer	Field Sampling Time (minutes)			Start flow (ml/min)	End flow (ml/min)	Average flow (ml/min)	Total Volume (L)	Validated Lab Result (ug/m3)	Validation Qualifer
				Start time	End time	Total time						
VP-MHD1	7/14/2012	0.2	U	11:47	12:00	13	202.7	205.2	204.0	2.65	0.075	U
VP-MHD2	7/14/2012	0.247	U	13:59	14:12	13	198.8	202.4	200.6	2.61	0.095	U
VP-HD1	7/14/2012	0.378	U	15:15	15:28	13	200.4	202.5	201.4	2.62	0.144	U
VP-HD3	7/14/2012	0.2	U	16:18	16:31	13	200.0	200.3	200.2	2.60	0.077	U
VP-HD3 (Duplicate)	7/14/2012	0.347	U	16:32	16:45	13	200.0	200.3	200.2	2.60	0.133	U
VP-HD4	7/14/2012	0.2	U	17:13	17:26	13	199.2	199.9	199.5	2.59	0.077	U
AMBIENT BLANK	7/14/2012	0.2	UJ	17:52	18:05	13	200.0	199.0	199.5	2.59	0.077	UJ
TRIP BLANK	7/14/2012	0.268		NA	NA	NA	NA	NA	NA	2.60	**0.103**	

Notes:

Trip blank concentration calculated from a nominal 2.6 L volume

All samples except the ambient blank were qualified as non-detect due to trip blank contamination.

During data validation, data at locations VP-MHD2, VP-HD1, and FD03 were flagged "U" at the concentration measured since detected concentrations at these locations were greater than the RL.

During data validation, data at locations VP-MHD1, VP-HD3, and VP-HD4 were raised to the RL and flagged "U" since detected concentrations were less than the RL.

The mercury vapor data were provided by the laboratory in nanograms per sample. The laboratory results were converted to micrograms per cubic meter (µg/m3) by dividing by the total volume of air sampled. The total volume of air sampled was derived from the field sampling flow rates and times.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was analyzed for, but was not detected above the reported sample quantitation limit. However, the reported value is qualified approximate due to temperature exceedance during shipment to the lab.

Detections are shown in **bold**

ng = nanograms

TABLE 2-9

Risk-Based Screening for Mercury Vapor

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Location ID	Date	Result (ug/m3)	Q	Ambient Air				Indoor Air			
				Res RSL [1] (ug/m3)	Ind RSL [1] (ug/m3)	Result > Res RSL	Result > Ind RSL	Res VISL [2] (ug/m3)	Ind VISL [2] (ug/m3)	Result > Res VISL	Result > Ind VISL
VP-MHD1	7/14/2012	0.075	U	0.31	1.3	No	No	3.1	13	No	No
VP-MHD2	7/14/2012	0.095	U	0.31	1.3	No	No	3.1	13	No	No
VP-HD1	7/14/2012	0.144	U	0.31	1.3	No	No	3.1	13	No	No
VP-HD3	7/14/2012	0.077	U	0.31	1.3	No	No	3.1	13	No	No
VP-HD3 (Duplicate)	7/14/2012	0.133	U	0.31	1.3	No	No	3.1	13	No	No
VP-HD4	7/14/2012	0.077	U	0.31	1.3	No	No	3.1	13	No	No
AMBIENT BLANK	7/14/2012	0.077	UJ	0.31	1.3	No	No	NA[3]	NA[3]	NA[3]	NA[3]
TRIP BLANK	7/14/2012	**0.103**		0.31	1.3	No	No	3.1	13	No	No

Notes:

[1] USEPA's RSLs for ambient air, based on a hazard index of 1 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/).

[2] VISLs obtained from USEPA's VISL calculator and are the target sub-slab and exterior soil gas concentrations, based on a hazard index of 1. (http://www.epa.gov/oswer/vaporintrusion/guidance.html).

[3] Ambient air standard; therefore, not compared to vapor intrusion screening levels.

Ind = Industrial

Res = Residential

RSL = Regional Screening Level

VISL = Vapor Intrusion Screening Level

ug/m^3 = microgram per cubic meter

Q = data qualifier as a result of data validatation

U = Data is qualified as non-detect because of blank contamination.

The mercury vapor data were provided by the laboratory in nanograms per sample. The laboratory results were converted to micrograms per cubic meter (µg/m3) by dividing by the total volume of air sampled. The total volume of air sampled was derived from the field sampling flow rates and times.

TABLE 2-10

Test Pit/Trench Observation Summary

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Test Pit/Trench Location	Disposal Material Interval (feet bgs)	Disposal Material Observed	Native Soil Encountered at Bottom of Disposal Material
TP-1	None	Minor (metal debris), visually clean fill material	Yes
TP-2	None	Minor (trace glass, concrete, and metal), visually clean fill material	Yes
TP-3	2.0 to 4.0	Burnt waste (nails, metal, paper, brick)	No (water encountered)
TP-4	2.0 to 3.0	Burnt waste (metal, barrel lids and rings) pockets	Yes
TP-5	3.0 to 10.0	Burnt waste (wood, metal, glass and shingles)	No (10 feet max depth reached)
TP-6	0.5 to 8.0 (varies, ramp shape)	Burnt waste (nails, metal, glass, paper)	Yes
TP-7	None	None, native soil encountered	Yes

Notes:

bgs = below ground surface

Test Pit/Trenching occurred July 16 and 17, 2012

TABLE 2-11

Summary of RME Excess Lifetime Cancer Risks and Hazard Indices

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Receptor Group	Media	Exposure Route	ELCR	Chemicals with ELCR $>10^{-4}$	Chemicals with ELCR $>10^{-5}$ and $<10^{-4}$	HI	Chemicals with HI>1
Current/Future Industrial Worker	Surface Soil	Ingestion	9E-06			0.5	
		Dermal Contact	4E-06			0.03	
		Inhalation	6E-08			0.00002	
		Total	1E-05			0.5	
Current/Future Trespasser/Visitor Adult	Surface Soil	Ingestion	1E-06			0.07	
		Dermal Contact	5E-07			0.004	
		Inhalation	2E-09			0.0000007	
		Total	2E-06			0.07	
Current/Future Trespasser/Visitor Youth	Surface Soil	Ingestion	2E-06			0.2	
		Dermal Contact	4E-07			0.008	
		Inhalation	9E-10			0.0000007	
		Total	2E-06			0.2	
Future Resident Adult	Surface Soil	Ingestion	NA			0.7	
		Dermal Contact	NA			0.02	
		Inhalation	NA			0.00009	
		Total	NA			0.7	
Future Resident Child	Surface Soil	Ingestion	NA			6	Cobalt
		Dermal Contact	NA			0.2	
		Inhalation	NA			0.00009	
		Total	NA			6	Cobalt
Future Resident Child/Adult	Surface Soil	Ingestion	4E-05		n-Nitrosodimethylamine, Arsenic	NA	
		Dermal Contact	8E-06			NA	
		Inhalation	3E-07			NA	
		Total	5E-05		n-Nitrosodimethylamine, Arsenic	NA	
Future Resident Adult	Soil*	Ingestion	NA			0.7	
		Dermal Contact	NA			0.03	
		Inhalation	NA			0.0002	
		Total	NA			0.7	
Future Resident Child	Soil*	Ingestion	NA			6	Cobalt
		Dermal Contact	NA			0.2	

TABLE 2-11

Summary of RME Excess Lifetime Cancer Risks and Hazard Indices

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

Receptor Group	Media	Exposure Route	ELCR	Chemicals with ELCR >10^{-4}	Chemicals with ELCR >10^{-5} and <10^{-4}	HI	Chemicals with HI>1
		Inhalation	NA			0.0002	
		Total	NA			6	Cobalt
Future Resident Child/Adult	Soil*	Ingestion	5E-05		n-Nitrosodimethylamine, Arsenic	NA	
		Dermal Contact	1E-05			NA	
		Inhalation	8E-07			NA	
		Total	6E-05		n-Nitrosodimethylamine, Arsenic	NA	
Future	Soil*	Ingestion	1E-06			0.08	
Construction Worker		Dermal Contact	3E-07			0.0002	
		Inhalation	7E-09			0.00006	
		Total	2E-06			0.08	
	Groundwater	Ingestion	NA			NA	
		Dermal Contact	7E-07			0.00000002	
		Inhalation	3E-11			0.000000000004	
		Total	7E-07			0.00000002	
	All Media	Total	2E-06			0.08	

Notes:

Soil* = surface soil and subsurface soil combined.

NA = Not available/not applicable

ELCR = excess lifetime cancer risk

HI = hazard index

TABLE 5-1
Individual Analysis of Alternative 1—No Action
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Overall Protection Of Human Health and Environment	
Protection of human health	Previous studies and test pitting/trenching activities indicate that there are buried debris/ waste materials at the AOC that could be exposed during future intrusive or excavation activities. This alternative does not provide a means to prevent or eliminate contact with these materials.
Environmental protection	The ecological conditions (poor habitat and small size) of the AOC make direct contact with landfill contents by ecological receptors an insignificant pathway.
Compliance With ARARs[1]	
Chemical-specific	No chemical-specific ARARs were identified.
Location-specific	No location-specific ARARs were identified.
Action-specific	Not applicable because no action will be taken under this alternative.
Long-Term Effectiveness and Permanence	
Magnitude of residual risk	Residual risks are moderate to low. The only risk is future exposure to buried waste and debris materials.
Adequacy and reliability of controls	There are no controls implemented under this alternative.
5-year review	Not applicable
Long-term management	Not applicable
Reduction of Toxicity, Mobility, and Volume through Treatment	
Reduction of toxicity and volume	There is no active treatment and therefore no reduction in toxicity and volume.
Reduction in mobility	There is no active treatment and therefore no reduction in mobility.
Short-Term Effectiveness	
Risk to community during remedial action	Not applicable
Risk to workers during remedial action	Not applicable
Time until remedial goals achieved	Not applicable
Environmental impacts	Not applicable
Implementability	
Technical feasibility of operation and construction	Not applicable
Reliability of technology	Not applicable
Availability of services and material	Not applicable

TABLE 5-1
Individual Analysis of Alternative 1—No Action
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Cost	
Present value cost	$0
Modifying Criteria	
State acceptance	No
Community acceptance	To be determined

[1] ARARs are discussed in Section 3.4 of this FS.

TABLE 5-2
Individual Analysis of Alternative 2—Land Use Controls
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Overall Protection of Human Health and Environment	
Protection of human health	Previous studies and test pitting/trenching activities indicate there are buried debris/waste materials at the AOC that could be exposed during future intrusive or excavation activities. This alternative does provide a means to prevent or eliminate contact with these materials.
Environmental protection	The ecological conditions (poor habitat and small size) of the AOC make direct contact with landfill contents by ecological receptors an insignificant pathway.
Compliance With ARARs[1]	
Chemical-specific	No chemical-specific ARARs were identified.
Location-specific	No location-specific ARARs were identified.
Action-specific	Action-specific ARARs would not apply to the land use control alternative.
Long-Term Effectiveness and Permanence	
Reduction of residual risk	Implementation of environmental covenants will reduce the potential for exposure to buried waste and debris.
Adequacy and reliability of controls	Adequate.
5-year review	5-year reviews to document compliance with the LUCs will be performed.
Long-term management	Long-term management will be required to help ensure compliance with the environmental covenants. Periodic inspection to confirm compliance with the covenant would ensure protectiveness of the alternative.
Reduction of Toxicity, Mobility, and Volume through Treatment	
Reduction of toxicity and volume	There is no active treatment and therefore no reduction in toxicity and volume.
Reduction in mobility	There is no active treatment and therefore no reduction in mobility.
Short-Term Effectiveness	
Risk to community during remedial action	No risk because environmental covenants are administratively implemented.
Risk to workers during remedial action	No risk because environmental covenants are administratively implemented.
Time until remedial goals achieved	Not applicable.
Environmental impacts	Not applicable.
Implementability	
Technical feasibility of operation and construction	Easily implementable.
Reliability of technology	Reliable.
Availability of services and material	Readily available.

TABLE 5-2
Individual Analysis of Alternative 2—Land Use Controls
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Cost	
Present value cost	$62,800
Modifying Criteria	
State acceptance	Yes.
Community acceptance	To be determined.

[1] ARARs are discussed in Section 3.4 of this FS.

TABLE 5-3
Individual Analysis of Alternative 3—Excavation and Off-Site Disposal
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Overall Protection Of Human Health and Environment	
Protection of human health	Previous studies and test pitting/trenching activities indicate there are buried debris and waste materials at the AOC that could be exposed during future intrusive or excavation activities. This alternative does provide a means to prevent or eliminate contact with these materials because this alternative would remove the buried debris from the AOC.
Environmental protection	The ecological conditions (poor habitat and small size) of the AOC make direct contact with landfill contents by ecological receptors an insignificant pathway. However, this alternative will alter the habitat in the area and will possibly disrupt environmental receptors for a period of time, though recovery is ultimately expected.
Compliance With ARARs[1]	
Chemical-specific	No chemical-specific ARARs were identified.
Location-specific	No location-specific ARARs were identified.
Action-specific	Anticipated to be compliant with the ARAR.
Long-Term Effectiveness and Permanence	
Reduction of residual risk	Removal would eliminate the residual risks associated with the buried debris.
Adequacy and reliability of controls	Adequate.
5-year review	A 5-year review would not be necessary since the buried waste/debris materials would no longer be present at the site.
Long-term management	Long-term management would not be necessary.
Reduction of Toxicity, Mobility, and Volume Through Treatment	
Reduction of toxicity and volume	There is no active treatment. The volume would be reduced by removal and disposal.
Reduction in mobility	There is no active treatment; however, the removal of the buried debris/waste would reduce the potential for leaching to groundwater.
Short-Term Effectiveness	
Risk to community during remedial action	Dust generation, increased noise levels, and increased truck traffic may have a small impact on the surrounding community.
Risk to workers during remedial action	The risks to worker during construction consist of, but are not limited to, heavy equipment, excavation, and removal of buried debris/waste materials. The risks can be managed through safety planning and personal protective equipment. There is evidence of methane being generated from natural/geologic deposits beneath the AOC. While not associated with the AOC, consideration for potentially encountering methane gases in the open excavation will need to be addressed in safety plans for construction activities.
Time until remedial goals achieved	RAO will be achieved upon completion of the remedial action.

TABLE 5-3
Individual Analysis of Alternative 3—Excavation and Off-Site Disposal
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Environmental impacts	Construction will introduce environmental impacts. These impacts are from the production and use of fuel for the heavy equipment and hauling trucks, the disturbance of soil, and dust generation. Complete removal of the buried waste/debris would reduce the potential for future releases to groundwater.
Implementability	
Technical feasibility of operation and construction	Soil removal is a common industry approach and given the anticipated depths of the excavation, can easily be implemented.
Reliability of technology	Reliable technology
Availability of services and material	Readily available
Cost	
Present value cost	$724,000
Modifying Criteria	
State acceptance	Yes
Community acceptance	To be determined

[1] ARARs are discussed in Section 3.4 of this FS.

TABLE 5-4
Comparative Analysis of Alternatives
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Criteria	Alternative 1—No Action	Alternative 2— Land Use Controls	Alternative 3— Excavation and Off-Site Disposal
Overall Protection of Human Health and the Environment	■	⊙	⊙
Compliance with Applicable or Relevant and Appropriate Requirements[1]	NA	⊙	⊙

Ranking:

⊙ Meets criterion ■ Does not meet criterion

Long-Term Effectiveness and Permanence	■	○	⊙
Reduction of TMV Through Treatment[2]	NA	NA	NA
Short-Term Effectiveness	■	⊙	⊙
Implementability	NA	⊙	⊙
Cost[3]	\$0[(2)]	\$62,800[(3)]	\$724,000[(3)]
State/Support Agency Acceptance	TBD	TBD	TBD
Community Acceptance	TBD	TBD	TBD

Ranking:

⊙ Well satisfies criterion **O** Moderately satisfies criterion □ Poorly satisfies criterion ■ Does not meet criterion

[1] There are no chemical- and location-specific ARARs.

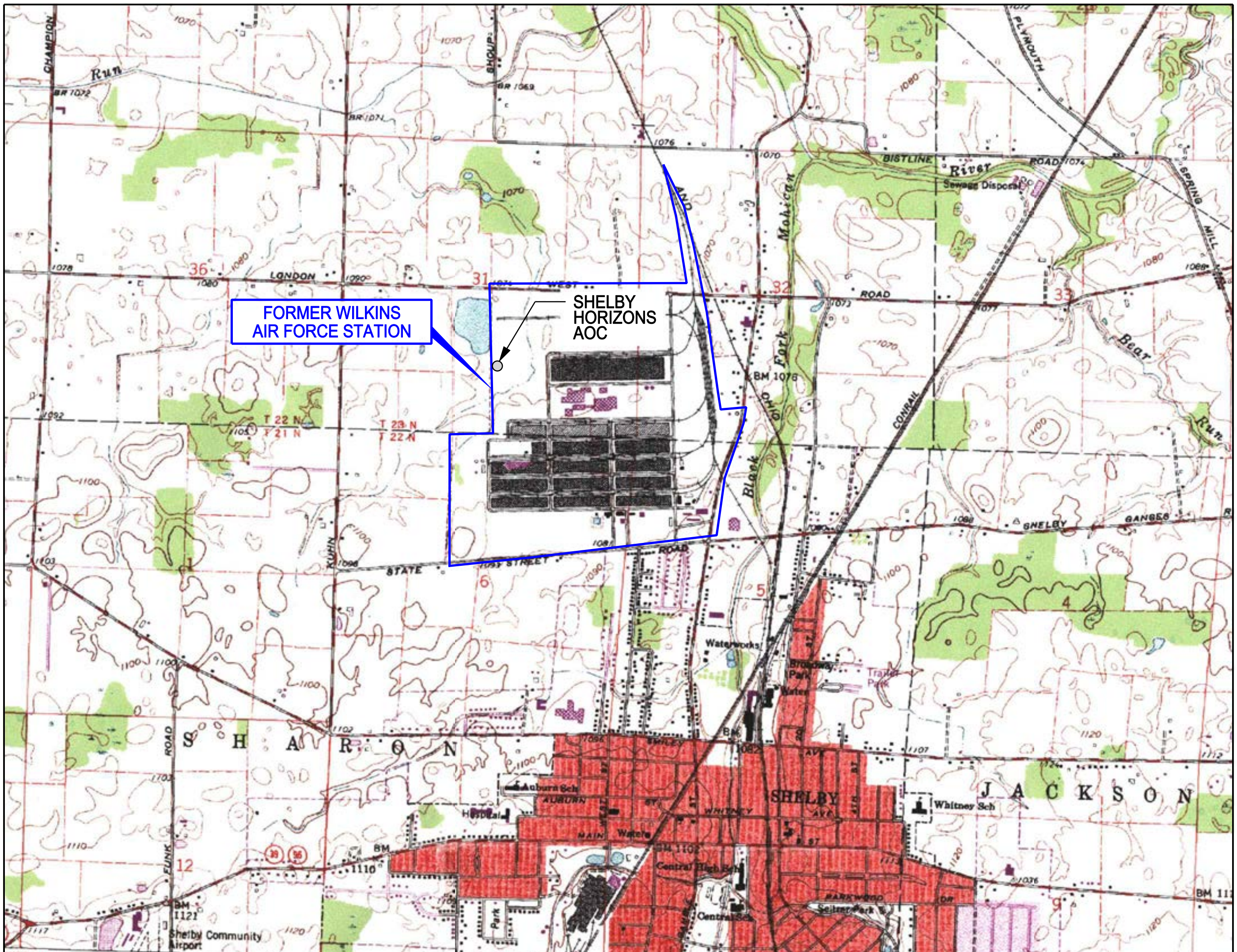
[2] No treatment will occur.

[3] Cost is the total present-worth value; cost accuracy ranges from +50 percent to -30 percent.

NA = The criterion does not apply to this alternative.

TBD = To be determined

Figures



Shelby, Ohio USGS Quadrangle, 7.5 minute series

SITE LOCATION

NOTE:
THE CENTER OF THE FORMER WILKINS AIR FORCE STATION IS:
LAT.: 40 degrees 54 minutes 06 seconds
LONG.: 82 degrees 40 minutes 10 seconds

SHELBY HORIZONS AOC IS LOCATED AT :
LAT.: 40 degrees 54 minutes 15 seconds
LONG.: 82 degrees 40 minutes 32 seconds

North

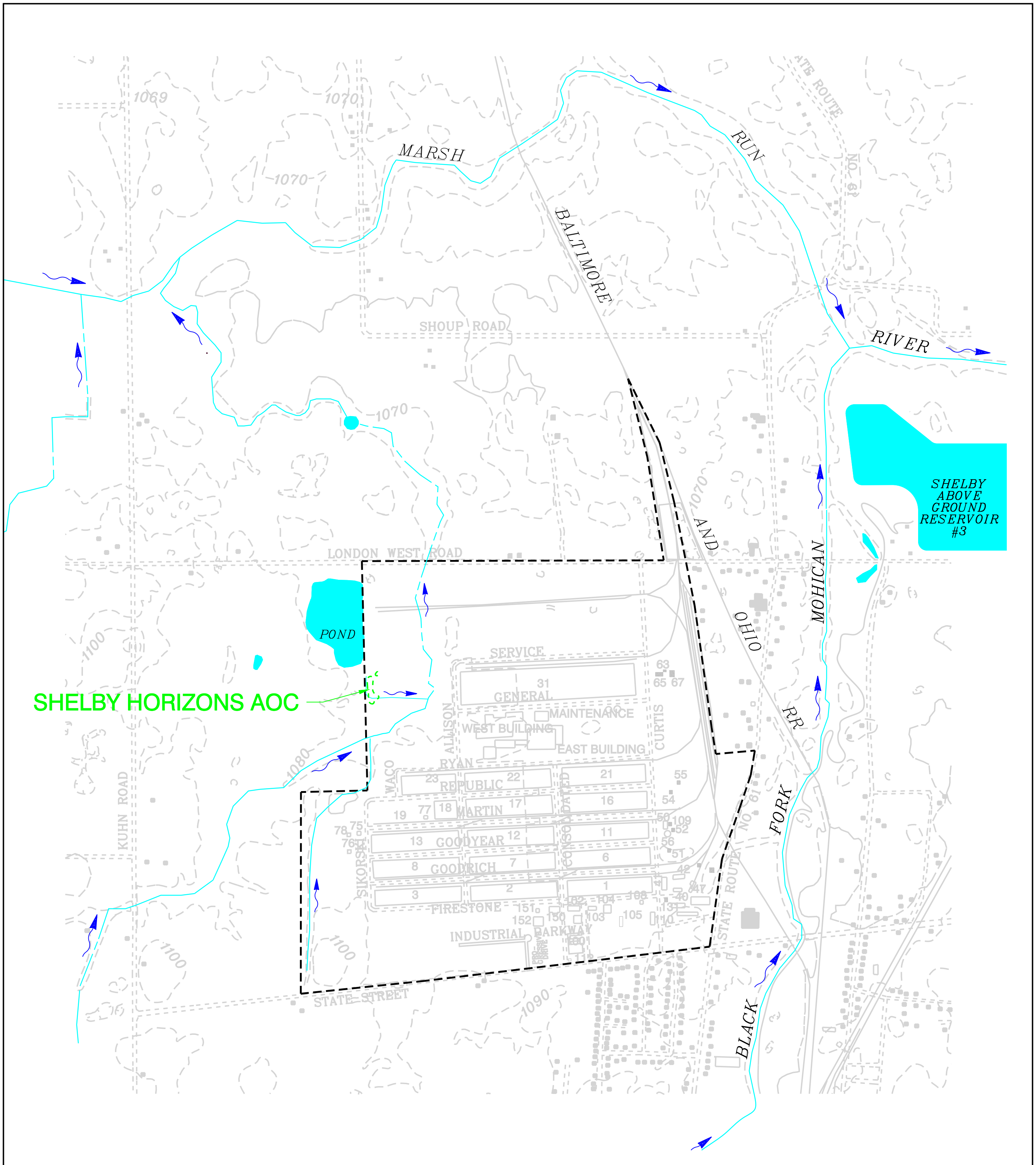
0 1/4 1/2 1
Approximate scale in miles

FIGURE 1-1

Former Wilkins Air Force Station Site Location Map
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

shelby_figure_1-1.dgn



LEGEND

FORMER WILKINS AFS APPROXIMATE PROPERTY BOUNDARY

CONTOURS

RAILROAD

INTERMITTENT DRAINAGE DITCH

STREAM/RIVER

GEOPHYSICAL ANOMALIES

EXISTING BUILDINGS

DIRECTIONAL FLOW ARROW

SOURCE: 7.5 MINUTE QUADRANGLE SHELBY, OHIO, 1960 (PHOTO REVISED 1982).
BASIC LAYOUT, DRAINAGE SYSTEM, WILKINS AF SPECIALIZED DEPOT, FEBRUARY 13, 1952.
BASIC LAYOUT PLAN, SHELBY AIR FORCE DEPOT, WILKINS AIR FORCE STATION.

North

0 800 1600

Approximate scale in feet

FIGURE 2-1

Site Layout and Shelby Horizons AOC Location
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

shelby_figure_2-1.dgn

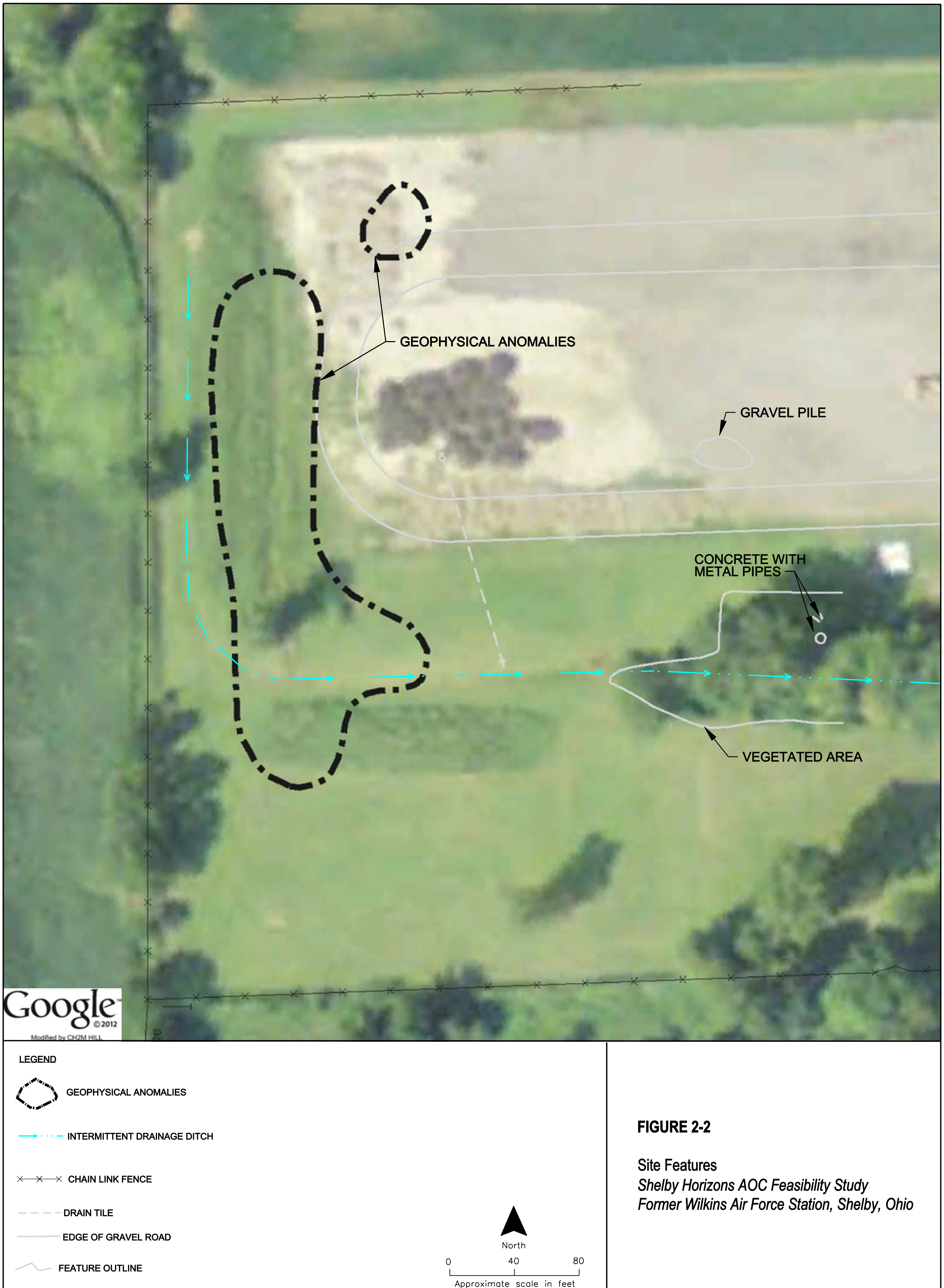
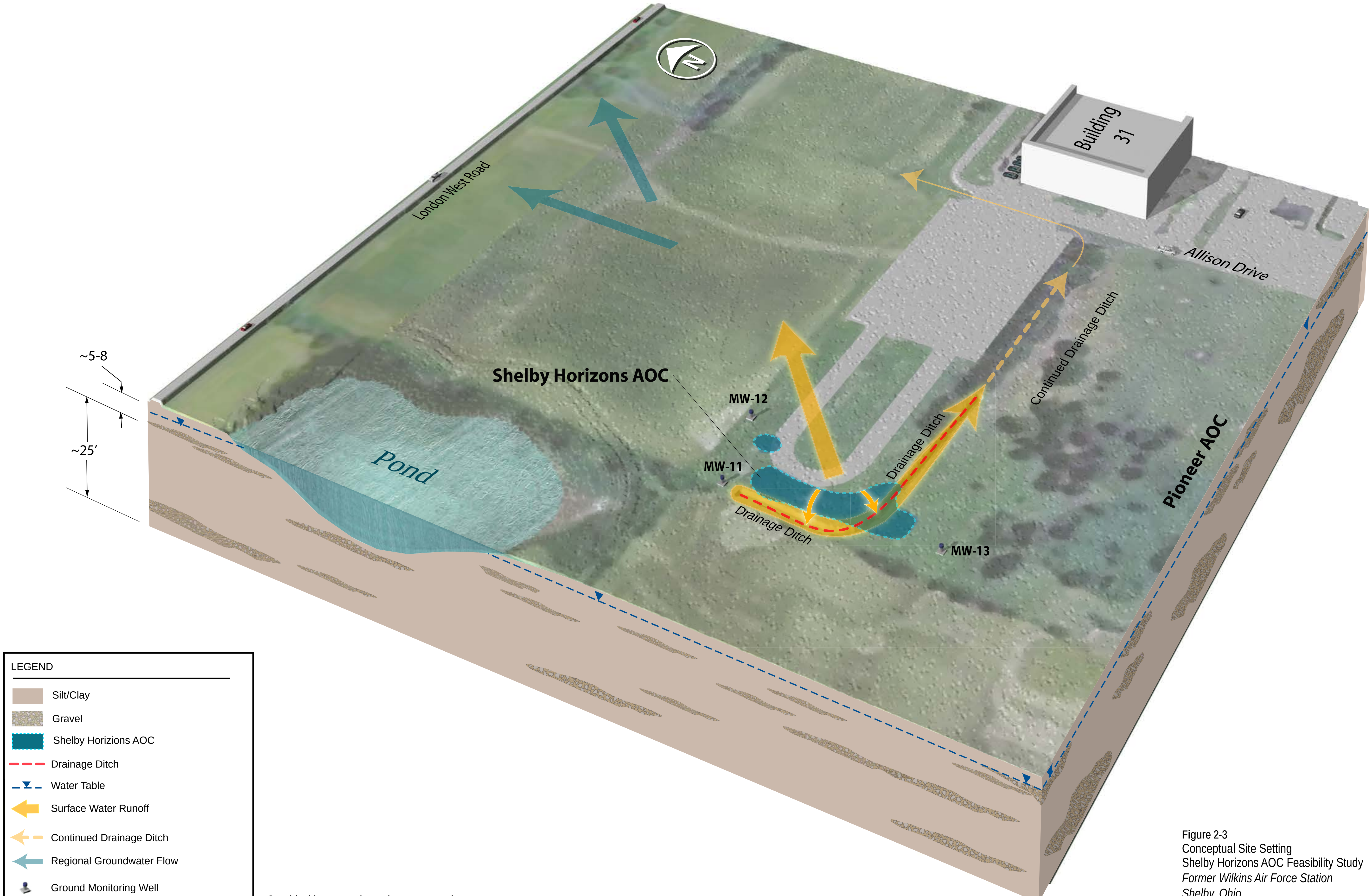


FIGURE 2-2

Site Features
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

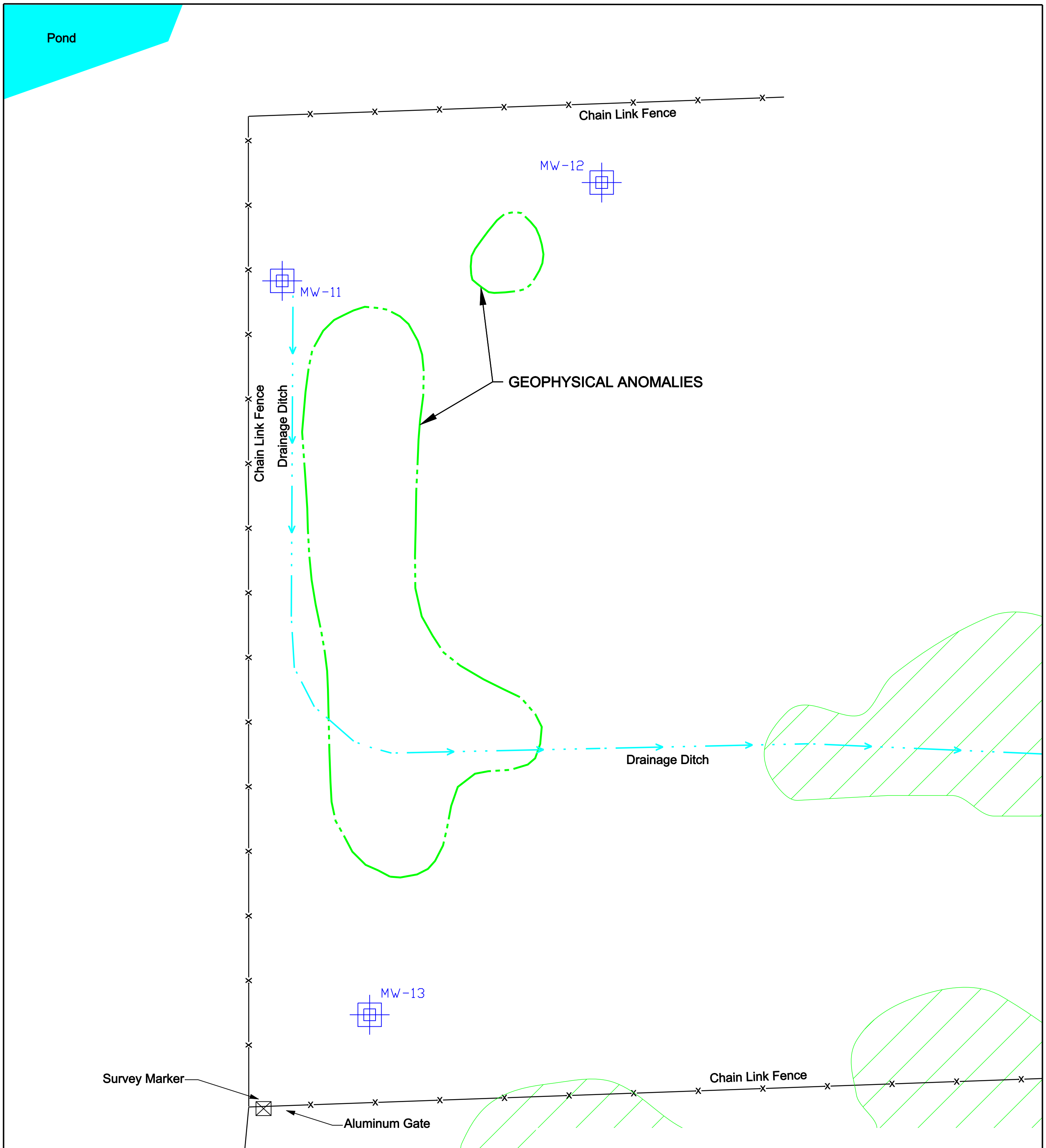
CH2MHILL

Shelby_Figure-2-2.dgn



Graphical interpretation only – not to scale

Figure 2-3
Conceptual Site Setting
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station
Shelby, Ohio



LEGEND

GEOPHYSICAL ANOMALIES

INTERMITTENT DRAINAGE DITCH

GROUNDWATER MONITORING WELLS

CHAIN LINK FENCE

APPROXIMATE EXTENT OF HEAVILY WOODED AREA

North

0 40 80

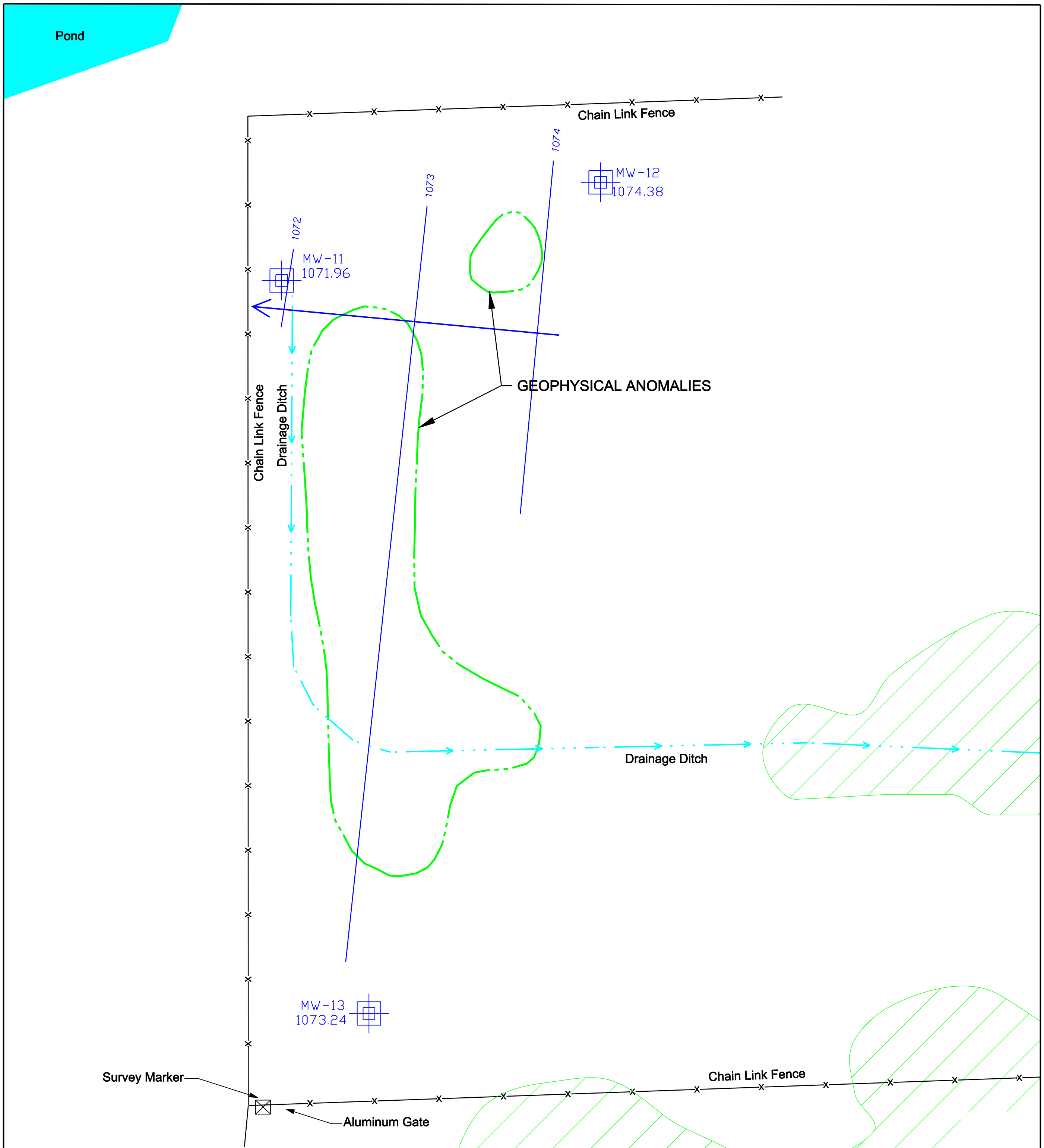
Approximate scale in feet

FIGURE 2-4

Groundwater Monitoring Well Locations
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

Shelby_Figure-2-4.dgn



LEGEND

- GEOPHYSICAL ANOMALIES
- GROUNDWATER MONITORING WELL
- 1073.24 GROUNDWATER ELEVATION
- GROUNDWATER ELEVATION CONTOUR
- CHAIN LINK FENCE
- INTERMITTENT DRAINAGE DITCH
- GENERALIZED GROUNDWATER FLOW DIRECTION
- APPROXIMATE EXTENT OF HEAVILY WOODED AREA

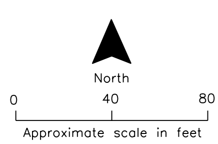
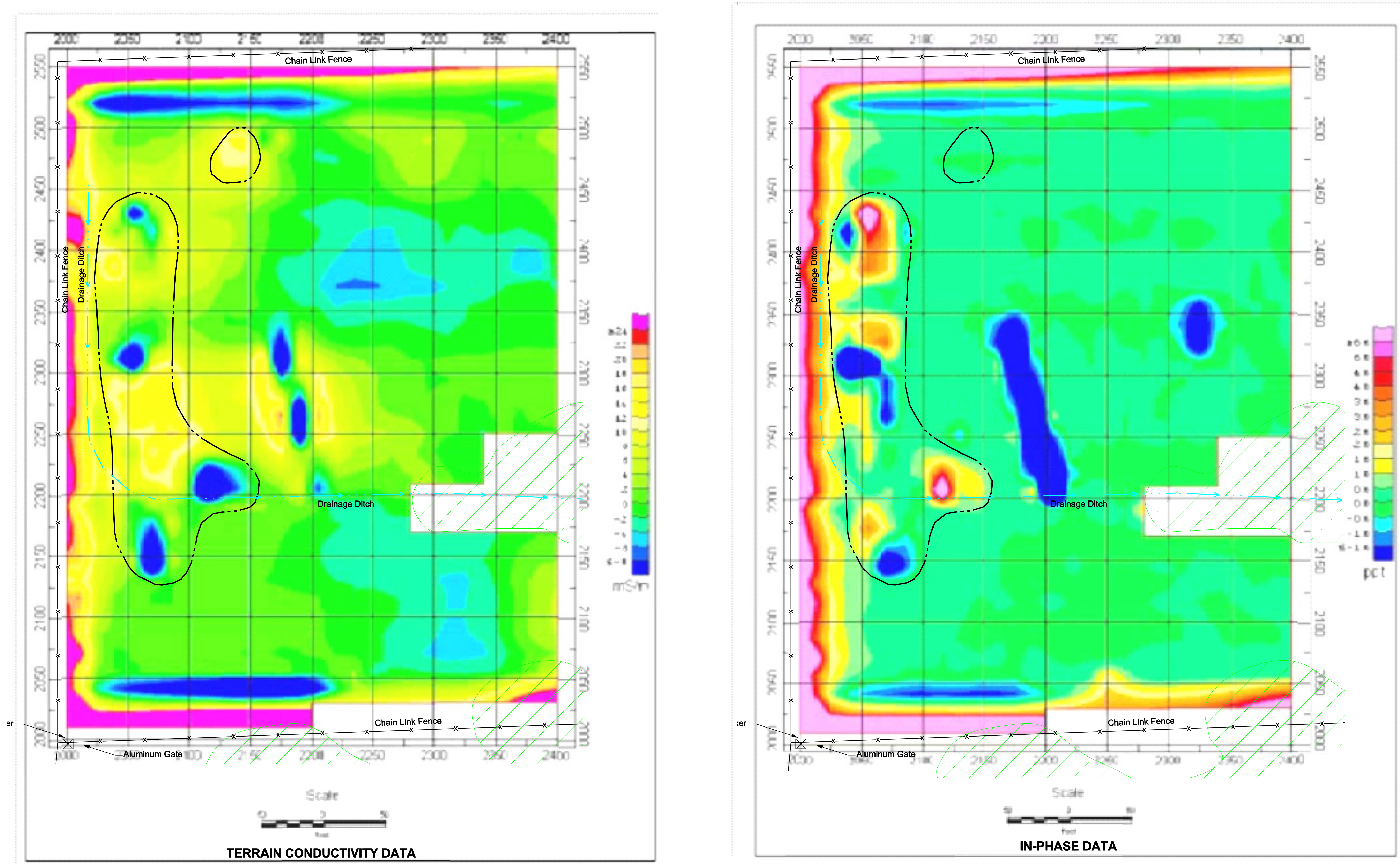


FIGURE 2-5

July 2009 Potentiometric Map
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL



LEGEND

- GEOPHYSICAL ANOMALIES
- FENCE
- INTERMITTENT DRAINAGE DITCH
- APPROXIMATE EXTENT OF HEAVILY WOODED AREA

North

0 40 80

Approximate scale in feet

FIGURE 2-6

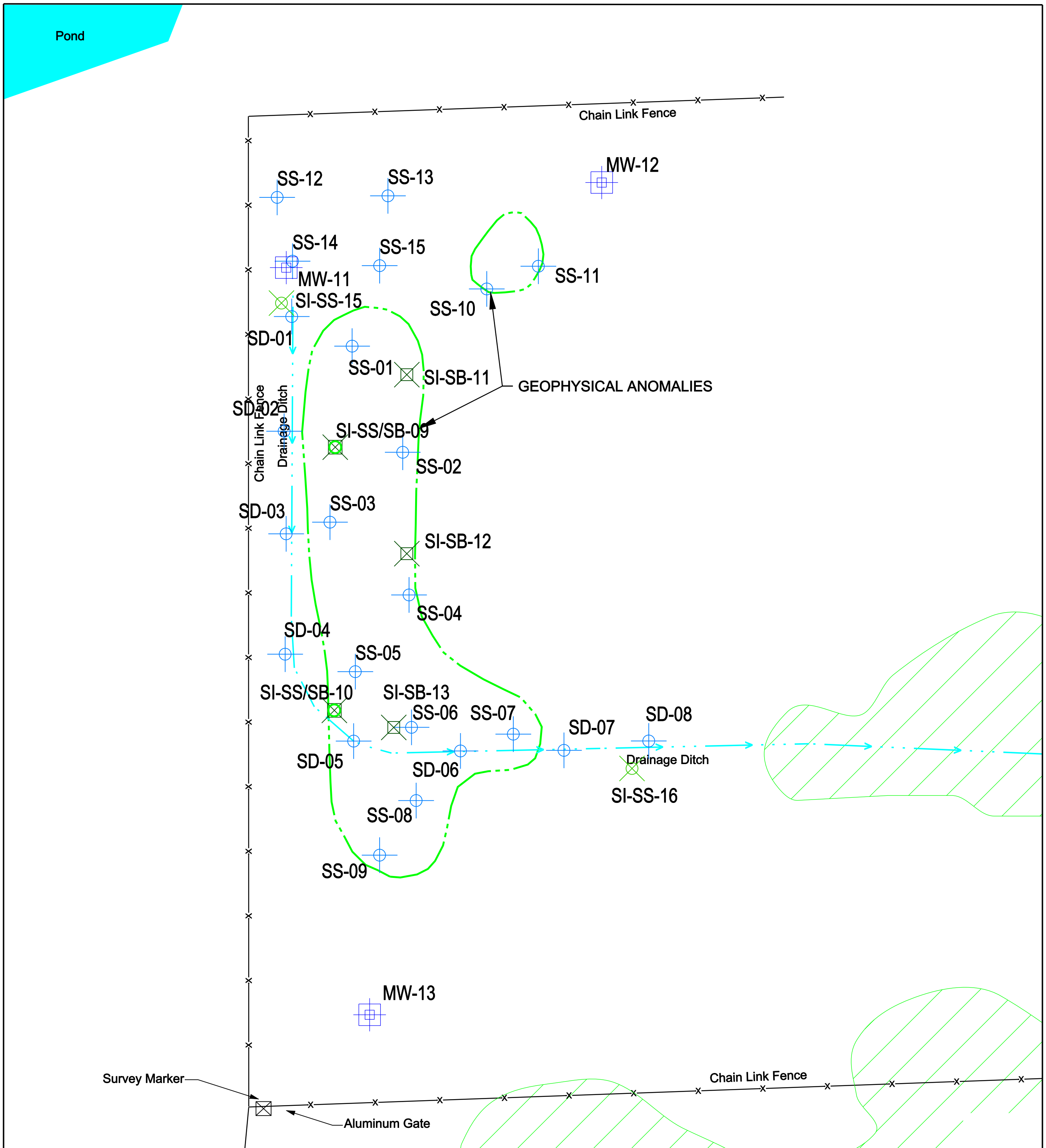
Geophysical Data

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

Shelby_Figure-2-6.dgn



LEGEND

- GEOPHYSICAL ANOMALIES
- CHAIN LINK FENCE
- INTERMITTENT DRAINAGE DITCH
- APPROXIMATE EXTENT OF HEAVILY WOODED AREA
- RI MONITORING WELL LOCATION
- RI SURFACE SOIL SAMPLE LOCATION
- SI SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION
- SI SURFACE SOIL SAMPLE LOCATION
- SI SUBSURFACE SOIL SAMPLE LOCATION

North

0 40 80

Approximate scale in feet

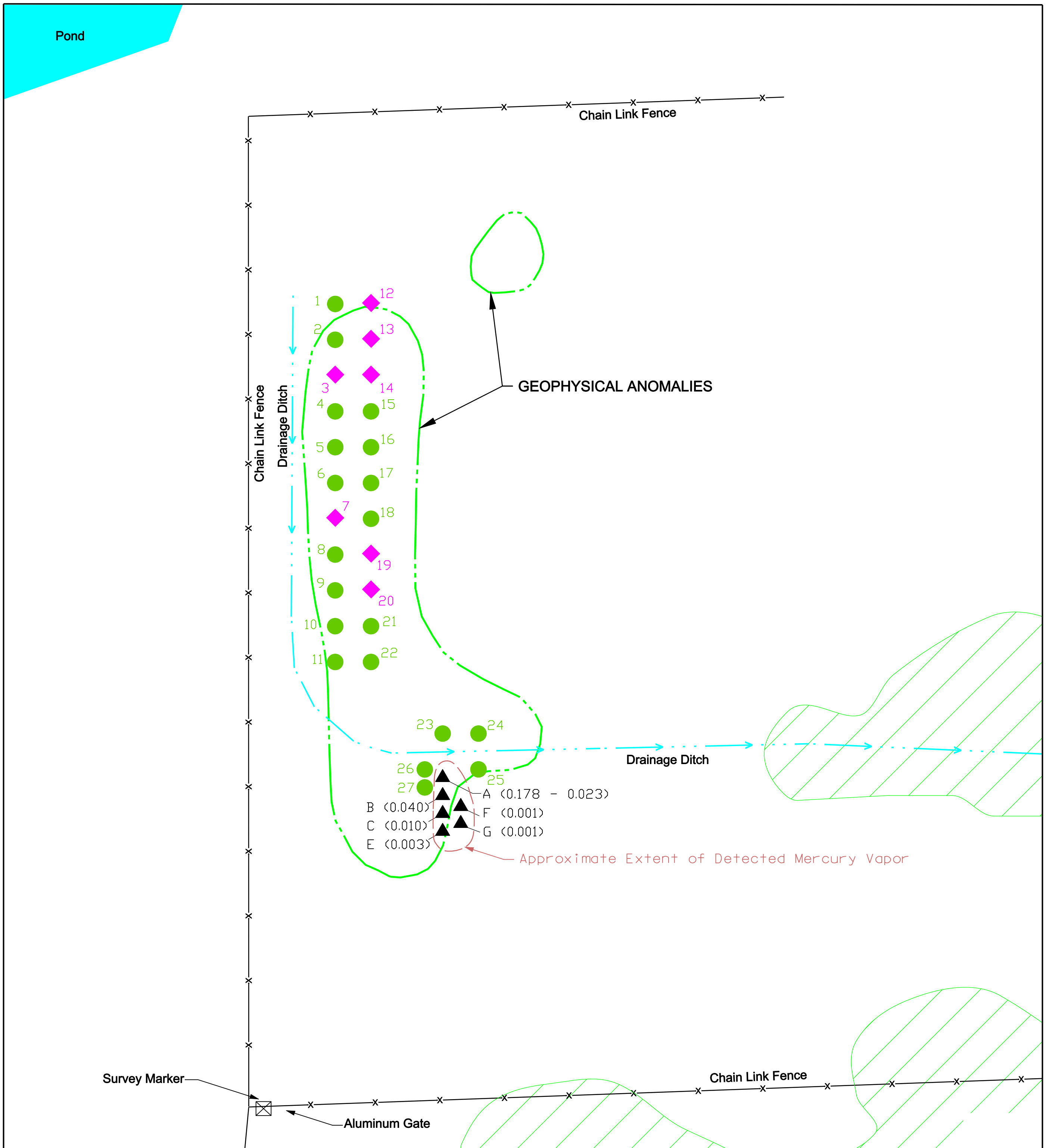
FIGURE 2-7

SI and RI Soil and Groundwater Sampling Locations

Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

Shelby_Figure-2-7.dgn



LEGEND

- GEOPHYSICAL ANOMALIES
- PLEXUS SI MERCURY VAPOR SCREENING LOCATION AND DETECTED RESULTS (mg/m3)
- PLEXUS SI MERCURY VAPOR SCREENING LOCATION (NON DETECT)
- PLEXUS SI MERCURY VAPOR SCREENING LOCATION (SAMPLE UNATTAINABLE)
- CHAIN LINK FENCE
- INTERMITTENT DRAINAGE DITCH
- AREA OF MERCURY VAPOR DETECTION
- APPROXIMATE EXTENT OF HEAVILY WOODED AREA

NOTES:

1. Sampling point D is not plotted due to incorrect coordinates obtained during the SI.

North

0 40 80

Approximate scale in feet

FIGURE 2-8

SI Mercury Vapor Field Sampling Locations

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

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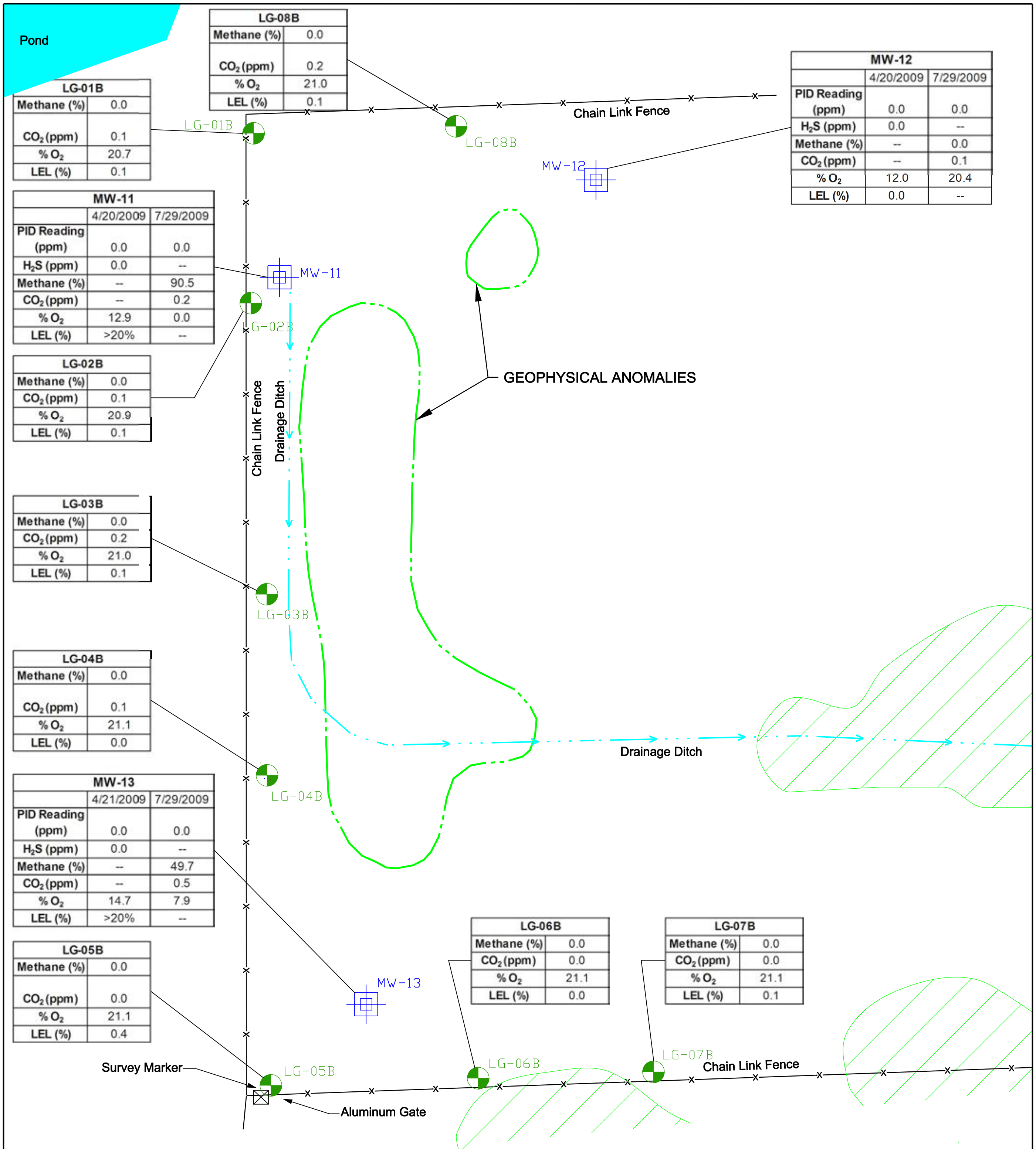
Shelby_Figure-2-8.dgn



LG-08B	
Methane (%)	0.0
CO_2 (ppm)	0.2
% O_2	21.0
LEL (%)	0.1

LG-01B	
Methane (%)	0.0
CO_2 (ppm)	0.1
% O_2	20.7
LEL (%)	0.1

MW-12	4/20/2009	7/29/2009
PID Reading (ppm)	0.0	0.0
H_2S (ppm)	0.0	--
Methane (%)	--	0.0
CO_2 (ppm)	--	0.1
% O_2	12.0	20.4
LEL (%)	0.0	--

MW-11	4/20/2009	7/29/2009
PID Reading (ppm)	0.0	0.0
H_2S (ppm)	0.0	--
Methane (%)	--	90.5
CO_2 (ppm)	--	0.2
% O_2	12.9	0.0
LEL (%)	>20%	--

LG-02B	
Methane (%)	0.0
CO_2 (ppm)	0.1
% O_2	20.9
LEL (%)	0.1

LG-03B	
Methane (%)	0.0
CO_2 (ppm)	0.2
% O_2	21.0
LEL (%)	0.1

LG-04B	
Methane (%)	0.0
CO_2 (ppm)	0.1
% O_2	21.1
LEL (%)	0.0

MW-13	4/21/2009	7/29/2009
PID Reading (ppm)	0.0	0.0
H_2S (ppm)	0.0	--
Methane (%)	--	49.7
CO_2 (ppm)	--	0.5
% O_2	14.7	7.9
LEL (%)	>20%	--

LG-05B	
Methane (%)	0.0
CO_2 (ppm)	0.0
% O_2	21.1
LEL (%)	0.4

LG-06B	
Methane (%)	0.0
CO_2 (ppm)	0.0
% O_2	21.1
LEL (%)	0.0

LG-07B	
Methane (%)	0.0
CO_2 (ppm)	0.0
% O_2	21.1
LEL (%)	0.1

LEGEND

- GEOPHYSICAL ANOMALIES
- SOIL GAS SURVEY LOCATION
- CHAIN LINK FENCE
- INTERMITTENT DRAINAGE DITCH
- MONITORING WELL LOCATION
- APPROXIMATE EXTENT OF HEAVILY WOODED AREA

NOTES:

1. Landfill Gas Survey conducted 10/31/2008.
2. Down well readings were only collected in April and July 2009
3. -- - Indicates measurement not available with instrument used
4. LEL - lower explosive limit
5. H2S - hydrogen sulfide
6. O2 Oxygen
7. CO2 - carbon dioxide
8. ppm - parts per million

North

0 40 80

Approximate scale in feet

FIGURE 2-9

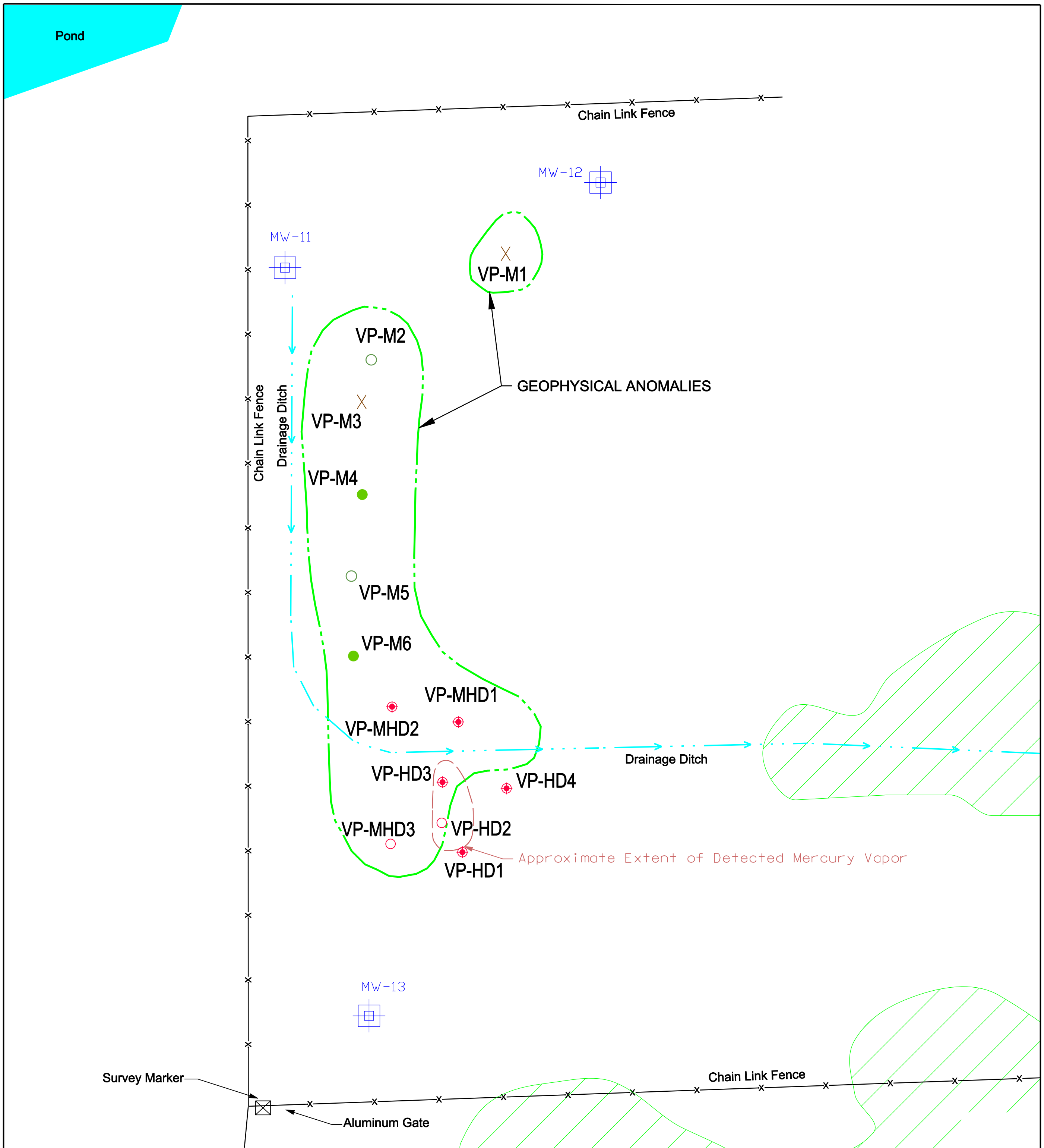
Landfill Gas Survey Locations

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

Shelby_Figure-2-9.dgn



LEGEND

GEOPHYSICAL ANOMALIES
MONITORING WELL LOCATIONS
CHAIN LINK FENCE
INTERMITTENT DRAINAGE DITCH
AREA OF MERCURY VAPOR DETECTION
APPROXIMATE EXTENT OF HEAVILY WOODED AREA

INSTALLED MERCURY PROBE LOCATION NO LAB SAMPLES COLLECTED
METHANE SUBSURFACE SAMPLING LOCATION
MERCURY VAPOR SUBSURFACE SAMPLING LOCATION
PLANNED METHANE LOCATION NO VAPOR PROBE INSTALLED
INSTALLED METHANE PROBE LOCATION NO LAB SAMPLES COLLECTED

North

0 40 80

Approximate scale in feet

FIGURE 2-10

Methane and Mercury Vapor Investigation Sampling Locations

Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

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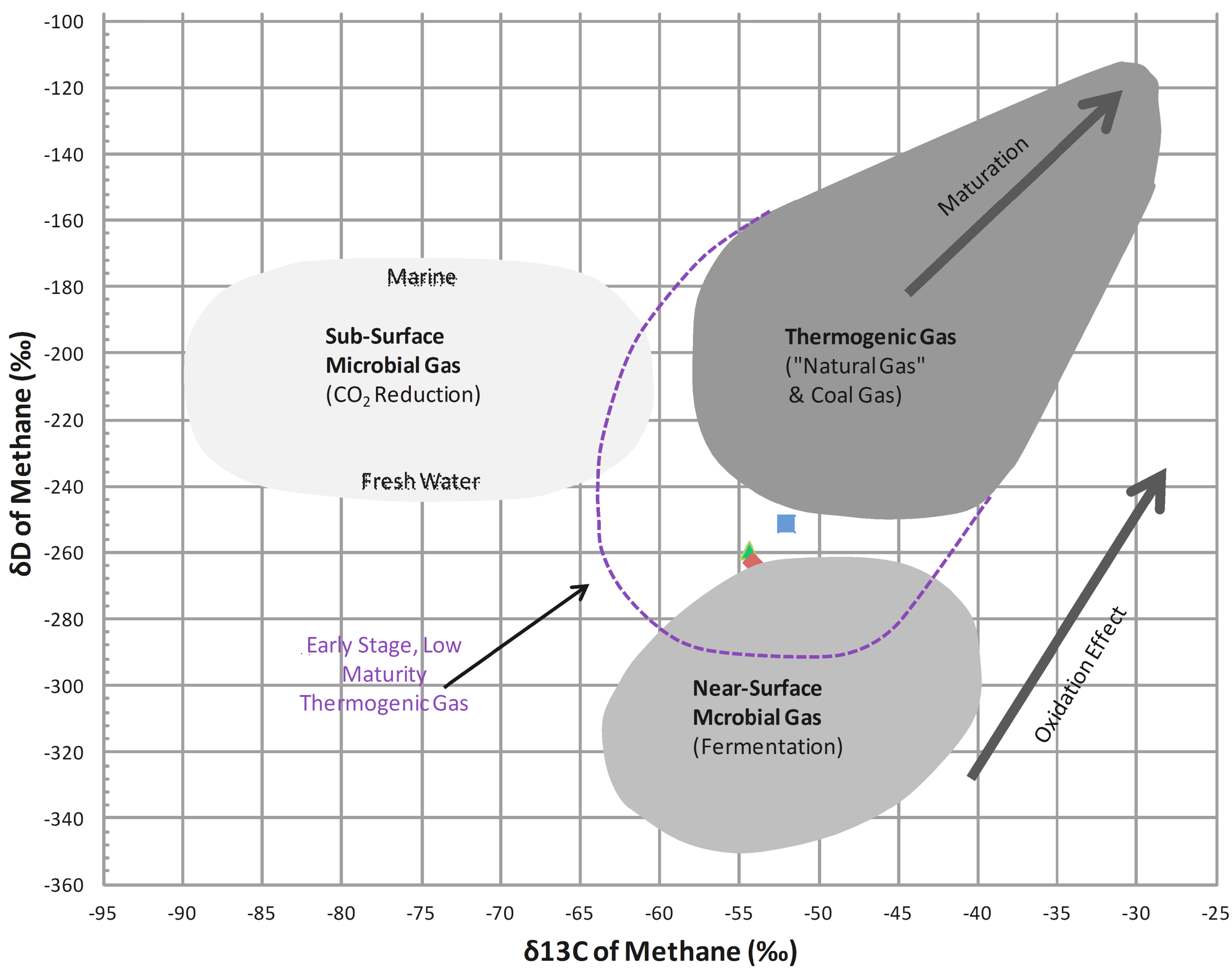
Shelby_Figure-2-10.dgn



Legend

Source: Isotech Laboratories, Inc.

VP-M4

MW-11

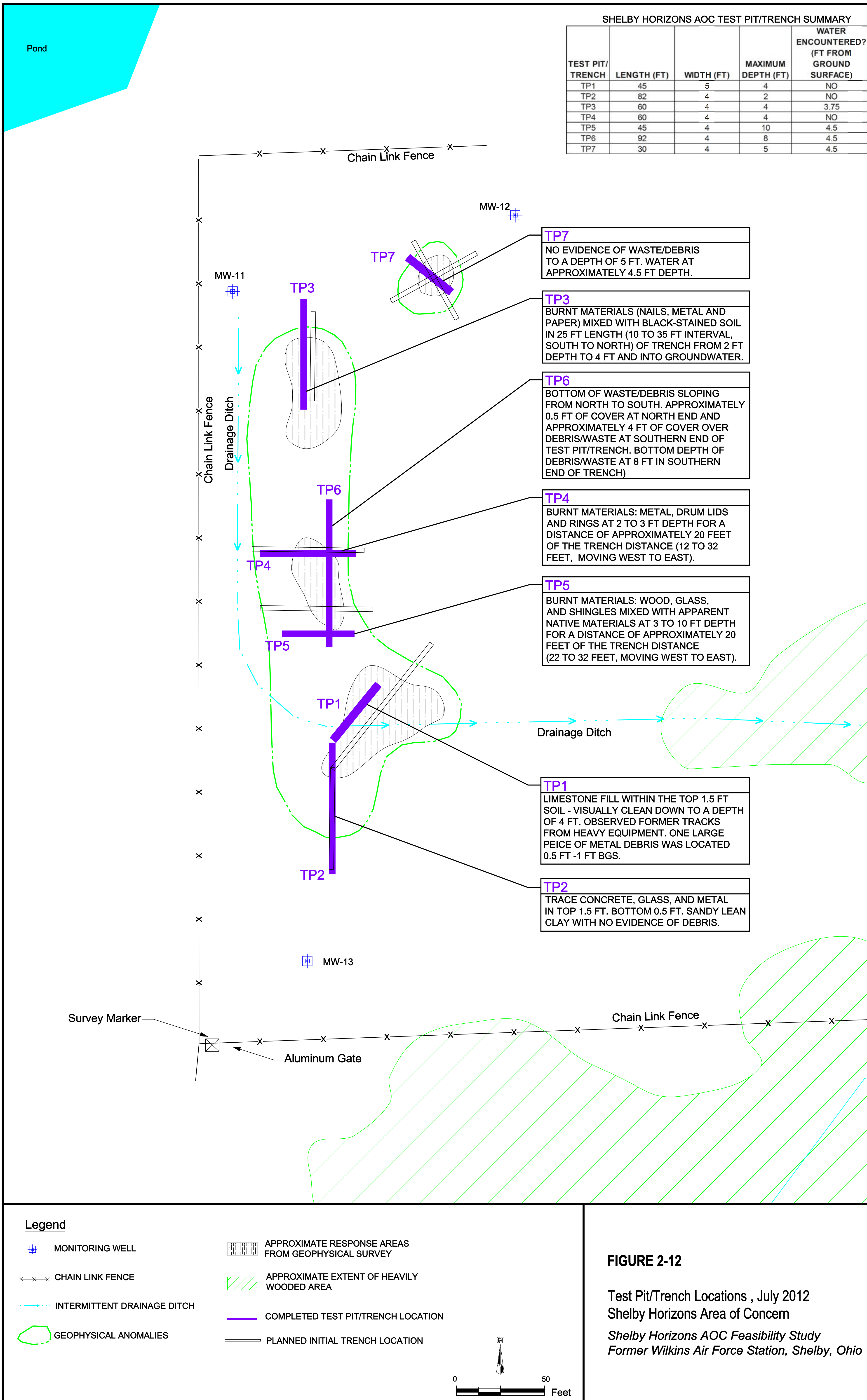
MW13

FIGURE 2-11

Shelby Horizons AOC Methane δ13C and δD data and Typical Domains for Methane Sources
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

Shelby_Figure-2-11.dgn

CH2MHILL



SHELBY HORIZONS AOC TEST PIT/TRENCH SUMMARY

TEST PIT/ TRENCH	LENGTH (FT)	WIDTH (FT)	MAXIMUM DEPTH (FT)	WATER ENCOUNTERED? (FT FROM GROUND SURFACE)
TP1	45	5	4	NO
TP2	82	4	2	NO
TP3	60	4	4	3.75
TP4	60	4	4	NO
TP5	45	4	10	4.5
TP6	92	4	8	4.5
TP7	30	4	5	4.5

FIGURE 2-12

Test Pit/Trench Locations , July 2012
Shelby Horizons Area of Concern

Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

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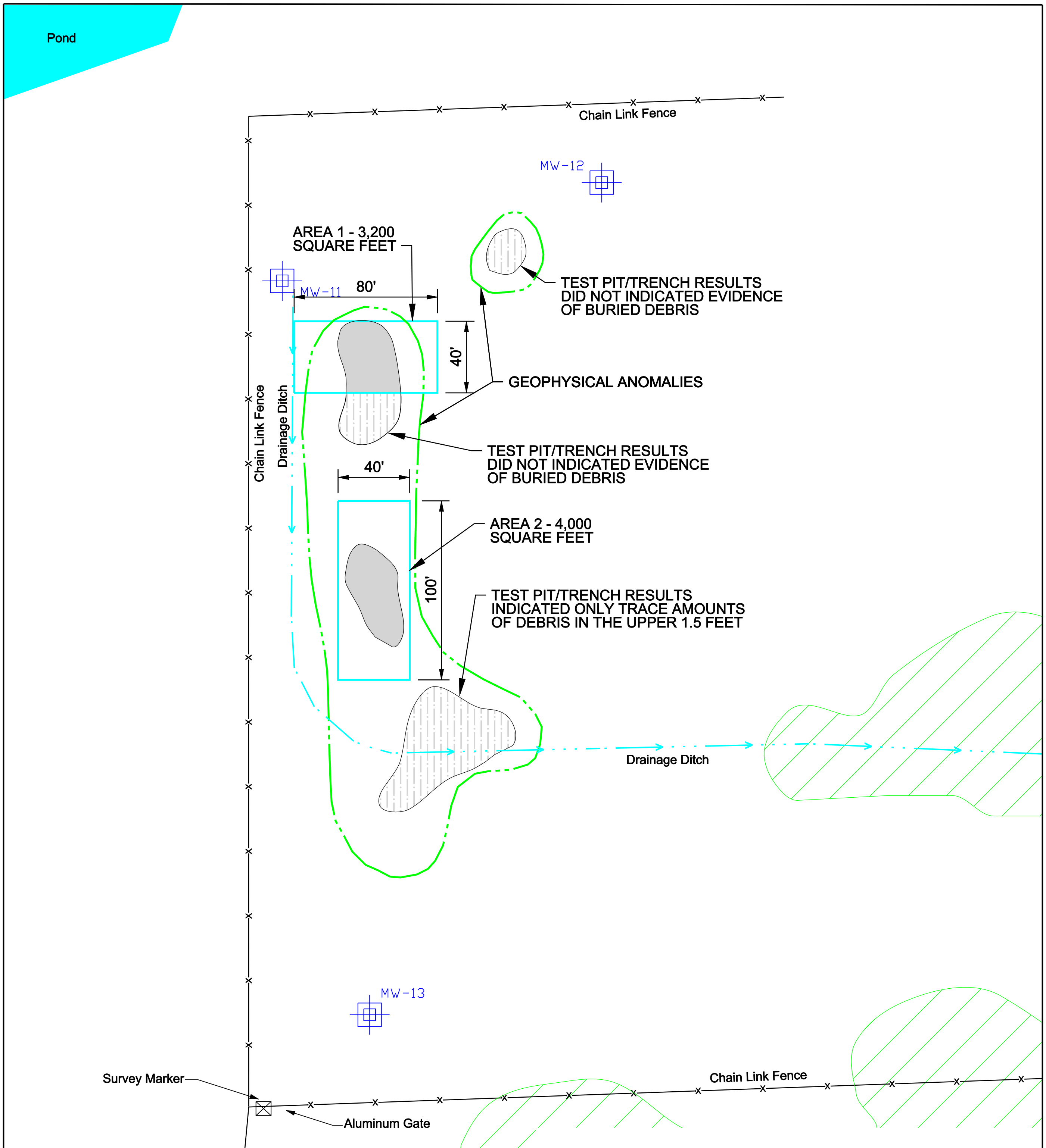
Shelby_Figure-2-12.dgn



LEGEND

GEOPHYSICAL ANOMALIES

INTERMITTENT DRAINAGE DITCH

GROUNDWATER MONITORING WELLS

CHAIN LINK FENCE

APPROXIMATE EXTENT OF HEAVILY WOODED AREA

EXCAVATION AREA

APPROXIMATE RESPONSE AREA FROM GEOPHYSICAL SURVEY WERE DEBRIS MATERIAL WAS OBSERVED

APPROXIMATE RESPONSE AREA FROM GEOPHYSICAL SURVEY NOT USED TO DEFINE BURIED DEBRIS. NO DEBRIS OR ONLY TRACE AMOUNTS OF DEBRIS MATERIAL WERE OBSERVED

North

0 40 80

Approximate scale in feet

FIGURE 3-1

Estimated Extent of Buried Material
Shelby Horizons AOC Feasibility Study
Former Wilkins Air Force Station, Shelby, Ohio

CH2MHILL

Shelby_Figure-3-1.dgn

Appendix A
Methane and Mercury Vapor Investigation Field Documentation and Laboratory Reports

TABLE A-1

Measured Groundwater Elevations – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

				7/10/2102	
Well Name	Top of Casing (ft amsl)	Northing	Easting	Static Water Level (ft btoc)	Elevation (ft amsl)
MW-11	1080.97	451190.75	1919856.02	13.65	1067.32
MW-12	1081.85	451240.99	1920034.16	5.62	1076.23
MW-13	1080.51	450772.85	1919904.57	7.35	1073.16

Notes:

ft amsl = feet above mean sea level

ft btoc = feet below top of casing

Survey data was collected during the Remedial Investigation in 2008

TABLE A-2

Water Quality Field Parameters – July 2012

Shelby Horizons AOC Feasibility Study

Former Wilkins Air Force Station, Shelby, Ohio

		Water Column Data			Water Quality Parameters					
Well ID	Date	Initial DTW (feet btoc)	Total Depth (feet btoc)	Height of Water Column	pH	DO (mg/L)	Specific Conductance (mS/cm)	ORP (mV)	Temperature (°C)	Turbidity (NTU)
MW-11	7/11/2012	7.80	27.00	19.20	7.86	0.77	0.543	-189.0	20.60	12.6
MW-12	7/10/2012	5.62	22.44	16.82	6.98	0.62	1.010	97.0	18.82	0.6
MW-13	7/11/2012	7.50	26.41	18.91	7.49	0.63	0.671	-182.0	16.91	NA

Notes:

Parameters shown were recorded immediately before sampling

°C = degree(s) Celsius

btoc = below top of casing

DO = dissolved oxygen

DTW = static water level before purging

mg/L = milligram(s) per liter

mS/cm = microsiemen(s) per centimeter

mV = millivolt(s)

NA = not available; turbidity meter was malfunctioning and no reading could be collected

NTU = nephelometric turbidity unit(s)

ORP = oxidation reduction potential

Shelby Horizons AOC Vapor Investigation

PHOTOGRAPH 1
Initial Methane Readings at MW-11 Using the GEM 2000 Landfill Gas Meter, J-plug, and Valve

PHOTOGRAPH 2
J-Plug and Valve Setup for Initial GEM 2000 Methane Readings at MW-13

PHOTOGRAPH 3
Groundwater Sampling Setup at MW-13

PHOTOGRAPH 4
VP-M2 Exploratory Boring via Geoprobe. Native and fill material can be seen.

PHOTOGRAPH 5

VP-M2 Vapor Probe Installation

PHOTOGRAPH 6

VP-M2 Installation Complete

PHOTOGRAPH 7

MW-11 Total Reduced Sulfur (TRS) Sampling via Lung Box and Vacuum Pump

PHOTOGRAPH 8

VP-M4 TRS and Fixed Gases Samples Being Taken After Purge and Passing Helium Leak-check

PHOTOGRAPH 9

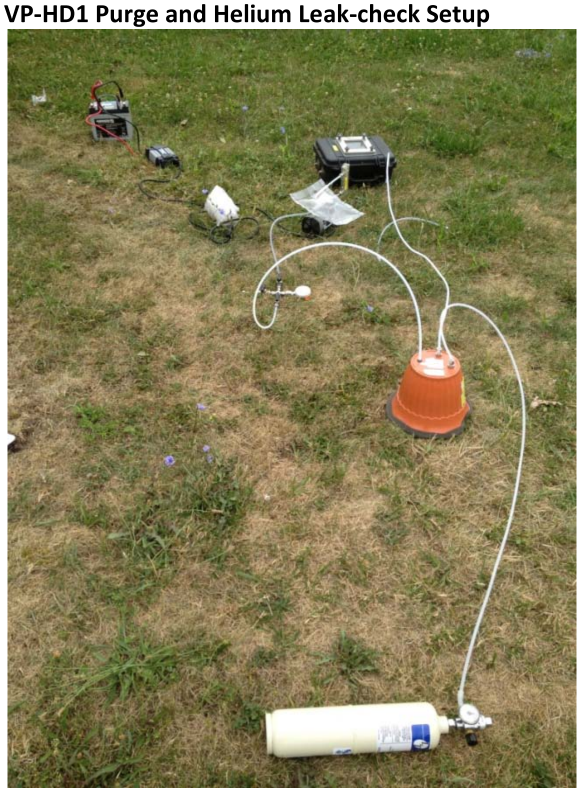
VP-M6 Preliminary GEM 2000 Readings

PHOTOGRAPH 10

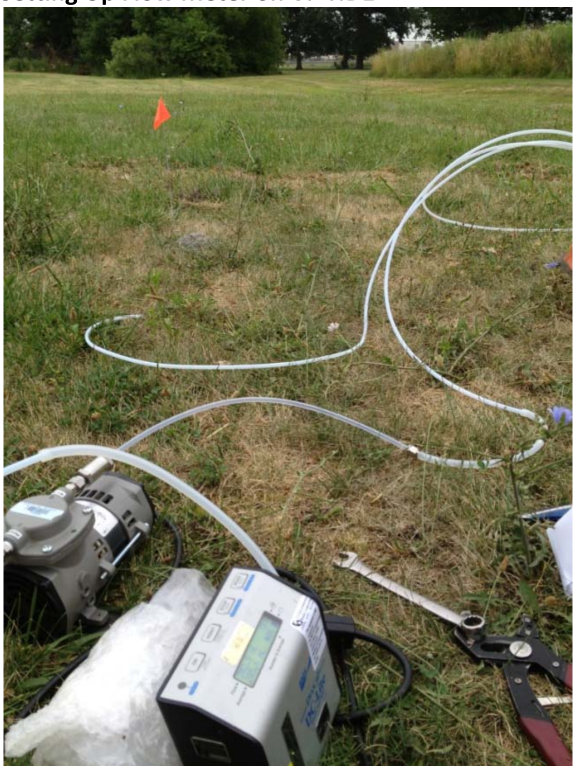
Total Reduced Sulfur Samples Prepared for Dangerous Goods Shipping

PHOTOGRAPH 11

VP-HD1 Purge and Helium Leak-check Setup



PHOTOGRAPH 12
Setting Up Flow Meter on VP-HD1



PHOTOGRAPH 13
Sampling VP-HD3 Sampling, Flow Meter Check to Ensure Correct Sampling Flow

CH2MHILL

PROJECT NUMBER 435223 (MC)

BORING NUMBER VP-MHD1

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: Sunny 80's DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 5' END: LOGGER: B. Ribber

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
		28/48	MC		Fill: Brown Silty Clay (CL), dry, loose, w/ crushed limestone	0.0 / 0.0
2.5					as above but dk gray for 6" + moist	
5.0		32/48	MC		Brown + Gray Silty Clay (CL) w/ trace fine sand and gravel wet	0.0 / 0.0
7.5						0.0 / 0.0
					Boring terminated @ 8' bgs	VP set @ 2' bgs
10						

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET
435223 (MC)	VP-MHD2	1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons – Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: Sunny 80's slight breeze DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 AT

WATER LEVELS START: 6.5 END: LOGGER: B. Ribber

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
		32/48	MC		Fill: Brown & gray Silty Clay (CL), dry, loose, w/ crushed limestone	
2.5					as above, but dk gray & w/ organics for 8"	
5.0		38/48	MC		Brown Clayey Silt (ML) damp stiff	
					Gray Silty Clay (CL), w/ fine sand & gravel, moist, stiff	
7.5					Boring terminated @ 8' bgs.	
10.0						VP set @ 4.5'

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER: 435223 (mc)

BORING NUMBER: VP-MHD 3

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: Mid 70's sunny DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 5.5 END: NA LOGGER: B. Roblar

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
		38/48	mc		Fill: Brown + gray silty clay (CL) w/t to w/s crushed limestone, loose dry	0.0 / 0.0
2.5					@3'10" (2" of coal pieces)	
					Fill: Dk gray silty clay (CL) damp med stiff, w/t coal, metal + glass pieces	
5		30/48	mc		as above but wet @ 5.5	0.0 / 0.0
					Brown + gray silty clay (CL), firm, damp, with trace fine sand + gravel	
7.5						0.0 / 0.0
					Boring terminated @ 8' bgs	
10						VP @ 3.5 feet

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET
435223 (MC)	VP-HA2	1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby OH DATE: 12 July 12

(MC) WEATHER: sunny 70's DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe, 6620 DT

WATER LEVELS START: 7.8 END: LOGGER: B. Robber

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
		36/48	MC		Fill: Brown silty Clay (CL) dry, loose w/t crushed limestone as above but w/organics for 4"	
4		40/48	MC		Fill: Brown & gray, Silty Clay firm, damp w/t fine sand	→ 2" sandstone small cobbles @ 6'
					Reddish brown silty clay (CL) w/t fine sand	Wet @ 7.8'
8					Boring terminated @ 8' bgs. Note: This boring is about 2.5 feet higher than the other Hg Vapor points. Elevation will be obtained via gps at a later time this week.	VP = 6.5'

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER 435223

BORING NUMBER VP-HD1

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS　LOCATION: Shelby, OH　DATE: 12 July 12

WEATHER: Sunny mid 80's　DRILLING CONTRACTOR: Frantz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620DT

WATER LEVELS　START: 6.5　END: NA　LOGGER: B. Robber

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
		42/48	MC		Fill: Brown Silty Clay (CL) dry, loose w/ crushed limestone SS	
4		38/48	MC		Brown Silty Clay (CL) med stiff, damp w/ fine sand + gravel as above but very moist	
8					Boring terminated @ 8'	
						VP = 3.5' outfitted @ 1500

Sampler Signature: [signature]　Date: 12 July 12

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET
435223 (MC)	VP-HD3	1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons – Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: sunny 70's DRILLING CONTRACTOR: Frantz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: ? END: NA LOGGER: B. Robbar

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
		42/48	MC		Fill: Brown Silty Clay (CL), with trace crushed limestone, dry loose	
2.5						
					Gray + brown (CL), med stiff, moist, w/ fine sand + gravel	
5		40/48	MC			
					as above but soft & wet	
7.5						
					Boring terminated @ 8' bgs	
10						VP @ 3.5' bgs

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER 435223

BORING NUMBER VP-HQ4

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: Sunny Mid 70's DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 6' END: LOGGER: B. Robber

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone	Above Hole
		32/48	MC		Fill: Brown Silty Clay (CL), with trace limestone fragments, dry loose	0.0	0.0
2.5							
5		36/48	MC		Reddish brown & gray Silty Clay (CL) w/ fine sand & gravel, stiff & damp. as above but very moist	0.0	0.0
7.5						0.6	0.0
					Boring terminated @ 8' bgs		
10						VP set @ 3'	

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET
435223	VP-M1	1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 11 July 12

WEATHER: Sunny 90° DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 6.6 END: NA LOGGER: B. Robben

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
					Fill: Dark gray Silty Clay (CL), stiff w/ crushed limestone	0.0 / 0.0
		36/48	MC		Reddish brown w/ gray CL-CH silty clay to clay w/ very fine sand and gravel (subrounded) damp, med stiff	
2.5						
						0.0 / 0.0
5		42/48	MC		Brown w/ some gray Silty Clay (CL) damp, medium stiff	
					as above w/ very fine sand and gravel, wet	
7.5					Gray Silty Clay (CL), firm, moist w/ some fine to medium gravel	
					Boring terminated @ 8 feet bgs.	
10						
					Note: No vapor point set due to lack of fill soils encountered	

Sampler Signature: [signature] Date: 11 July 12

CH2MHILL	PROJECT NUMBER 435223 (MC)	BORING NUMBER VP-M2	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons Wilkins AFS LOCATION: Shelby, OH DATE: 11 July 12

WEATHER: Sunny 80s (upper) DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 4' END: NA LOGGER: B, Robben

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone	Above Hole
					Fill: Brown silty Clay (CL), w/s crushed limestone, loose, dry	0.0	0.0
					Fill: Lt brown Clayey Silt (ML) dry, loose		
		36/48	MC		Fill: Gray w/s brown silty Clay (CL), dry, loose		
2.5							
					Fill: Dark brown to black silty clay (CL) w/t sand, glass fragments and a nail. loose, wet @ 4'	0.0	0.0
5							
		28/48	MC		as above with trace organics (wood pieces) and metal fragments.		
						0.0	0.0
7.5					Dark brown silty clay (CL), firm, moist		
					Boring terminated @ 8 feet bgs.		
10							
					Vapor point installed @ 3' bgs.		

Sampler Signature: [signature] Date: 11 July 12

CH2MHILL

PROJECT NUMBER: 435223 (MC)

BORING NUMBER: VP-M5

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 12

WEATHER: Sunny 80's warm DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 7' (MC) END: LOGGER: R. Robben

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone	Above Hole
					Fill: Lt. Brown, Silty clay (CL), loose, dry w/ crushed limestone	0.0	0.0
2.5		42/48	MC				
					Fill: Brown Silty Clay (CL), firm, damp w/ crushed limestone		
5						0.0	0.0
		24/48	MC		as above but wet @ 7' bgs, soft and w/ fine sand and gravel, coal pieces & leave pieces (Fill)		
7.5							
					Gray Silty Clay (CL) stiff, moist, w/ fine sand & gravel		
10		36/48	MC			0.0	0.0
12.5					Boring terminated @ 12' bgs		

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 1
436223 (MC)	VP-M4	

SOIL BORING LOG

PROJECT: Shelby Horizons - Wilkins AFS LOCATION: Shelby, OH DATE: 12 July 2012

WEATHER: Clear 70's DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS START: 6.5 END: NA LOGGER: B. Robben

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone / Above Hole
		30/48	MC		Fill: Brown Silty Clay (CL), w/ crushed limestone dry, loose	0.0 / 0.0
2.5					Fill: Dark brown Silty Clay (CL) damp, firm, w/ trace fine sand & roots	
5		48/48	MC		Lt. Brown Silty Clay (CL) moist, soft, with trace fine sand & medium gravel	0.0 / 0.0
7.5						0.0 / 0.0
					Boring terminated @ 8 feet bgs.	
10						VP installed @ 3.5 feet

Sampler Signature: [signature] Date: 12 July 12

CH2MHILL

PROJECT NUMBER: 435223 (mc)

BORING NUMBER: VP-M6

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: Shelby Horizons

LOCATION: Shelby, OH

DATE: 12 July 12

WEATHER: Mid to upper 80s

DRILLING CONTRACTOR: Frontz Drilling

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6620 DT

WATER LEVELS:

START: 6

END:

LOGGER: B. Robben

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (IN)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. OVM (ppm): Breathing Zone Above Hole
					Fill: Brown Silty Clay (CL) w/ to w/s crushed limestone dry loose	
2.5		40/48	mc		Fill: Brown + gray Silty Clay w/ crushed limestone, moist firm,	
5		42/48	mc			
7.5					Gray Silty Clay, (CL) moist stiff Boring terminated @ 8' bgs	
10						

Sampler Signature: [signature]

Date: 12 July 12

CH2MHILL

PROJECT NUMBER	WELL NUMBER
435223.02.03.01.01	SHEET 1 OF 1

LOW FLOW SAMPLING LOG

Well Number: MW-11
Field Crew: Leslie Baechler
Well Depth (ft): 27'
DTW (ft): 7.80
Water Column (ft): 19.2
Well Diameter (in): 2"
Gal. Per ft: .163
Well volume (gal): 3.12
Depth of Screen (ft): 10' screen

Purge Methodology: Low Flow w/Peristaltic

Site: Shelby Horizons AOC
Date: 7/11/12

Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
2"	0.163	5"	1.02
3"	0.367	6"	1.469
4"	0.653	8"	2.611

Field Parameters

	Time	DTW (toc)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/L)	Turbidity (NTU)	Color/Odor
	Stabilization	<0.3'	300-500		0.1	1 C	3%	10 mV	10%	10%	
INT.	1455	10.10	150	0.5	7.67	21.14	.546	-104	2.54	35.8	clear/none Bubbles in tubing
1 VOL.	1505	11.35	150	.75	7.72	20.93	.545	-120	1.63	32.1	"
2 VOL.	1510	12.12	150	1.0	7.68	20.64	.543	-136	1.14	29.8	"
3 VOL.	1522	13.36	150	1.5	7.70	20.80	.536	-149	0.81	22.7	"
4 VOL.	1526	13.85	150	1.75	7.76	20.78	.535	-156	0.74	17.7	"
5 VOL.	1532	14.30	150	2.0	7.76	20.85	.534	-163	0.68	21.6	"
6 VOL.	1538	14.56	150	2.25	7.77	20.66	.536	-165	0.68	22.8	"
7 VOL.	1543	14.92	150	2.5	7.82	20.80	.537	-172	0.63	21.7	"
8 VOL.	1547	15.21	150	2.75	7.85	20.80	.537	-176	0.59	15.8	"
9 VOL.	1556	15.86	150	3.25	7.86	20.59	.540	-182	0.55	15.6	"
10 VOL.	1600	16.07	150	3.75	7.75	21.01	.534	-177	0.60	15.0	"
11 VOL.	1610	16.57	150	4.0	7.84	20.66	.539	-186	0.72	14.4	"
12 VOL.	1615	16.71	150	4.25	7.85	20.59	.540	-188	0.76	13.5	"
13 VOL.	1620	16.93	150	4.5	7.83	20.62	.542	-189	0.78	12.2	"
14 VOL.	1625	17.07	150	4.75	7.86	20.60	.543	-189	0.77	12.6	"
15 VOL.	1630	SAMPLE TIME									
16 VOL.											
17 VOL.											
18 VOL.											
19 VOL.											
20 VOL.											

Remarks:
GW-MW11-071112
FD01-071112

Sampling

Depth to Water Before Sampling: 17.07
Depth sample was acquired: ~23
Sample Methodology: Low Flow Peristaltic
Sample Date/Time: 7/11/12 @ 1630
Signed Sampler: [signature]
Filtered Metals Collected: Y / N (N circled)
Filter Size:
Sample Observations: Clear/none
Parameters: MEE Disolved gases CH_4 + CO_2

CH2MHILL

PROJECT NUMBER 435223.02.03.01.01

WELL NUMBER

SHEET 1 OF 1

LOW FLOW SAMPLING LOG

Well Number: MW-12

Field Crew: Leslie Baechler

Well Depth (ft): 22.44

DTW (ft): 5.62

Water Column (ft): 16.82

Well Diameter (in): 2"

Gal. Per ft: .163

Well volume (gal): 2.74

Depth of Screen (ft): 10' (22-12)

Purge Methodology: Low Flow w/Peristaltic

Site: Shelby Horizons AOC

Date: 7/10/12

Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
2"	0.163	5"	1.02
3"	0.367	6"	1.469
4"	0.653	8"	2.611

Field Parameters

	Time	DTW (toc)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/L)	Turbidity (NTU)	Color/Odor
	Stabilization	<0.3'	300-500		0.1	1 C	3%	10 mV	10%	10%	
INT.	1500	5.64	200	—	6.73	19.73	0.996	142	6.53	2.5	clear/none
1 VOL.	1505	6.50	200	.5	6.89	19.02	1.00	125	2.38	0.8	"
2 VOL.	1510	6.76	200	1	7.02	18.75	.990	114	1.27	0.4	"
3 VOL.	1515	6.76	175	1.5	7.04	18.87	1.00	107	0.83	0.5	"
4 VOL.	1520	6.77	175	2	7.02	18.76	1.01	103	0.74	0.7	"
5 VOL.	1525	6.78	175	2.5	6.98	18.82	1.00	100	0.67	0.6	"
6 VOL.	1530	6.78	175	2.75	6.97	18.82	1.01	98	0.64	0.5	"
7 VOL.	1535	6.78	175	3.0	6.98	18.82	1.01	97	0.62	0.6	
8 VOL.	1540	—	—	—	—	— SAMPLE —					
9 VOL.											
10 VOL.											
11 VOL.											
12 VOL.											
13 VOL.											
14 VOL.											
15 VOL.											
16 VOL.											
17 VOL.											
18 VOL.											
19 VOL.											
20 VOL.											

Remarks: GW-MW12-071012

TOC TOR 1.5"

TPro to Concr 36'5

TOR gr s 3'4 40

Sampling

Depth to Water Before Sampling: 6.78'

Depth sample was acquired: ~18'

Sample Methodology: Low flow Peristaltic

Sample Date/Time: 7/10/12

Signed Sampler: [signature]

Filtered Metals Collected: Y (N) Filter Size: —

Sample Observations: clear/none

Parameters: MEE (CO_2 + CH_4) Dissolved Gases RSK-175 (3) 40ml VOA

CH2MHILL

PROJECT NUMBER	WELL NUMBER
435223.02.03.01.01	SHEET 1 OF 1

LOW FLOW SAMPLING LOG

Well Number: MW-13
Field Crew: Leslie Boechler
Well Depth (ft): 26.41
DTW (ft): 7.50
Water Column (ft): 18.91
Well Diameter (in): 2"
Gal. Per ft: 0.163
Well volume (gal): 3.08
Depth of Screen (ft): 10' Screen

Purge Methodology: Low Flow Peristaltic Pump

Site: Shelby Horizons AOC
Date: 7/11/12

Diameter	Gal. Per Foot	Diameter	Gal. Per Foot
2" (circled)	0.163	5"	1.02
3"	0.367	6"	1.469
4"	0.653	8"	2.611

Field Parameters

	Time	DTW (toc)	Flow Rate (ml/min)	Total Volume (gal)	pH (Std. Units)	Temp (C)	Cond. (mS/cm)	ORP (mV)	D.O. [Surface] (mg/L)	Turbidity (NTU)	Color/Odor
	Stabilization	<0.3'	300-500		0.1	1 C	3%	10 mV	10%	10%	
INT.	1011	8.05	175*	—	6.93	17.99	0.703	-179	3.21	50.8	clear/no odor
1 VOL.	1018	8.36	150	0.5	7.11	17.04	.701	-187	1.86	42.0	"
2 VOL.	1023	8.47	150	1.0	7.19	16.55	.698	-188	1.35	22.5	"
3 VOL.	1035	8.61	150	1.5	7.19	16.30	.694	-186	1.17	18.6	"
4 VOL.	1040	8.80	150	2.0	7.20	16.08	.693	-184	1.03	15.4	"
5 VOL.	1045	8.93	150	2.25	7.15	16.01	.692	-182	0.95	17.7	"
6 VOL.	1050	8.96	150	2.5	7.19	16.23	.690	-183	0.85	18.0	"
7 VOL.	1055	8.94	150	2.75	7.20	16.12	.688	-182	0.79	16.4	
(*) 8 VOL.	1100	8.70	150	3.0	7.27	16.35	.679	-184	0.74	283	Looks clear in tub, cloudy bucket
9 VOL.	1113	8.77	150	3.5	7.25	16.55	.680	-184	0.70	135	
10 VOL.	1123	8.70	150	4.0	7.33	16.56	.673	-185	0.62	101	
11 VOL.	1132	8.75	150	4.25	7.52	17.02	.661	-184	0.65	90.3	
(*) 12 VOL.	1137	8.65	150	4.50	7.56	16.78	.680	-185	0.67	372	cloudy/none
13 VOL.	1142	8.65	150	4.75	7.49	16.84	.678	-182	0.64	433	cloudy/none
14 VOL.	1147	8.65	150	5.0	7.48	16.91	.675	-180	0.63	539	"
15 VOL.	1152	8.60	150	5.25	7.50	16.89	.674	-181	0.62	>1000	"
16 VOL.	1201	8.60	150	5.5	7.49	16.91	.671	-182	0.63	—	Turb sensor messed up
17 VOL.	1205					SAMPLE	TIME				
18 VOL.											
19 VOL.											
20 VOL.											

Remarks:
* This well is known to go dry. Lowered flow to 150ml/min in order to minimize draw down. (occasional bubbles in tubing)
(*) Don't know what happened here WL went up & Turb went up. track mounted excavator ~100 ft away (just parked there), when it moves, turb & WL go up

Sampling

Depth to Water Before Sampling: 8.60
Depth sample was acquired: ~20'
Sample Methodology: Low Flow w/ peristaltic
GW-MW13-071112
Sample Date/Time: 7/11/12 @ 1205
Signed Sampler: [signature]
Filtered Metals Collected: Y (N)
Filter Size: —
Sample Observations: Clear / none
Parameters: Dissolved gasses (CH4 + CO2) MEE RSK-175

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	258386	Job #:	18854
Sample Name/Number:	VP-MW11-071312		
Company:	CH2M Hill		
Date Sampled:	7/13/2012		
Container:	Cali-5-Bond Bag		
Field/Site Name:	Shelby/Wilkins		
Location:	Shelby, OH		
Formation/Depth:			
Sampling Point:			
Date Received:	7/31/2012	Date Reported:	8/21/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	^{14}C conc. pMC	Tritium TU
Carbon Monoxide ------------	nd				
Hydrogen Sulfide ------------	na				
Helium --------------------------	0.0148				
Hydrogen ----------------------	nd				
Argon ---------------------------	0.163				
Oxygen -------------------------	3.29				
Nitrogen ------------------------	15.42				
Carbon Dioxide --------------	0.19				
Methane ------------------------	80.89	-54.21	-262.9	< 0.4	
Ethane --------------------------	0.0298				
Ethylene ------------------------	nd				
Propane ------------------------	nd				
Propylene ----------------------	nd				
Iso-butane ---------------------	nd				
N-butane -----------------------	nd				
Iso-pentane --------------------	nd				
N-pentane ---------------------	nd				
Hexanes + ---------------------	nd				

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 820
Specific gravity, calculated: 0.639

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	258388	Job #:	18854
Sample Name/Number:	VP-MW13-071312		
Company:	CH2M Hill		
Date Sampled:	7/13/2012		
Container:	Cali-5-Bond Bag		
Field/Site Name:	Shelby/Wilkins		
Location:	Shelby, OH		
Formation/Depth:			
Sampling Point:			
Date Received:	7/31/2012	Date Reported:	8/21/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	^{14}C conc. pMC	Tritium TU
Carbon Monoxide ------------	nd				
Hydrogen Sulfide ------------	na				
Helium -------------------------	0.0165				
Hydrogen ----------------------	nd				
Argon --------------------------	0.0894				
Oxygen ------------------------	0.59				
Nitrogen -----------------------	8.19				
Carbon Dioxide --------------	0.45	-29.53			
Methane -----------------------	90.57	-54.44	-259.2	0.4 ± 0.1	
Ethane -------------------------	0.0984				
Ethylene -----------------------	nd				
Propane -----------------------	0.0001				
Propylene ---------------------	0.0001				
Iso-butane --------------------	nd				
N-butane ----------------------	nd				
Iso-pentane -------------------	nd				
N-pentane ---------------------	nd				
Hexanes + --------------------	nd				

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 920
Specific gravity, calculated: 0.597

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	258390	Job #:	18854
Sample Name/Number:	VP-M4-071312		
Company:	CH2M Hill		
Date Sampled:	7/13/2012		
Container:	Cali-5-Bond Bag		
Field/Site Name:	Shelby/Wilkins		
Location:	Shelby, OH		
Formation/Depth:			
Sampling Point:			
Date Received:	7/31/2012	Date Reported:	8/21/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	^{14}C conc. pMC	Tritium TU
Carbon Monoxide	nd				
Hydrogen Sulfide	na				
Helium	0.0148				
Hydrogen	0.0017				
Argon	0.866				
Oxygen	15.65				
Nitrogen	71.90				
Carbon Dioxide	3.46	-22.41			
Methane	8.10	-52.07	-251.3	1.6 ± 0.1	
Ethane	0.0097				
Ethylene	nd				
Propane	nd				
Propylene	nd				
Iso-butane	nd				
N-butane	nd				
Iso-pentane	nd				
N-pentane	nd				
Hexanes +	nd				

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 82
Specific gravity, calculated: 0.978

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	258391	Job #:	18854
Sample Name/Number:	VP-M6-071412		
Company:	CH2M Hill		
Date Sampled:	7/14/2012		
Container:	Cali-5-Bond Bag		
Field/Site Name:	Shelby/Wilkins		
Location:	Shelby, OH		
Formation/Depth:			
Sampling Point:			
Date Received:	7/31/2012	Date Reported:	8/21/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	^{14}C conc. pMC	Tritium TU
Carbon Monoxide ------------	nd				
Hydrogen Sulfide ------------	na				
Helium -------------------------	nd				
Hydrogen ----------------------	nd				
Argon --------------------------	0.964				
Oxygen ------------------------	10.89				
Nitrogen -----------------------	79.74				
Carbon Dioxide ---------------	8.41	-23.36		94.5 ± 0.4	
Methane -----------------------	nd				
Ethane -------------------------	nd				
Ethylene -----------------------	nd				
Propane -----------------------	nd				
Propylene ---------------------	nd				
Iso-butane --------------------	nd				
N-butane ----------------------	nd				
Iso-pentane -------------------	nd				
N-pentane ---------------------	nd				
Hexanes + --------------------	nd				

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 0
Specific gravity, calculated: 1.033

Remarks:

Report revised 09-06-2012 to include C14 data for carbon dioxide.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

ISOTECH
ISOTECH LABORATORIES INC

ANALYSIS REPORT

Lab #:	258392	Job #:	18854
Sample Name/Number:	FD02-071312		
Company:	CH2M Hill		
Date Sampled:	7/13/2012		
Container:	Cali-5-Bond Bag		
Field/Site Name:	Shelby/Wilkins		
Location:	Shelby, OH		
Formation/Depth:			
Sampling Point:			
Date Received:	7/31/2012	Date Reported:	8/21/2012

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	^{14}C conc. pMC	Tritium TU
Carbon Monoxide ------------	nd				
Hydrogen Sulfide ------------	na				
Helium --------------------------	0.0169				
Hydrogen ----------------------	nd				
Argon ---------------------------	0.0419				
Oxygen ------------------------	0.42				
Nitrogen -----------------------	5.38				
Carbon Dioxide ---------------	0.20				
Methane -----------------------	93.91	-54.31	-262.3	< 0.3	
Ethane --------------------------	0.0347				
Ethylene -----------------------	nd				
Propane ------------------------	nd				
Propylene ----------------------	nd				
Iso-butane ---------------------	nd				
N-butane -----------------------	nd				
Iso-pentane -------------------	nd				
N-pentane ---------------------	nd				
Hexanes + ---------------------	nd				

Total BTU/cu.ft. dry @ 60deg F & 14.73psia, calculated: 953
Specific gravity, calculated: 0.581

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. Calculations for BTU and specific gravity per ASTM D3588. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

CH2MHILL
Applied Sciences Laboratory

ANALYTICAL REPORT

For:
Wilkins - Shelby Horizons AOC

ASL Report #: L2011
Project ID: 435223.02.03.01.01
Attn: Marie Chiller/DAY

Authorized and Released By:

Kathy McKinley

Laboratory Project Manager
Kathy McKinley
(541) 758-0235 ext.23144
July 30, 2012

This data package meets standards requested by client and is not intended or implied to meet any other standard.

All analyses performed by CH2M HILL are clearly indicated. Any subcontracted analyses are included as appended reports as received from the subcontracted laboratory. The results included in this report only relate to the samples listed on the following Sample Cross-Reference page. This report shall not be reproduced except in full, without the written approval of the laboratory.

Any unusual difficulties encountered during the analysis of your samples are discussed in the attached case narratives.

ASL Report #: L2011

Sample Receipt Comments

We certify that the test results meet all standard ASL requirements.

Sample Cross-Reference

ASL Sample ID	Client Sample ID	Date/Time Collected	Date Received
L201101	GW-MW12-071012	07/10/12 15:40	07/12/12
L201102	GW-MW13-071112	07/11/12 12:05	07/12/12
L201103	GW-MW11-071112	07/11/12 16:30	07/12/12
L201104	FD01-071112	07/11/12	07/12/12

ASL Report #: L2011

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CH2M HILL
Applied Sciences Laboratory (ASL)
1100 NE Circle Blvd
Suite 300
Corvallis, OR 97330
Tel 541.768.3120
Fax 541.752.0276

Organic CLP-Like Data Qualifiers

U — The analyte was analyzed for, but not detected above the reported sample quantitation limit.

J — The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ — The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

N — The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ — The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

P — The primary and confirmation analyte result recoveries do not match.

E — The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.

R — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Inorganic CLP-Like Data Qualifiers

U — The analyte was analyzed for, but not detected above the reported sample quantitation limit.

J — The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ — The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

E — The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.

N — The matrix spike/matrix spike duplicate recovery for the analyte is outside of acceptance criteria—qualifier is applied to the native sample only.

R — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

METHANE AND CARBON DIOXIDE
BY METHOD RSK-175

CASE NARRATIVE
HEADSPACE ANALYSIS

Lab Name: CH2M HILL/LAB/CVO ASL SDG#: L2011

Project: Wilkins Project #: 435223.02.03.01.01

I. Method(s):

Analysis: RSK-175
Preparation: METHOD

II. Receipt/Holding Times:

All acceptance criteria were met.

III. Analysis:

A. Initial Calibration(s):
All acceptance criteria were met.

B. Calibration Verification(s):
All acceptance criteria were met.

C. Blank(s):
All acceptance criteria were met.

D. Laboratory Control Sample(s):
All acceptance criteria were met.

E. Laboratory Duplicate Sample(s):
Analyzed in accordance with standard operating procedure.

F. Analytical Exception(s):
None.

IV. Documentation Exception(s):

None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signatures.

Prepared by: [signature] Date: 7/26/12

Reviewed by: [signature] Date: 07/30/12

SAMPLE DATA
SUMMARY

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **GW-MW12-071012**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.7 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201101

Lab File ID: 006B0601.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 1

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	5.47	37.0	37.0	U
124-38-9	Carbon dioxide	54.6	256	48600	

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **GW-MW13-071112**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201102

Lab File ID: 007B0701.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 1

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	5.78	39.0	21000	E
124-38-9	Carbon dioxide	55.8	262	22000	

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **GW-MW13-071112DL**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201102DL

Lab File ID: 008B0801.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 2

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	11.6	78.0	16000	
124-38-9	Carbon dioxide	112	524	18400	

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **GW-MW11-071112**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 26.9 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201103

Lab File ID: 009B0901.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 1

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	5.91	40.0	21300	E
124-38-9	Carbon dioxide	56.4	265	9870	

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **GW-MW11-071112DL**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.7 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201103DL

Lab File ID: 010B1001.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 2

Instrument: TCD

GC Column: SBX-50   ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	10.9	73.0	20800	
124-38-9	Carbon dioxide	109	513	10500	

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **FD01-071112**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201104

Lab File ID: 011B1101.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 1

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	5.78	39.0	26700	E
124-38-9	Carbon dioxide	55.8	262	10800	

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **FD01-071112DL**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 27.3 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L201104DL

Lab File ID: 012B1201.D

Date Received: 07/12/12

Date Analyzed: 07/23/12

Dilution Factor: 2

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	11.4	77.0	25900	
124-38-9	Carbon dioxide	111	522	9570	

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **XB1-0723**

SDG No.: L2011

Analysis Method: RSK-175

Matrix: WATER

Sample wt/vol: (G/ML) 28 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: XB1-0723

Lab File ID: 005B0501.D

Date Received: / /

Date Analyzed: 07/23/12

Dilution Factor: 1

Instrument: TCD

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ug/L

CAS No.	Analyte	DL	PQL	Result	Q
74-82-8	Methane	5.93	40.0	40.0	U
124-38-9	Carbon dioxide	56.4	265	265	U

QC DATA
SUMMARY

WATER VOLATILE BLANK SPIKE RECOVERY

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Blank Spike ID: BS1X0723

GC Column: SBX-50 ID: 0.25 (mm)

Instrument Name: TCD

Analyte	Spike Added (ug/L)	BS Result (ug/L)	%R	QC Limits %R	Q
Methane	398	355	89	80-120	
Carbon dioxide	2650	2520	95	80-120	

* Values outside of QC limits

Comments:

WATER VOLATILE METHOD BLANK SUMMARY

Field Sample ID:

XB1-0723

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Lab Sample ID: XB1-0723

Lab File ID: 005B0501.D

Date Analyzed: 07/23/12

GC Column: SBX-50 ID: 0.25 (mm)

Time Analyzed: 1438

Instrument Name: TCD

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS, AND MSD:

	Field Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
1	BS1X0723	BS1X0723	003B0301.D	07/23/12	1340
2	GW-MW12-071012	L201101	006B0601.D	07/23/12	1531
3	GW-MW13-071112	L201102	007B0701.D	07/23/12	1548
4	GW-MW13-071112DL	L201102DL	008B0801.D	07/23/12	1617
5	GW-MW11-071112	L201103	009B0901.D	07/23/12	1634
6	GW-MW11-071112DL	L201103DL	010B1001.D	07/23/12	1654
7	FD01-071112	L201104	011B1101.D	07/23/12	1712
8	FD01-071112DL	L201104DL	012B1201.D	07/23/12	1727

Comments:

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Calibration Date(s): 11/02/10 11/02/10

Instrument Name: TCD

Calibration Times: 1213 1340

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ppmv

ICAL Sample IDs:	LEVEL1	LEVEL2	LEVEL3	LEVEL4	LEVEL5	LEVEL6
ICAL File IDs:	003B0301.D	004B0401.D	005B0501.D	006B0601.D	007B0701.D	008B0801.D

Analyte	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Std 6	RF 6
Methane	100	0.0292	500	0.0243	1000	0.0252	5000	0.0253	10000	0.0250	40000	0.0263
Carbon dioxide	100	0.0194	500	0.0170	1000	0.0178	5000	0.0176	10000	0.0173	50000	0.0187

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Calibration Date(s): 11/02/10 11/02/10

Instrument Name: TCD

Calibration Times: 1213 1245

GC Column: SBX-50 ID: 0.25 (mm)

Concentration Units: ppmv

Analyte	Curve Type	Avg. RF	%RSD	Mean %RSD	r	COD	Q
Methane	AVG	0.0259	6.81	5.92			
Carbon dioxide	AVG	0.0180	5.04	5.92			

GC VOLATILE INITIAL CALIBRATION

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Calibration Date/Time: 11/02/10 1418

Instrument ID: TCD

Init. Calib. Date(s): 11/02/10 11/02/10

2nd Source ID: ICV-1102

Init. Calib. Time(s): 1213 1245

Lab File ID: 009B0901.D

GC Column: SBX-50 ID: 0.25 (mm)

Heat Purge (Y/N): N

Concentration Units: ppmv

Analyte	Expected	Found	%D	Max. %D	Q
Methane	10000	10700	7.0	20	
Carbon dioxide	10000	11700	17.0	20	

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Calibration Date/Time: 07/23/12 1204

Instrument ID: TCD

Init. Calib. Date(s): 11/02/10 11/02/10

Cal Check ID: CV1-0723

Init. Calib. Time(s): 1213 1245

Lab File ID: 001B0101.D

GC Column: SBX-50 ID: 0.25 (mm)

Heat Purge (Y/N): N

Concentration Units: ppmv

Analyte	Expected	Found	%D	Max. %D	Q
Methane	1000	1040	4.0	20	
Carbon dioxide	1000	1100	10.0	20	

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2011

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

Calibration Date/Time: 07/23/12 1749

Instrument ID: TCD

Init. Calib. Date(s): 11/02/10 11/02/10

Cal Check ID: CV3-0723

Init. Calib. Time(s): 1213 1245

Lab File ID: 014B1401.D

GC Column: SBX-50 ID: 0.25 (mm)

Heat Purge (Y/N): N

Concentration Units: ppmv

Analyte	Expected	Found	%D	Max. %D	Q
Methane	1000	1120	12.0	20	
Carbon dioxide	1000	1160	16.0	20	

GC VOLATILE ANALYTICAL SEQUENCE

SDG No.: L2011 Lab Name: CH2M HILL/LAB/CVO

Analysis Method: RSK-175

GC Column: SBX-50 ID: 0.25 (mm) Instrument Name: TCD

	Field Sample ID/Std ID/ Blank ID/QC Sample ID	Lab Sample ID	Date Started	Time Started	Date Completed	Time Completed
1	LEVEL1	LEVEL1	11/02/10	1213	11/02/10	1223
2	LEVEL2	LEVEL2	11/02/10	1228	11/02/10	1238
3	LEVEL3	LEVEL3	11/02/10	1245	11/02/10	1255
4	LEVEL4	LEVEL4	11/02/10	1300	11/02/10	1310
5	LEVEL5	LEVEL5	11/02/10	1316	11/02/10	1326
6	LEVEL6	LEVEL6	11/02/10	1339	11/02/10	1349
7	ICV-1102	ICV-1102	11/02/10	1418	11/02/10	1428
8	CV1-0723	CV1-0723	07/23/12	1204	07/23/12	1214
9	BS1X0723	BS1X0723	07/23/12	1340	07/23/12	1350
10	XB1-0723	XB1-0723	07/23/12	1438	07/23/12	1448
11	GW-MW12-071012	L201101	07/23/12	1531	07/23/12	1541
12	GW-MW13-071112	L201102	07/23/12	1548	07/23/12	1558
13	GW-MW13-071112DL	L201102DL	07/23/12	1617	07/23/12	1627
14	GW-MW11-071112	L201103	07/23/12	1634	07/23/12	1644
15	GW-MW11-071112DL	L201103DL	07/23/12	1654	07/23/12	1704
16	FD01-071112	L201104	07/23/12	1712	07/23/12	1722
17	FD01-071112DL	L201104DL	07/23/12	1727	07/23/12	1737
18	CV3-0723	CV3-0723	07/23/12	1749	07/23/12	1759

CH2MHILL
Applied Sciences Laboratory (ASL)

1100 NE Circle Blvd., Suite 300
Corvallis, OR 97330
Tel 541-768-3120 Fax 541-752-0276

DL Study Report

Analytical Method: RSK-175

Matrix: Water

Instrument ID: TCD

Concentration Units: UG/L

Analyte	Analysis Date	Amt. Spiked	Replicates 1	2	3	4	5	6	7	8	Std. Dev.	DL
Methane	11/01/11	19.9	19.5	17.2	17.2	20.4	19.6	18.4	18.2	18.1	1.18	3.55
Carbon dioxide	11/01/11	132	127	119	112	119	146	113	143	117	13.3	39.8

MDL FORM

CHAIN OF CUSTODY/SHIPPING DOCUMENTS

CH2MHILL Applied Sciences Lab
CHAIN OF CUSTODY RECORD
AND AGREEMENT TO PERFORM SERVICES

1100 NE Circle Blvd., Suite 300
Corvallis, OR 97330
(541) 768-3120 FAX (541) 752-0276

COC #

Project # or Purchase Order #: 435223.02.02.01.01

Project Name: Shelby Horizons AOC - Wilkins

Company Name or Home Address/Phone Number: CH2MHill - Dayton

Email Address for Reporting: marie.chiller@ch2m.com

Report Copy to: Marie Chiller / DAY

Turnaround Time: ☐24 hours ☐48 hours ☐72 hours ☐7 days ☐14 days ☐21 days (STD)

Drinking Water? Yes ☐ No ☒

Sample Disposal: Dispose ☒ Return ☐

Requested Analytical Method #: Dissolved gases CH4 + CO2 (MEE) RSK-175

THIS AREA FOR LAB USE ONLY
Lab # L2011 | Page | of
2.3° C
EPA Tier QC Level: 1 (Screening) 2 3 4

Date	Time	COMP	GRAB	WATER	SOIL	AIR	CLIENT SAMPLE ID	TOTAL # OF CONTAINERS	UNPRES	H_2SO_4	HNO_3	HCl	NaOH	ZnAcNaOH	Canister ID	Lab ID
7/10/12	1540		X	X			GW-MW12-071012	3	X							-1
7/11/12	1205		X	X			GW-MW13-071112	3	X							-2
7/11/12	1630		X	X			GW-MW11-071112	3	X							-3
7/11/12	—		X	X			FD01-071112	~~3~~ 2 (LOB 7/11/12)	X							-4

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Volatile Contaminants/Odorous ☐ Biohazard ☒ Other Methane

Relinquished By: Leslie Baechler	Date/Time: 7/11/12 1930	Received By: — Date/Time:
Sampled By and Title (Please sign and print name): Leslie Baechler	Date/Time: 7/11/12 1930	Relinquished By (Please sign and print name) — Date/Time:
Received By (Please sign and print name): Janel McGeary	Date/Time: 7/12/12 1015	Relinquished By (Please sign and print name) — Date/Time:
Received By (Please sign and print name)	Date/Time:	Shipped Via: UPS (Fed-Ex) Other ______ Tracking # 798610037919

Special Instructions: 1 Voa broke (no extra) for FD

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original – LAB, Yellow – LAB, Pink – Client
Rev 10/2011 LAB FORM 340

CH2MHILL
Applied Sciences Laboratory (ASL)

Sample Receipt Record

Batch Number: L2011
Client/Project: Shelby Horizons ADC-Wilkins

Date received: 7/12/12
Checked by: Gm
Checked by:

VERIFICATION OF SAMPLE CONDITIONS (verify all items), HD = Client Hand delivered Samples	NA	YES	NO
Radiological Screening for DoD	✓		
Were custody seals intact and on the outside of the cooler?		✓	
Type of packing material: (Ice) Blue Ice Bubble wrap		✓	
Was a Chain of Custody (CoC) Provided?		✓	
Was the CoC correctly filled out (If No, document in the SRER)		✓	
Did the CoC list a correct bottle count and the preservative types (Y=OK, N=Corrected on CoC)		✓	
Were the sample containers in good condition (broken or leaking)?		✓	
Containers supplied by ASL?		✓	
Any sample with < 1/2 holding time remaining? If so contact LPM			✓
Samples have multi-phase? If yes, document on SRER			✓
Was there ice in the cooler? Enter temp. If >6°C contact client/SRER 2.3 °C		✓	

All VOCs free of air bubbles? No, document on SRER	✓		
pH of all samples checked and met requirements? No, then document in SRER	✓		
Enough sample volume provided for analysis? No, document in SRER		✓	
Did sample labels agree with COC? No, document in SRER		✓	
Dissolved/Soluble metals filtered in the field?	✓		
Dissolved/Soluble metals have sediment in bottom of container? Document in SRER	✓		

Sample ID	Reagent	Reagent Lot Number	Volume Added	Initials

From: Chiller, Marie/DAY
Sent: Thursday, July 12, 2012 2:38 PM
To: McKinley, Kathy/CVO
Cc: Thompson, Ben/CVO; Baechler, Leslie/PHL; de Groot, Patricia/WPB
Subject: RE: Wilkins Water Samples Shipped Today

Methane and CO2 please

Thanks

Marie W. Chiller
Associate Consultant
CH2M HILL
One South Main Street, Suite 1100
Dayton, OH 45402
Direct - 937.220.2956
Fax - 937.228.7572
Mobile - 513.673.2201
www.ch2mhill.com

Solutions Without Boundaries

From: McKinley, Kathy/CVO
Sent: Thursday, July 12, 2012 5:30 PM
To: Chiller, Marie/DAY
Cc: Thompson, Ben/CVO; Baechler, Leslie/PHL; de Groot, Patricia/WPB
Subject: RE: Wilkins Water Samples Shipped Today

Marie
We received the samples today. Just to clarify
The COC lists methane/CO2, MEE
Do you want MEE/CO2
or methane/CO2?

Kathy McKinley
CH2M HILL ASL
Client Services Manager

From: Chiller, Marie/DAY
Sent: Wednesday, July 11, 2012 5:54 PM
To: McKinley, Kathy/CVO
Cc: Thompson, Ben/CVO; Baechler, Leslie/PHL; de Groot, Patricia/WPB
Subject: Wilkins Water Samples Shipped Today

Hi Kathy

We shipped 4 water samples that were collected yesterday and today (see attached COC). This cooler should arrive tomorrow. **Tracking Number: 798610037919**

Please let us know if there are any issues with the cooler/samples tomorrow.

Thanks

Marie W. Chiller
Associate Consultant

ANALYTICAL REPORT

For:
Wilkins - Shelby - Wilkins

ASL Report #: L2025
Project ID: 435223.02.03.01.01
Attn: Marie Chiller/DAY

Authorized and Released By:

Kathy McKinley

Laboratory Project Manager
Kathy McKinley
(541) 758-0235 ext.23144
July 25, 2012

This data package meets standards requested by client and is not intended or implied to meet any other standard.

All analyses performed by CH2M HILL are clearly indicated. Any subcontracted analyses are included as appended reports as received from the subcontracted laboratory. The results included in this report only relate to the samples listed on the following Sample Cross-Reference page. This report shall not be reproduced except in full, without the written approval of the laboratory.

Any unusual difficulties encountered during the analysis of your samples are discussed in the attached case narratives.

ASL Report #: L2025

Sample Receipt Comments

We certify that the test results meet all standard ASL requirements.

Sample Cross-Reference

ASL Sample ID	Client Sample ID	Date/Time Collected	Date Received
L202501	VP-MW11-071312	07/13/12 12:59	07/16/12
L202502	VP-MW13-071312	07/13/12 13:57	07/16/12
L202503	VP-M4-071312	07/13/12 15:01	07/16/12
L202504	FD02-071312	07/13/12	

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CH2MHILL
Applied Sciences Laboratory (ASL)

CH2M HILL
Applied Sciences Laboratory (ASL)
1100 NE Circle Blvd
Suite 300
Corvallis, OR 97330
Tel 541.768.3120
Fax 541.752.0276

Organic CLP-Like Data Qualifiers

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.

J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

P	The primary and confirmation analyte result recoveries do not match.

E	The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.

R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Inorganic CLP-Like Data Qualifiers

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.

J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

E	The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.

N	The matrix spike/matrix spike duplicate recovery for the analyte is outside of acceptance criteria—qualifier is applied to the native sample only.

R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

FIXED GASES ANALYSIS

BY EPA 3C

CASE NARRATIVE
VOLATILE ORGANIC ANALYSIS

Analytical Method: Fixed Gases by Method EPA 3C

SDG: L2025

Lab Name: CH2M HILL Applied Science Laboratories

Project # 435223.02.03.01.01

Base/Command: Shelby - Wilkins

Prime Contractor: ______

I. RECEIPT

A. Date: 7-16-2012

B. Sample Information:

LAB SAMPLE ID	CLIENT SAMPLE ID	CANISTER ID	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	RECEIVED PRESS. (torr)
L202501	VP-MW11-071312	Tedlar Bag	AIR	7-13-12	12:59	760
L202502	VP-MW13-071312	Tedlar Bag	AIR	7-13-12	13:57	760
L202503	VP-M4-071312	Tedlar Bag	AIR	7-13-12	15:01	760
L202504	FD02-071312	Tedlar Bag	AIR	7-13-12		760

II. Holding Times:
All acceptance criteria were met.

III. Analysis:

A. Calibration:
All acceptance criteria were met.

B. Blanks:
All acceptance criteria were met.

C. Duplicate Sample(s):
All acceptance criteria were met.

D. Laboratory Control Sample (LCS):
All acceptance criteria were met.

E. Matrix Spike(MS)/Matrix Spike Duplicate(MSD):
Not applicable.

IV. Sampling Equipment Exceptions:
None.

V. Documentation Exceptions:
None.

VI. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared By: Doug Malcolm Date: 7-19-12

Reviewed By: [signature] Date: 07-25-12

SAMPLE DATA SUMMARY

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **VP-MW11-071312**

SDG No.: L2025

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L202501

Lab File ID: L202501DL.D

Date Received: 07/16/12

Date Analyzed: 07/16/12

Dilution Factor: 2

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.500	1.00	0.729	J
7727-37-9	Nitrogen	0.500	2.00	4.55	
630-08-0	Carbon monoxide	0.140	1.00	1.00	U
74-82-8	Methane	0.140	0.800	94.5	
124-38-9	Carbon dioxide	0.140	1.00	0.190	J

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **VP-MW13-071312**

SDG No.: L2025

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L202502

Lab File ID: L202502DL.D

Date Received: 07/16/12

Date Analyzed: 07/16/12

Dilution Factor: 2

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.500	1.00	0.922	J
7727-37-9	Nitrogen	0.500	2.00	6.66	
630-08-0	Carbon monoxide	0.140	1.00	1.00	U
74-82-8	Methane	0.140	0.800	92.0	
124-38-9	Carbon dioxide	0.140	1.00	0.453	J

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **VP-M4-071312**

SDG No.: L2025

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L202503

Lab File ID: L202503.D

Date Received: 07/16/12

Date Analyzed: 07/16/12

Dilution Factor: 1

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.250	0.500	14.7	
7727-37-9	Nitrogen	0.250	1.00	53.9	
630-08-0	Carbon monoxide	0.0700	0.500	0.500	U
74-82-8	Methane	0.0700	0.400	0.400	U
124-38-9	Carbon dioxide	0.0700	0.500	3.73	

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **FD02-071312**

SDG No.: L2025

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L202504

Lab File ID: L202504.D

Date Received: 07/16/12

Date Analyzed: 07/16/12

Dilution Factor: 2

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.500	1.00	0.738	J
7727-37-9	Nitrogen	0.500	2.00	4.58	
630-08-0	Carbon monoxide	0.140	1.00	1.00	U
74-82-8	Methane	0.140	0.800	94.5	
124-38-9	Carbon dioxide	0.140	1.00	0.192	J

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **XB2-0716**

SDG No.: L2025

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: XB2-0716

Lab File ID: XB2-0716.D

Date Received: / /

Date Analyzed: 07/16/12

Dilution Factor: 1

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.250	0.500	0.500	U
7727-37-9	Nitrogen	0.250	1.00	1.00	U
630-08-0	Carbon monoxide	0.0700	0.500	0.500	U
74-82-8	Methane	0.0700	0.400	0.400	U
124-38-9	Carbon dioxide	0.0700	0.500	0.500	U

QC DATA SUMMARY

3B

AIR VOLATILE BLANK SPIKE RECOVERY

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Blank Spike ID: BS1X0716

GC Column: CARBOXENE ID: 0.12 (mm)

Instrument Name: GCA

Analyte	Spike Added (percent)	BS Result (percent)	%R	QC Limits %R	Q
Carbon dioxide	5.00	4.98	100	80-120	
Oxygen	5.00	4.45	89	80-120	
Nitrogen	5.00	4.05	81	80-120	
Carbon monoxide	5.00	4.56	91	80-120	
Methane	4.00	3.86	97	80-120	

* Values outside of QC limits

Comments:

4A

AIR VOLATILE METHOD BLANK SUMMARY

Field Sample ID:

XB2-0716

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Lab Sample ID: XB2-0716

Lab File ID: XB2-0716.D

Date Analyzed: 07/16/12

GC Column: CARBOXENE ID: 0.12 (mm)

Time Analyzed: 1212

Instrument Name: GCA

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS, AND MSD:

	Field Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
1	BS1X0716	BS1X0716	BS1X0716.D	07/16/12	1136
2	VP-MW11-071312	L202501	L202501DL.D	07/16/12	1342
3	VP-MW13-071312	L202502	L202502DL.D	07/16/12	1412
4	FD02-071312	L202504	L202504.D	07/16/12	1430
5	VP-M4-071312	L202503	L202503.D	07/16/12	1505

Comments:

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

ICAL Sample IDs:	LEVEL1	LEVEL2	LEVEL3	LEVEL4	LEVEL5	LEVEL6
ICAL File IDs:	002B0201.D	003B0301.D	004B0401.D	005B0501.D	006B0601.D	007B0701.D

Analyte	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Std 6	RF 6
Oxygen			.5	5.95E-4	1	6.44E-4	10	6.28E-4	25	5.41E-4	50	6.60E-4
Nitrogen			.5	3.45E-4	1	4.02E-4	10	4.89E-4	25	4.42E-4	50	5.56E-4
Carbon monoxide	.1	8.14E-4	.5	6.12E-4	1	6.13E-4	10	5.27E-4	25	4.43E-4	50	5.34E-4
Methane	.08	6.60E-4	.4	5.91E-4	.8	6.07E-4	8	5.26E-4	20	4.45E-4	40	5.36E-4
Carbon dioxide	.1	4.50E-4	.5	3.93E-4	1	4.01E-4	10	3.45E-4	25	2.93E-4	50	3.53E-4

6A

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

ICAL Sample IDs: LEVEL7

ICAL File IDs: 008B0801.D

Analyte	Std 7	RF 7	Std 8	RF 8	Std 9	RF 9
Oxygen	100	6.72E-4				
Nitrogen	100	5.77E-4				
Carbon monoxide	100	5.39E-4				
Methane	80	5.42E-4				
Carbon dioxide	100	3.54E-4				

6A

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

Analyte	Curve Type	Avg. RF	%RSD	Mean %RSD	r	COD	Q
Oxygen	AVG	6.10E-4	7.74	10.6			
Nitrogen	AVG	4.35E-4	19.2	10.6			
Carbon monoxide	LINR	5.83E-4			0.998		
Methane	AVG	5.77E-4	12.4	10.6			
Carbon dioxide	AVG	3.70E-4	13.5	10.6			

GC VOLATILE INITIAL CALIBRATION

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 01/10/12 2308

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

2nd Source ID: ICV-0110

Init. Calib. Time(s): 2059 2250

Lab File ID: 009B0901.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	10.0	10.2	1.63	30	
Nitrogen	10.0	10.4	3.81	30	
Carbon monoxide	10.0	10.4	3.64	30	
Methane	10.0	10.4	4.23	30	
Carbon dioxide	10.0	10.6	5.88	30	

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 07/16/12 1119

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

Cal Check ID: CV1-0716

Init. Calib. Time(s): 2059 2250

Lab File ID: CV1-0716.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	5.00	4.53	-9.34	20	
Nitrogen	5.00	4.30	-14.0	20	
Carbon monoxide	5.00	4.57	-8.50	20	
Methane	4.00	3.87	-3.37	20	
Carbon dioxide	5.00	5.02	0.47	20	

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2025

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 07/16/12 1741

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

Cal Check ID: CV4-0716

Init. Calib. Time(s): 2059 2250

Lab File ID: CV4-0716.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	5.00	4.81	-3.79	20	
Nitrogen	5.00	4.10	-18.0	20	
Carbon monoxide	5.00	5.08	1.56	20	
Methane	4.00	4.29	7.20	20	
Carbon dioxide	5.00	5.58	11.6	20	

GC VOLATILE ANALYTICAL SEQUENCE

SDG No.: L2025 Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

GC Column: CARBOXENE ID: 0.12 (mm) Instrument Name: GCA

	Field Sample ID/Std ID/ Blank ID/QC Sample ID	Lab Sample ID	Date Started	Time Started	Date Completed	Time Completed
1	LEVEL1	LEVEL1	01/10/12	2059	01/10/12	2111
2	LEVEL2	LEVEL2	01/10/12	2118	01/10/12	2130
3	LEVEL3	LEVEL3	01/10/12	2138	01/10/12	2150
4	LEVEL4	LEVEL4	01/10/12	2157	01/10/12	2209
5	LEVEL5	LEVEL5	01/10/12	2214	01/10/12	2226
6	LEVEL6	LEVEL6	01/10/12	2232	01/10/12	2244
7	LEVEL7	LEVEL7	01/10/12	2250	01/10/12	2302
8	ICV-0110	ICV-0110	01/10/12	2308	01/10/12	2320
9	CV1-0716	CV1-0716	07/16/12	1119	07/16/12	1131
10	BS1X0716	BS1X0716	07/16/12	1136	07/16/12	1148
11	XB2-0716	XB2-0716	07/16/12	1212	07/16/12	1224
12	VP-MW11-071312	L202501	07/16/12	1342	07/16/12	1354
13	VP-MW13-071312	L202502	07/16/12	1412	07/16/12	1424
14	FD02-071312	L202504	07/16/12	1430	07/16/12	1442
15	VP-M4-071312	L202503	07/16/12	1505	07/16/12	1517
16	CV4-0716	CV4-0716	07/16/12	1741	07/16/12	1753

CH2MHILL
Applied Sciences Laboratory (ASL)

1100 NE Circle Blvd., Suite 300
Corvallis, OR 97330
Tel 541-768-3120 Fax 541-752-0276

DL Study Report

Analytical Method: E3C

Matrix: Air

Instrument ID: GCA

Concentration Units: PERCENT

Analyte	Analysis Date	Amt. Spiked	Replicates 1	2	3	4	5	6	7	8	Std. Dev.	DL
Oxygen	11/22/11	0.250	0.170	0.161	0.182	0.168	0.169	0.149	0.174		0.0600	0.250
Nitrogen	11/22/11	0.500	0.154	0.108	0.0490	0.0580	0.124	0.0410	0.0790		0.0500	0.250
Carbon monoxide	11/22/11	0.250	0.214	0.228	0.209	0.203	0.214	0.205	0.217		0.0757	0.0700
Methane	11/22/11	0.200	0.155	0.175	0.173	0.169	0.182	0.165	0.178		0.0610	0.0700
Carbon dioxide	11/22/11	0.250	0.215	0.223	0.214	0.202	0.215	0.207	0.220		0.0759	0.0700

MDL FORM

CHAIN OF CUSTODY/SHIPPING DOCUMENTS

CH2MHILL Applied Sciences Lab
1000 NE Circle Blvd., Suite 10350
Corvallis, OR 97330
(541) 768-3120 FAX (541) 752-0276

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

COC #

Project # or Purchase Order #: 435223.02.02.01.01

Project Name: Shelby - Wilkins

Company Name or Home Address/Phone Number: CH2MHill - DAY - 937 220 2956

Email Address for Reporting: marie.chiller@ch2m.com

Report Copy to: Marie Chiller

Turnaround Time: Per SOW ☐24 hours ☐48 hours ☐72 hours ☐7 days ☐14 days ☐21 days (STD)

Drinking Water? Yes ☐ No ☒

Sample Disposal: Dispose ☒ Return ☐

Requested Analytical Method #: Fixed Gases USEPA 3C

THIS AREA FOR LAB USE ONLY — Lab # L2025 | Page | of

EPA Tier QC Level: 1 (Screening) 2 3 4

Date	Time	COMP	GRAB	WATER	SOIL	AIR	CLIENT SAMPLE ID	TOTAL # OF CONTAINERS	UNPRES (Fixed Gases USEPA 3C)	H_2SO_4	HNO_3	HCl	NaOH	ZnAcNaOH			Canister ID	Lab ID
7/13	1259		X			X	VP-MW11-071312	1	X									-1
7/13	1357		X			X	VP-MW13-071312	1	X									-2
7/13	1501		X			X	VP-M4-071312	1	X									-3
7/13	—		X			X	FD02-071312	1	X									-4

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Volatile Contaminants/Odorous ☐ Biohazard ☒ Other methane

Relinquished By: [signature] Leslie Baechler	Date/Time: 7/13/12 1900	Received By:	Date/Time
Sampled By and Title (Please sign and print name): [signature] Leslie Baechler	Date/Time: 7/13/12 1900	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name): [signature] Janel McGeary	Date/Time: 7/16/12 0815	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via: UPS (Fed-Ex) Other ______	Tracking #

Special Instructions

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original – LAB, Yellow – LAB, Pink – Client
Rev 09/2010 LAB FORM 340

CH2MHILL
Applied Sciences Laboratory (ASL)

Sample Receipt Record

Batch Number: L2025
Client/Project: Shelby - Wilkins

Date received: 7/16/12
Checked by: Jm
Checked by: ______

VERIFICATION OF SAMPLE CONDITIONS (verify all items), HD = Client Hand delivered Samples	NA	YES	NO
Radiological Screening for DoD	✓		
Were custody seals intact and on the outside of the cooler?		✓	
Type of packing material: Ice Blue Ice ~~Bubble wrap~~		✓	
Was a Chain of Custody (CoC) Provided?		✓	
Was the CoC correctly filled out (If No, document in the SRER)		✓	
Did the CoC list a correct bottle count and the preservative types (Y=OK, N=Corrected on CoC)		✓	
Were the sample containers in good condition (broken or leaking)?	✓		
Containers supplied by ASL?			✓
Any sample with < 1/2 holding time remaining? If so contact LPM			✓
Samples have multi-phase? If yes, document on SRER	✓		
Was there ice in the cooler? Enter temp. If >6°C contact client/SRER box °C	✓		
All VOCs free of air bubbles? No, document on SRER	✓		
pH of all samples checked and met requirements? No, then document in SRER	✓		
Enough sample volume provided for analysis? No, document in SRER	✓		
Did sample labels agree with COC? No, document in SRER		✓	
Dissolved/Soluble metals filtered in the field?	✓		
Dissolved/Soluble metals have sediment in bottom of container? Document in SRER	✓		

Sample ID	Reagent	Reagent Lot Number	Volume Added	Initials

McKinley, Kathy/CVO

From: Thompson, Ben/CVO
Sent: Monday, July 16, 2012 2:18 PM
To: McKinley, Kathy/CVO
Subject: FW: Transfer Hrs Wilkins

Correct task number for both batches is 02.0**3**.01.01

From: Chiller, Marie/DAY
Sent: Monday, July 16, 2012 2:03 PM
To: Thompson, Ben/CVO
Subject: RE: Transfer Hrs

Yeah, there are way too many tasks, and all very similar for this project. Okay, week ending 6/29 will go on QAPP and other 2 weeks on vapor field event. Thanks

All lab analysis should be on task: 02.0**3**.01.01 - Vapor Field Investigation task

Thanks

Marie W. Chiller
Associate Consultant
CH2M HILL
One South Main Street, Suite 1100
Dayton, OH 45402
Direct - 937.220.2956
Fax - 937.228.7572
Mobile - 513.673.2201
www.ch2mhill.com

Solutions Without Boundaries

From: Thompson, Ben/CVO
Sent: Monday, July 16, 2012 4:46 PM
To: Chiller, Marie/DAY
Subject: RE: Transfer Hrs

Sorry. I must have mis-understood one of Pat's emails.

I think my time should go under workplan for week ending 6/29 (maybe I charged the wrong actual project number). But for the week ending 7/6 and last week it should be the field work task.

What number should the lab analysis be going on? I think it has .02.02.01.01 on the COC

From: Chiller, Marie/DAY
Sent: Monday, July 16, 2012 11:58 AM
To: Thompson, Ben/CVO
Subject: Transfer Hrs

Hi Ben,

I just checked the financials and I think you have been charging to the wrong task these past 3 weeks. I see your hours showing up on the 02.02.01.01 - Work Plans task: 7 hrs week ending 6/29, 4 hrs week ending 7/6, and 7 hrs last week.

CH2MHILL
Applied Sciences Laboratory

ANALYTICAL REPORT

For:
Wilkins

ASL Report #: L2032
Project ID: 435223.02.03.01.01
Attn: Marie Chiller/DAY

Authorized and Released By:

Kathy McKinley

Laboratory Project Manager
Kathy McKinley
(541) 758-0235 ext.23144
August 16, 2012

This data package meets standards requested by client and is not intended or implied to meet any other standard.

All analyses performed by CH2M HILL are clearly indicated. Any subcontracted analyses are included as appended reports as received from the subcontracted laboratory. The results included in this report only relate to the samples listed on the following Sample Cross-Reference page. This report shall not be reproduced except in full, without the written approval of the laboratory.

Any unusual difficulties encountered during the analysis of your samples are discussed in the attached case narratives.

Sample Receipt Comments

We certify that the test results meet all standard ASL requirements except those listed below:

- Samples were received at a temperature of 8.4°C.

Sample Cross-Reference

ASL Sample ID	Client Sample ID	Date/Time Collected	Date Received
L203201	VP-MHD1-071412	07/14/12 12:00	07/17/12
L203202	VP-MHD2-071412	07/14/12 14:12	07/17/12
L203203	VP-HD1-071412	07/14/12 15:28	07/17/12
L203204	VP-HD3-071412	07/14/12 16:31	07/17/12
L203205	VP-HD4-071412	07/14/12 17:26	07/17/12
L203206	FD03-071412	07/14/12	07/17/12
L203207	AMB-071412	07/14/12 18:05	07/17/12
L203208	TB-071412	07/14/12 18:15	07/17/12
L203209	VP-M6-071412	07/14/12 18:55	07/17/12

Table of Contents

CH2M HILL
Applied Sciences Laboratory (ASL)
1100 NE Circle Blvd
Suite 300
Corvallis, OR 97330
Tel 541.768.3120
Fax 541.752.0276

Organic CLP-Like Data Qualifiers

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
P	The primary and confirmation analyte result recoveries do not match.
E	The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Inorganic CLP-Like Data Qualifiers

U	The analyte was analyzed for, but not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
E	The analyte was positively identified; the associated numerical value exceeded the instrument calibration range.
N	The matrix spike/matrix spike duplicate recovery for the analyte is outside of acceptance criteria—qualifier is applied to the native sample only.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

FIXED GASES ANALYSIS

BY EPA 3C

CASE NARRATIVE
VOLATILE ORGANIC ANALYSIS

Analytical Method: Fixed Gases by Method EPA 3C

SDG: L2032

Lab Name: CH2M HILL Applied Science Laboratories

Project # 435223.02.03.01.01

Base/Command: Wilkins

Prime Contractor: ____________________

I. RECEIPT

A. Date: 7-17-2012

B. Sample Information:

LAB SAMPLE ID	CLIENT SAMPLE ID	CANISTER ID	SAMPLE MATRIX	DATE SAMPLED	TIME SAMPLED	RECEIVED PRESS. (torr)
L203209	VP-M6-071412	Tedlar Bag	AIR	7-14-2012	18:55	760

II. Holding Times:
All acceptance criteria were met.

III. Analysis:

A. Calibration:
All acceptance criteria were met.

B. Blanks:
All acceptance criteria were met.

C. Duplicate Sample(s):
All acceptance criteria were met.

D. Laboratory Control Sample (LCS):
All acceptance criteria were met.

E. Matrix Spike(MS)/Matrix Spike Duplicate(MSD):
Not applicable.

IV. Sampling Equipment Exceptions:
None.

V. Documentation Exceptions:
None.

VI. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signature.

Prepared By: Doug Malcolm Date: 7-19-12

Reviewed By: [signature] Date: 07-23-12

SAMPLE DATA
SUMMARY

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **VP-M6-071412**

SDG No.: L2032

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: L203209

Lab File ID: L203209.D

Date Received: 07/17/12

Date Analyzed: 07/17/12

Dilution Factor: 1

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.250	0.500	7.70	
7727-37-9	Nitrogen	0.250	1.00	55.3	
630-08-0	Carbon monoxide	0.0700	0.500	0.500	U
74-82-8	Methane	0.0700	0.400	0.400	U
124-38-9	Carbon dioxide	0.0700	0.500	10.3	

1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

Field Sample ID: **XB2-0717**

SDG No.: L2032

Analysis Method: E3C

Matrix: AIR

Sample wt/vol: (G/ML) 1 ML

Level: (LOW/MED) LOW

Lab Name: CH2M HILL/LAB/CVO

Lab Sample ID: XB2-0717

Lab File ID: XB2-0716.D

Date Received: / /

Date Analyzed: 07/17/12

Dilution Factor: 1

Instrument: GCA

GC Column: CARBOXENE ID: 0.12 (mm)

Concentration Units: percent

CAS No.	Analyte	DL	PQL	Result	Q
7782-44-7	Oxygen	0.250	0.500	0.500	U
7727-37-9	Nitrogen	0.250	1.00	1.00	U
630-08-0	Carbon monoxide	0.0700	0.500	0.500	U
74-82-8	Methane	0.0700	0.400	0.400	U
124-38-9	Carbon dioxide	0.0700	0.500	0.500	U

QC DATA
SUMMARY

3B

AIR VOLATILE BLANK SPIKE RECOVERY

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Blank Spike ID: BS1X0717

GC Column: CARBOXENE ID: 0.12 (mm)

Instrument Name: GCA

Analyte	Spike Added (percent)	BS Result (percent)	%R	QC Limits %R	Q
Carbon dioxide	5.00	4.79	96	80-120	
Oxygen	5.00	4.51	90	80-120	
Nitrogen	5.00	4.18	84	80-120	
Carbon monoxide	5.00	4.55	91	80-120	
Methane	4.00	3.82	95	80-120	

* Values outside of QC limits

Comments:

4A

AIR VOLATILE METHOD BLANK SUMMARY

Field Sample ID:

XB2-0717

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Lab Sample ID: XB2-0717

Lab File ID: XB2-0716.D

Date Analyzed: 07/17/12

GC Column: CARBOXENE ID: 0.12 (mm)

Time Analyzed: 1508

Instrument Name: GCA

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS, AND MSD:

	Field Sample ID	Lab Sample ID	Lab File ID	Date Analyzed	Time Analyzed
1	BS1X0717	BS1X0717	BS1X0716.D	07/17/12	1434
2	VP-M6-071412	L203209	L203209.D	07/17/12	1526

Comments:

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

ICAL Sample IDs:	LEVEL1	LEVEL2	LEVEL3	LEVEL4	LEVEL5	LEVEL6
ICAL File IDs:	002B0201.D	003B0301.D	004B0401.D	005B0501.D	006B0601.D	007B0701.D

Analyte	Std 1	RF 1	Std 2	RF 2	Std 3	RF 3	Std 4	RF 4	Std 5	RF 5	Std 6	RF 6
Oxygen			.5	5.95E-4	1	6.44E-4	10	6.28E-4	25	5.41E-4	50	6.60E-4
Nitrogen			.5	3.45E-4	1	4.02E-4	10	4.89E-4	25	4.42E-4	50	5.56E-4
Carbon monoxide	.1	8.14E-4	.5	6.12E-4	1	6.13E-4	10	5.27E-4	25	4.43E-4	50	5.34E-4
Methane	.08	6.60E-4	.4	5.91E-4	.8	6.07E-4	8	5.26E-4	20	4.45E-4	40	5.36E-4
Carbon dioxide	.1	4.50E-4	.5	3.93E-4	1	4.01E-4	10	3.45E-4	25	2.93E-4	50	3.53E-4

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

ICAL Sample IDs: LEVEL7

ICAL File IDs: 008B0801.D

Analyte	Std 7	RF 7	Std 8	RF 8	Std 9	RF 9						
Oxygen	100	6.72E-4										
Nitrogen	100	5.77E-4										
Carbon monoxide	100	5.39E-4										
Methane	80	5.42E-4										
Carbon dioxide	100	3.54E-4										

6A

VOLATILE ORGANICS INITIAL CALIBRATION DATA

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date(s): 01/10/12 01/10/12

Instrument Name: GCA

Calibration Times: 2059 2250

Heat Purge: (Y/N) F

Concentration Units: percent

Analyte	Curve Type	Avg. RF	%RSD	Mean %RSD	r	COD	Q
Oxygen	AVG	6.10E-4	7.74	10.6			
Nitrogen	AVG	4.35E-4	19.2	10.6			
Carbon monoxide	LINR	5.83E-4			0.998		
Methane	AVG	5.77E-4	12.4	10.6			
Carbon dioxide	AVG	3.70E-4	13.5	10.6			

7A

GC VOLATILE INITIAL CALIBRATION

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 01/10/12 2308

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

2nd Source ID: ICV-0110

Init. Calib. Time(s): 2059 2250

Lab File ID: 009B0901.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	10.0	10.2	1.63	30	
Nitrogen	10.0	10.4	3.81	30	
Carbon monoxide	10.0	10.4	3.64	30	
Methane	10.0	10.4	4.23	30	
Carbon dioxide	10.0	10.6	5.88	30	

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 07/17/12 1414

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

Cal Check ID: CV1-0717

Init. Calib. Time(s): 2059 2250

Lab File ID: CV1-0716.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	5.00	4.56	-8.90	20	
Nitrogen	5.00	4.28	-14.5	20	
Carbon monoxide	5.00	4.58	-8.43	20	
Methane	4.00	3.84	-3.95	20	
Carbon dioxide	5.00	4.83	-3.30	20	

7A

GC VOLATILE CONTINUING CALIBRATION

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

Calibration Date/Time: 07/17/12 1621

Instrument ID: GCA

Init. Calib. Date(s): 01/10/12 01/10/12

Cal Check ID: CV2-0717

Init. Calib. Time(s): 2059 2250

Lab File ID: CV2-0717.D

GC Column: CARBOXENE ID: 0.12 (mm)

Heat Purge (Y/N): N

Concentration Units: percent

Analyte	Expected	Found	%D	Max. %D	Q
Oxygen	5.00	4.42	-11.7	20	
Nitrogen	5.00	4.02	-19.7	20	
Carbon monoxide	5.00	4.50	-10.0	20	
Methane	4.00	3.80	-5.11	20	
Carbon dioxide	5.00	4.95	-1.07	20	

GC VOLATILE ANALYTICAL SEQUENCE

SDG No.: L2032 Lab Name: CH2M HILL/LAB/CVO

Analysis Method: E3C

GC Column: CARBOXENE ID: 0.12 (mm) Instrument Name: GCA

	Field Sample ID/Std ID/ Blank ID/QC Sample ID	Lab Sample ID	Date Started	Time Started	Date Completed	Time Completed
1	LEVEL1	LEVEL1	01/10/12	2059	01/10/12	2111
2	LEVEL2	LEVEL2	01/10/12	2118	01/10/12	2130
3	LEVEL3	LEVEL3	01/10/12	2138	01/10/12	2150
4	LEVEL4	LEVEL4	01/10/12	2157	01/10/12	2209
5	LEVEL5	LEVEL5	01/10/12	2214	01/10/12	2226
6	LEVEL6	LEVEL6	01/10/12	2232	01/10/12	2244
7	LEVEL7	LEVEL7	01/10/12	2250	01/10/12	2302
8	ICV-0110	ICV-0110	01/10/12	2308	01/10/12	2320
9	CV1-0717	CV1-0717	07/17/12	1414	07/17/12	1426
10	BS1X0717	BS1X0717	07/17/12	1434	07/17/12	1446
11	XB2-0717	XB2-0717	07/17/12	1508	07/17/12	1520
12	VP-M6-071412	L203209	07/17/12	1526	07/17/12	1538
13	CV2-0717	CV2-0717	07/17/12	1621	07/17/12	1633

CH2MHILL
Applied Sciences Laboratory (ASL)

1100 NE Circle Blvd., Suite 300
Corvallis, OR 97330
Tel 541-768-3120 Fax 541-752-0276

DL Study Report

Analytical Method: E3C

Matrix: Air

Instrument ID: GCA

Concentration Units: PERCENT

Analyte	Analysis Date	Amt. Spiked	Replicates 1	2	3	4	5	6	7	8	Std. Dev.	DL
Oxygen	11/22/11	0.250	0.170	0.161	0.182	0.168	0.169	0.149	0.174		0.0600	0.250
Nitrogen	11/22/11	0.500	0.154	0.108	0.0490	0.0580	0.124	0.0410	0.0790		0.0500	0.250
Carbon monoxide	11/22/11	0.250	0.214	0.228	0.209	0.203	0.214	0.205	0.217		0.0757	0.0700
Methane	11/22/11	0.200	0.155	0.175	0.173	0.169	0.182	0.165	0.178		0.0610	0.0700
Carbon dioxide	11/22/11	0.250	0.215	0.223	0.214	0.202	0.215	0.207	0.220		0.0759	0.0700

MERCURY

CASE NARRATIVE
METALS ANALYSIS

Lab Name: CH2M HILL/LAB/CVO — ASL SDG#: L2032

Project: Wilkins — Project #: 435223.02.03.01.01

I. Method(s):

Analysis: E245.7, NIOSH 6009
Preparation: METHOD

II. Receipt/Holding Times:

All acceptance criteria were met.

III. Analysis:

A. Initial Calibration(s):

All acceptance criteria were met.

B. Calibration Verification(s):

All acceptance criteria were met.

C. Blanks:

All acceptance criteria were met.

D. Laboratory Control Sample(s):

All acceptance criteria were met.

E. Matrix Spike/Matrix Spike Duplicate Sample(s):

A blank spike/blank spike duplicate analysis was performed due to lack of sample. All acceptance criteria were met.

F. Interference Check Sample(s):

Not applicable.

G. Serial Dilution(s):

Not applicable.

H. Digestion Exception(s):

None.

I. Analytical Exception(s):

The air results are reported using EPA method 245.7.

IV. Documentation Exception(s):

None.

V. I certify that this data package is in compliance with the terms and conditions agreed to by the client and CH2M HILL, both technically and for completeness, except for the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or designee, as verified by the following signatures.

Prepared by: Shauna McKinley — Date: 8.14.12

Reviewed by: [signature] — Date: 8.14.12

SAMPLE DATA

SUMMARY

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: VP-MHD1-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203201

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000120	J		AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

VP-MHD2-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203202

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000247			AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

VP-HD1-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203203

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000378			AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: VP-HD3-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203204

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.0000864	J		AV

Comments:

1A
INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

VP-HD4-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203205

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000141	J		AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: FD03-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203206

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000347			AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

AMB-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203207

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000200	U		AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID: TB-071412

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: AIR

Lab Sample ID: L203208

Percent Moisture: 100

Date Received: 07/17/12

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000268			AV

Comments:

1A

INORGANICS ANALYSIS DATA SHEET

Field Sample ID:

WB1-0806

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Matrix: WATER

Lab Sample ID: WB1-0806

Percent Moisture: 100

Date Received: / /

Preparation: Total

Concentration Units: ug

CAS No.	Analyte	Date Analyzed	DF	DL	PQL	Result	C	Q	M
7439-97-6	Mercury	08/07/12	1	0.0000232	0.000200	0.000200	U		AV

Comments:

QC DATA SUMMARY

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Initial Calibration ID: 073112HG

Concentration Units: ug/L

Instrument ID: HGHYDRA

2nd Source/ICV ID: ICV-0807

CCV1 ID: CV1-0807

Initial Calibration				Continuing Calibration								
Analyte	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	Found	%R(1)	M
Mercury	0.0100	0.0110	110	0.0100	0.00951	95					AV

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

SW846 Control Limits: Mercury and GFAA 80-120; ICP 90-110; Cyanide 85-115

BLANKS

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Initial Calibration ID: 073112HG

Concentration Units: UG/L

Instrument ID: HGHYDRA

ICB ID: ICB-0807 CCB1 ID: CB1-0807

Analyte	Method	Initial Calib. Blank	Continuing Calibration Blank			
			1	2	3	M
Mercury	E245.7	0.00500U	0.00500U			AV

Comments:

LABORATORY CONTROL SAMPLE

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Aqueous LCS ID: BS1W0806

Solid LCS ID:

Analyte	Method	Aqueous (ug) True	Aqueous (ug) Found	Aqueous (ug) %R	Solid (mg/Kg) True	Solid (mg/Kg) Found	Solid (mg/Kg) %R	Limits	C
Mercury	E245.7	0.00800	0.00856	107				76-113	

Comments:

INSTRUMENT DETECTION LIMITS

SDG No.: L2032

Lab Name: CH2M HILL/LAB/CVO

Instrument ID: HGHYDRA

Matrix: WATER

Concentration Units: ug/L

Analyte	Method	Wavelength (nm)	Background	DL	RL	M
Mercury	E245.7	254	NA	0.000581	0.00500	AV

Comments:

PREPARATION LOG

SDG No.: L2032 Lab Name: CH2M HILL/LAB/CVO

Method Code: AV

	Field Sample ID	Lab Sample ID	Date Prepared	Weight (g)	Volume (ml)
1	AMB-071412	L203207	08/06/12	NA	40.0
2	BS1W0806	BS1W0806	08/06/12	NA	40.0
3	FD03-071412	L203206	08/06/12	NA	40.0
4	TB-071412	L203208	08/06/12	NA	40.0
5	VP-HD1-071412	L203203	08/06/12	NA	40.0
6	VP-HD3-071412	L203204	08/06/12	NA	40.0
7	VP-HD4-071412	L203205	08/06/12	NA	40.0
8	VP-MHD1-071412	L203201	08/06/12	NA	40.0
9	VP-MHD2-071412	L203202	08/06/12	NA	40.0
10	WB1-0806	WB1-0806	08/06/12	NA	40.0

Comments:

ANALYSIS RUN LOG

SDG No.: L2032 Lab Name: CH2M HILL/LAB/CVO

Instrument ID: HGHYDRA Method: E245.7 Sequence Name: 073112HG

	Field Sample ID	Lab Sample ID	DF	Date Analyzed	Time Analyzed
1	CAL BLK	CAL BLK	1	07/31/12	1424
2	CAL 1	CAL 1	1	07/31/12	1431
3	CAL 2	CAL 2	1	07/31/12	1440
4	CAL 3	CAL 3	1	07/31/12	1401
5	CAL 4	CAL 4	1	07/31/12	1408
6	CAL 5	CAL 5	1	07/31/12	1414
7	ICV-0807	ICV-0807	1	08/07/12	1225
8	ICB-0807	ICB-0807	1	08/07/12	1231
9	WB1-0806	WB1-0806	1	08/07/12	1309
10	BS1W0806	BS1W0806	1	08/07/12	1316
11	VP-MHD1-071412	L203201	1	08/07/12	1329
12	VP-MHD2-071412	L203202	1	08/07/12	1336
13	VP-HD1-071412	L203203	1	08/07/12	1342
14	VP-HD3-071412	L203204	1	08/07/12	1349
15	VP-HD4-071412	L203205	1	08/07/12	1355
16	FD03-071412	L203206	1	08/07/12	1402
17	AMB-071412	L203207	1	08/07/12	1408
18	TB-071412	L203208	1	08/07/12	1415
19	CV1-0807	CV1-0807	1	08/07/12	1422
20	CB1-0807	CB1-0807	1	08/07/12	1428

COMMENTS:

CH2MHILL
Applied Sciences Laboratory (ASL)

1100 NE Circle Blvd., Suite 300
Corvallis, OR 97330
Tel 541-768-3120 Fax 541-752-0276

DL Study Report

Matrix: Water

Concentration Units: UG/L

Analyte	Method	Analysis Date	Amt. Spiked	Replicates 1	2	3	4	5	6	7	8	Std. Dev.	DL	Instrument ID
Mercury	E245.7	11/15/10	0.00250	0.00217	0.00218	0.00211	0.00186	0.00190	0.00205	0.00230	0.00245	0.000194	0.000581	HGHYDRA

CHAIN OF CUSTODY/SHIPPING DOCUMENTS

CH2MHILL Applied Sciences Lab
CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

1000 NE Circle Blvd., Suite 10350
Corvallis, OR 97330
(541) 768-3120 FAX (541) 752-0276

COC #

Project # or Purchase Order #: 435223.02.02.01.01
Project Name: Shelby Horizons AOC-Wilkins
Company Name or Home Address/Phone Number: CH2MHill - Dayton
Email Address for Reporting: mariechiller@ch2m.com
Report Copy to: Marie Chiller/Day
Turnaround Time: ☐24 hours ☐48 hours ☐72 hours ☐7 days ☐14 days ☐21 days (STD)
Drinking Water? Yes ☐ No ☐
Sample Disposal: Dispose ☐ Return ☐

THIS AREA FOR LAB USE ONLY
Lab #: L2032 Page ___ of ___
8.4°C
EPA Tier QC Level: 1 (Screening) 2 3 4

Requested Analytical Method #: Mercury NIOSH 6009; Fixed Gases USEPA 3C

Date	Time	COMP	GRAB	WATER	SOIL	AIR	CLIENT SAMPLE ID	TOTAL # OF CONTAINERS	Mercury NIOSH 6009 (Preservative: 4C)	H₂SO₄	HNO₃	HCl	NaOH	ZnAcNaOH	Fixed Gases USEPA 3C (Preservative: Unpreserved)		Canister ID	Lab ID
7/14	1200		X			X	VP-MHD1-071412	1	X									-1
7/14	1412		X			X	VP-MHD2-071412	1	X									-2
7/14	1528		X			X	VP-HD1-071412	1	X									-3
7/14	1631		X			X	VP-HD3-071412	1	X									-4
7/14	1726		X			X	VP-HD4-071412	1	X									-5
7/14	—		X			X	FD03-071412	1	X									-6
7/14	1805		X			X	AMB-071412	1	X									-7
7/14	1815		X			X	TB-071412	1	X									-8
7/14	1855		X			X	VP-M6-071412	1							X			-9

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Volatile Contaminants/Odorous ☐ Biohazard ☐ Other ______

Relinquished By: Leslie Baechler	Date/Time: 7/16/12 1900	Received By:	Date/Time
Sampled By and Title (Please sign and print name): Leslie Baechler	Date/Time: 7/16/12 1900	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name): Janel McGeary	Date/Time: 7/17/12 1200	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via: UPS Fed-Ex Other____	Tracking #

Special Instructions

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original – LAB, Yellow – LAB, Pink – Client
Rev 09/2010 LAB FORM 340

CH2MHILL
Applied Sciences Laboratory (ASL)

Sample Receipt Record

Batch Number: L2032
Client/Project: Wilkins

Date received: 7/17/12
Checked by: Jm
Checked by:

VERIFICATION OF SAMPLE CONDITIONS (verify all items), HD = Client Hand delivered Samples	NA	YES	NO
Radiological Screening for DoD	✓		
Were custody seals intact and on the outside of the cooler?		✓	
Type of packing material: (Ice) Blue Ice Bubble wrap		✓	
Was a Chain of Custody (CoC) Provided?		✓	
Was the CoC correctly filled out (If No, document in the SRER)		✓	
Did the CoC list a correct bottle count and the preservative types (Y=OK, N=Corrected on CoC)		✓	
Were the sample containers in good condition (broken or leaking)?		✓	
Containers supplied by ASL?			✓
Any sample with < 1/2 holding time remaining? If so contact LPM			✓
Samples have multi-phase? If yes, document on SRER			✓
Was there ice in the cooler? Enter temp. If >6°C contact client/SRER 8.4 °C		✓	

	NA	YES	NO
All VOCs free of air bubbles? No, document on SRER	✓		
pH of all samples checked and met requirements? No, then document in SRER	✓		
Enough sample volume provided for analysis? No, document in SRER		✓	
Did sample labels agree with COC? No, document in SRER		✓	
Dissolved/Soluble metals filtered in the field?	✓		
Dissolved/Soluble metals have sediment in bottom of container? Document in SRER	✓		

Sample ID	Reagent	Reagent Lot Number	Volume Added	Initials

CH2MHILL
Applied Sciences Laboratory (ASL)

Sample Receipt Exception Report

Sample Batch Number: L2032 **Client/Project** 7/17/12

The following exceptions were noted:		
		Comments (write number of exception description and the impacted sample numbers)
	1. No custody seal as required by project	5) Samples received at 8.4°C.
	2. No chain-of-custody provided	
	3. Analysis, description, date of collection not provided	
	4. Samples broken or leaking on receipt.	
X	5. Temperature of samples inappropriate for analysis requested	
	6. Container inappropriate for analysis requested	
	7. Inadequate sample volume.	
	8. Preservation inappropriate for analysis requested	
	9. Samples received out of holding time for analysis requested	
	10. Discrepancies between COC form and container labels.	
	11. Other.	

ACTION TAKEN:

Originator: JM Date: 7/17/12

Client was notified on: Client Contact:
(Date/Time)

Client Services:

LABORATORY REPORT

July 25, 2012

Shane Lowe
CH2M Hill
1034 South Brentwood Blvd., Suite 2300
Richmond Heights, MO 63117

RE: Wilkins - Shelby / 435223.02.02.01.01

Dear Shane:

Enclosed are the results of the samples submitted to our laboratory on July 14, 2012. For your reference, these analyses have been assigned our service request number P1202848.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein. Your report contains 81 pages.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA015272011-1; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

FOR

Kate Aguilera
Project Manager

Columbia Analytical Services

ADDRESS 2655 Park Center Drive, Suite A, Simi Valley, CA 93065
PHONE +1 805 526 7161 | FAX +1 805 526 7270
Columbia Analytical Services, Inc.
Part of the ALS Group A Campbell Brothers Limited Company

Client: CH2M Hill
Project: Wilkins - Shelby / 435223.02.02.01.01

Service Request No: P1202848

CASE NARRATIVE

The samples were received intact under chain of custody on July 14, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Sulfur Analysis

The samples were analyzed for twenty sulfur compounds per ASTM D 5504-08 using a gas chromatograph equipped with a sulfur chemiluminescence detector (SCD). All compounds with the exception of hydrogen sulfide and carbonyl sulfide are quantitated against the initial calibration curve for methyl mercaptan.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

COLUMBIA ANALYTICAL SERVICES, INC.

DETAIL SUMMARY REPORT

Client: CH2M Hill

Project ID: Wilkins - Shelby / 435223.02.02.01.01

Service Request: P1202848

Date Received: 7/14/2012

Time Received: 11:30

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	ASTM D5504-08 - Sulfur Bag
VP-MW11-071312	P1202848-001	Air	7/13/2012	13:08	X
VP-MW13-071312	P1202848-002	Air	7/13/2012	14:01	X
VP-M4-071312	P1202848-003	Air	7/13/2012	15:05	X
FDF02-071312	P1202848-004	Air	7/13/2012	00:00	X

GCAL
GULF COAST ANALYTICAL LABORATORIES, INC
7979 GSRI Avenue, Baton Rouge, Louisiana 70820-7402
Phone 225.769.4900 • Fax 225.767.5717

CHAIN OF CUSTODY RECORD

Lab use only	Client Name	Client #	Workorder #	Due Date
			P1202848	

Report to:
Client: CH2M Hill
Address: One South Main St. Ste 1100
Dayton OH, 45402
Contact: Marie Chiller
Phone: 937 220 2956
Fax:

Bill to:
Client:
Address:
Contact:
Phone:
Fax:

P.O. Number

Project Name/Number Wilkins-Shelby 435223.02.02.01.01

Sampled By: Leslie Baechler

Analytical Requests & Method

Matrix[1]	Date	Time (2400)	Comp	Grab	Sample Description	Preservatives	No Containers	Reduced Sulfur - ASTM 5504	Remarks	Lab ID
A	7/13/12	1308		X	VP-MW11-071312	—	1	X		/
A	7/13/12	1401		X	VP-MW13-071312	—	1	X		
A	7/13	1505		X	VP-M4-071312	—	1	X		
A	7/13	—		X	FD02-071312	—	1	X		

Lab use only:
Custody Seal
used ☐ yes ☐ no
in tact ☐ yes ☐ no
Temperature °C

Turn Around Time: ☐ 24-48 hrs. ☐ 3 days ☐ 1 week ☐ Standard ☐ Other Per SOW

Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
[signature]	[signature]	7/13/12	1900
[signature]	[signature]	7/14/12	1130

Note:

4

By submitting these samples, you agree to the terms and conditions contained in our most recent schedule of services.

Matrix[1]: W = water, S = soil, SD = solid, L = liquid, SL = sludge, o = oil, CT = charcoal tube, A = air bag

We cannot accept verbal changes. Please fax written changes to (225) 767-5717

WHITE: CLIENT FINAL REPORT — CANARY: LABORATORY — PINK: CLIENT

GCAL-06 11/98

Columbia Analytical Services, Inc.
Sample Acceptance Check Form

Client: CH2M Hill Work order: P1202848

Project: Wilkins - Shelby / 435223.02.02.01.01

Sample(s) received on: 7/14/2012 Date opened: 7/14/2012 by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☐	☒	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☒	☐	☐
	Location of seal(s)? Outside of exemption shipper canister. Sealing Lid?	☒	☐	☐
	Were signature and date included?	☒	☐	☐
	Were seals intact?	☒	☐	☐
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1202848-001.01	1.0 L Tedlar Bag					
P1202848-002.01	1.0 L Tedlar Bag					
P1202848-003.01	1.0 L Tedlar Bag					
P1202848-004.01	1.0 L Tedlar Bag					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

RESULTS OF ANALYSIS

COLUMBIA ANALYTICAL SERVICES, INC.
Now Part of the ALS Group
RESULTS OF ANALYSIS

Client: **CH2M Hill**
Client Sample ID: **VP-MW11-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-001

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 13:08
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 11:56
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	Data Qualifier
7783-06-4	**Hydrogen Sulfide**	**25**	7.0	2.5	**18**	5.0	1.8	
74-93-1	Methyl Mercaptan	9.8	9.8	4.7	5.0	5.0	2.4	U
75-08-1	Ethyl Mercaptan	13	13	6.1	5.0	5.0	2.4	U
75-18-3	Dimethyl Sulfide	13	13	6.1	5.0	5.0	2.4	U
75-33-2	Isopropyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
75-66-1	tert-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
107-03-9	n-Propyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
624-89-5	Ethyl Methyl Sulfide	16	16	7.5	5.0	5.0	2.4	U
110-02-1	Thiophene	17	17	8.3	5.0	5.0	2.4	U
513-44-0	Isobutyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
352-93-2	Diethyl Sulfide	18	18	8.8	5.0	5.0	2.4	U
109-79-5	n-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
624-92-0	Dimethyl Disulfide	9.6	9.6	4.6	2.5	2.5	1.2	U
616-44-4	3-Methylthiophene	20	20	9.6	5.0	5.0	2.4	U
110-01-0	Tetrahydrothiophene	18	18	8.7	5.0	5.0	2.4	U
638-02-8	2,5-Dimethylthiophene	23	23	11	5.0	5.0	2.4	U
872-55-9	2-Ethylthiophene	23	23	11	5.0	5.0	2.4	U
110-81-6	Diethyl Disulfide	12	12	6.0	2.5	2.5	1.2	U

U = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: [signature] Date: 7/23/12

Client: **CH2M Hill**
Client Sample ID: **VP-MW11-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-001

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 13:08
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 11:56
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
463-58-1	Carbonyl Sulfide	12	12	5.0	5.0	U
75-15-0	**Carbon Disulfide**	**32**	7.8	**10**	2.5	

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

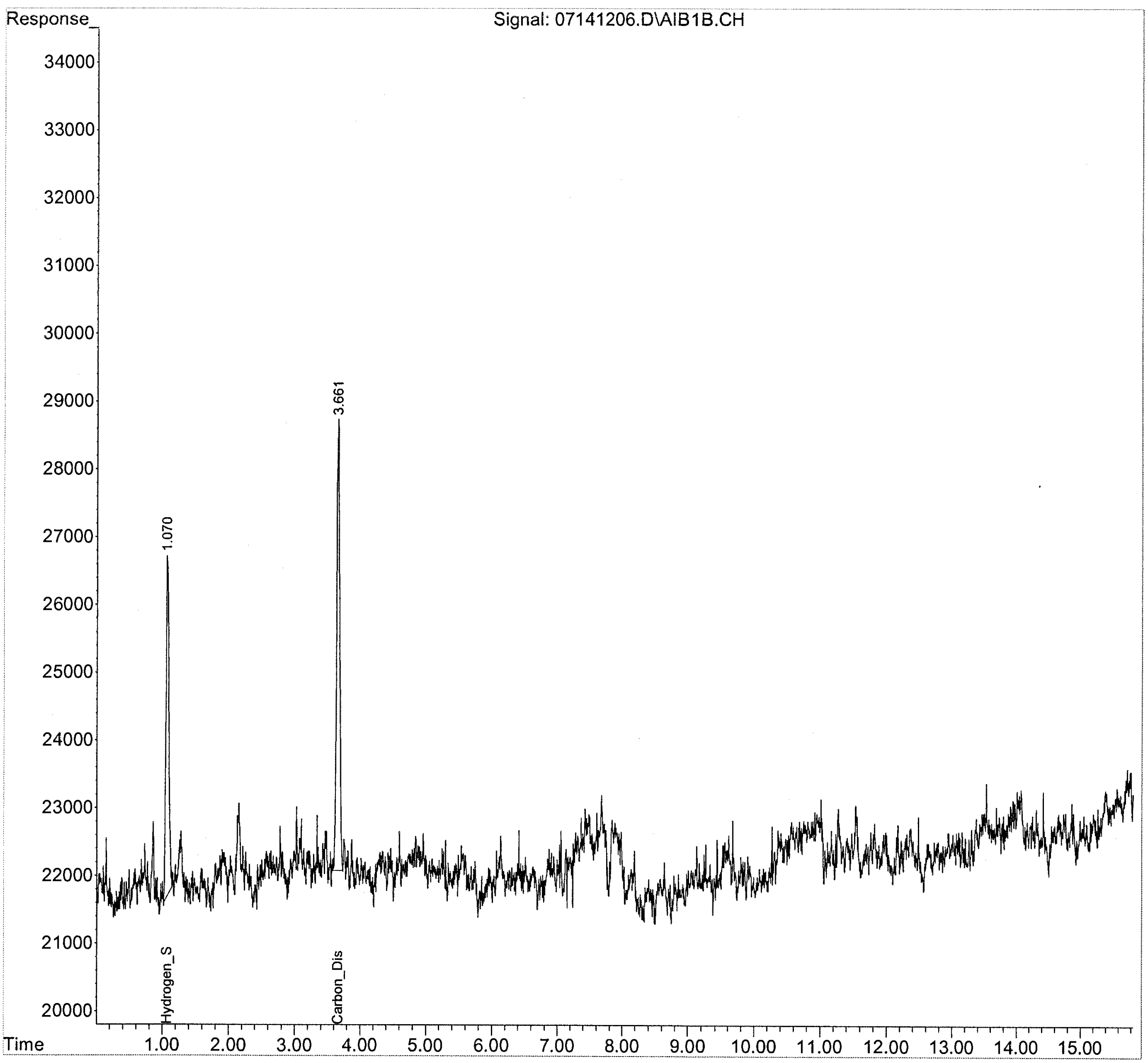
Verified By: [signature] Date: 7/23/12

Quantitation Report (QT Reviewed)

```
Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141206.D
Signal(s) : AIB1B.CH
Acq On    : 14 Jul 2012  11:56 am
Operator  : WHH
Sample    : 2848-001 1ml
Misc      :
ALS Vial  : 6   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:48:30 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj.  :
Signal Phase :
Signal Info  :
```



9

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141206.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 11:56 am
Operator : WHH
Sample : 2848-001 1ml
Misc :
ALS Vial : 6 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:48:30 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.073	161505	17.683	ppb
2)	W	Carbonyl_Sulfide	0.000	0	N.D.	ppb
3)	T	Methyl_Mercaptan	0.000	0	N.D.	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	3.662	219478	10.432	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

COLUMBIA ANALYTICAL SERVICES, INC.

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RESULTS OF ANALYSIS

Client: **CH2M Hill**
Client Sample ID: **VP-MW13-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-002

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 14:01
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:16
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
7783-06-4	**Hydrogen Sulfide**	**230**	7.0	2.5	**160**	5.0	1.8	
74-93-1	Methyl Mercaptan	9.8	9.8	4.7	5.0	5.0	2.4	U
75-08-1	Ethyl Mercaptan	13	13	6.1	5.0	5.0	2.4	U
75-18-3	Dimethyl Sulfide	13	13	6.1	5.0	5.0	2.4	U
75-33-2	Isopropyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
75-66-1	tert-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
107-03-9	n-Propyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
624-89-5	Ethyl Methyl Sulfide	16	16	7.5	5.0	5.0	2.4	U
110-02-1	Thiophene	17	17	8.3	5.0	5.0	2.4	U
513-44-0	Isobutyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
352-93-2	Diethyl Sulfide	18	18	8.8	5.0	5.0	2.4	U
109-79-5	n-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
624-92-0	Dimethyl Disulfide	9.6	9.6	4.6	2.5	2.5	1.2	U
616-44-4	3-Methylthiophene	20	20	9.6	5.0	5.0	2.4	U
110-01-0	Tetrahydrothiophene	18	18	8.7	5.0	5.0	2.4	U
638-02-8	2,5-Dimethylthiophene	23	23	11	5.0	5.0	2.4	U
872-55-9	2-Ethylthiophene	23	23	11	5.0	5.0	2.4	U
110-81-6	Diethyl Disulfide	12	12	6.0	2.5	2.5	1.2	U

U = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: ____f____ Date: 7/23/12

COLUMBIA ANALYTICAL SERVICES, INC.

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RESULTS OF ANALYSIS

Client: **CH2M Hill**
Client Sample ID: **VP-MW13-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-002

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 14:01
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:16
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
463-58-1	Carbonyl Sulfide	12	12	5.0	5.0	U
75-15-0	**Carbon Disulfide**	**15**	7.8	**4.8**	2.5	

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

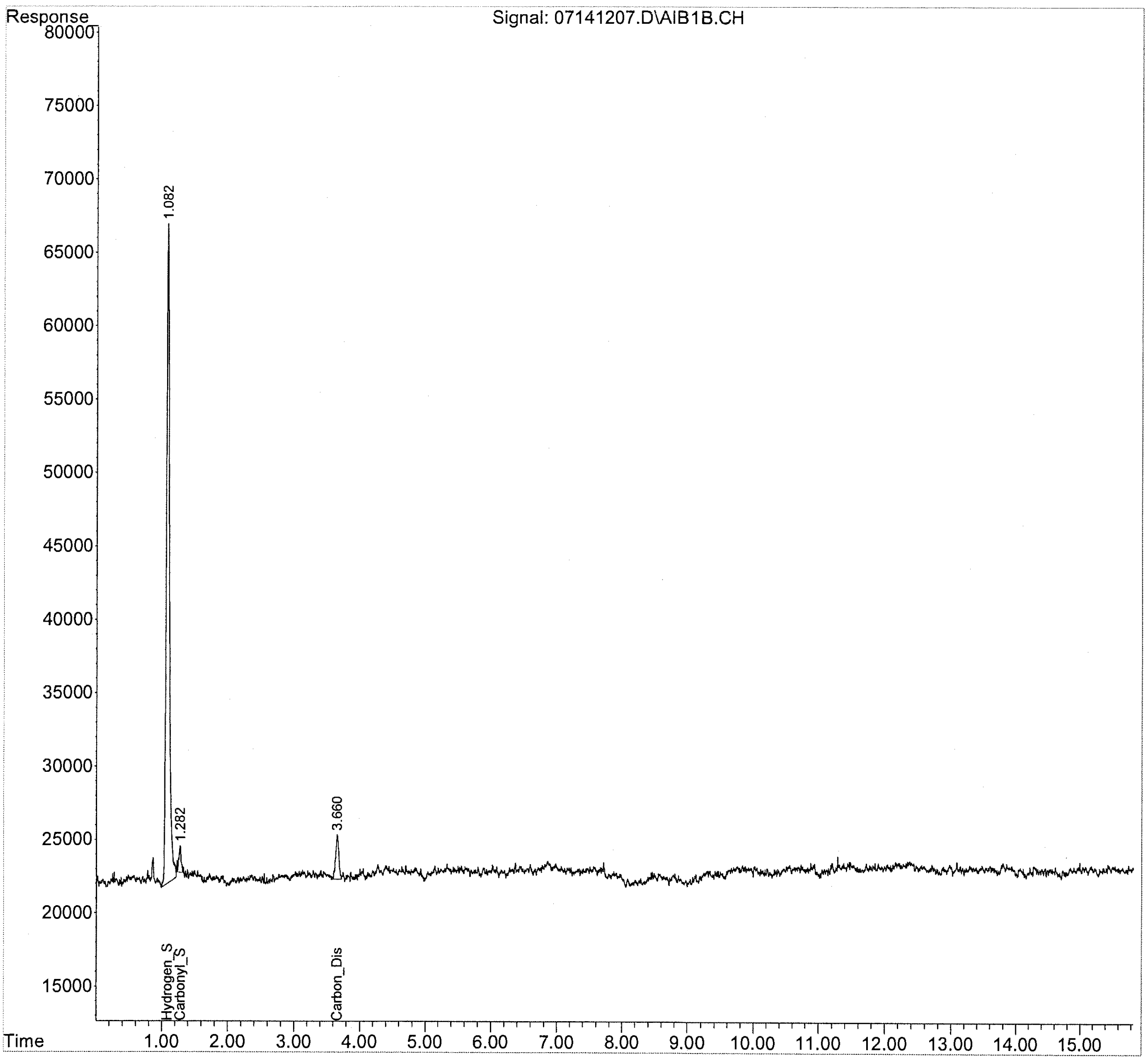
Verified By: [signature] Date: 7/23/12

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141207.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:16 pm
Operator : WHH
Sample : 2848-002 1ml
Misc :
ALS Vial : 7 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:49:07 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141207.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:16 pm
Operator : WHH
Sample : 2848-002 1ml
Misc :
ALS Vial : 7 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:49:07 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

	Compound	R.T.	Response	Conc Units	
	Target Compounds				
1) Z	Hydrogen_Sulfide	1.083	1497879	163.999 ppb	
2) W	Carbonyl_Sulfide	1.282	43368	3.836 ppb	m
3) T	Methyl_Mercaptan	0.000	0	N.D. ppb	
4) T	Ethyl_Mercaptan	0.000	0	N.D. ppb	
5) T	Dimethyl_Sulfide	0.000	0	N.D. ppb	
6) T	Carbon_Disulfide	3.662	101568	4.827 ppb	
7) T	2-Propyl_Mercaptan	0.000	0	N.D. ppb	
8) T	t-Butyl_Mercaptan	0.000	0	N.D. ppb	
9) T	Propyl_Mercaptan	0.000	0	N.D. ppb	
10) T	Ethyl_Methyl_Sulfide	0.000	0	N.D. ppb	
11) T	Thiophene	0.000	0	N.D. ppb	
12) T	i-Butyl_Mercaptan	0.000	0	N.D. ppb	
13) T	Diethyl_Sulfide	0.000	0	N.D. ppb	
14) T	n-Butyl_Mercaptan	0.000	0	N.D. ppb	
15) T	Dimethyl_Disulfide	0.000	0	N.D. ppb	
16) T	2-Methylthiophene	0.000	0	N.D. ppb	
17) T	3-Methylthiophene	0.000	0	N.D. ppb	
18) T	Tetrahydrothiophene	0.000	0	N.D. ppb	
19) T	2,5-Dimethylthiophene	0.000	0	N.D. ppb	
20) T	2-Ethylthiophene	0.000	0	N.D. ppb	
21) T	Diethyl_Disulfide	0.000	0	N.D. ppb	
22) T	Dimethyltrisulfide	0.000	0	N.D. ppb	

(f)=RT Delta > 1/2 Window (m)=manual int.

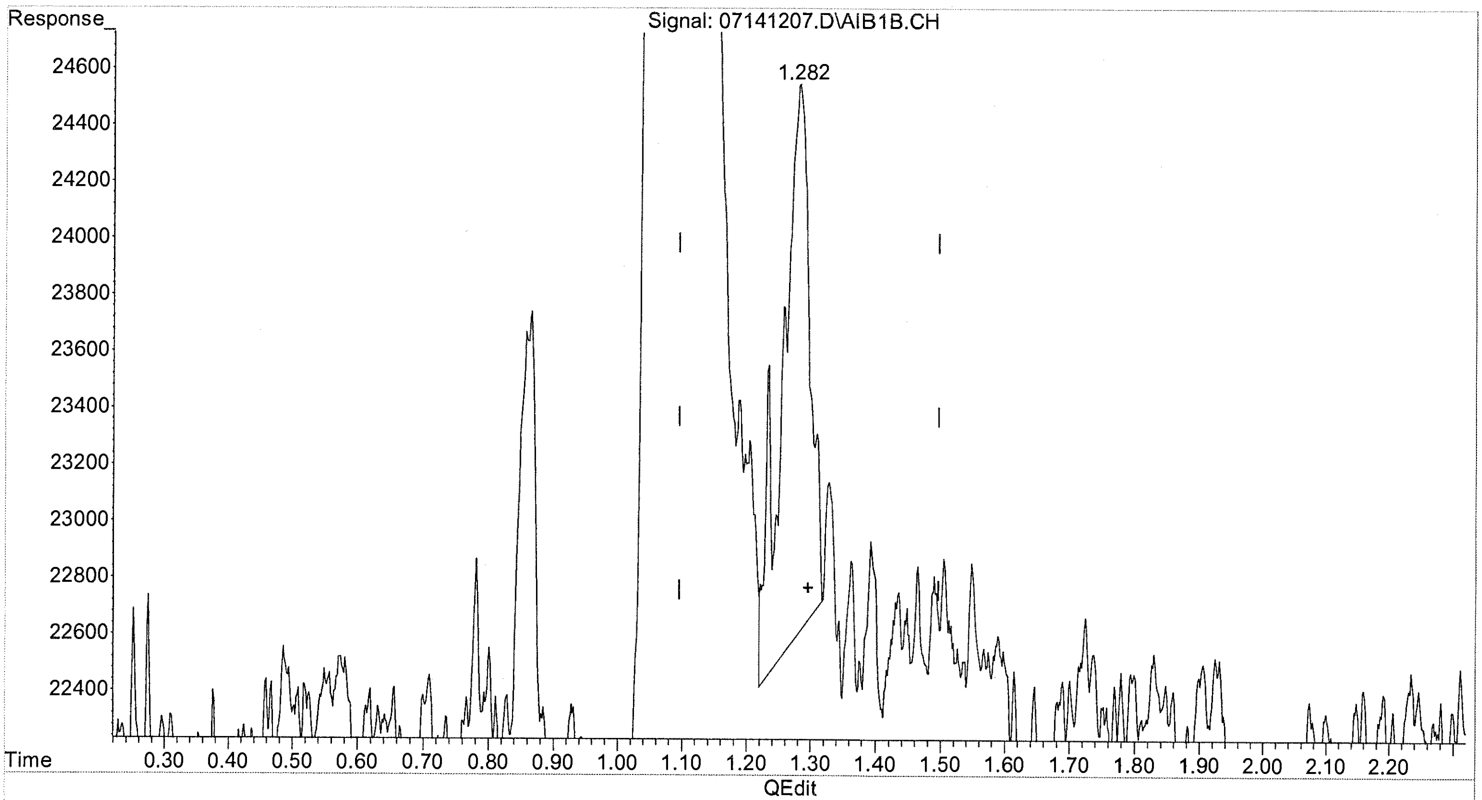
14

Quantitation Report (Qedit)

```
Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141207.D
Signal(s) : AIB1B.CH
Acq On    : 14 Jul 2012  12:16 pm
Operator  : WHH
Sample    : 2848-002 1ml
Misc      :
ALS Vial  : 7   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:48:57 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj.  :
Signal Phase :
Signal Info  :
```



(2) Carbonyl_Sulfide (W)

1.284min 5.090 ppb

response 57545

15

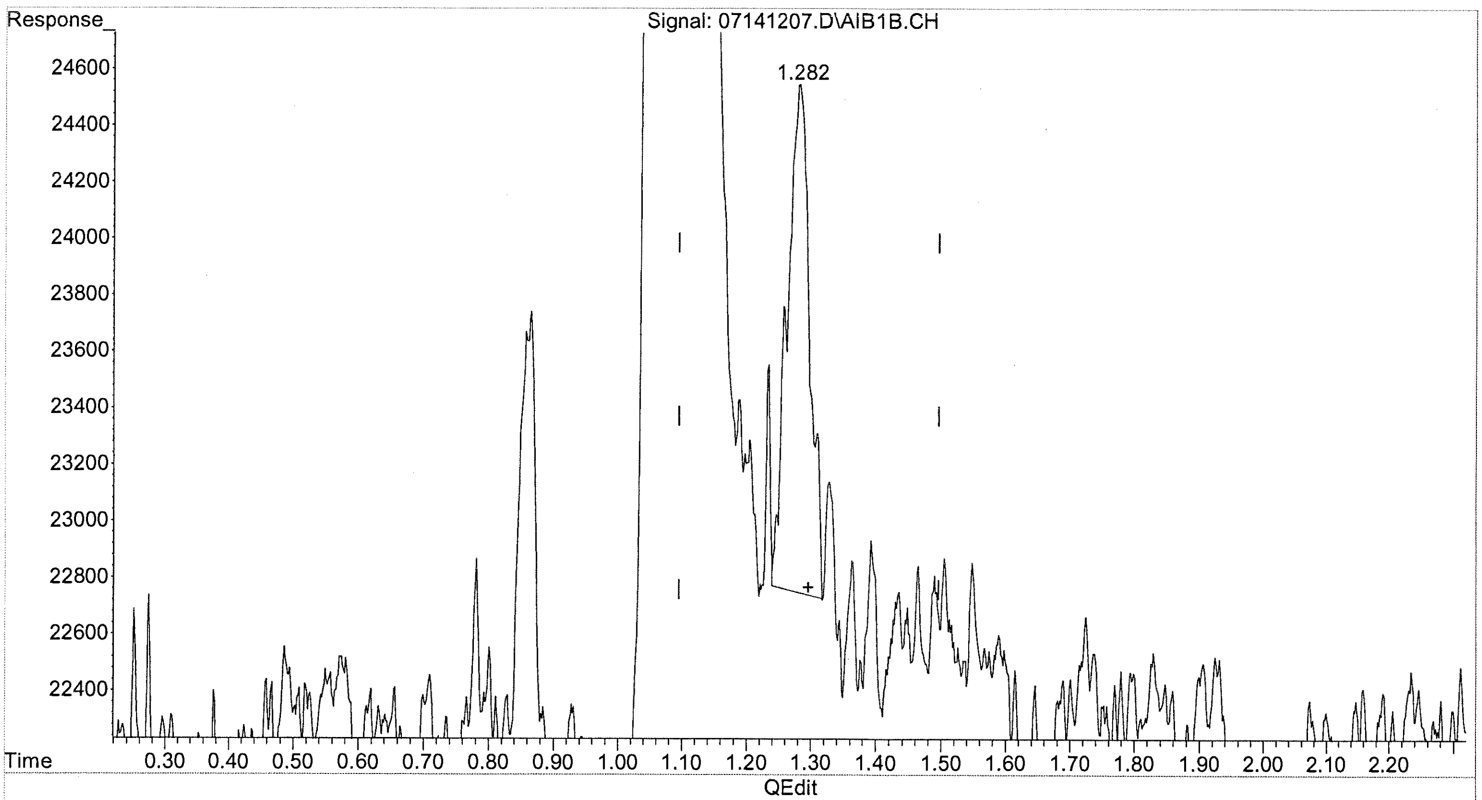
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141207.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:16 pm
Operator : WHH
Sample : 2848-002 1ml
Misc :
ALS Vial : 7 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:48:57 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(2) Carbonyl_Sulfide (W)
1.282min 3.836 ppb m
response 43368

16

(+) = Expected Retention Time

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RESULTS OF ANALYSIS

Client: **CH2M Hill**
Client Sample ID: **VP-M4-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-003

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 15:05
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:37
Volume(s) Analyzed: 1.0 ml(s)

CAS #	**Compound**	**Result** $\mu g/m^3$	MRL $\mu g/m^3$	MDL $\mu g/m^3$	**Result ppbV**	MRL ppbV	MDL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	7.0	7.0	2.5	5.0	5.0	1.8	U
74-93-1	Methyl Mercaptan	9.8	9.8	4.7	5.0	5.0	2.4	U
75-08-1	Ethyl Mercaptan	13	13	6.1	5.0	5.0	2.4	U
75-18-3	Dimethyl Sulfide	13	13	6.1	5.0	5.0	2.4	U
75-33-2	Isopropyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
75-66-1	tert-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
107-03-9	n-Propyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
624-89-5	Ethyl Methyl Sulfide	16	16	7.5	5.0	5.0	2.4	U
110-02-1	Thiophene	17	17	8.3	5.0	5.0	2.4	U
513-44-0	Isobutyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
352-93-2	Diethyl Sulfide	18	18	8.8	5.0	5.0	2.4	U
109-79-5	n-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
624-92-0	Dimethyl Disulfide	9.6	9.6	4.6	2.5	2.5	1.2	U
616-44-4	3-Methylthiophene	20	20	9.6	5.0	5.0	2.4	U
110-01-0	Tetrahydrothiophene	18	18	8.7	5.0	5.0	2.4	U
638-02-8	2,5-Dimethylthiophene	23	23	11	5.0	5.0	2.4	U
872-55-9	2-Ethylthiophene	23	23	11	5.0	5.0	2.4	U
110-81-6	Diethyl Disulfide	12	12	6.0	2.5	2.5	1.2	U

U = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: [signature] Date: 7/23/12

COLUMBIA ANALYTICAL SERVICES, INC.

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RESULTS OF ANALYSIS

Client: **CH2M Hill**
Client Sample ID: **VP-M4-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-003

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 15:05
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:37
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
463-58-1	**Carbonyl Sulfide**	**41**	12	**17**	5.0	
75-15-0	**Carbon Disulfide**	**57**	7.8	**18**	2.5	

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

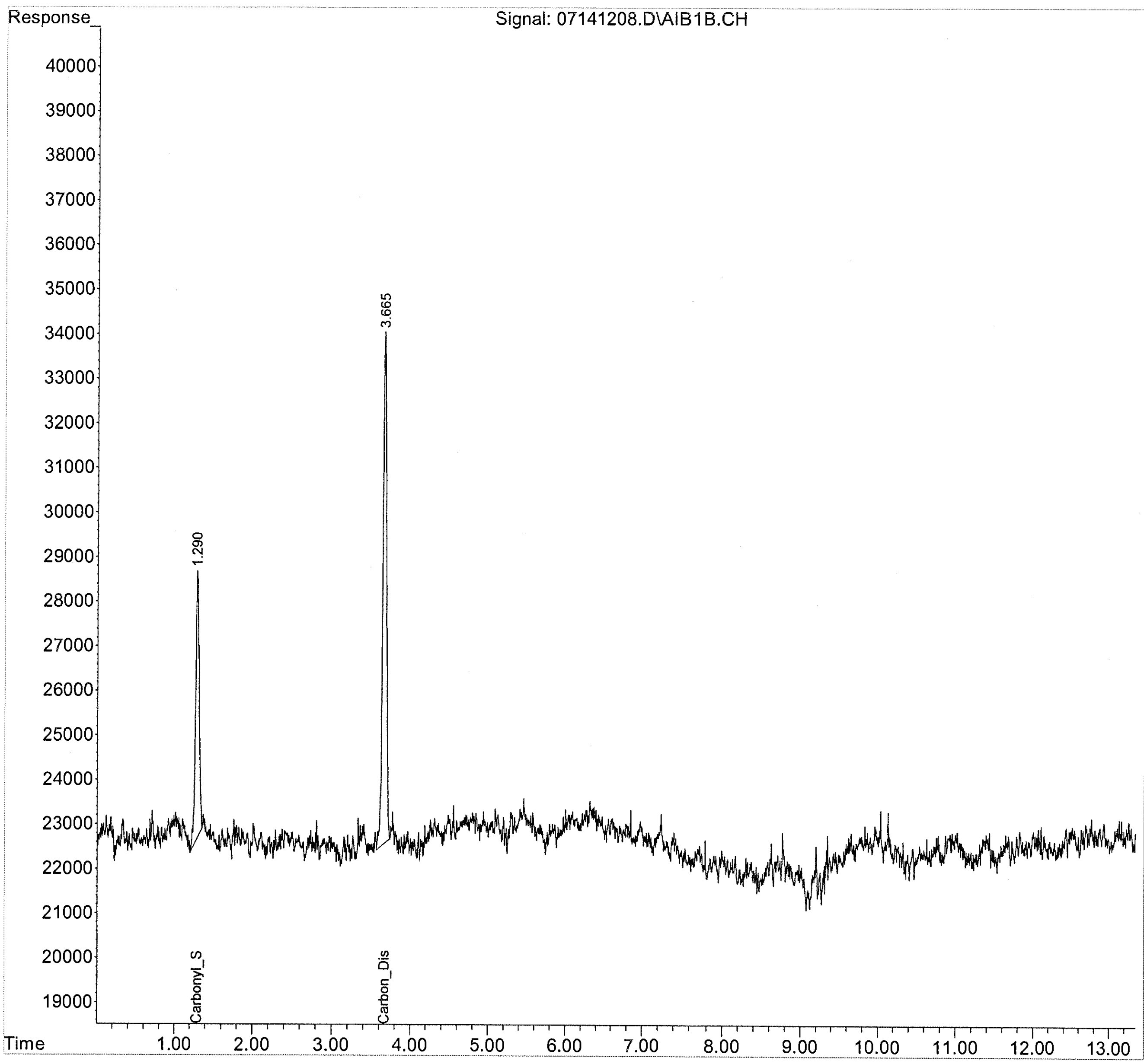
Verified By: [signature] Date: 7/25/12

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141208.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:37 pm
Operator : WHH
Sample : 2848-003 1ml
Misc :
ALS Vial : 8 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 15:15:20 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141208.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:37 pm
Operator : WHH
Sample : 2848-003 1ml
Misc :
ALS Vial : 8 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 15:15:20 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

	Compound	R.T.	Response	Conc	Units
Target Compounds					
1) Z	Hydrogen_Sulfide	0.000	0	N.D.	ppb
2) W	Carbonyl_Sulfide	1.292	188014	16.631	ppb
3) T	Methyl_Mercaptan	0.000	0	N.D.	ppb
4) T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5) T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6) T	Carbon_Disulfide	3.665	386086	18.350	ppb
7) T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8) T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9) T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10) T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11) T	Thiophene	0.000	0	N.D.	ppb
12) T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13) T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14) T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15) T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16) T	2-Methylthiophene	0.000	0	N.D.	ppb
17) T	3-Methylthiophene	0.000	0	N.D.	ppb
18) T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19) T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20) T	2-Ethylthiophene	0.000	0	N.D.	ppb
21) T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22) T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Client: **CH2M Hill**
Client Sample ID: **FDF02-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-004

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: NA
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:55
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
7783-06-4	**Hydrogen Sulfide**	**26**	7.0	2.5	**19**	5.0	1.8	
74-93-1	Methyl Mercaptan	9.8	9.8	4.7	5.0	5.0	2.4	U
75-08-1	Ethyl Mercaptan	13	13	6.1	5.0	5.0	2.4	U
75-18-3	Dimethyl Sulfide	13	13	6.1	5.0	5.0	2.4	U
75-33-2	Isopropyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
75-66-1	tert-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
107-03-9	n-Propyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
624-89-5	Ethyl Methyl Sulfide	16	16	7.5	5.0	5.0	2.4	U
110-02-1	Thiophene	17	17	8.3	5.0	5.0	2.4	U
513-44-0	Isobutyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
352-93-2	Diethyl Sulfide	18	18	8.8	5.0	5.0	2.4	U
109-79-5	n-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
624-92-0	Dimethyl Disulfide	9.6	9.6	4.6	2.5	2.5	1.2	U
616-44-4	3-Methylthiophene	20	20	9.6	5.0	5.0	2.4	U
110-01-0	Tetrahydrothiophene	18	18	8.7	5.0	5.0	2.4	U
638-02-8	2,5-Dimethylthiophene	23	23	11	5.0	5.0	2.4	U
872-55-9	2-Ethylthiophene	23	23	11	5.0	5.0	2.4	U
110-81-6	Diethyl Disulfide	12	12	6.0	2.5	2.5	1.2	U

U = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: ____ Date: 7/23/12

Client: **CH2M Hill**
Client Sample ID: **FDF02-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-004

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: NA
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 12:55
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
463-58-1	**Carbonyl Sulfide**	**13**	12	**5.1**	5.0	
75-15-0	**Carbon Disulfide**	**26**	7.8	**8.4**	2.5	

U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

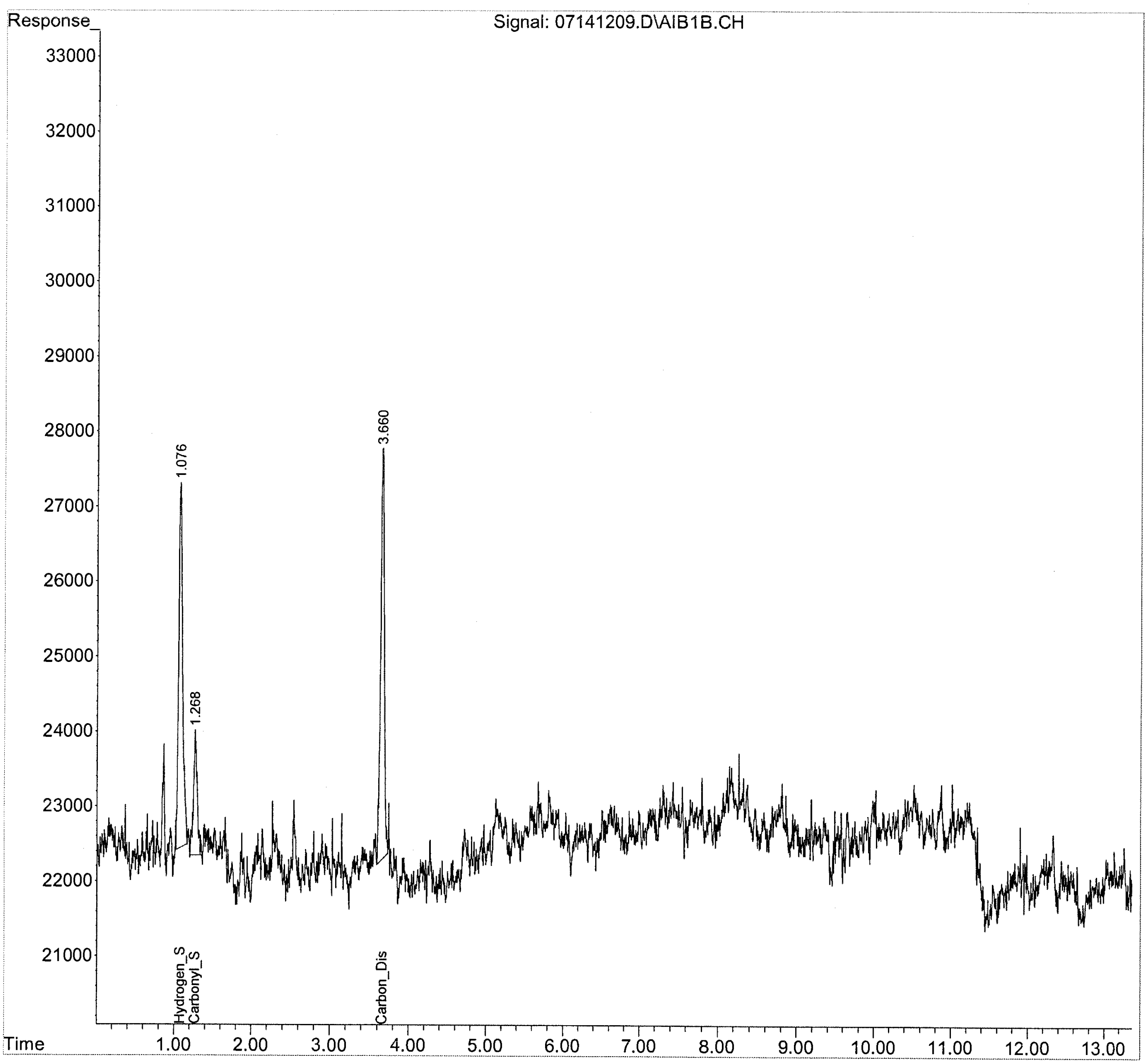
Verified By: [signature] Date: 7/23/12

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:45 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:45 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units	
Target Compounds							
1)	Z	Hydrogen_Sulfide	1.076	173132	18.956	ppb	m
2)	W	Carbonyl_Sulfide	1.268	57795	5.112	ppb	m
3)	T	Methyl_Mercaptan	0.000	0	N.D.	ppb	
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb	
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb	
6)	T	Carbon_Disulfide	3.662	176938	8.410	ppb	
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb	
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb	
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb	
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb	
11)	T	Thiophene	0.000	0	N.D.	ppb	
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb	
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb	
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb	
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb	
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb	
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb	
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb	
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb	
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb	
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb	
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb	

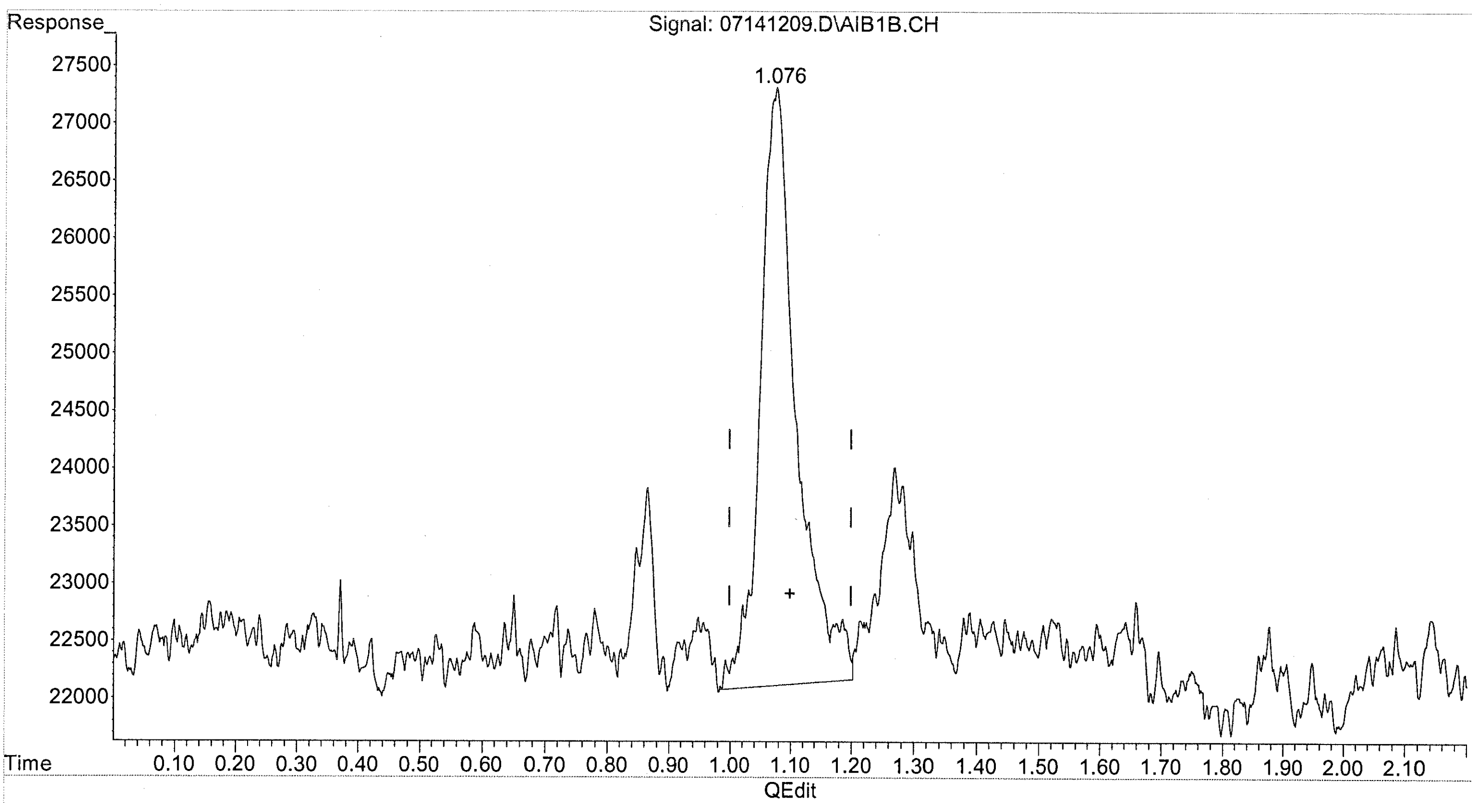
(f)=RT Delta > 1/2 Window (m)=manual int.

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:21 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(1) Hydrogen_Sulfide (Z)
1.076min 23.759 ppb
response 217003

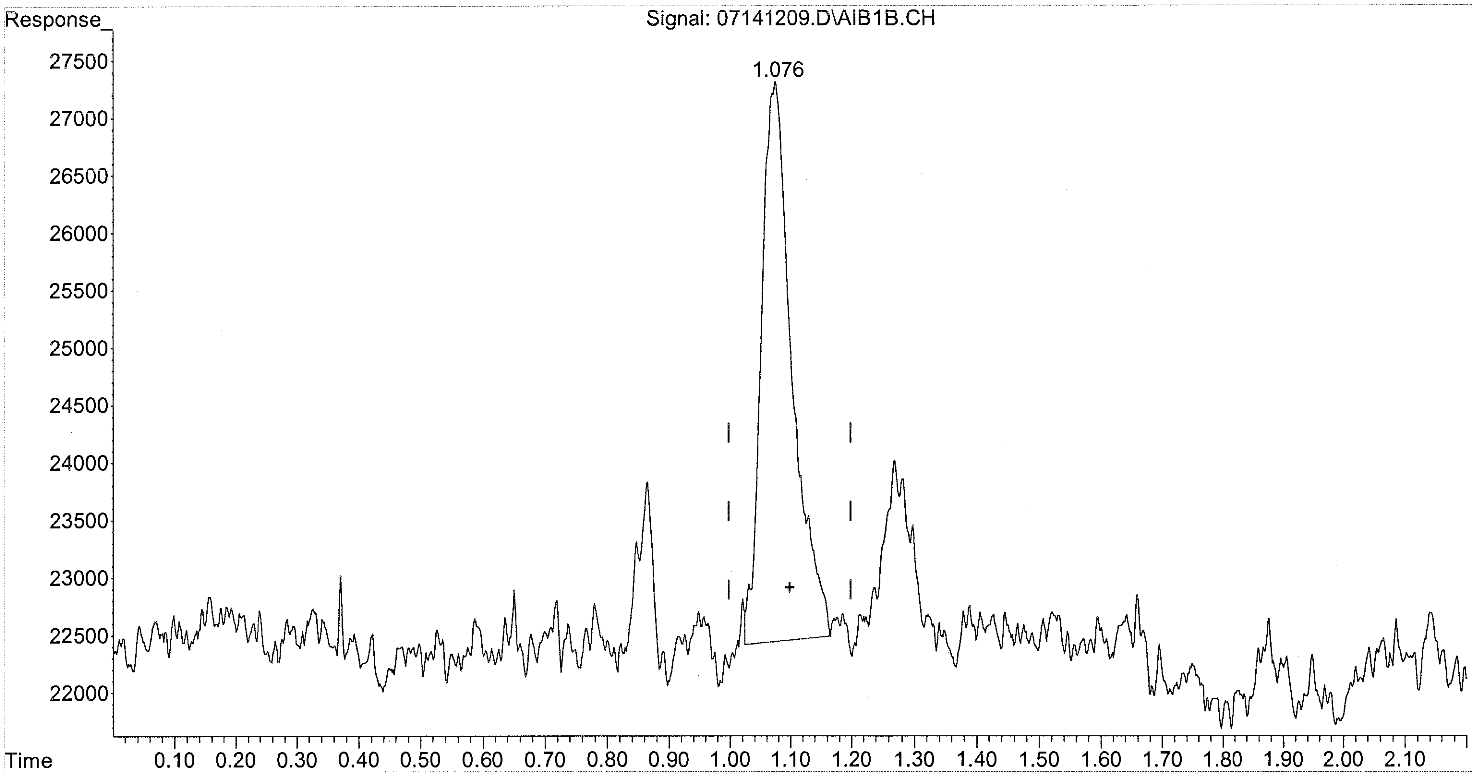
(+) = Expected Retention Time
GC13071212A.M Mon Jul 16 17:50:27 2012

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:21 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



QEdit

(1) Hydrogen_Sulfide (Z)
1.076min 18.956 ppb m
response 173132

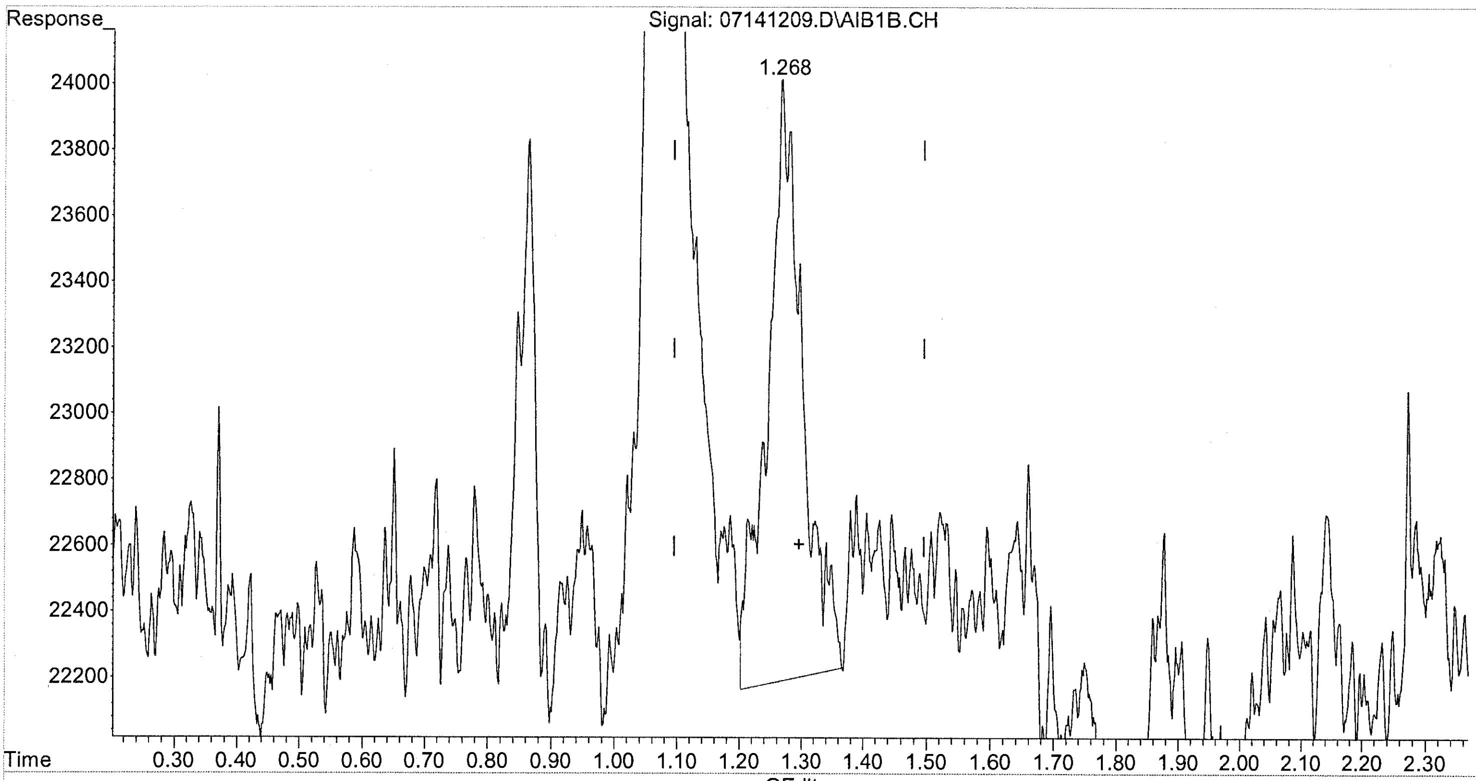
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:21 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



QEdit

(2) Carbonyl_Sulfide (W)
1.270min 6.360 ppb
response 71894

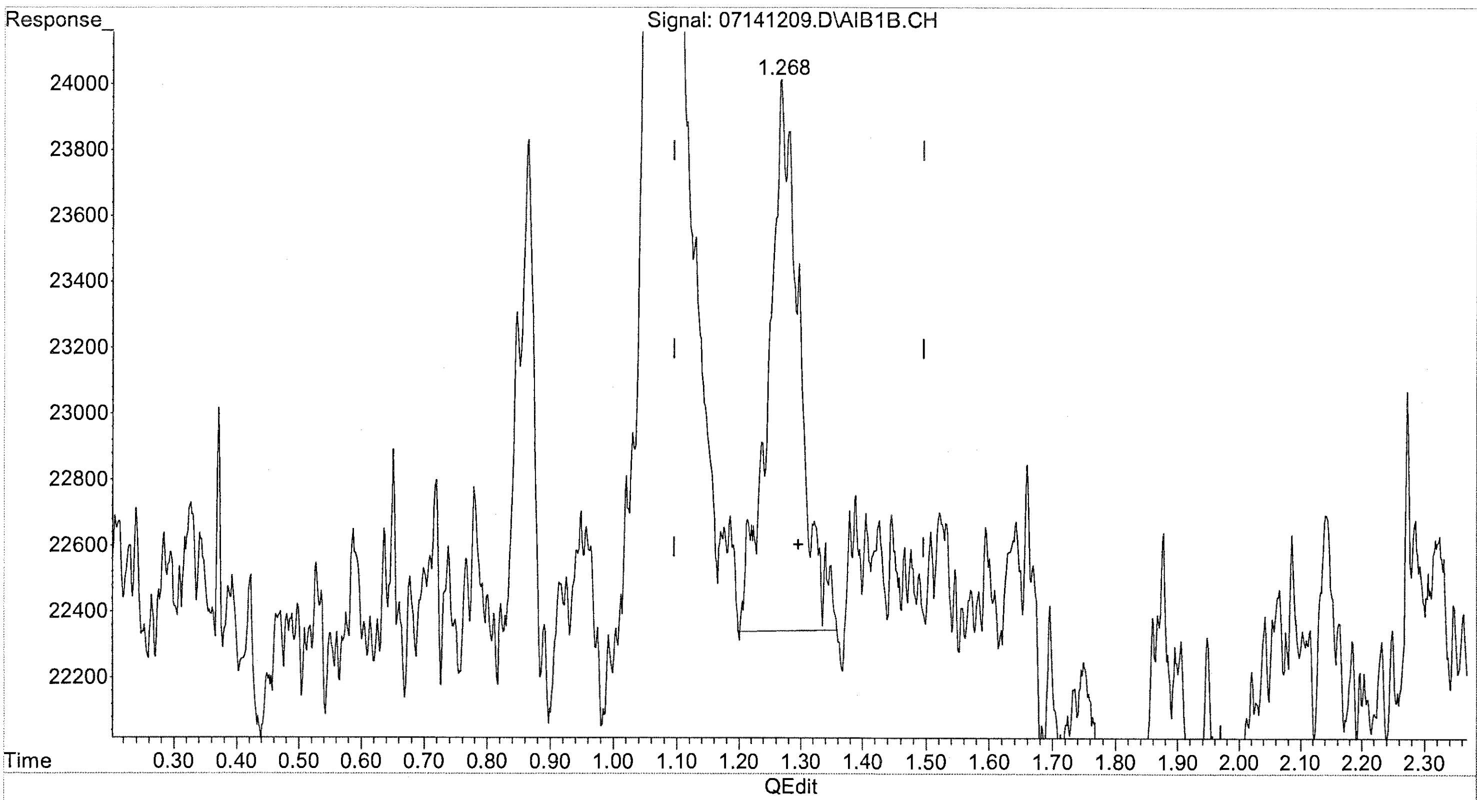
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141209.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 12:55 pm
Operator : WHH
Sample : 2848-004 1ml
Misc :
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:50:21 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(2) Carbonyl_Sulfide (W)
1.268min 5.112 ppb m
response 57795

(+) = Expected Retention Time

Client: **CH2M Hill**
Client Sample ID: **Method Blank**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P120714-MB

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: NA
Time Collected: NA
Date Received: NA
Date Analyzed: 7/14/12
Time Analyzed: 11:19
Volume(s) Analyzed: 1.0 ml(s)

CAS #	**Compound**	**Result µg/m³**	MRL µg/m³	MDL µg/m³	**Result ppbV**	MRL ppbV	MDL ppbV	Data Qualifier
7783-06-4	Hydrogen Sulfide	7.0	7.0	2.5	5.0	5.0	1.8	U
74-93-1	Methyl Mercaptan	9.8	9.8	4.7	5.0	5.0	2.4	U
75-08-1	Ethyl Mercaptan	13	13	6.1	5.0	5.0	2.4	U
75-18-3	Dimethyl Sulfide	13	13	6.1	5.0	5.0	2.4	U
75-33-2	Isopropyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
75-66-1	tert-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
107-03-9	n-Propyl Mercaptan	16	16	7.5	5.0	5.0	2.4	U
624-89-5	Ethyl Methyl Sulfide	16	16	7.5	5.0	5.0	2.4	U
110-02-1	Thiophene	17	17	8.3	5.0	5.0	2.4	U
513-44-0	Isobutyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
352-93-2	Diethyl Sulfide	18	18	8.8	5.0	5.0	2.4	U
109-79-5	n-Butyl Mercaptan	18	18	8.8	5.0	5.0	2.4	U
624-92-0	Dimethyl Disulfide	9.6	9.6	4.6	2.5	2.5	1.2	U
616-44-4	3-Methylthiophene	20	20	9.6	5.0	5.0	2.4	U
110-01-0	Tetrahydrothiophene	18	18	8.7	5.0	5.0	2.4	U
638-02-8	2,5-Dimethylthiophene	23	23	11	5.0	5.0	2.4	U
872-55-9	2-Ethylthiophene	23	23	11	5.0	5.0	2.4	U
110-81-6	Diethyl Disulfide	12	12	6.0	2.5	2.5	1.2	U

U = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Verified By: ________ Date: 7/23/12

Client: CH2M Hill
Client Sample ID: Method Blank
Client Project ID: Wilkins - Shelby / 435223.02.02.01.01

CAS Project ID: P1202848
CAS Sample ID: P120714-MB

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: NA
Time Collected: NA
Date Received: NA
Date Analyzed: 7/14/12
Time Analyzed: 11:19
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Result µg/m³	MRL µg/m³	Result ppbV	MRL ppbV	Data Qualifier
463-58-1	Carbonyl Sulfide	12	12	5.0	5.0	U
75-15-0	Carbon Disulfide	7.8	7.8	2.5	2.5	U

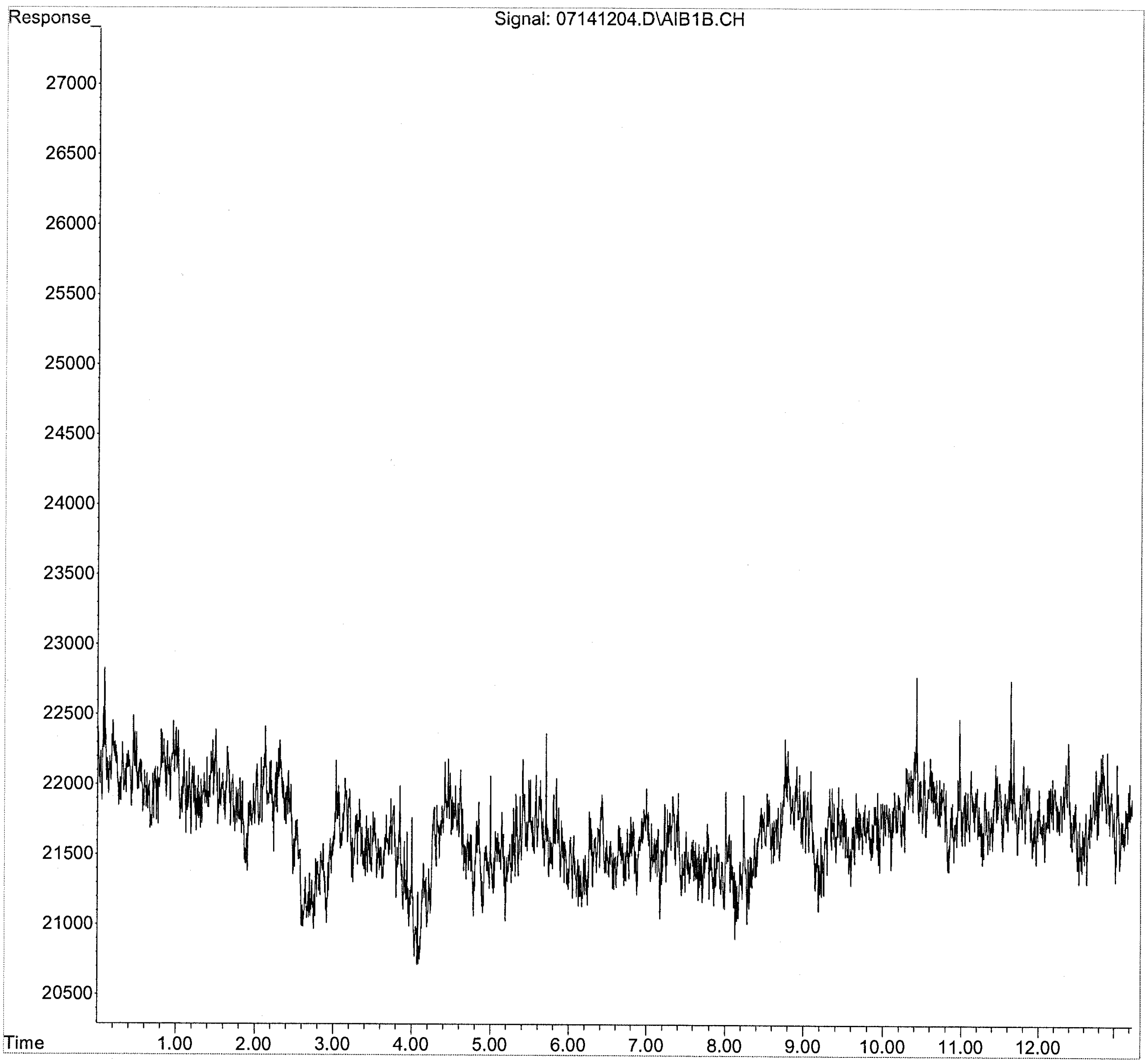
U = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

Quantitation Report (Not Reviewed)

```
Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141204.D
Signal(s) : AIB1B.CH
Acq On    : 14 Jul 2012  11:19 am
Operator  : WHH
Sample    : MB 1ml
Misc      :
ALS Vial  : 4   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:45:55 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj.   :
Signal Phase  :
Signal Info   :
```



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Quantitation Report (Not Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141204.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 11:19 am
Operator : WHH
Sample : MB 1ml
Misc :
ALS Vial : 4 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:45:55 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

Compound			R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	0.000	0	N.D.	ppb
2)	W	Carbonyl_Sulfide	0.000	0	N.D.	ppb
3)	T	Methyl_Mercaptan	0.000	0	N.D.	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	0.000	0	N.D.	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

QC SUMMARY FORMS

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LABORATORY CONTROL SAMPLE SUMMARY

Client: **CH2M Hill**
Client Sample ID: **Lab Control Sample**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P120714-LCS

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/14/12
Volume(s) Analyzed: NA ml(s)

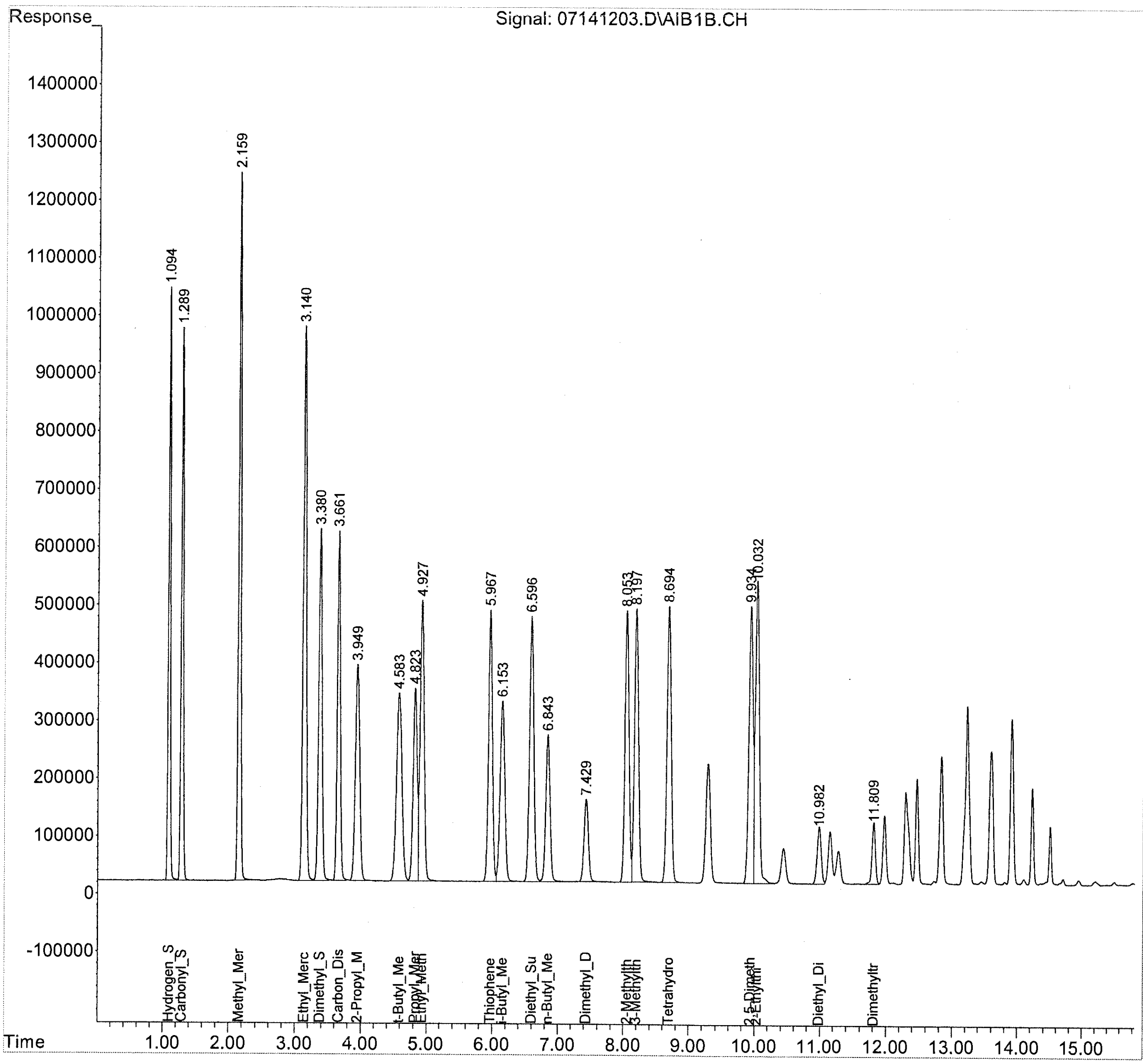
CAS #	Compound	Spike Amount μg/m³	Result μg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
7783-06-4	Hydrogen Sulfide	3,300	**3,280**	**99**	51-141	
463-58-1	Carbonyl Sulfide	6,100	**4,870**	**80**	63-147	
74-93-1	Methyl Mercaptan	4,600	**5,750**	**125**	54-156	

Verified By: [signature] Date: 7/23/12

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141203.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 10:57 am
Operator : WHH
Sample : rt/lcs
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:45:19 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report   (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141203.D
Signal(s) : AIB1B.CH
Acq On   : 14 Jul 2012 10:57 am
Operator : WHH
Sample   : rt/lcs
Misc   :
ALS Vial : 3   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:45:19 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.095	21524000	2356.603	ppb
2)	W	Carbonyl_Sulfide	1.290	22425765	1983.760	ppb
3)	T	Methyl_Mercaptan	2.160	30728144	2920.974	ppb
4)	T	Ethyl_Mercaptan	3.141	32473841	3086.917	ppb
5)	T	Dimethyl_Sulfide	3.380	21541511	2047.706	ppb
6)	T	Carbon_Disulfide	3.662	19464971	925.156	ppb
7)	T	2-Propyl_Mercaptan	3.950	17014823	1617.405	ppb
8)	T	t-Butyl_Mercaptan	4.583	18616307	1769.640	ppb
9)	T	Propyl_Mercaptan	4.824	13796341	1311.461	ppb
10)	T	Ethyl_Methyl_Sulfide	4.927	20994181	1995.677	ppb
11)	T	Thiophene	5.968	19514606	1855.031	ppb
12)	T	i-Butyl_Mercaptan	6.153	15591121	1482.070	ppb
13)	T	Diethyl_Sulfide	6.596	20685052	1966.292	ppb
14)	T	n-Butyl_Mercaptan	6.843	11594066	1102.116	ppb
15)	T	Dimethyl_Disulfide	7.431	6309834	299.902	ppb
16)	T	2-Methylthiophene	8.054	20126276	1913.175	ppb
17)	T	3-Methylthiophene	8.198	20433326	1942.363	ppb
18)	T	Tetrahydrothiophene	8.694	21482983	2042.142	ppb
19)	T	2,5-Dimethylthiophene	9.935	20764867	1973.879	ppb
20)	T	2-Ethylthiophene	10.033	23244391	2209.579	ppb
21)	T	Diethyl_Disulfide	10.982	4295410	204.158	ppb
22)	T	Dimethyltrisulfide	11.810	3829914	121.355	ppb

(f)=RT Delta > 1/2 Window   (m)=manual int.

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LABORATORY DUPLICATE SUMMARY RESULTS

Client: **CH2M Hill**
Client Sample ID: **VP-MW13-071312**
Client Project ID: **Wilkins - Shelby / 435223.02.02.01.01**

CAS Project ID: P1202848
CAS Sample ID: P1202848-002DUP

Test Code: ASTM D 5504-08
Instrument ID: Agilent 6890A/GC13/SCD
Analyst: Wade Henton
Sampling Media: 1.0 L Tedlar Bag
Test Notes:

Date Collected: 7/13/12
Time Collected: 14:01
Date Received: 7/14/12
Date Analyzed: 7/14/12
Time Analyzed: 13:30
Volume(s) Analyzed: 1.0 ml(s)

CAS #	Compound	Sample Result µg/m³	Sample Result ppbV	Duplicate Sample Result µg/m³	Duplicate Sample Result ppbV	Average **ppbV**	% RPD	RPD Limit	Data Qualifier
7783-06-4	**Hydrogen Sulfide**	229	164	232	167	165.5	**2**	34	
463-58-1	Carbonyl Sulfide	ND	ND	ND	ND	-	-	35	
74-93-1	Methyl Mercaptan	ND	ND	ND	ND	-	-	41	
75-08-1	Ethyl Mercaptan	ND	ND	ND	ND	-	-	41	
75-18-3	Dimethyl Sulfide	ND	ND	ND	ND	-	-	41	
75-15-0	**Carbon Disulfide**	15.0	4.83	12.6	4.04	4.435	**18**	41	
75-33-2	Isopropyl Mercaptan	ND	ND	ND	ND	-	-	41	
75-66-1	tert-Butyl Mercaptan	ND	ND	ND	ND	-	-	41	
107-03-9	n-Propyl Mercaptan	ND	ND	ND	ND	-	-	41	
624-89-5	Ethyl Methyl Sulfide	ND	ND	ND	ND	-	-	41	
110-02-1	Thiophene	ND	ND	ND	ND	-	-	41	
513-44-0	Isobutyl Mercaptan	ND	ND	ND	ND	-	-	41	
352-93-2	Diethyl Sulfide	ND	ND	ND	ND	-	-	41	
109-79-5	n-Butyl Mercaptan	ND	ND	ND	ND	-	-	41	
624-92-0	Dimethyl Disulfide	ND	ND	ND	ND	-	-	41	
616-44-4	3-Methylthiophene	ND	ND	ND	ND	-	-	41	
110-01-0	Tetrahydrothiophene	ND	ND	ND	ND	-	-	41	
638-02-8	2,5-Dimethylthiophene	ND	ND	ND	ND	-	-	41	
872-55-9	2-Ethylthiophene	ND	ND	ND	ND	-	-	41	
110-81-6	Diethyl Disulfide	ND	ND	ND	ND	-	-	41	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.

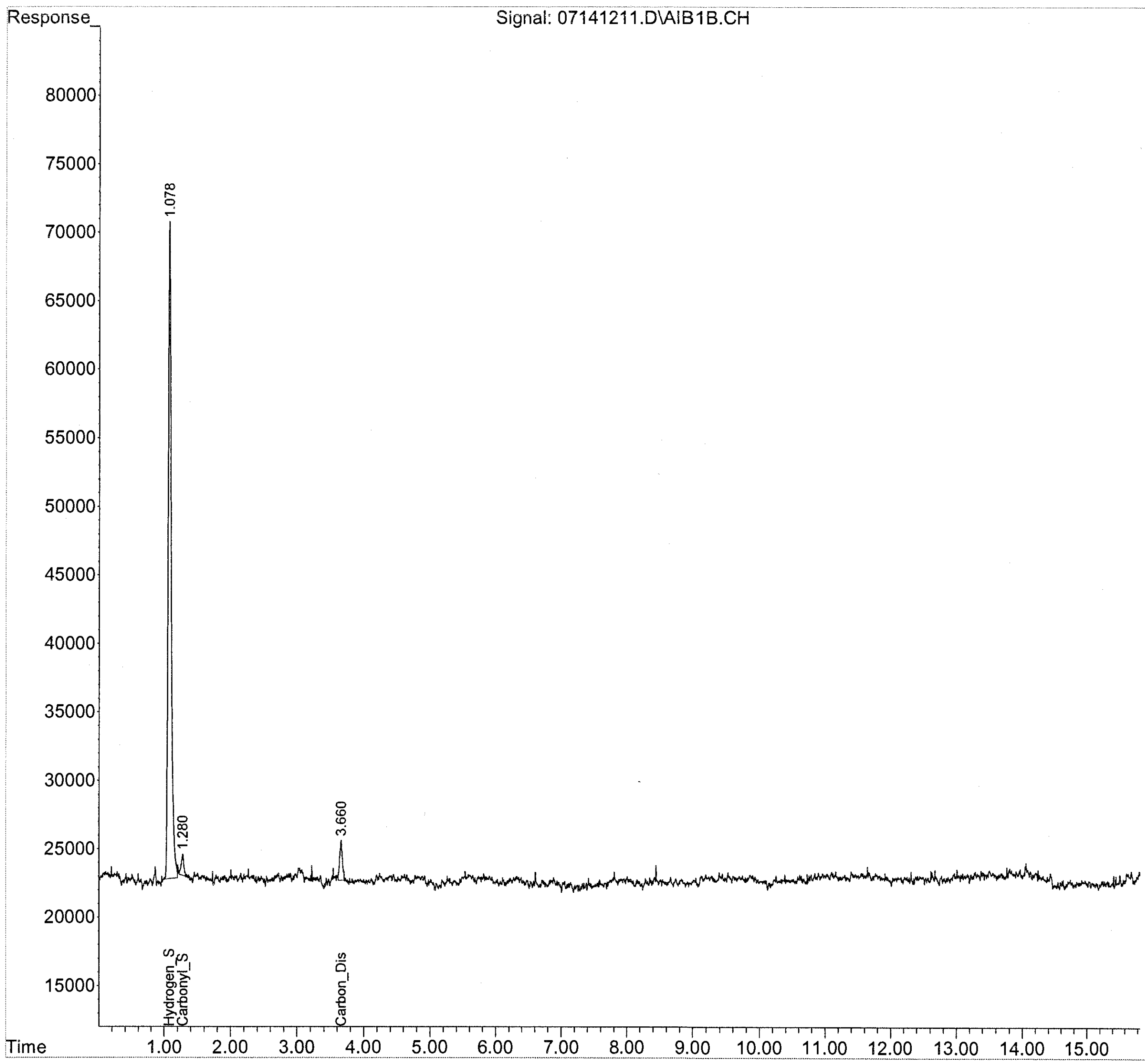
Verified By: ____ Date: 7/23/12

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:52:29 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:52:29 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units	
Target Compounds							
1)	Z	Hydrogen_Sulfide	1.078	1523572	166.812	ppb	m
2)	W	Carbonyl_Sulfide	1.280	41800	3.698	ppb	m
3)	T	Methyl_Mercaptan	0.000	0	N.D.	ppb	
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb	
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb	
6)	T	Carbon_Disulfide	3.660	85027	4.041	ppb	m
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb	
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb	
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb	
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb	
11)	T	Thiophene	0.000	0	N.D.	ppb	
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb	
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb	
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb	
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb	
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb	
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb	
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb	
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb	
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb	
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb	
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb	

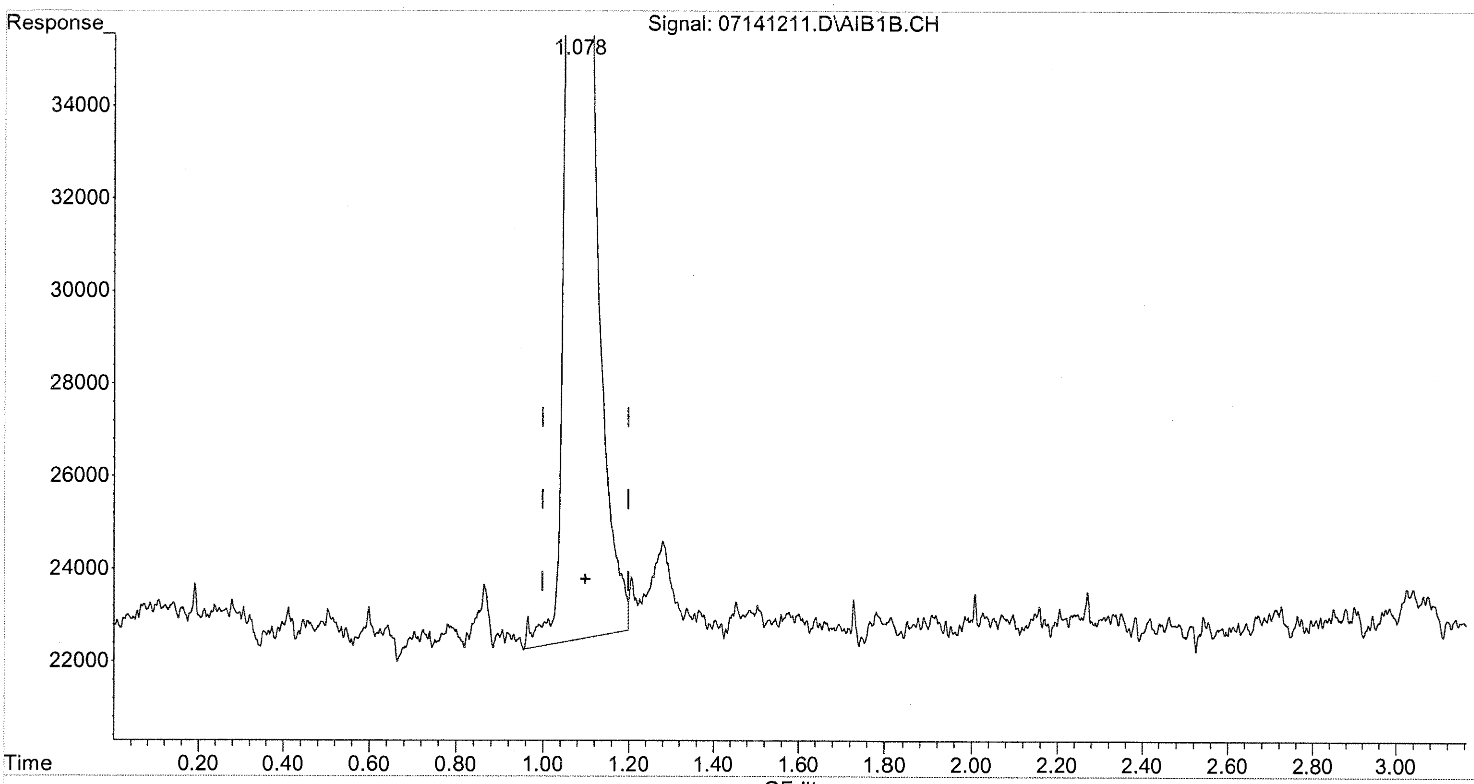
(f)=RT Delta > 1/2 Window (m)=manual int.

Quantitation Report (Qedit)

```
Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On    : 14 Jul 2012   1:30 pm
Operator  : WHH
Sample    : 2848-002 1ml dup
Misc      :
ALS Vial  : 3   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj.  :
Signal Phase :
Signal Info  :
```



QEdit

(1) Hydrogen_Sulfide (Z)

1.079min 171.945 ppb

response 1570454

40

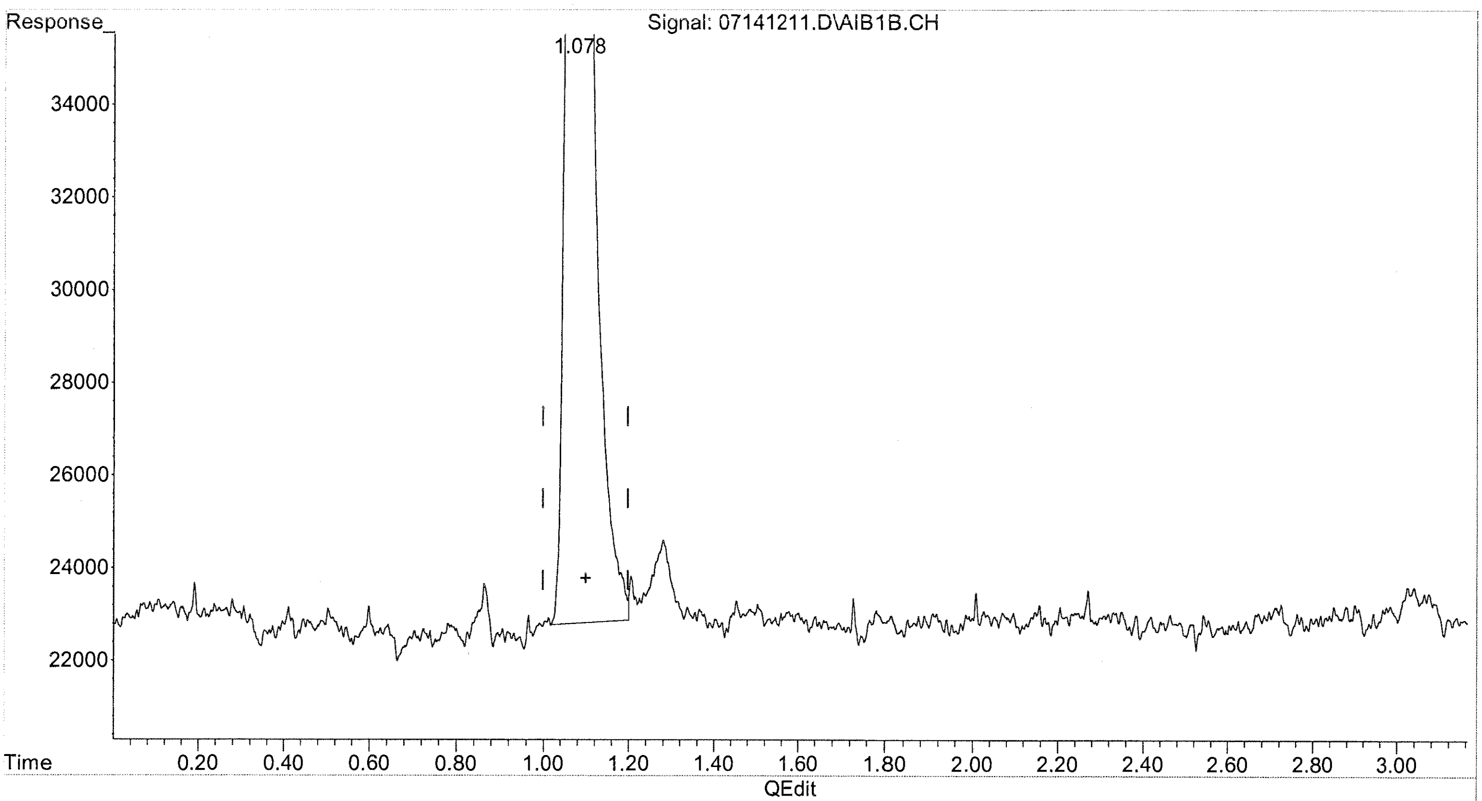
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(1) Hydrogen_Sulfide (Z)
1.078min 166.812 ppb m
response 1523572

(+) = Expected Retention Time

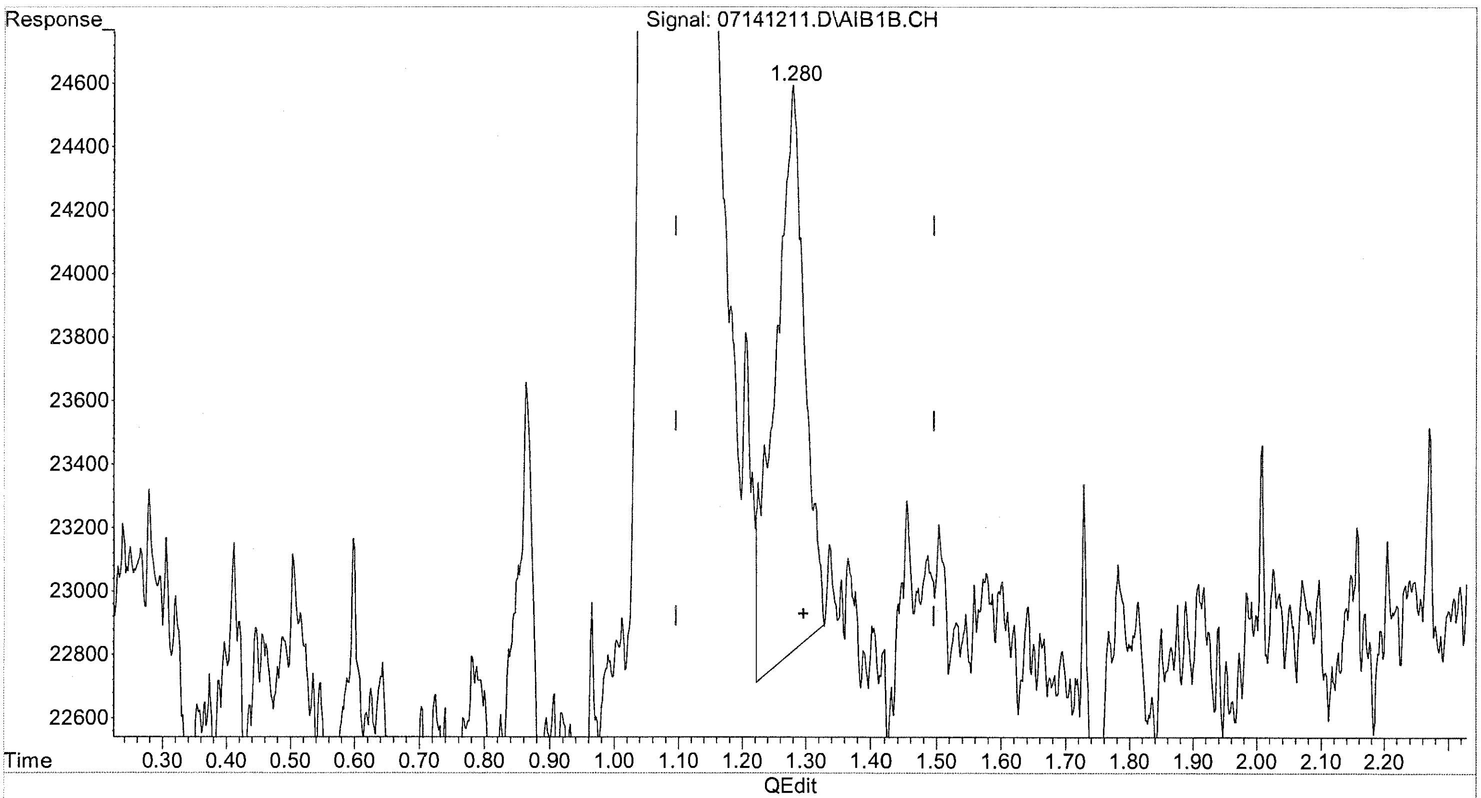
41

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(2) Carbonyl_Sulfide (W)
1.281min 5.105 ppb
response 57705

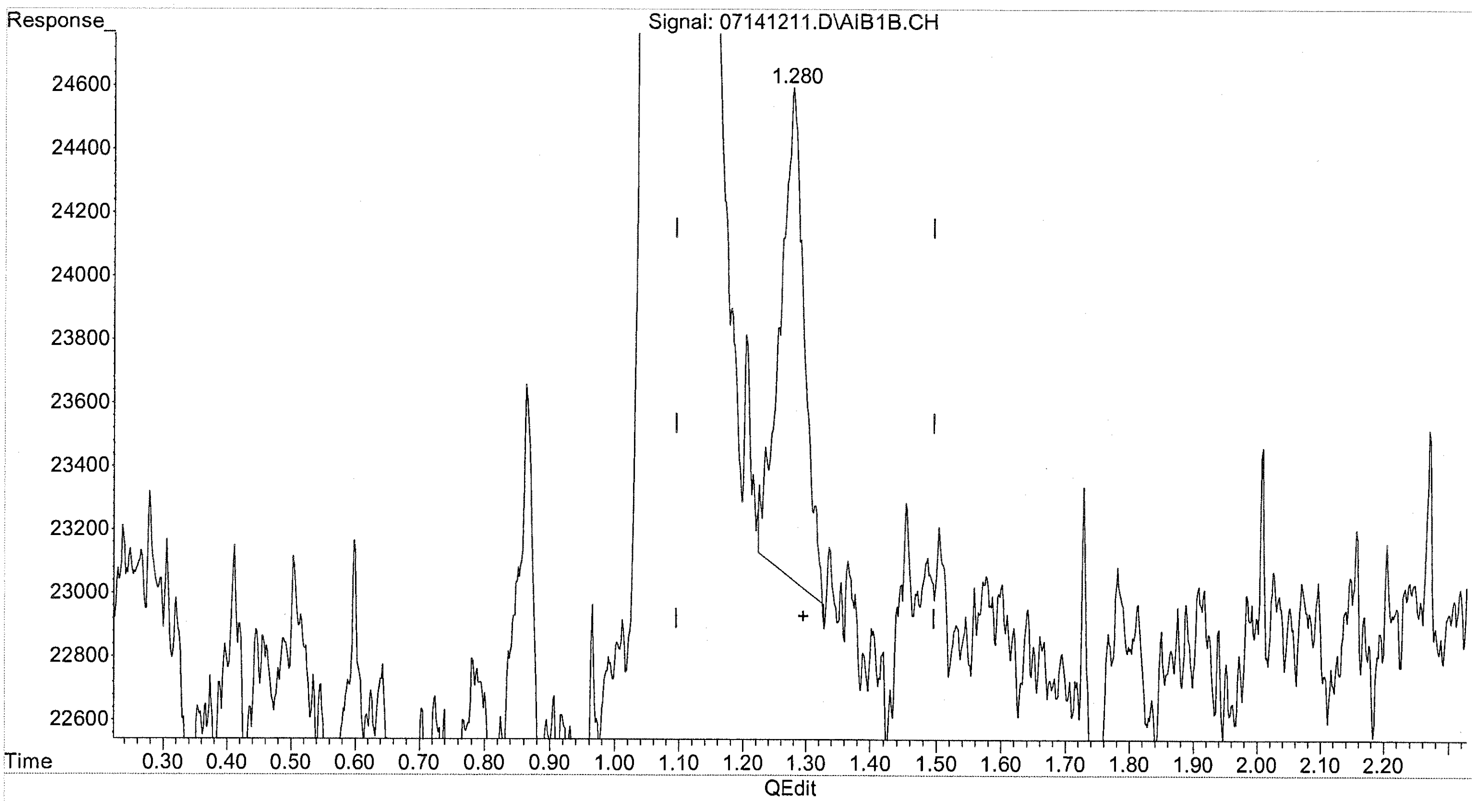
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(2) Carbonyl_Sulfide (W)
1.280min 3.698 ppb m
response 41800

WH 7/16/12
BLC
7/17/12

43

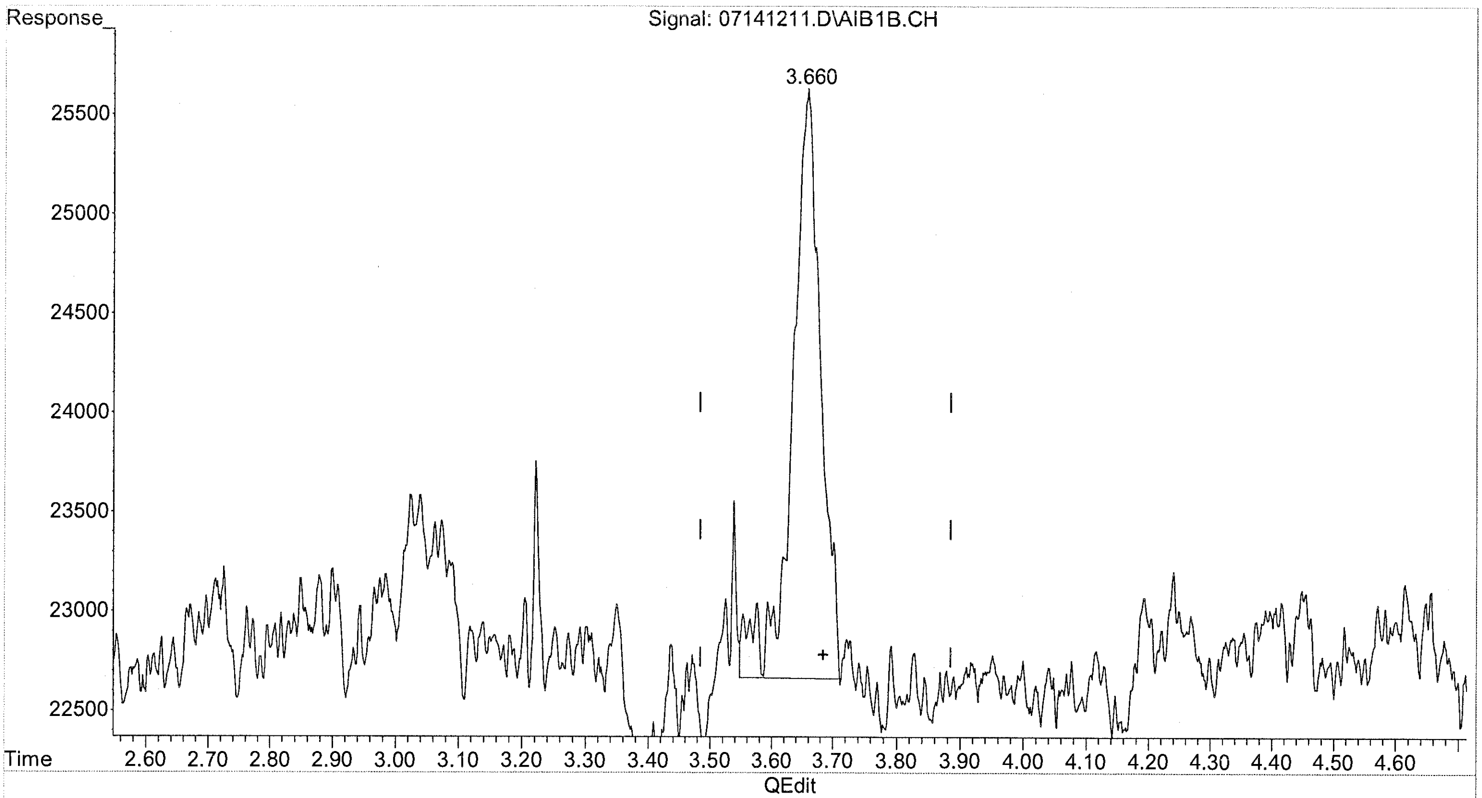
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(6) Carbon_Disulfide (T)
3.660min 4.632 ppb
response 97458

44

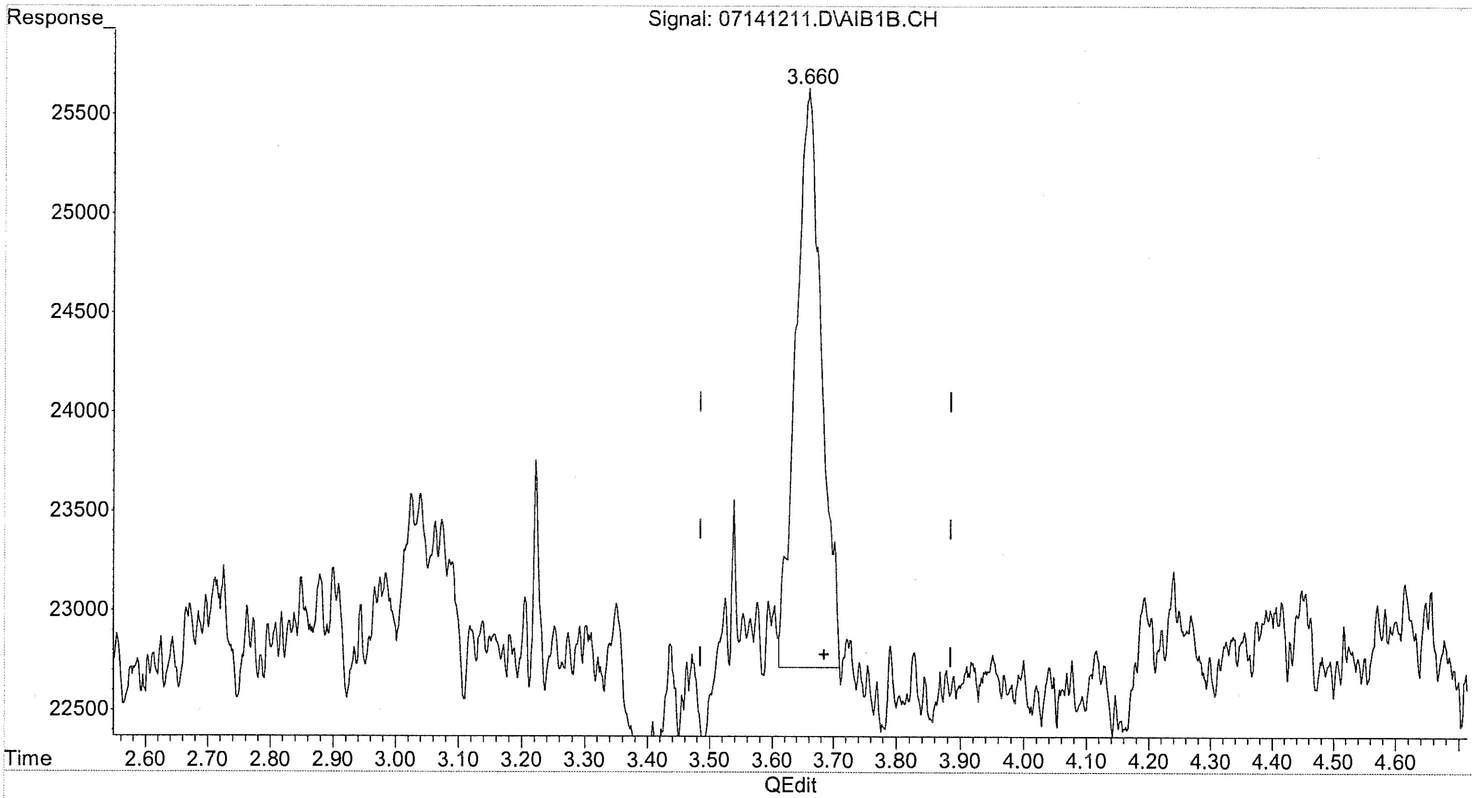
(+) = Expected Retention Time

Quantitation Report (Qedit)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141211.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:30 pm
Operator : WHH
Sample : 2848-002 1ml dup
Misc :
ALS Vial : 3 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:39 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



(6) Carbon_Disulfide (T)
3.660min 4.041 ppb m
response 85027

45

(+) = Expected Retention Time
GC13071212A.M Mon Jul 16 17:52:33 2012

INITIAL CALIBRATION STANDARDS

Response Factor Report GC13

Method Path : J:\GC13\METHODS\
Method File : GC13071212A.M
Title : 20 Sulfurs Initial Calibration
Last Update : Fri Jul 13 12:44:45 2012
Response Via : Initial Calibration

Calibration Files

1	=07121206.D	2	=07121212.D	3	=07121208.D
4	=07121209.D	5	=07121210.D	6	=07121211.D

		Compound	1	2	3	4	5	6	Avg		%RSD
1)	Z	Hydrogen_Sulfide	0.837	0.874	0.769	0.968	0.867	1.165	0.913	E4	15.22
2)	W	Carbonyl_Sulfide	1.191	1.036	1.093	1.177	1.034	1.251	1.130	E4	7.88
3)	T	Methyl_Mercaptan	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
4)	T	Ethyl_Mercaptan	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
5)	T	Dimethyl_Sulfide	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
6)	T	Carbon_Disulfide	1.961	1.872	1.821	2.369	2.043	2.558	2.104	E4	14.00
7)	T	2-Propyl_Merc...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
8)	T	t-Butyl_Merca...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
9)	T	Propyl_Mercaptan	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
10)	T	Ethyl_Methyl_...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
11)	T	Thiophene	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
12)	T	i-Butyl_Merca...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
13)	T	Diethyl_Sulfide	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
14)	T	n-Butyl_Merca...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
15)	T	Dimethyl_Disu...	1.961	1.872	1.821	2.369	2.043	2.558	2.104	E4	14.00
16)	T	2-Methylthiop...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
17)	T	3-Methylthiop...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
18)	T	Tetrahydrothi...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
19)	T	2,5-Dimethylt...	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
20)	T	2-Ethylthiophene	0.981	0.936	0.911	1.184	1.021	1.279	1.052	E4	14.00
21)	T	Diethyl_Disul...	1.961	1.872	1.821	2.369	2.043	2.558	2.104	E4	14.00
22)	T	Dimethyltrisu...	2.942	2.808	2.732	3.553	3.064	3.837	3.156	E4	14.00

(#) = Out of Range

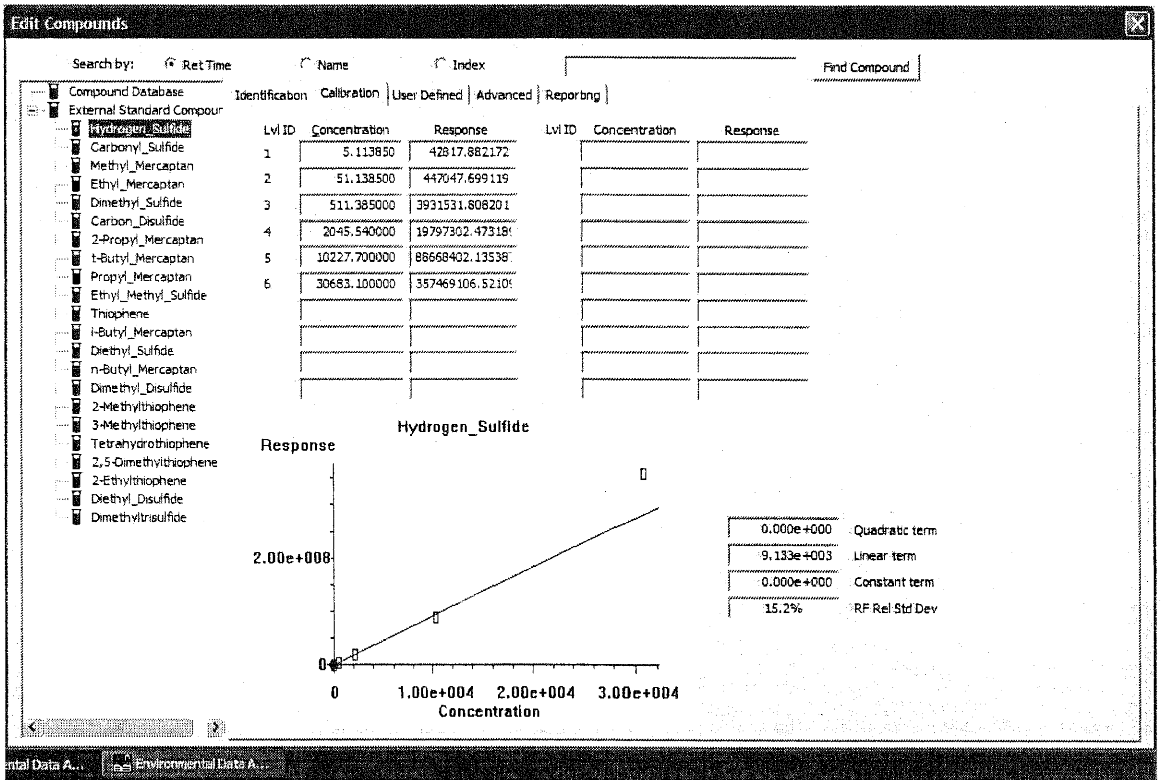
GC13071212A.M Fri Jul 13 12:45:41 2012

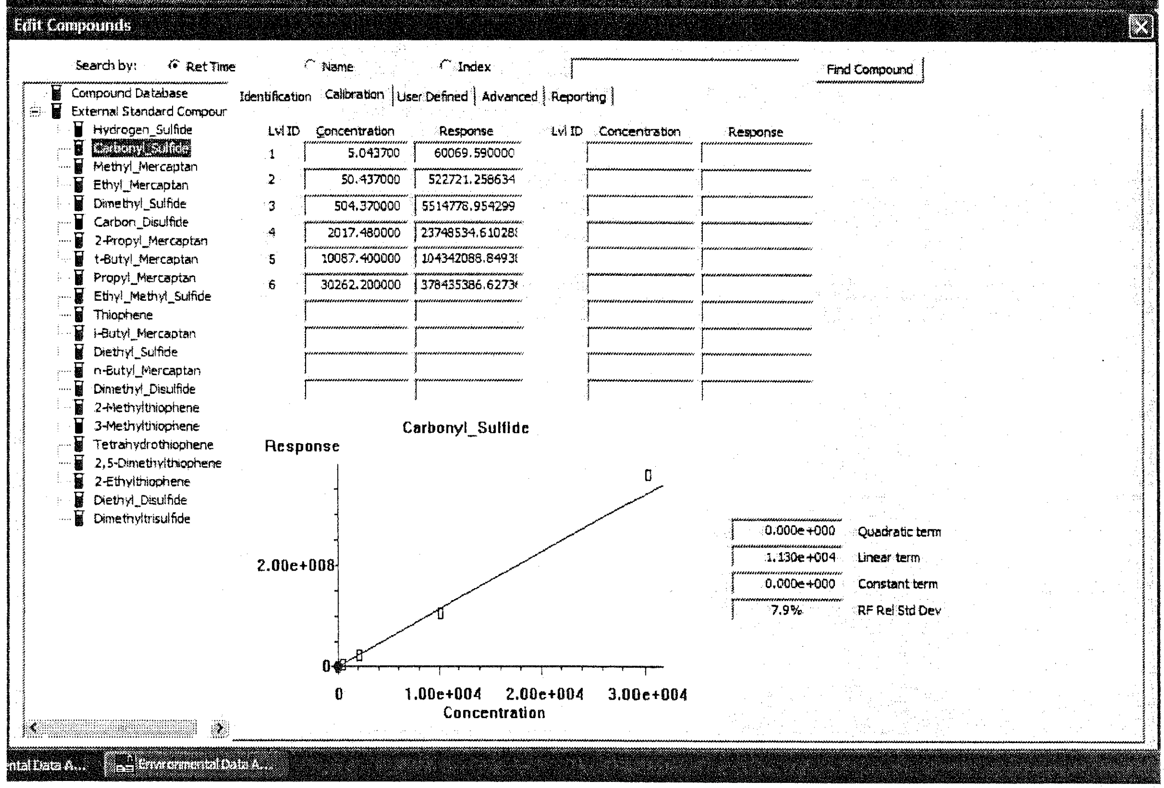
Calibration Status Report GC13

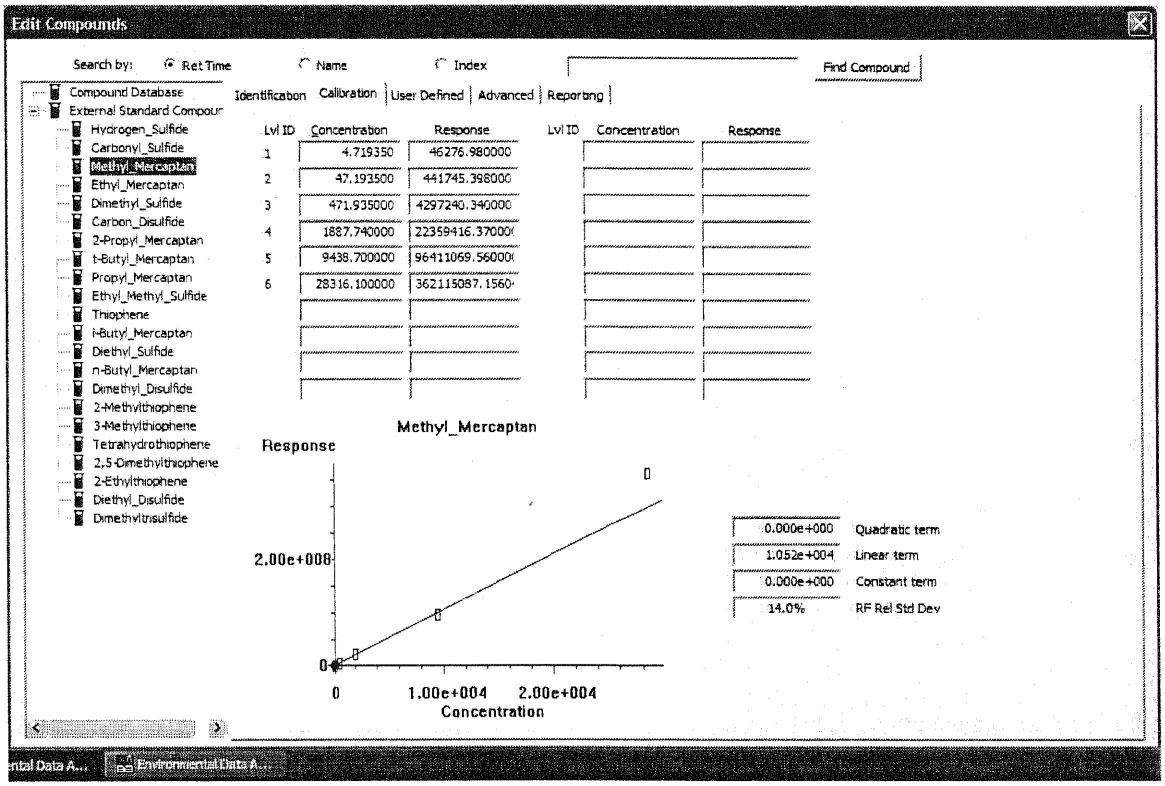
Method Path : J:\GC13\METHODS\
Method File : GC13071212A.M
Title : 20 Sulfurs Initial Calibration
Last Update : Fri Jul 13 12:44:45 2012
Response Via : Initial Calibration

#	ID	Conc	ISTD Conc	Path\File
1	1	2	0	J:\GC13\DATA\SCD\2012_07\12\07121206.D
2	2	16	0	J:\GC13\DATA\SCD\2012_07\12\07121212.D
3	3	157	0	J:\GC13\DATA\SCD\2012_07\12\07121208.D
4	4	629	0	J:\GC13\DATA\SCD\2012_07\12\07121209.D
5	5	3146	0	J:\GC13\DATA\SCD\2012_07\12\07121210.D
6	6	9439	0	J:\GC13\DATA\SCD\2012_07\12\07121211.D

#	ID	Update Time	Quant Time	Acquisition Time
1	1	Jul 13 12:29 2012	Jul 13 12:27 2012	12 Jul 2012 12:01 pm
2	2	Jul 13 12:35 2012	Jul 13 12:35 2012	12 Jul 2012 2:15 pm
3	3	Jul 13 12:33 2012	Jul 13 12:30 2012	12 Jul 2012 12:17 pm
4	4	Jul 13 12:33 2012	Jul 13 12:33 2012	12 Jul 2012 12:40 pm
5	5	Jul 13 12:34 2012	Jul 13 12:34 2012	12 Jul 2012 12:56 pm
6	6	Jul 13 12:34 2012	Jul 13 12:34 2012	12 Jul 2012 1:45 pm


Edit Compounds
Search by: Ret Time Name Index
Find Compound
Compound Database
External Standard Compour
Hydrogen_Sulfide
Carbonyl_Sulfide
Methyl_Mercaptan
Ethyl_Mercaptan
Dimethyl_Sulfide
Carbon_Disulfide
2-Propyl_Mercaptan
t-Butyl_Mercaptan
Propyl_Mercaptan
Ethyl_Methyl_Sulfide
Thiophene
i-Butyl_Mercaptan
Diethyl_Sulfide
n-Butyl_Mercaptan
Dimethyl_Disulfide
2-Methylthiophene
3-Methylthiophene
Tetrahydrothiophene
2,5-Dimethylthiophene
2-Ethylthiophene
Diethyl_Disulfide
Dimethyltrisulfide
Identification Calibration User Defined Advanced Reporting
Lvl ID Concentration Response Lvl ID Concentration Response
1 5.113850 42817.882172
2 51.138500 447047.699119
3 511.385000 3931531.808201
4 2045.540000 19797302.47318
5 10227.700000 88668402.13538
6 30683.100000 357469106.5210
Hydrogen_Sulfide
Response
2.00e+008
0
0 1.00e+004 2.00e+004 3.00e+004
Concentration
0.000e+000 Quadratic term
9.133e+003 Linear term
0.000e+000 Constant term
15.2% RF Rel Std Dev
ntal Data A... Environmental Data A...


Edit Compounds
Search by: Ret Time Name Index
Find Compound
Compound Database
External Standard Compour
Hydrogen_Sulfide
Carbonyl_Sulfide
Methyl_Mercaptan
Ethyl_Mercaptan
Dimethyl_Sulfide
Carbon_Disulfide
2-Propyl_Mercaptan
t-Butyl_Mercaptan
Propyl_Mercaptan
Ethyl_Methyl_Sulfide
Thiophene
i-Butyl_Mercaptan
Diethyl_Sulfide
n-Butyl_Mercaptan
Dimethyl_Disulfide
2-Methylthiophene
3-Methylthiophene
Tetrahydrothiophene
2,5-Dimethylthiophene
2-Ethylthiophene
Diethyl_Disulfide
Dimethyltrisulfide
Identification Calibration User Defined Advanced Reporting
Lvl ID Concentration Response Lvl ID Concentration Response
1 5.043700 60069.590000
2 50.437000 522721.258634
3 504.370000 5514776.954299
4 2017.480000 23748534.61028
5 10087.400000 104342088.8493
6 30262.200000 378435386.6273
Carbonyl_Sulfide
Response
2.00e+008
0
0 1.00e+004 2.00e+004 3.00e+004
Concentration
0.000e+000 Quadratic term
1.130e+004 Linear term
0.000e+000 Constant term
7.9% RF Rel Std Dev
ntal Data A... Environmental Data A...

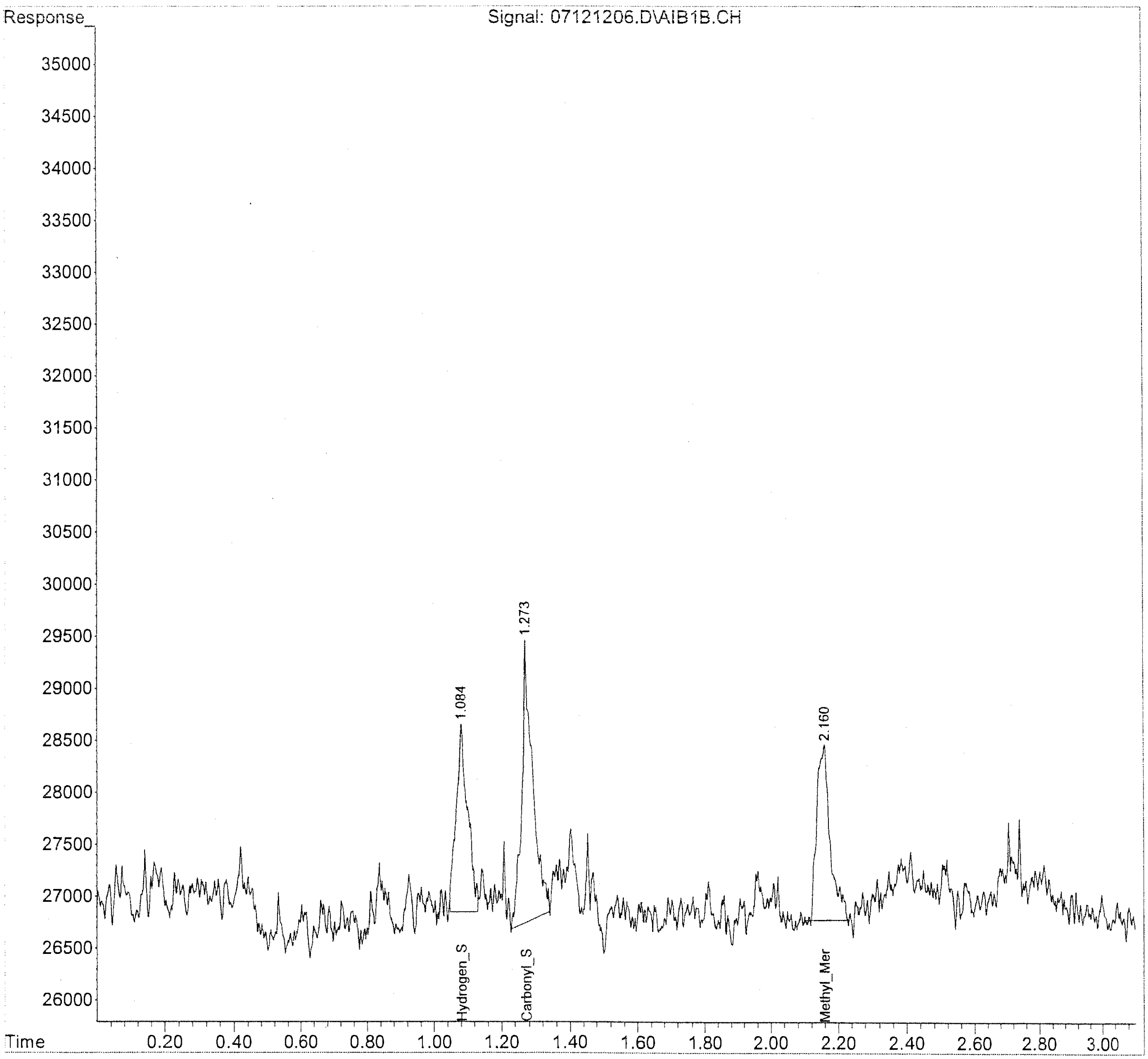


Lvl ID	Concentration	Response	Lvl ID	Concentration	Response
1	4.719350	46276.980000			
2	47.193500	441745.398000			
3	471.935000	4297240.340000			
4	1887.740000	22359416.37000(			
5	9438.700000	96411069.56000(			
6	28316.100000	362115087.1560·			

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:01 pm
Operator : WHH
Sample : s27-07121201 5ppm
Misc : 100ul of 200xdilution of s27-07111201
ALS Vial : 6 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:33 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:01 pm
Operator : WHH
Sample : s27-07121201 5ppm
Misc : 100ul of 200xdilution of s27-07111201
ALS Vial : 6 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:33 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units	
Target Compounds							
1)	Z	Hydrogen_Sulfide	1.084	42818	4.863	ppb	m
2)	W	Carbonyl_Sulfide	1.275	60070	5.887	ppb	
3)	T	Methyl_Mercaptan	2.160	46277	4.876	ppb	m
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb	
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb	
6)	T	Carbon_Disulfide	0.000	0	N.D.	ppb	
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb	
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb	
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb	
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb	
11)	T	Thiophene	0.000	0	N.D.	ppb	
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb	
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb	
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb	
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb	
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb	
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb	
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb	
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb	
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb	
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb	
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb	

(f)=RT Delta > 1/2 Window (m)=manual int.

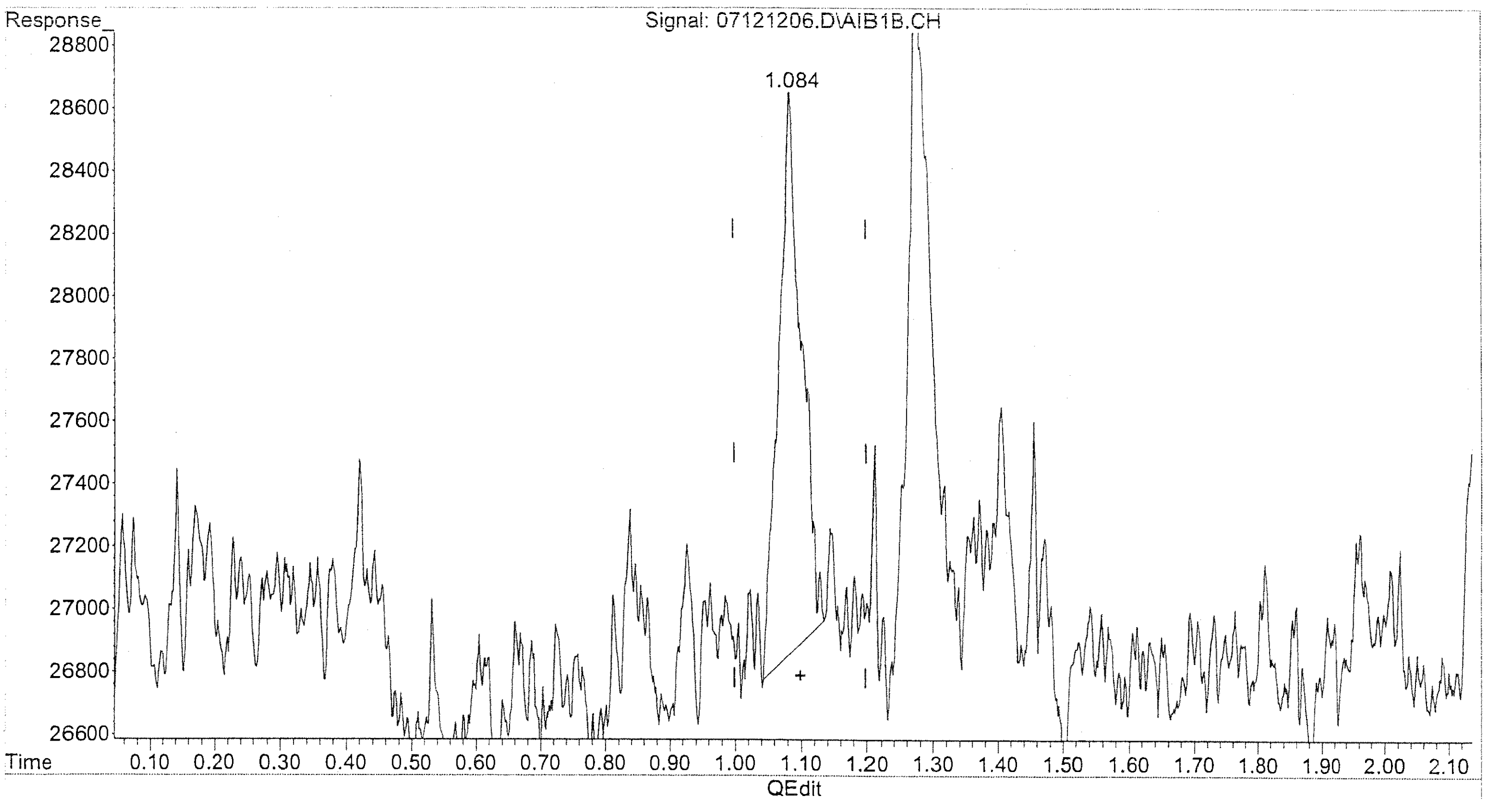
7/13/12

Quantitation Report (Qedit)

```
Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On    : 12 Jul 2012  12:01 pm
Operator  : WHH
Sample    : s27-07121201 5ppm
Misc      : 100ul of 200xdilution of s27-07111201
ALS Vial  : 6   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:14 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation   6890 Scale Mode: Large solvent peaks clipped

Volume Inj.  :
Signal Phase :
Signal Info  :
```



(1) Hydrogen_Sulfide (Z)
1.085min 4.773 ppb
response 42024

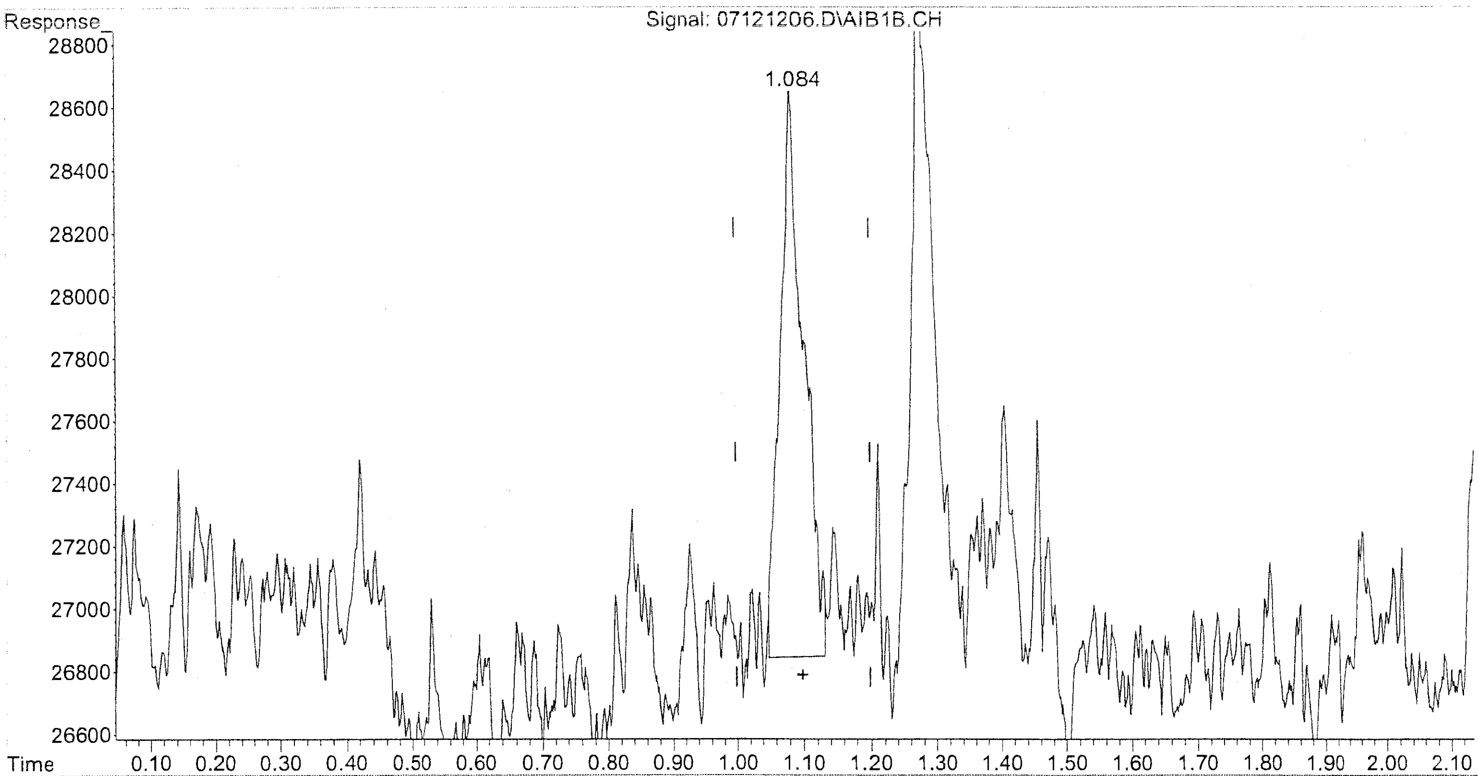
(+) = Expected Retention Time

53

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:01 pm
Operator : WHH
Sample : s27-07121201 5ppm
Misc : 100ul of 200xdilution of s27-07111201
ALS Vial : 6 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:14 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



QEdit

(1) Hydrogen_Sulfide (Z)
1.084min 4.863 ppb m
response 42818

7/13/12 BN

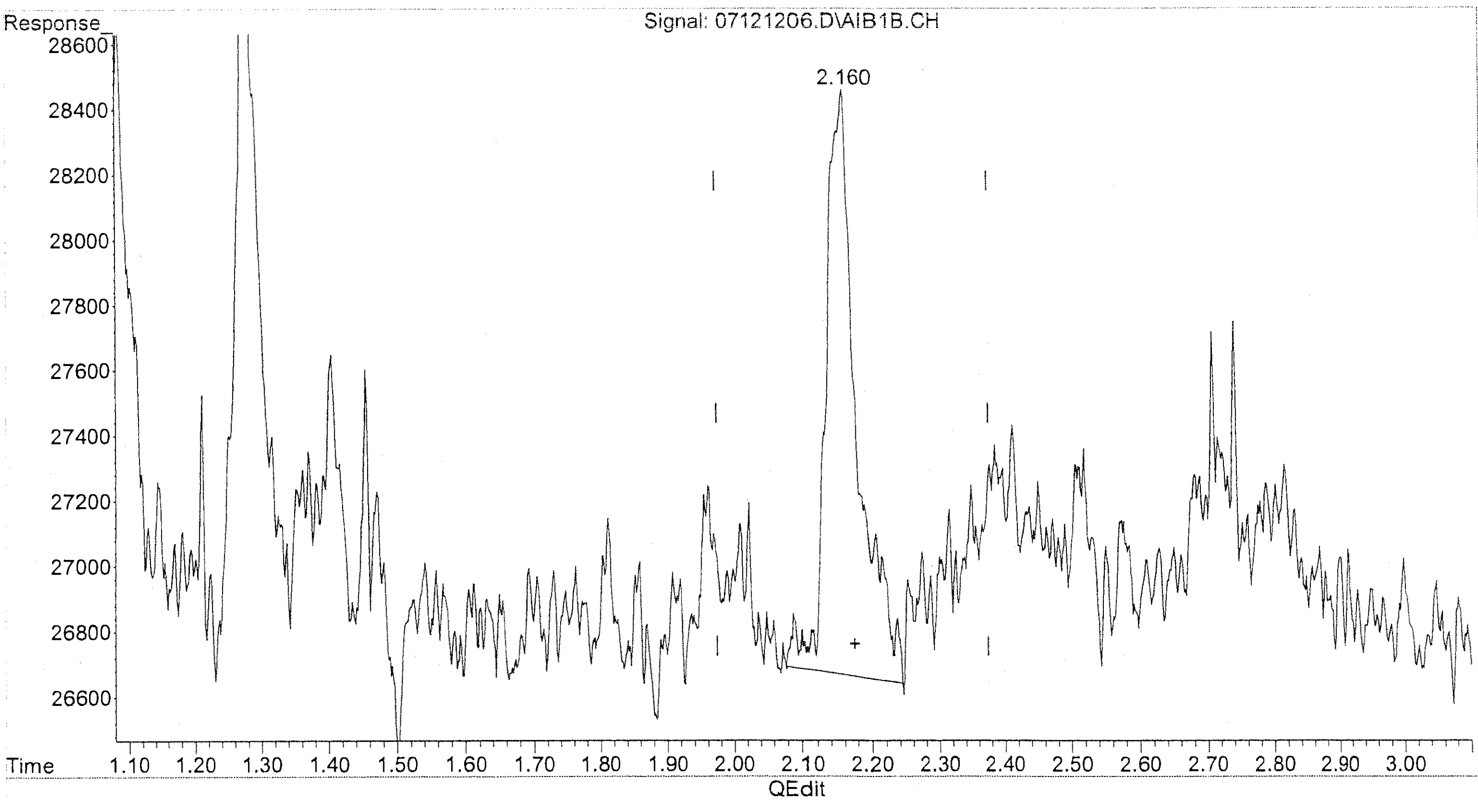
WHH 7/13/12

(+) = Expected Retention Time

```
Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On    : 12 Jul 2012  12:01 pm
Operator  : WHH
Sample    : s27-07121201 5ppm
Misc      : 100ul of 200xdilution of s27-07111201
ALS Vial  : 6   Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:14 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title  : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation    6890 Scale Mode: Large solvent peaks clipped

Volume Inj.  :
Signal Phase :
Signal Info  :
```



(3) Methyl_Mercaptan (T)

2.159min 5.963 ppb

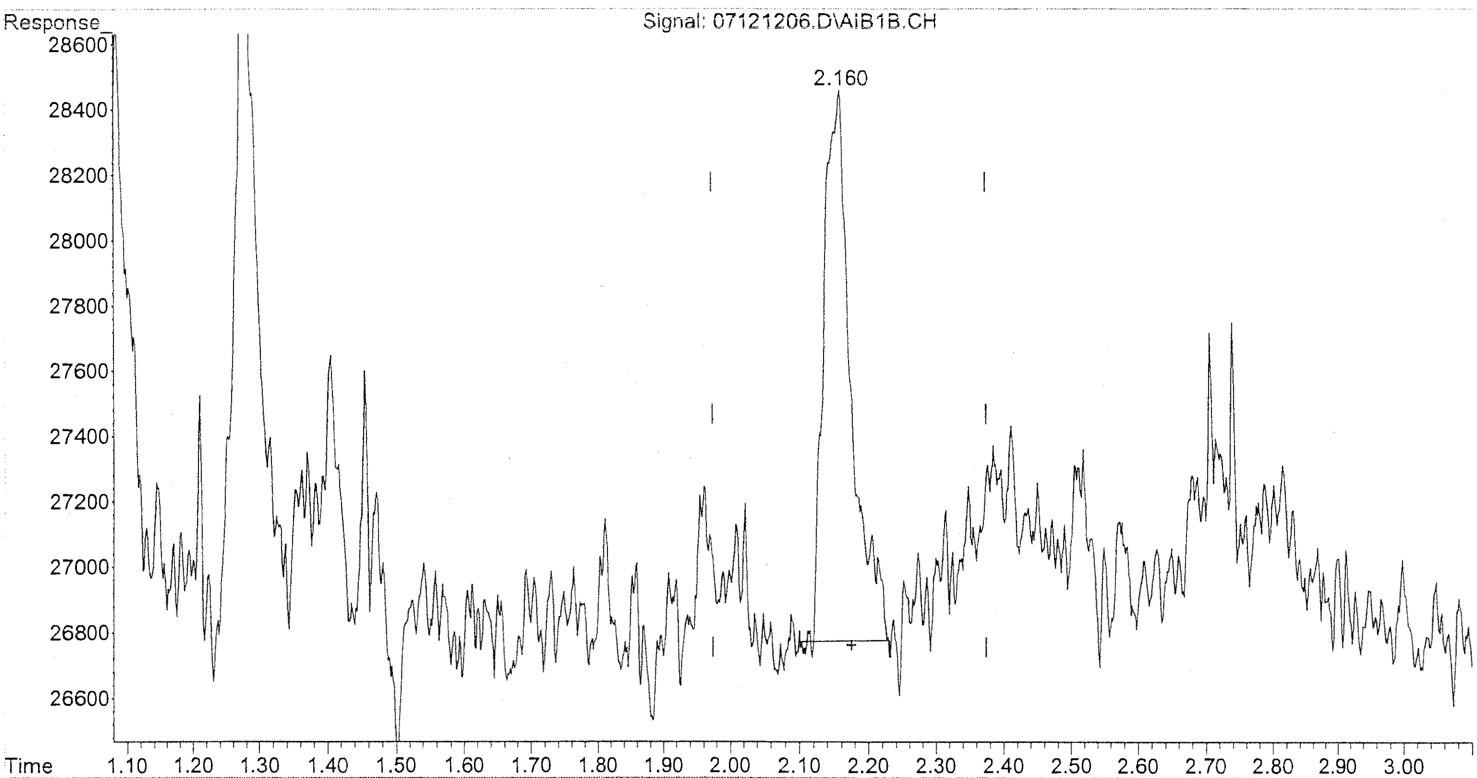
response 56597

(+) = Expected Retention Time

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121206.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:01 pm
Operator : WHH
Sample : s27-07121201 5ppm
Misc : 100ul of 200xdilution of s27-07111201
ALS Vial : 6 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:27:14 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:20:54 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



QEdit

(3) Methyl_Mercaptan (T)
2.160min 4.876 ppb m
response 46277

7/13/12 BW

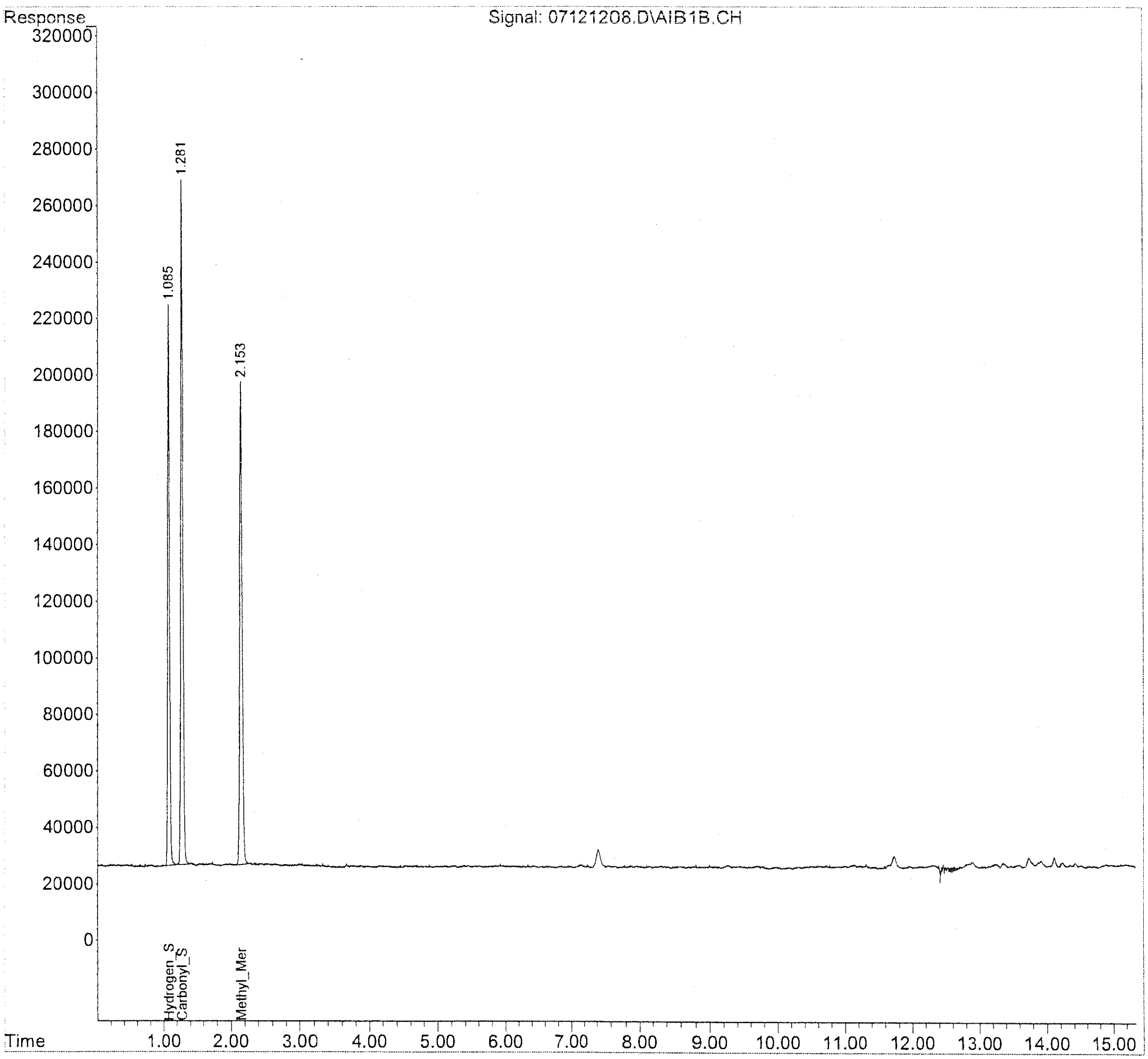
WH 7/13/12

(+) = Expected Retention Time

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121208.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:17 pm
Operator : WHH
Sample : s27-07111201 500ppm
Misc : 50ul of s27-07111201
ALS Vial : 8 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:30:23 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:29:25 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121208.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:17 pm
Operator : WHH
Sample : s27-07111201 500ppm
Misc : 50ul of s27-07111201
ALS Vial : 8 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:30:23 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:29:25 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

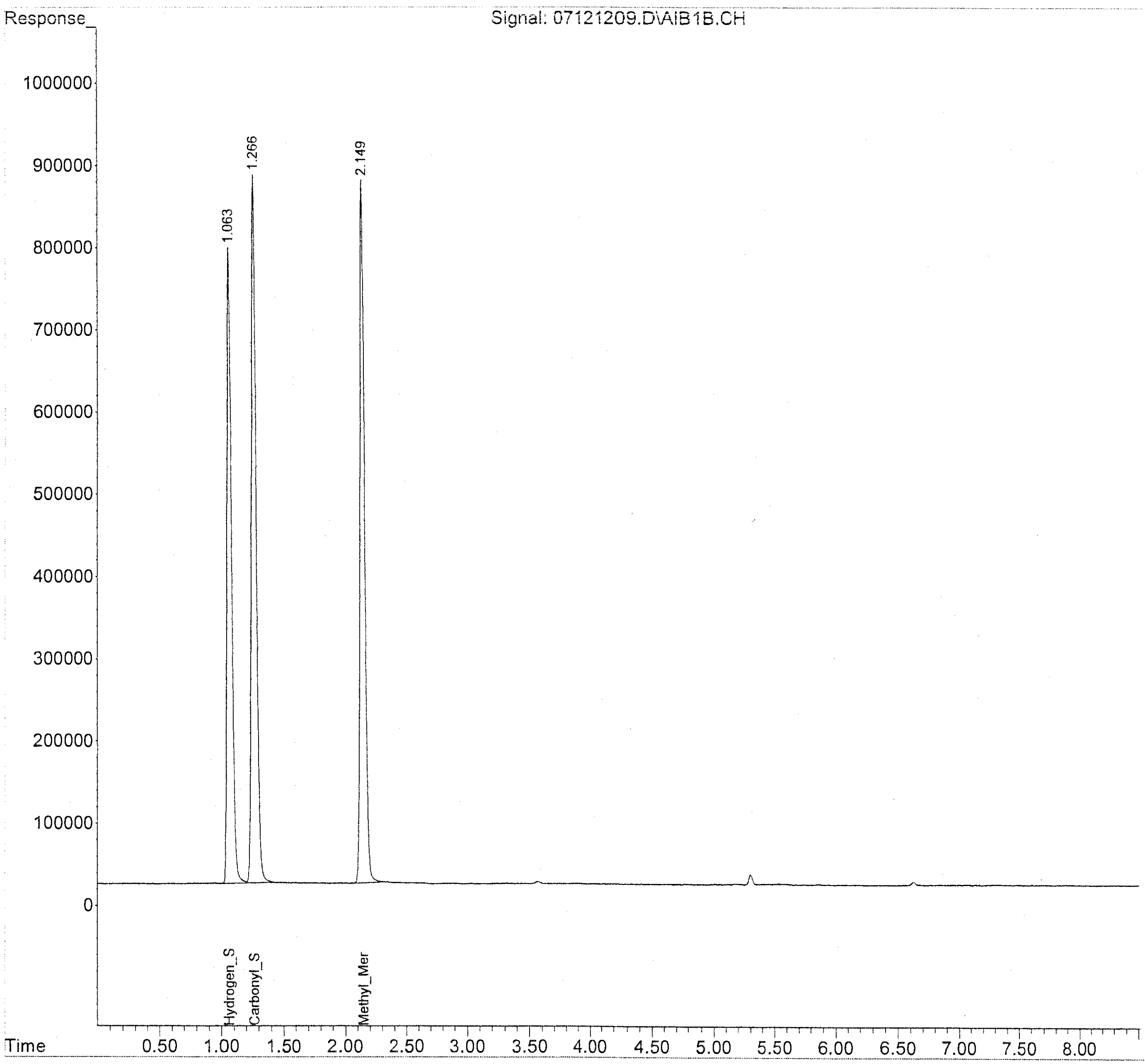
		Compound	R.T.	Response	Conc	Units
Target		Compounds				
1)	Z	Hydrogen_Sulfide	1.085	3931532	469.553	ppb
2)	W	Carbonyl_Sulfide	1.282	5514779	463.044	ppb
3)	T	Methyl_Mercaptan	2.154	4297240	438.235	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	0.000	0	N.D.	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	7.432	296174	NoCal	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	11.729f	155006	NoCal	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121209.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:40 pm
Operator : WHH
Sample : s27-07111201 2000ppm
Misc : 200ul of s27-07111201
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:33:36 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:33:19 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121209.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:40 pm
Operator : WHH
Sample : s27-07111201 2000ppm
Misc : 200ul of s27-07111201
ALS Vial : 9 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:33:36 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:33:19 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

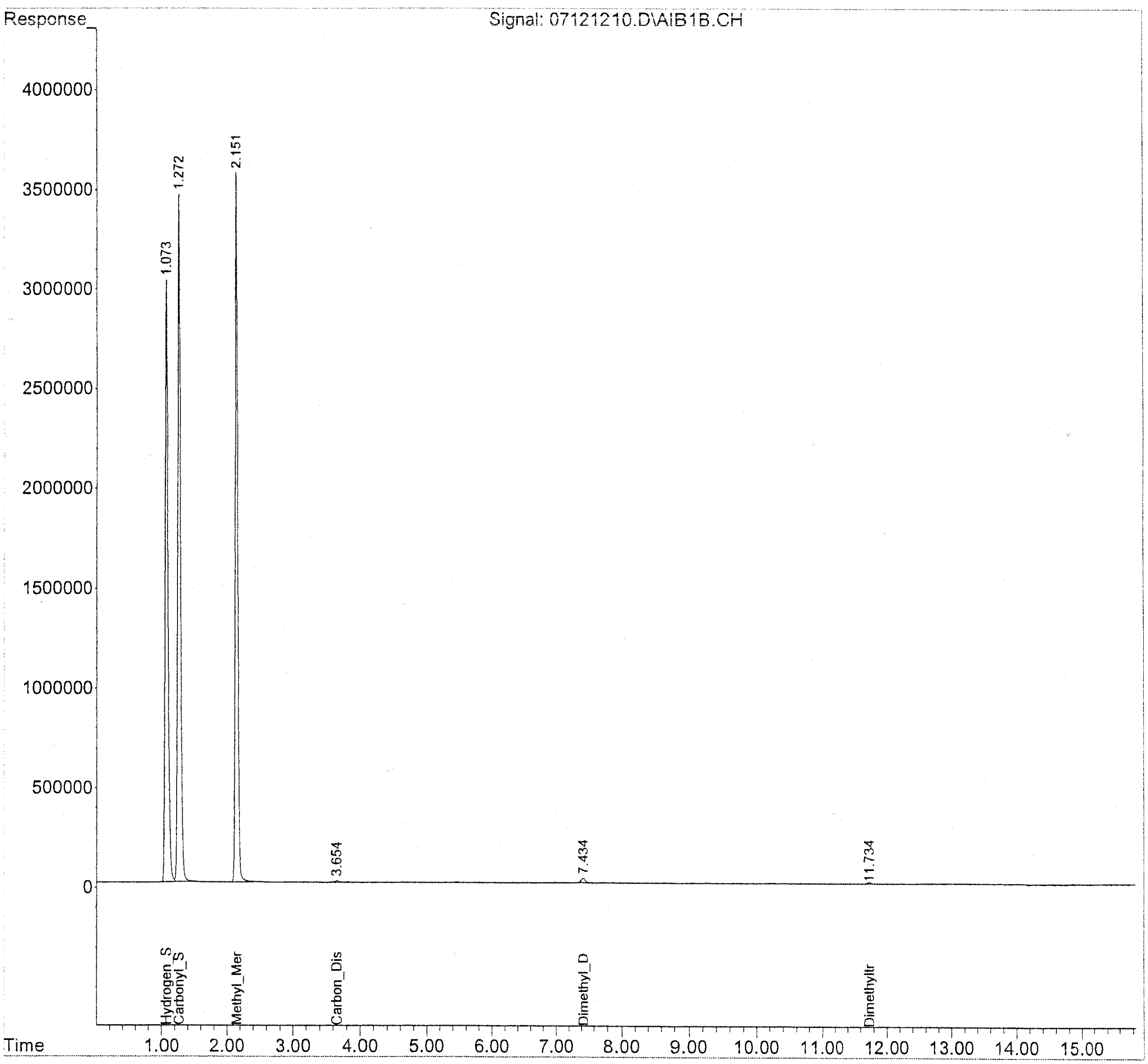
		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.064	19797302	639.028	ppb
2)	W	Carbonyl_Sulfide	1.267	23748535	538.989	ppb
3)	T	Methyl_Mercaptan	2.150	22359416	609.984	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	3.573f	77579	NoCal	ppb
6)	T	Carbon_Disulfide	3.573f	77579	NoCal	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	6.629	81737	NoCal	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121210.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:56 pm
Operator : WHH
Sample : s27-07111201 10000ppm
Misc : 1mll of s27-07111201
ALS Vial : 10 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:34:06 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:33:53 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121210.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 12:56 pm
Operator : WHH
Sample : s27-07111201 10000ppm
Misc : 1mll of s27-07111201
ALS Vial : 10 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:34:06 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:33:53 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

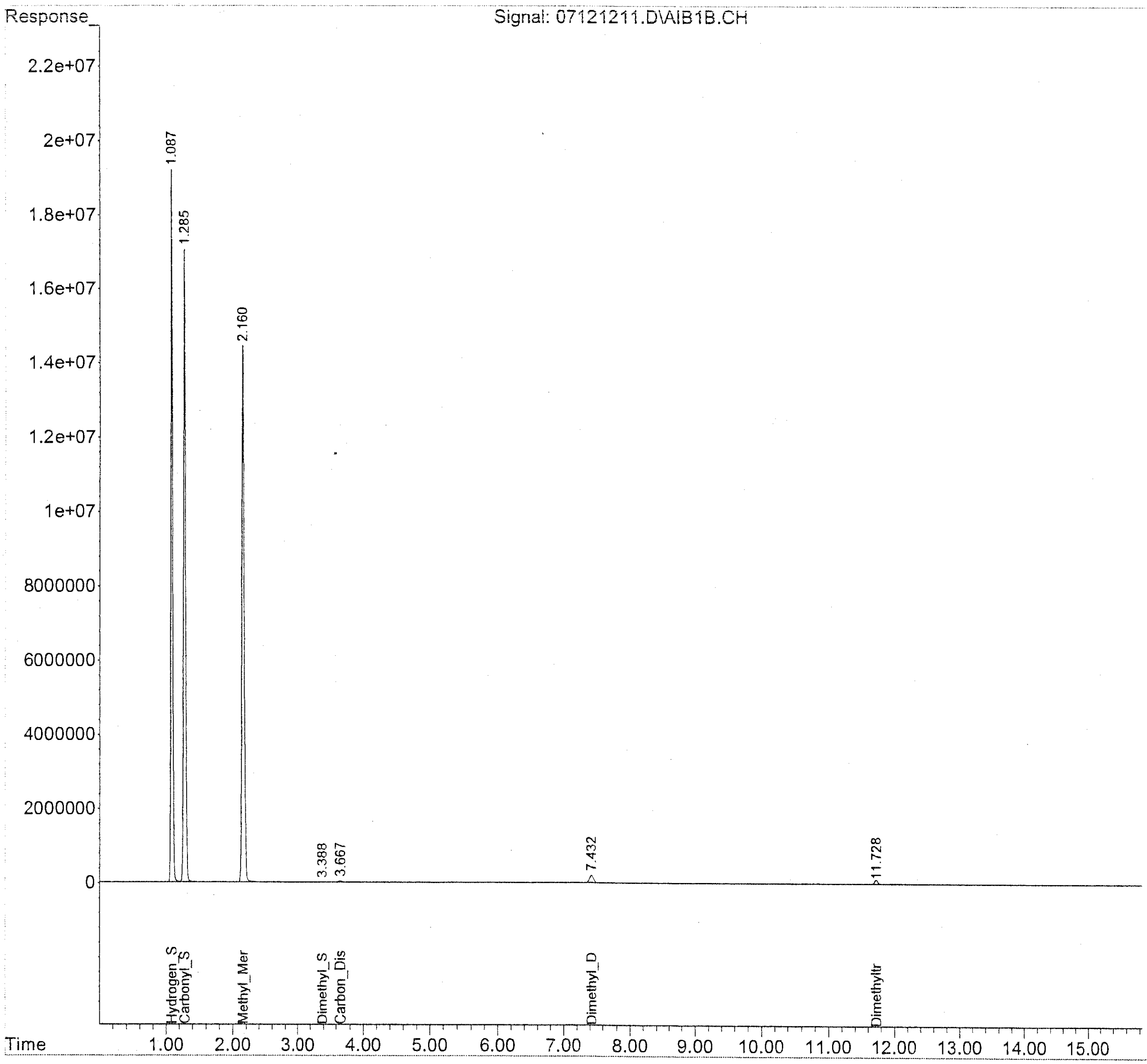
		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.074	88668402	3456.208	ppb
2)	W	Carbonyl_Sulfide	1.273	104342089	2899.294	ppb
3)	T	Methyl_Mercaptan	2.151	96411070	3165.906	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	3.655	307647	3743.011	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	7.434	997355	144.475	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	11.733f	312951	57.746	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121211.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 1:45 pm
Operator : WHH
Sample : s27-12051105 30000ppm
Misc : 30ul of s27-12051105
ALS Vial : 11 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:34:35 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:34:19 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121211.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 1:45 pm
Operator : WHH
Sample : s27-12051105 30000ppm
Misc : 30ul of s27-12051105
ALS Vial : 11 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:34:35 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:34:19 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

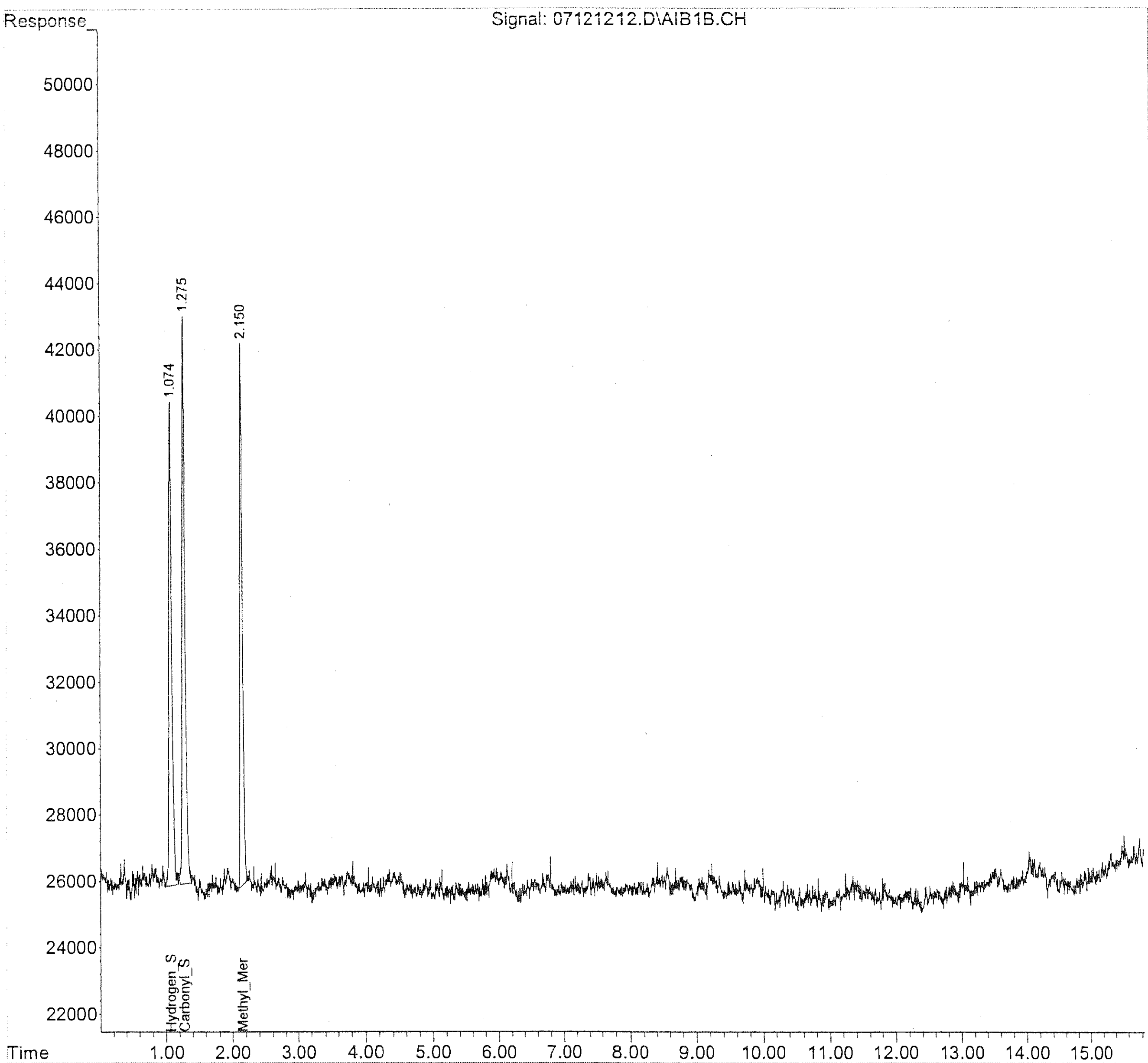
		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.088	357469107	16060.437	ppb
2)	W	Carbonyl_Sulfide	1.285	378435387	12263.057	ppb
3)	T	Methyl_Mercaptan	2.160	362115087	13713.766	ppb
4)	T	Ethyl_Mercaptan	3.133	6616	NoCal	ppb
5)	T	Dimethyl_Sulfide	3.388	99081	2410.967	ppb
6)	T	Carbon_Disulfide	3.667	1166444	15828.997	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	7.432	8718984	1865.958	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	11.729f	3932307	1078.502	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121212.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 2:15 pm
Operator : WHH
Sample : s27-07121202 50ppm
Misc : 1ml of s27-07121201
ALS Vial : 12 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:35:03 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:34:51 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121212.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 2:15 pm
Operator : WHH
Sample : s27-07121202 50ppm
Misc : 1ml of s27-07121202 7/13/12
ALS Vial : 12 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:35:03 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:34:51 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

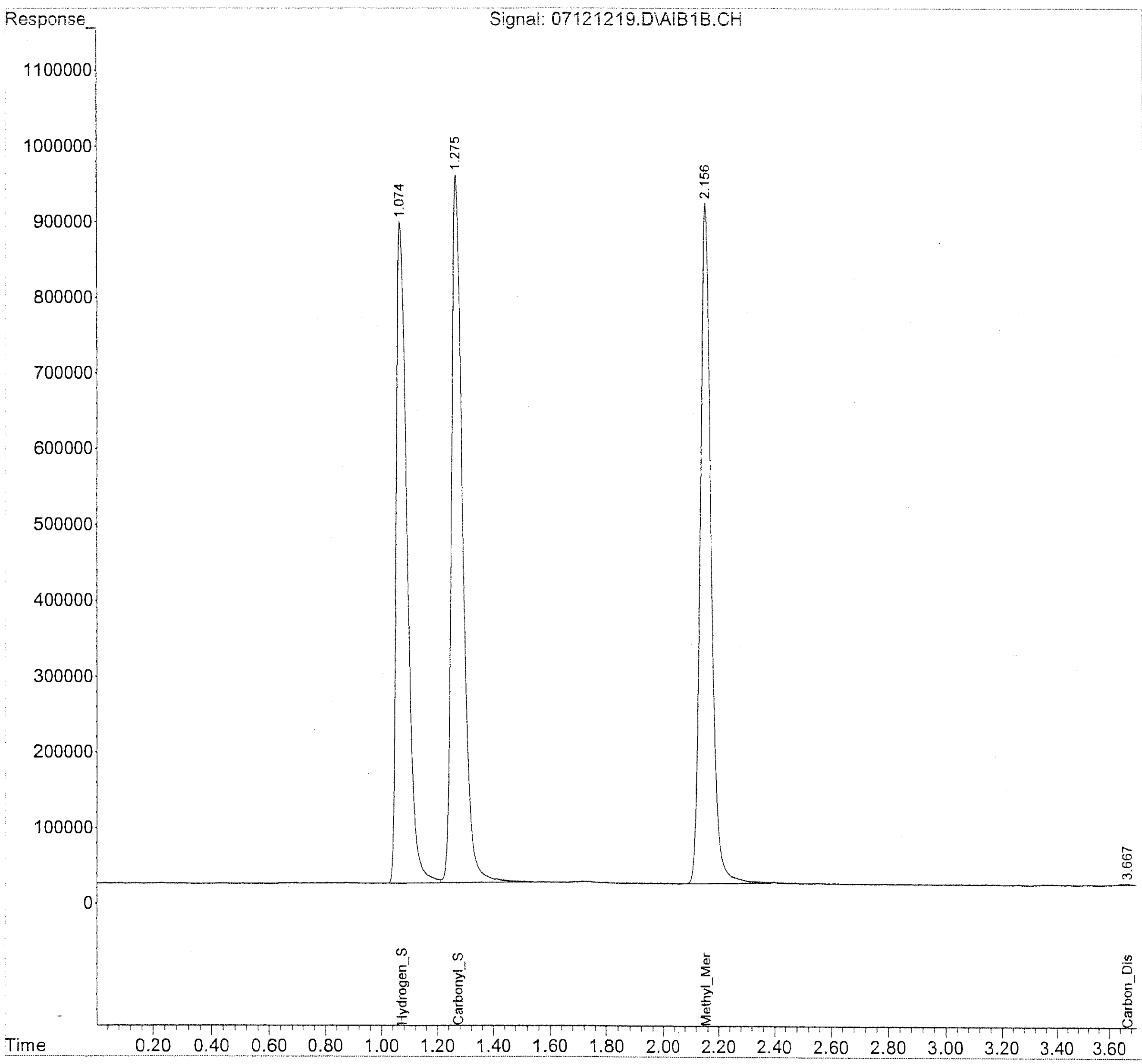
		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.075	447048	21.818	ppb
2)	W	Carbonyl_Sulfide	1.276	522721	18.802	ppb
3)	T	Methyl_Mercaptan	2.152	441745	18.303	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	0.000	0	N.D.	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121219.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 4:04 pm
Operator : WHH
Sample : icv s27-07121303
Misc : 1ml of s27-07121201
ALS Vial : 19 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:49:31 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121219.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 4:04 pm
Operator : WHH
Sample : icv s27-07121303 2000ppb
Misc : 1~~ml of s27-07121201~~ 7/13/12
ALS Vial : 19 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:49:31 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

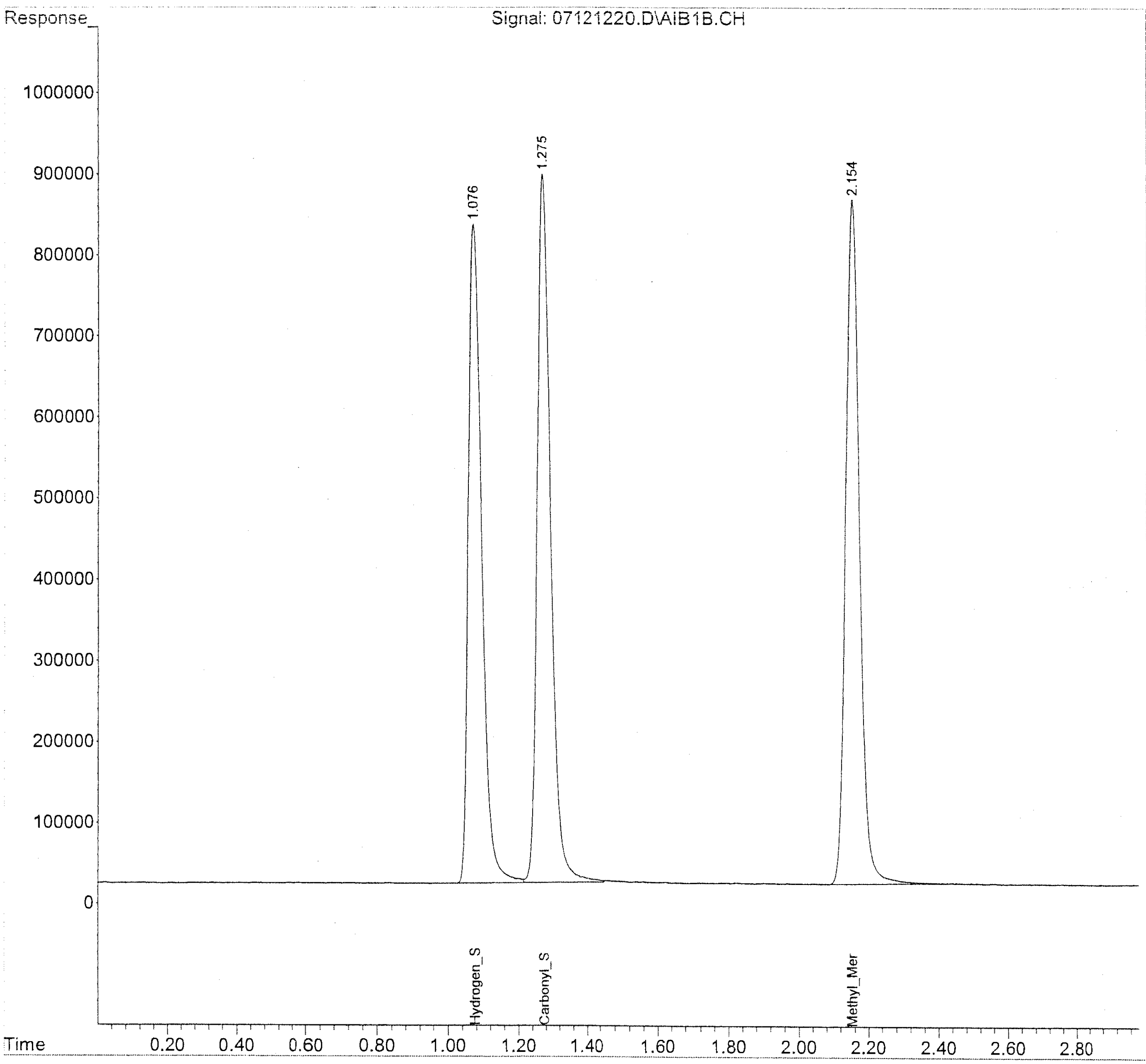
		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.075	23367598	2558.454	ppb
2)	W	Carbonyl_Sulfide	1.276	26292073	2325.769	ppb
3)	T	Methyl_Mercaptan	2.157	24652011	2343.385	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	3.667	28919	1.375	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121220.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 4:09 pm
Operator : WHH
Sample : icv s27-07121303
Misc : 1ml of s27-07121201
ALS Vial : 20 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:49:46 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Data Path : J:\GC13\DATA\SCD\2012_07\12\
Data File : 07121220.D
Signal(s) : AIB1B.CH
Acq On : 12 Jul 2012 4:09 pm
Operator : WHH
Sample : icv s27-07121303 2000ppb
Misc : 1~~ml of s27-07121201~~ 7/13/12
ALS Vial : 20 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 13 12:49:46 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

	Compound	R.T.	Response	Conc Units
	Target Compounds			
1) Z	Hydrogen_Sulfide	1.077	21499646	2353.937 ppb
2) W	Carbonyl_Sulfide	1.276	24385756	2157.138 ppb
3) T	Methyl_Mercaptan	2.155	23219275	2207.191 ppb
4) T	Ethyl_Mercaptan	0.000	0	N.D. ppb
5) T	Dimethyl_Sulfide	0.000	0	N.D. ppb
6) T	Carbon_Disulfide	0.000	0	N.D. ppb
7) T	2-Propyl_Mercaptan	0.000	0	N.D. ppb
8) T	t-Butyl_Mercaptan	0.000	0	N.D. ppb
9) T	Propyl_Mercaptan	0.000	0	N.D. ppb
10) T	Ethyl_Methyl_Sulfide	0.000	0	N.D. ppb
11) T	Thiophene	0.000	0	N.D. ppb
12) T	i-Butyl_Mercaptan	0.000	0	N.D. ppb
13) T	Diethyl_Sulfide	0.000	0	N.D. ppb
14) T	n-Butyl_Mercaptan	0.000	0	N.D. ppb
15) T	Dimethyl_Disulfide	0.000	0	N.D. ppb
16) T	2-Methylthiophene	0.000	0	N.D. ppb
17) T	3-Methylthiophene	0.000	0	N.D. ppb
18) T	Tetrahydrothiophene	0.000	0	N.D. ppb
19) T	2,5-Dimethylthiophene	0.000	0	N.D. ppb
20) T	2-Ethylthiophene	0.000	0	N.D. ppb
21) T	Diethyl_Disulfide	0.000	0	N.D. ppb
22) T	Dimethyltrisulfide	0.000	0	N.D. ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

CONTINUING CALIBRATION STANDARDS

COLUMBIA ANALYTICAL INC.

REPORT SUMMARY

Method : 20 Sulfurs Initial Calibration
Client & Job# : CH2MHill P1202848
Analyst : WHH

Printed : 7/16/12
Instrument : GC#13, SCD#13
Date Acquired : 7/14/12

SAMPLE RESULT SUMMARIES (ppb)

Compounds	MDL	RL	ppbv	% Diff	ppbv		ppbv	ppbv	ppbv	ppbv	ppbv	ppbv	ppbv	ppbv	ppbv	ppbv	% Diff
Sample Information :	ppbv	ppbv	std 2000ppb s27-06131201		rt/lcs	% R	MB 1ml	2848-001 1ml	2848-002 1ml	2848-003 1ml	2848-004 1ml				2848-002 1ml dup	std 2000ppb s27-06131201	
Injection Volume (mL):	1.0	1.0	0.200				1.000	1.0	1.0	1.0	1.0				1.0	0.200	
Dilution:			1				1	1.0	1.0	1.0	1.0				1.0	1	
Pi:			1.0				1.00	1.00	1.00	1.00	1.00				1.00	1.00	
Pf:			1.0				1.00	1.00	1.00	1.00	1.00				1.00	1.00	
PiPf DF:	1.00	1.00	1.00				1.00	1.00	1.00	1.00	1.00				1.00	1.00	
Hydrogen_Sulfide	1.8	5.0	8642.35	14.3%	2356.6	99.2%	ND	17.68	164.00	ND	18.96				166.81	9550.05	5.3%
Carbonyl_Sulfide	5.0	5.0	8238.05	19.5%	1983.8	80.3%	ND	ND	ND	16.63	5.11				ND	9548.50	6.6%
Methyl_Mercaptan	2.4	5.0	7964.70	15.6%	2921.0	123.8%	ND	ND	ND	ND	ND				ND	9342.95	1.0%
Ethyl_Mercaptan	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Dimethyl_Sulfide	2.4	5.0				Spike	ND	ND	ND	ND	ND				ND	ND	
Carbon_Disulfide	2.5	2.5				Amount	ND	10.43	4.83	18.35	8.41				4.04	ND	
2-Propyl_Mercaptan	2.4	5.0			Hydrogen_Sulfide	2375.0	ND	ND	ND	ND	ND				ND	ND	
t-Butyl_Mercaptan(2-Me-2-	2.4	5.0			Carbonyl Sulfide	2470.0	ND	ND	ND	ND	ND				ND	ND	
Propyl_Mercaptan	2.4	5.0			Methyl Mercaptan	2360.0	ND	ND	ND	ND	ND				ND	ND	
Ethtyl_Methyl_Sulfide	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Thiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
i-Butyl_Mercaptan(2-Me-1-	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Diethyl_Sulfide	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
n-Butyl_Mercaptan	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Dimethyl_Disulfide	1.20	2.5					ND	ND	ND	ND	ND				ND	ND	
2-Methyl_Thiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
3-Methyl_Thiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Tetrahydrothiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
2,5-Dimethyl_Thiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
2-Ethyl_Thiophene	2.4	5.0					ND	ND	ND	ND	ND				ND	ND	
Diethyl_Disulfide	1.20	2.5					ND	ND	ND	ND	ND				ND	ND	
Methyltrisulfide	1.20	2.5					ND	ND	ND	ND	ND				ND	ND	

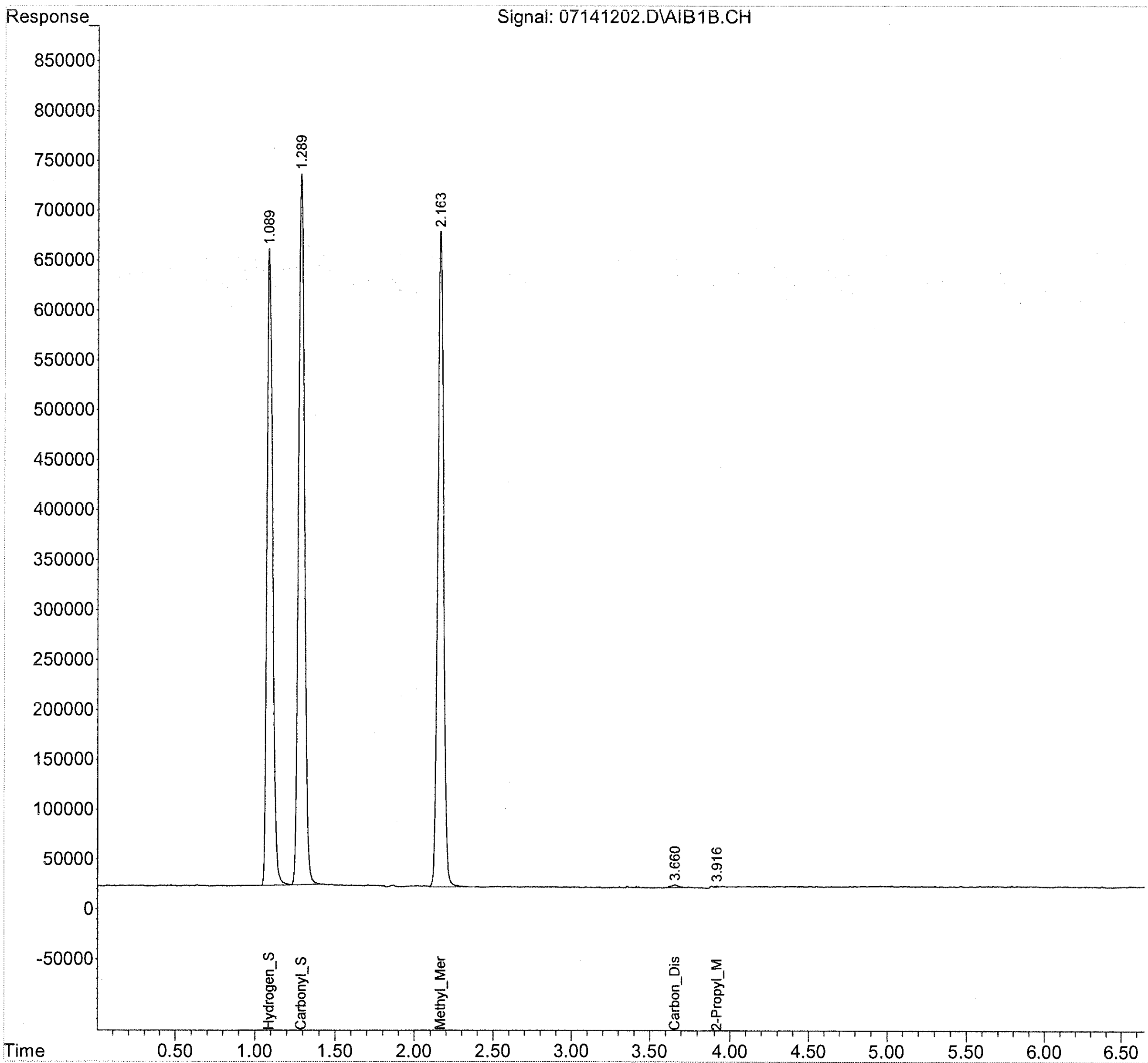
j = estimated concentration. Concentration greater than MDL but below RL.

Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141202.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 10:49 am
Operator : WHH
Sample : std 2000ppb s27-06131201
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:43:17 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (QT Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141202.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 10:49 am
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Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

WH 7/16/12

Volume Inj. :
Signal Phase :
Signal Info :

	Compound	R.T.	Response	Conc	Units
	Target Compounds				
1) Z	Hydrogen_Sulfide	1.090	15786935	1728.468	ppb
2) W	Carbonyl_Sulfide	1.289	18625667	1647.607	ppb
3) T	Methyl_Mercaptan	2.164	16757496	1592.944	ppb
4) T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5) T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6) T	Carbon_Disulfide	3.660	105152	4.998	ppb
7) T	2-Propyl_Mercaptan	3.917	15657	1.488	ppb
8) T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9) T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10) T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11) T	Thiophene	0.000	0	N.D.	ppb
12) T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13) T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14) T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15) T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16) T	2-Methylthiophene	0.000	0	N.D.	ppb
17) T	3-Methylthiophene	0.000	0	N.D.	ppb
18) T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19) T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20) T	2-Ethylthiophene	0.000	0	N.D.	ppb
21) T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22) T	Dimethyltrisulfide	0.000	0	N.D.	ppb

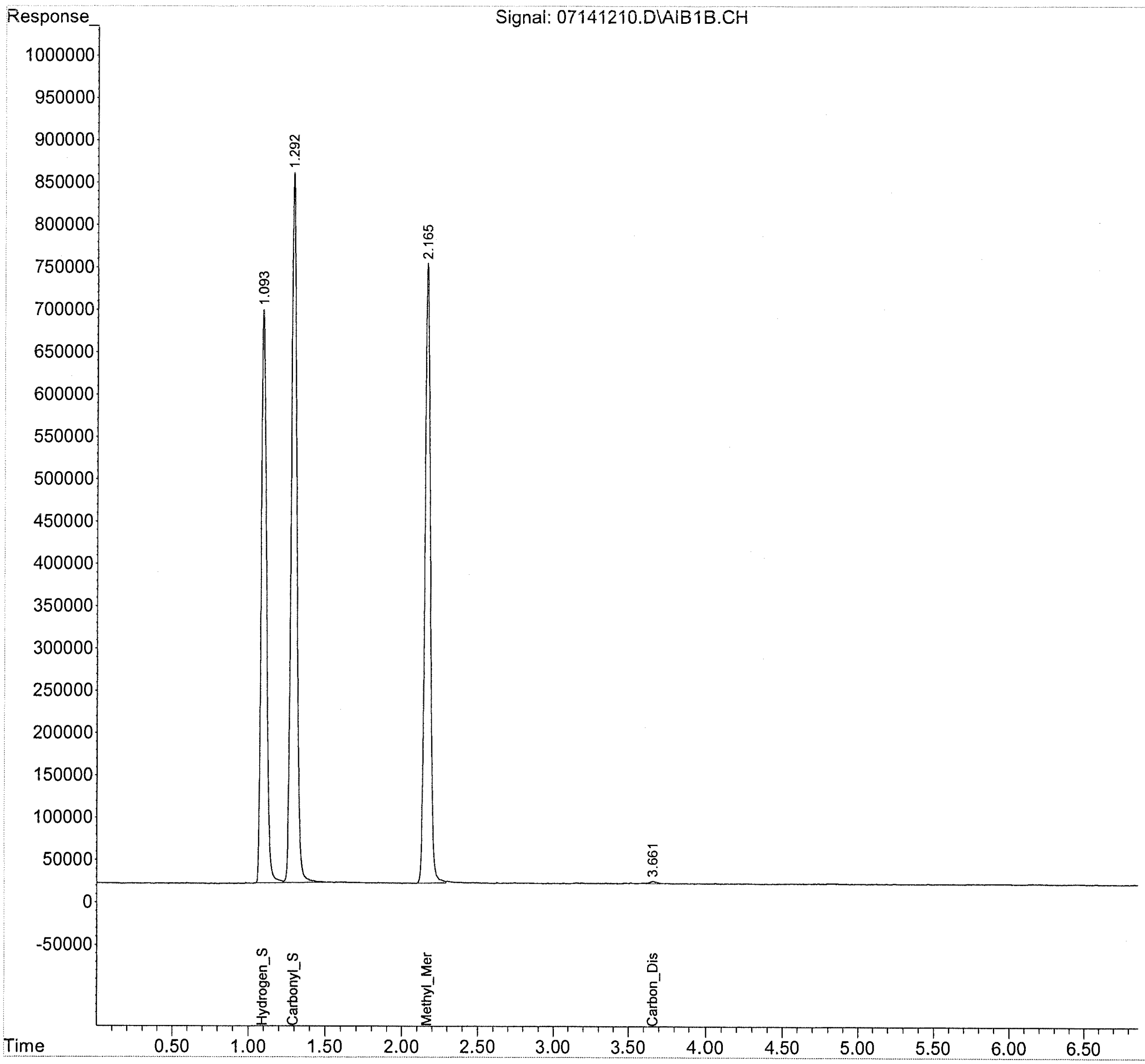
(f)=RT Delta > 1/2 Window (m)=manual int.

Quantitation Report (Not Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141210.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:12 pm
Operator : WHH
Sample : std 2000ppb s27-06131201
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:31 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (Not Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141210.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 1:12 pm
Operator : WHH
Sample : std 2000ppb s27-06131201
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:51:31 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

		Compound	R.T.	Response	Conc	Units
Target Compounds						
1)	Z	Hydrogen_Sulfide	1.094	16591232	1816.528	ppb
2)	W	Carbonyl_Sulfide	1.293	21379889	1891.242	ppb
3)	T	Methyl_Mercaptan	2.165	18606643	1768.721	ppb
4)	T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5)	T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6)	T	Carbon_Disulfide	3.662	84408	4.012	ppb
7)	T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8)	T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9)	T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10)	T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11)	T	Thiophene	0.000	0	N.D.	ppb
12)	T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13)	T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14)	T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15)	T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16)	T	2-Methylthiophene	0.000	0	N.D.	ppb
17)	T	3-Methylthiophene	0.000	0	N.D.	ppb
18)	T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19)	T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20)	T	2-Ethylthiophene	0.000	0	N.D.	ppb
21)	T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22)	T	Dimethyltrisulfide	0.000	0	N.D.	ppb

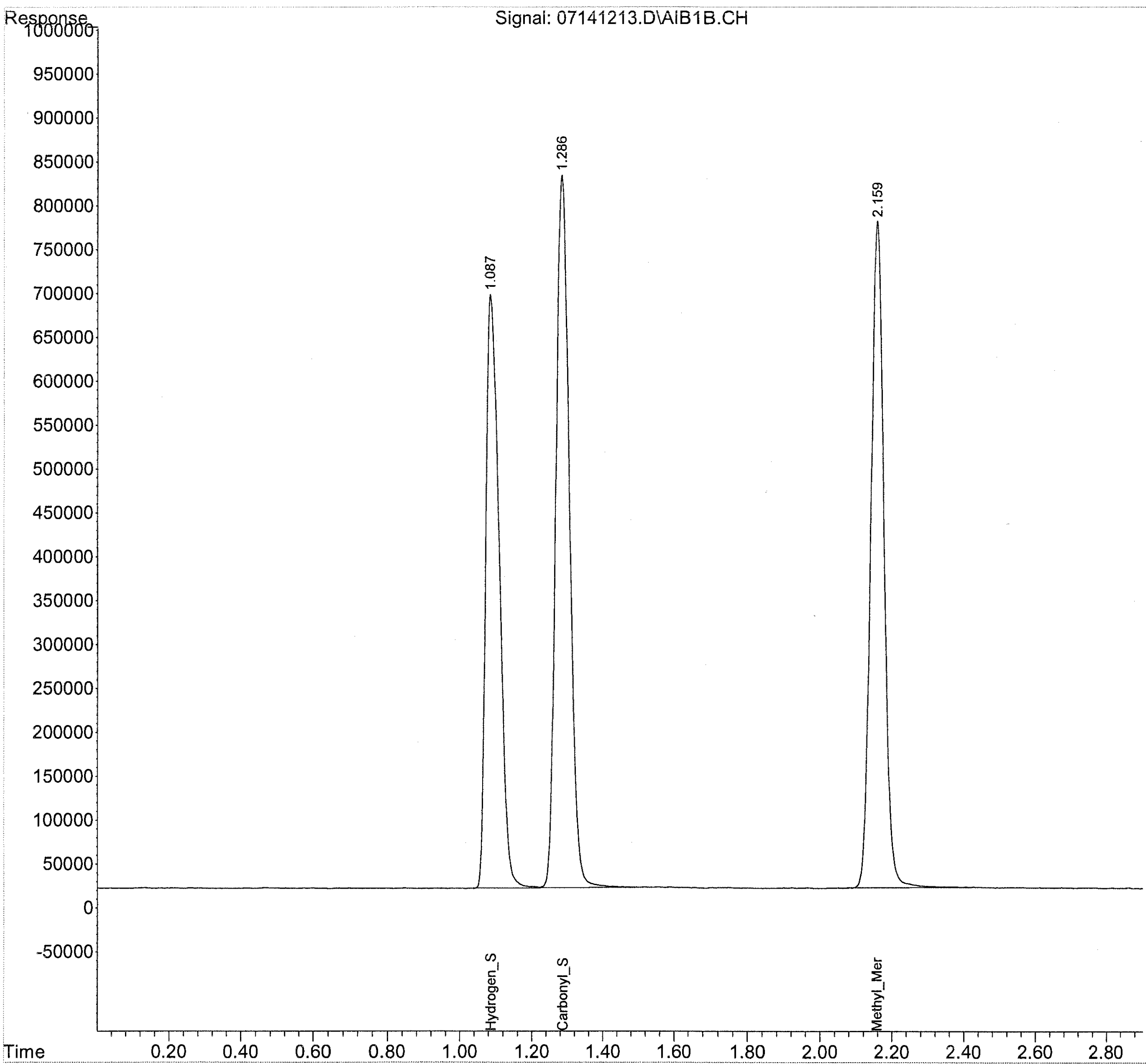
(f)=RT Delta > 1/2 Window (m)=manual int.

Quantitation Report (Not Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141213.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 2:20 pm
Operator : WHH
Sample : std 2000ppb s27-06131201
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:52:54 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :



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Quantitation Report (Not Reviewed)

Data Path : J:\GC13\DATA\SCD\2012_07\14\
Data File : 07141213.D
Signal(s) : AIB1B.CH
Acq On : 14 Jul 2012 2:20 pm
Operator : WHH
Sample : std 2000ppb s27-06131201
Misc :
ALS Vial : 2 Sample Multiplier: 1

Integration File: autoint1.e
Quant Time: Jul 16 17:52:54 2012
Quant Method : J:\GC13\METHODS\GC13071212A.M
Quant Title : 20 Sulfurs Initial Calibration
QLast Update : Fri Jul 13 12:44:45 2012
Response via : Initial Calibration
Integrator: ChemStation 6890 Scale Mode: Large solvent peaks clipped

Volume Inj. :
Signal Phase :
Signal Info :

	Compound	R.T.	Response	Conc	Units
Target Compounds					
1) Z	Hydrogen_Sulfide	1.088	17445048	1910.010	ppb
2) W	Carbonyl_Sulfide	1.287	21588579	1909.703	ppb
3) T	Methyl_Mercaptan	2.159	19657273	1868.593	ppb
4) T	Ethyl_Mercaptan	0.000	0	N.D.	ppb
5) T	Dimethyl_Sulfide	0.000	0	N.D.	ppb
6) T	Carbon_Disulfide	0.000	0	N.D.	ppb
7) T	2-Propyl_Mercaptan	0.000	0	N.D.	ppb
8) T	t-Butyl_Mercaptan	0.000	0	N.D.	ppb
9) T	Propyl_Mercaptan	0.000	0	N.D.	ppb
10) T	Ethyl_Methyl_Sulfide	0.000	0	N.D.	ppb
11) T	Thiophene	0.000	0	N.D.	ppb
12) T	i-Butyl_Mercaptan	0.000	0	N.D.	ppb
13) T	Diethyl_Sulfide	0.000	0	N.D.	ppb
14) T	n-Butyl_Mercaptan	0.000	0	N.D.	ppb
15) T	Dimethyl_Disulfide	0.000	0	N.D.	ppb
16) T	2-Methylthiophene	0.000	0	N.D.	ppb
17) T	3-Methylthiophene	0.000	0	N.D.	ppb
18) T	Tetrahydrothiophene	0.000	0	N.D.	ppb
19) T	2,5-Dimethylthiophene	0.000	0	N.D.	ppb
20) T	2-Ethylthiophene	0.000	0	N.D.	ppb
21) T	Diethyl_Disulfide	0.000	0	N.D.	ppb
22) T	Dimethyltrisulfide	0.000	0	N.D.	ppb

(f)=RT Delta > 1/2 Window (m)=manual int.

RUN LOGS

Injection Log

Directory: j:\gc13\data\scd\2012_07\12

Line	Vial	FileName	Multiplier	SampleName	Misc Info	Injected
1	1	07121201.d	1.	Prime		12 Jul 12 10:40
2	2	07121202.d	1.	Prime		12 Jul 12 11:01
3	3	07121203.d	1.	Prime		12 Jul 12 11:09
4	4	07121204.d	1.	Prime		12 Jul 12 11:24
5	5	07121205.d	1.	s27-07121201 5ppm	100ul of 200xdilution of s27-07111201	12 Jul 12 11:53
6	6	07121206.d	1.	s27-07121201 5ppm	100ul of 200xdilution of s27-07111201	12 Jul 12 12:01
7	7	07121207.d	1.	s27-07121201 50ppm	1ml of 200xdilution of s27-07111201	12 Jul 12 12:05
8	8	07121208.d	1.	s27-07111201 500ppm	50ul of s27-07111201	12 Jul 12 12:17
9	9	07121209.d	1.	s27-07111201 2000ppm	200ul of s27-07111201	12 Jul 12 12:40
10	10	07121210.d	1.	s27-07111201 10000ppm	1mll of s27-07111201	12 Jul 12 12:56
11	11	07121211.d	1.	s27-12051105 30000ppm	30ul of s27-12051105	12 Jul 12 13:45
12	12	07121212.d	1.	s27-07121202 50ppm	1ml of s27-07121202	12 Jul 12 14:15
13	13	07121213.d	1.	MB 1ml	1ml of s27-07121201	12 Jul 12 14:36
14	14	07121214.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 14:57
15	15	07121215.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 15:25
16	16	07121216.d	1.	xmisinject		12 Jul 12 15:31
17	17	07121217.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 15:57
18	18	07121218.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 16:01
19	19	07121219.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 16:04
20	20	07121220.d	1.	icv s27-07121303	1ml of s27-07121201	12 Jul 12 16:09
21	21	07121221.d	1.	std 2000ppb s27-06131201		12 Jul 12 16:13
22	22	07121222.d	1.	2804-001 1ml		12 Jul 12 16:30
23	23	07121223.d	1.	2804-002 1ml		12 Jul 12 16:38
24	20	07121224.d	1.	icvd s27-07121303	1ml of s27-07121201	12 Jul 12 17:07
25	21	07121225.d	1.	icvd s27-07121303	1ml of s27-07121201	12 Jul 12 17:27
26	22	07121226.d	1.	2813-003 1ml		12 Jul 12 17:41
27	23	07121227.d	1.	2813-004 1ml		12 Jul 12 17:59
28	24	07121228.d	1.	2813-015 1ml		12 Jul 12 18:15
29	25	07121229.d	1.	RT s27-11071103		12 Jul 12 18:36
30	27	07121231.d	1.	std		12 Jul 12 19:06

Injection Log

Directory: j:\GC13\DATA\SCD\2012_07\14

Line	Vial	FileName	Multiplier	SampleName	Misc Info	Injected
1	1	07141201.d	1.	Prime		14 Jul 2012 10:33
2	2	07141202.d	1.	std 2000ppb s27-06131201		14 Jul 2012 10:49
3	3	07141203.d	1.	rt/lcs		14 Jul 2012 10:57
4	4	07141204.d	1.	MB 1ml		14 Jul 2012 11:19
5	5	07141205.d	1.	QC AS00128 1ml		14 Jul 2012 11:36
6	6	07141206.d	1.	2848-001 1ml		14 Jul 2012 11:56
7	7	07141207.d	1.	2848-002 1ml		14 Jul 2012 12:16
8	8	07141208.d	1.	2848-003 1ml		14 Jul 2012 12:37
9	9	07141209.d	1.	2848-004 1ml		14 Jul 2012 12:55
10	2	07141210.d	1.	std 2000ppb s27-06131201		14 Jul 2012 13:12
11	3	07141211.d	1.	2848-002 1ml dup		14 Jul 2012 13:30
12	4	07141212.d	1.	2850-010 0.1ml		14 Jul 2012 13:59
13	2	07141213.d	1.	std 2000ppb s27-06131201		14 Jul 2012 14:20

Former Wilkins Air Force Station
Shelby Horizons Methane and Mercury Vapor Investigation, Data Quality Evaluation Report

Introduction

The object of the data quality evaluation (DQE) report was to assess the quality of analytical results for groundwater and soil gas samples collected at the Former Wilkins Air Force Station Shelby Horizons Landfill in Shelby, Ohio. Individual method requirements and guidelines from the *Final Quality Assurance Project Plan* (QAPP) *Methane and Mercury Vapor Investigation at the Shelby Horizon Area of Concern, Former Wilkins Air Force Station* (July 2012) were used as the basis for this assessment.

This report is intended as a general data quality assessment designed to summarize data issues.

Analytical Data

This DQE report covers nine soil vapor samples, three groundwater samples, two soil vapor field duplicates (FD), one groundwater FD, one ambient blank (AB), and one trip blank (TB). Table 1 lists the samples and collection dates. Samples were collected July 10-14, 2012. The sample results were reported in five sample delivery groups: L2011, L2025, L2032, P1202848 and 18854. The samples were sent to CH2M HILL Applied Sciences Laboratory (ASL) in Corvallis, Oregon; Columbia Analytical Services (CAS) in Simi Valley, California; and Isotech Laboratories Inc., in Champaign, Illinois.

TABLE 1
Samples Associated with DQE
Methane and Mercury Vapor Investigation, Shelby Horizons, Wilkins AFB

Matrix	Sample ID	QAQC Type	Sample Date
Water	GW-MW12-071012	N	07/10/2012
Water	GW-MW13-071112	N	07/11/2012
Water	GW-MW11-071112	N	07/11/2012
Water	FD01-071112	FD	07/11/2012
Air	VP-MW11-071312	N	07/11/2012
Air	VP-MW13-071312	N	07/13/2012
Air	VP-M4-071312	N	07/13/2012
Air	FD02-071312	FD	07/13/2012
Air	VP-MHD1-071412	N	07/14/2012
Air	VP-MHD2-071412	N	07/14/2012
Air	VP-HD1-071412	N	07/14/2012
Air	VP-HD3-071412	N	07/14/2012

TABLE 1
Samples Associated with DQE
Methane and Mercury Vapor Investigation, Shelby Horizons, Wilkins AFB

Matrix	Sample ID	QAQC Type	Sample Date
Air	VP-HD4-071412	N	07/14/2012
Air	VP-M6-071412	N	07/14/2012
Air	FD03-071412	FD	07/14/2012
Air	AMB-071412	AB	07/14/2012
Air	TB-071412	TB	07/14/2012

Samples were collected and shipped by overnight carrier to the laboratory for analysis. The samples were analyzed by one or more of the methods listed in Table 2.

TABLE 2
Summary of Analytical Parameters
Methane and Mercury Vapor Investigation, Shelby Horizons, Wilkins AFB

Parameter	Method	Laboratory
Dissolved Gases	RSK-175	ASL
Fixed Gases	EPA 3C	ASL
Mercury Vapor	EPA 245.7/NIOSH 6009	ASL
Total Reduced Sulfur	ASTM 5504-08	CAS
Biological Gas	BG-1 and BG-2	Isotech

Data validation was patterned after the USEPA Contract Laboratory National Functional Guidelines for Inorganic Data Review (2004) following the calibration and quality control requirements specified in the QAPP and the Louisville Army Corps Guidelines.

Data review and verification were performed in accordance with the QAPP.

One hundred percent of the data underwent review and verification and included the following items:

- A review of the data set narrative to identify issues that the laboratory reported in the data deliverable.
- A check of sample integrity (sample collection, preservation, and holding times).
- An evaluation of basic quality control (QC) measurements used to assess the accuracy, precision and representativeness of data including QC blanks, laboratory control samples (LCS), matrix spikes/matrix spike duplicates (MS/MSD), surrogate recovery when applicable, and field or laboratory duplicate results.

- A review of sample results, target compound lists, and detection limits to verify that project analytical requirements were met.
- A review to verify that corrective actions were initiated, as necessary, based on the data review findings.
- An evaluation of calibration and QC summary results against the project requirements.
- A qualification of the data using appropriate qualifier flags, as necessary, to reflect data usability limitations.
- Other method-specific QC requirements.

Data flags were assigned as specified in the QAPP. The flags and the reasons for them were entered into the electronic database. Multiple flags were routinely applied to specific sample method/matrix/analyte combinations, but there is only one final flag. A final flag was applied to the data and is the most conservative of the applied validation flags. The final flag also includes matrix and blank sample impacts. The data flags are defined below:

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

R The sample result was rejected because of serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte could not be verified.

U The analyte was analyzed for but was not detected above the reported sample quantitation limit.

UJ The analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Findings

The overall summaries of the data validation findings are contained in the following sections below and summarized in Table 4.

Holding Times/Preservation

All holding time criteria were met.

The mercury vapor samples were received at the laboratory above the temperature criteria of 4±2°C. The data were qualified as estimated detected and non-detected results and flagged “J” and “UJ” in the samples.

Calibration

All initial and continuing calibration requirements were met.

Method Blanks

Method blanks were analyzed at the required frequency and were free of contamination.

Field Blanks

An AB and TB were collected at the required frequency, analyzed, and were generally free of contamination with the following exception:

Mercury was detected at a concentration greater than the reporting limit (RL) in the trip blank. When the sample concentrations were less than five times the concentration in the blank, detected results less than the RL were qualified as not detected, raised to the RL and flagged “U” and results greater than the RL were qualified as not detected at the concentration measured and flagged “U” in the associated samples. Since all the samples (except the AB) had mercury detected at concentrations less than 5 times the concentration of mercury detected in the trip blank, all sample results from the vapor probes were flagged as “U”.

Field Duplicates

Field duplicates (FD) were collected at the frequency stated in the QAPP (10 percent). A list of the FDs and associated parent samples are presented in Table3.

TABLE 3
List of Field Duplicates
Methane and Mercury Vapor Investigation, Shelby Horizons, Wilkins AFB

Matrix	Field Duplicate ID	Parent Sample
Water	FD01-071112	GW-MW11-071112
Air	FD02-071312	VP-MW11-071312
Air	FD03-071412	VP-HD3-071412

The relative percent difference (RPD) criteria were met in all instances with the following exceptions:

The RPDs exceeded criteria for argon, oxygen and nitrogen in FD pair VP-MW11-071312/FD02-071312. The data were qualified as estimated detected results and flagged “J” in the FD pair.

Laboratory Duplicates

Laboratory duplicates were performed as required by the analytical methods. In some cases, other project samples were used to fulfill the laboratory’s QC batch requirements. When samples from Shelby Horizons were selected as laboratory duplicates, the RPDs were within laboratory established QC limits.

Laboratory Control Samples

LCSs were analyzed as required and all acceptance criteria were met.

Chain of Custody

Each sample was documented with a complete chain of custody and received at the laboratory in good condition.

Overall Assessment

The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and the resulting analytical data can be used to support the decision-making process. The procedures for assessing the precision, accuracy, representativeness, completeness, and comparability parameters were based on the *Final Quality Assurance Project Plan* (QAPP) *Methane and Mercury Vapor Investigation at the Shelby Horizon Area of Concern, Former Wilkins Air Force Station* (July 2012). The following summary highlights the findings for the above defined events.

Precision of the data was verified through the review of the field and laboratory data quality indicators that include FD and/or laboratory duplicate RPDs. Precision was generally acceptable, with a few compounds being qualified as estimated detected results due to FD RPD issues. Data users should consider the impact to any result that is qualified as estimated, as it may contain a bias that could affect the decision-making process.

Accuracy of the data was verified through the review of the calibration data and LCS recoveries, as well as, the evaluation of method/field blank data. Accuracy was generally acceptable with the exception of mercury which was qualified as not detected in all the samples due to contamination in the TB.

Representativeness of the data was verified through the sample collection, storage, and preservation procedures and verification of holding-time compliance. The mercury samples were received at the laboratory above temperature criteria, resulting in the data being qualified as estimated detected and non-detected results. All data were reported from analyses within USEPA recommended holding time.

Comparability of the data was ensured through the use of standard EPA analytical procedures and standard units for reporting. Results obtained are comparable to industry standards in that the collection and analytical techniques followed approved, documented procedures.

Completeness is a measure of the number of valid measurements obtained in relation to the total number of measurements planned. Completeness is expressed as the percentage of valid or usable measurements compared to planned measurements. Valid data are defined as all data that are not rejected for project use. All data were considered valid. The completeness goal was met for all compounds.

TABLE 4
Data Qualifier Summary

Method	Sample ID	Analyte	Result	Units	Final Flag	Validation Reason
E245.7	VP-MHD1-071412	Mercury	0.0002	ug	U	TB>RL, Temp>6°C
E245.7	VP-MHD2-071412	Mercury	0.00025	ug	U	TB>RL, Temp>6°C
E245.7	VP-HD1-071412	Mercury	0.00038	ug	U	TB>RL, Temp>6°C
E245.7	VP-HD3-071412	Mercury	0.0002	ug	U	TB>RL, Temp>6°C
E245.7	VP-HD4-071412	Mercury	0.0002	ug	U	TB>RL, Temp>6°C
E245.7	FD03-071412	Mercury	0.00035	ug	U	TB>RL, Temp>6°C
E245.7	AMB-071412	Mercury	0.0002	ug	UJ	Temp>6°C
BG-1	VP-MW11-071312	Argon	0.163	%	J	FD>RPD
BG-1	VP-MW11-071312	Nitrogen	15.42	%	J	FD>RPD
BG-1	VP-MW11-071312	Oxygen	3.39	%	J	FD>RPD
BG-1	FD02-071312	Argon	0.0419	%	J	FD>RPD
BG-1	FD02-071312	Nitrogen	5.38	%	J	FD>RPD
BG-1	FD02-071312	Oxygen	0.42	%	J	FD>RPD

FD>RPD = FD RPD criteria exceeded
TB>RL= Analyte was detected in the trip blank at a concentration greater than the reporting limit
Temp>6°C= Temperature exceeded criteria

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number	N/A
2. Page 1 of	1
3. Emergency Response Phone	4409927906/PENNOHIO
4. Waste Tracking Number	072712

5. Generator's Name and Mailing Address: USACE
600 MARTIN LUTHER KING DR
LOUISVILLE, KY 40202

Generator's Site Address (if different than mailing address):
USACE-FORMER WILKENS AIR FORCE BASE
CURTIS ROAD
SHELBY, OH

Generator's Phone:

6. Transporter 1 Company Name: THE PENNOHIO CORPORATION — U.S. EPA ID Number: OHR 000 028 837

7. Transporter 2 Company Name: — U.S. EPA ID Number:

8. Designated Facility Name and Site Address:
THE PENNOHIO CORPORATION
4813 WOODMAN AVENUE
ASHTABULA, OH 44004

Facility's Phone: 440 992 7906 — U.S. EPA ID Number: OHR 000 028 837

GENERATOR

9. Waste Shipping Name and Description	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.
1. NON HAZARDOUS SOLID - IDW SOIL	01	DM	306	P
2. NON HAZARDOUS SOLID - GENERAL TRASH & DEBRIS	03	DM	300	P
3. NON HAZARDOUS LIQUID - IDW WATER	01	DM	30	G
4.				

13. Special Handling Instructions and Additional Information

APPROVAL #'s: 1. 120713-01
2. 120713-02
3. 120713-03

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/Offeror's Printed/Typed Name: JOAN CULLEN/USACE — Signature: Joan Cullen — Month 07 Day 18 Year 12

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. — Port of entry/exit: ____
Transporter Signature (for exports only): — Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Thomas L. Bratton — Signature: [signature] — Month 7 Day 27 Year 12
Transporter 2 Printed/Typed Name: — Signature: — Month Day Year

DESIGNATED FACILITY

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 — Signature — Month Day Year

169-BLS-C 6 10497 (Rev. 9/09)

GENERATOR

NON-HAZARDOUS WASTE MANIFEST

1. Generator ID Number: N/A
2. Page 1 of: 1
3. Emergency Response Phone: 4409927906/PENNOHIO
4. Waste Tracking Number: 072712

5. Generator's Name and Mailing Address:
USACE
600 MARTIN LUTHER KING DR
LOUISVILLE, KY 40202

Generator's Site Address (if different than mailing address):
USACE-FORMER WILKENS AIR FORCE BASE
CURTIS ROAD
SHELBY, OH

Generator's Phone:

6. Transporter 1 Company Name: THE PENNOHIO CORPORATION — U.S. EPA ID Number: OHR 000 028 837

7. Transporter 2 Company Name: — U.S. EPA ID Number:

8. Designated Facility Name and Site Address:
THE PENNOHIO CORPORATION
4813 WOODMAN AVENUE
ASHTABULA, OH 44004

U.S. EPA ID Number: OHR 000 028 837

Facility's Phone: 440 992 7906

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.
1.	NON HAZARDOUS SOLID - IDW SOIL	01	DM	300	P
2.	NON HAZARDOUS SOLID - GENERAL TRASH & DEBRIS	03	DM	300	P
3.	NON HAZARDOUS LIQUID - IDW WATER	01	DM	30	G
4.					

13. Special Handling Instructions and Additional Information
APPROVAL #'s: 1. 120713-01
2. 120713-02
3. 120713-03

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/Offeror's Printed/Typed Name: JOAN CULLEN/USACE — Signature: Joan Cullen — Month 07 Day 18 Year 12

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter Signature (for exports only): Date leaving U.S.:

16. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: Thomas L. Bratton — Signature: [signature] — Month 7 Day 27 Year 12
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: Debbie Johnson — Signature: Debbie Johnson — Month 07 Day 27 Year 12

169-BLS-C 6 10497 (Rev. 9/09)

DESIGNATED FACILITY TO GENERATOR

Appendix B
Test Pitting/Trenching Observation Logs and Photographs

CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-1	SHEET 1 of 1

TEST PIT LOG

PROJECT: Shelby Horizons AOC LOCATION: N 450945.96 E 1919724.2 LOGGER: Anthony Moran
ELEVATION: 1069.20 CONTRACTOR: SWS
EXCAVATION EQUIPMENT USED: John Deere 75 D DATE EXCAVATED: 7/16/12
WATER LEVEL: — APPROX. DIMENS: Length: 45 Width: 5 Max. Depth: 4

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)

NE 0 4 8 12 16 20 24 28 32 36 40 44 45 SW

SANDY SILTY CLAY, some gravel, (CL), Grayish Brown, Dry, firm, Fill

some limestone Fill

FID = non detect
PID = non detect

1

SANDY LEAN CLAY, trace gravel, CL, Brown, moist, stiff Native

-one Former equipment track observed

2

3

4

5

CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-2 SHEET 1 of 1
	TEST PIT LOG

PROJECT: Shelby Horizons AOC LOCATION: N 450891.88, E 1919907.09 LOGGER: Anthony Moran
ELEVATION: 1069.03 CONTRACTOR: SWS
EXCAVATION EQUIPMENT USED: John Deere 75D DATE EXCAVATED: 7/16/12
WATER LEVEL: – APPROX. DIMENS: Length: 82' Width: 4' Max. Depth: 2'

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 82

North

SANDY SILTY CLAY WITH GRAVEL, (CL) Grayish brown, Dry, stiff, fill (Trace concrete) (Trace glass + metal)

1

SANDY LEAN CLAY, trace gravel, CL, Brown, moist, stiff, native

2

South

CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP3	SHEET 1 of 1
	TEST PIT LOG	

PROJECT: Shelby Horizons Ave | LOCATION: N 451153.27, E 1919906.88 | LOGGER: Anthony Moran

ELEVATION: 1032.73 | CONTRACTOR: SES

EXCAVATION EQUIPMENT USED: John Deere 350 | DATE EXCAVATED: 7/17/12

WATER LEVEL: 3.75 | APPROX. DIMENS: Length: 60 | Width: 4 | Max. Depth: 4

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)

Horizontal scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60. Depth scale: 1, 2, 3, 4.

South

North

SANDY SILTY CLAY WITH GRAVEL (CL) Brown, Dry, Stiff (Fill)

Native Same as 35–60

SANDY LEAN CLAY mixed with Burnt waste material (nails, metal, paper), Black, wet

SANDY LEAN CLAY, trace gravel, CL, Brown, wet, Stiff Native

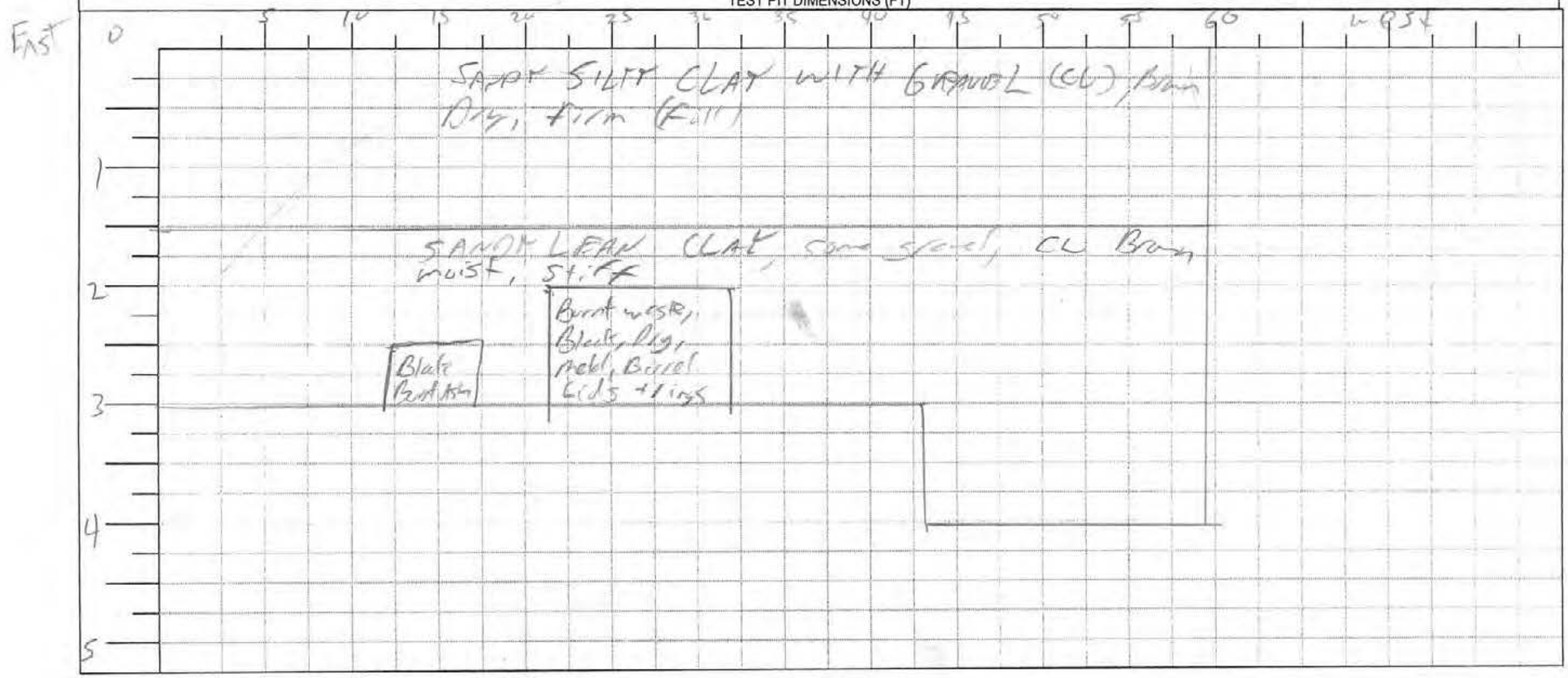
CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-4	SHEET 1 of 1
	TEST PIT LOG	

PROJECT: Shelby Horizons AOC
LOCATION: N 451026.48 E 1919900.25
LOGGER: Anthony Moran
ELEVATION: 1072.81
CONTRACTOR: SWS
EXCAVATION EQUIPMENT USED: John Deere 75 D
DATE EXCAVATED: 7/17/12
WATER LEVEL: —
APPROX. DIMENS: Length: 60 Width: 4 Max. Depth: 4

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)



CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-5	SHEET 1 of __

TEST PIT LOG

PROJECT: Shelby Horizons Ave LOCATION: N 450964.26, E 1919892.15 LOGGER: Anthony Moran

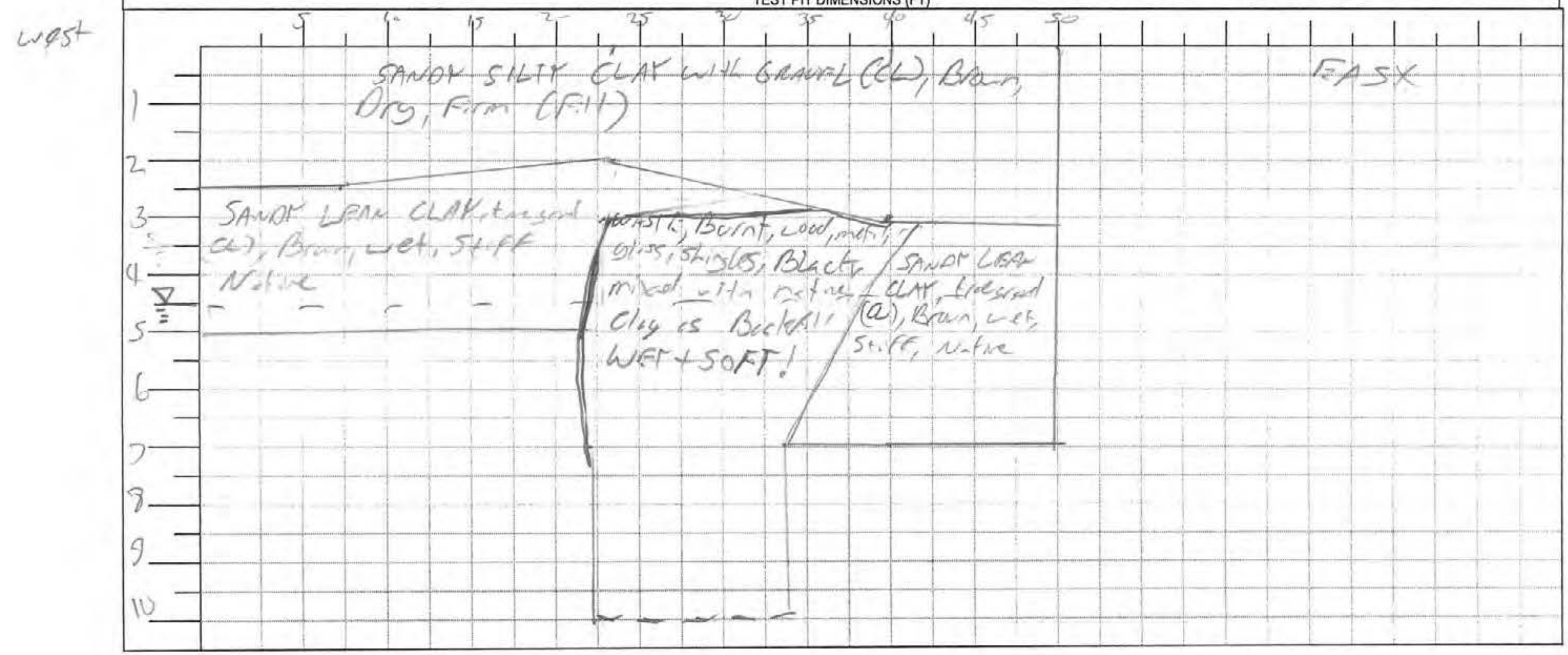
ELEVATION: 1069.58 CONTRACTOR: JLS

EXCAVATION EQUIPMENT USED: John Deere 750 DATE EXCAVATED: 7/17/12

WATER LEVEL: 4.5' APPROX. DIMENS: Length: 45' Width: 4' Max. Depth: 10'

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)



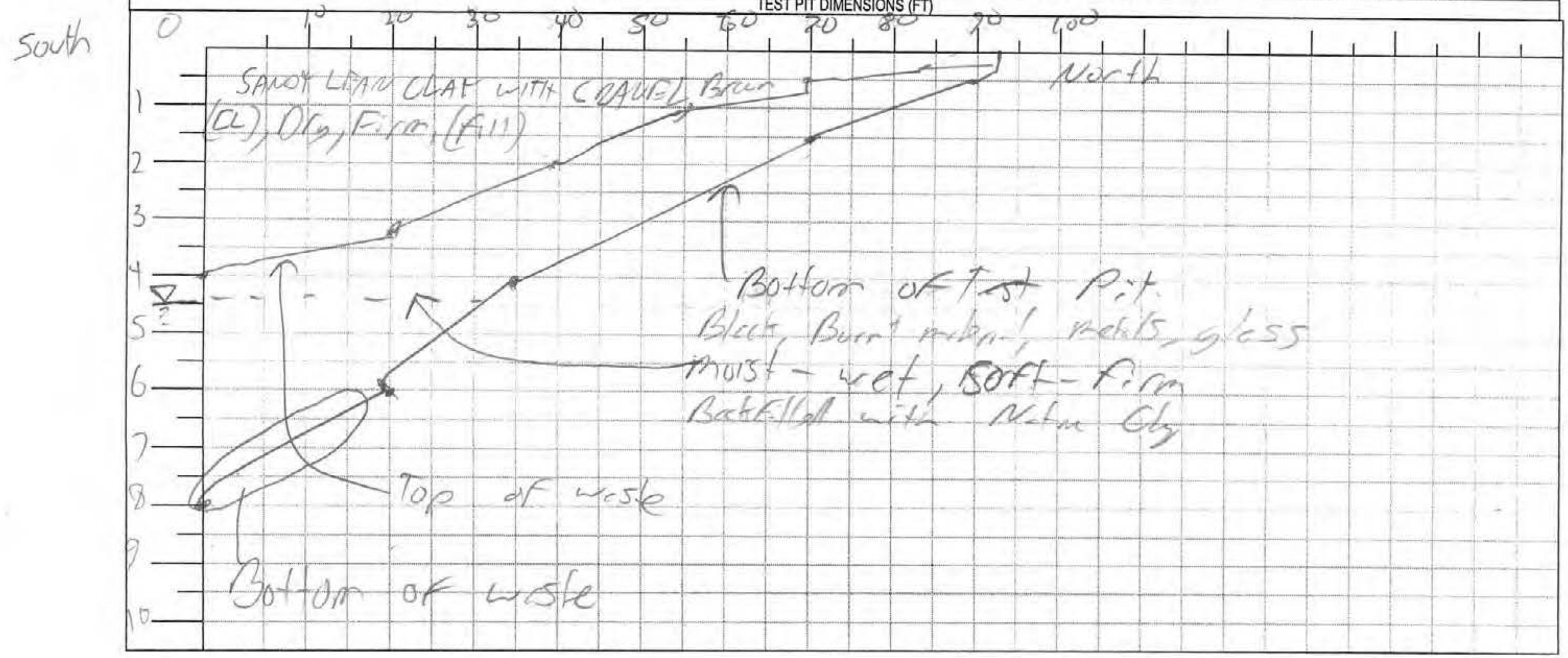
CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-6	SHEET 1 of 1
	TEST PIT LOG	

PROJECT: Shelby Horizons Acc LOCATION: N 451011.95, E 1919911.68 LOGGER: Anthony ...
ELEVATION: 1068.70 CONTRACTOR: SWS
EXCAVATION EQUIPMENT USED: John Deere 35D DATE EXCAVATED: 7/12/12
WATER LEVEL: ~4.5' APPROX. DIMENS: Length: 92' Width: 4' Max. Depth: 8'

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)



CH2MHILL.

PROJECT NUMBER 435223	TEST PIT NUMBER Shelby TP-7	SHEET 1 of 1

TEST PIT LOG

PROJECT: Shelby Horizons AOC LOCATION: LOGGER: Anthony [illegible]
ELEVATION: CONTRACTOR: [illegible]
EXCAVATION EQUIPMENT USED: John Deere 350 DATE EXCAVATED: 7/17/12
WATER LEVEL: 4.5' bgs APPROX. DIMENS: Length: 30' Width: 4' Max. Depth: 5'

DESCRIPTION	COMMENTS
SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DIFFICULTY IN EXCAVATION, RUNNING GRAVEL, CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, GRADATIONAL CONTACTS, TESTS, INSTRUMENTS, WATER SEEPAGE

TEST PIT DIMENSIONS (FT)

SE

0 5 10 15 20 25 30

Depth	Description	Comments
0–1	SANDY SILTY CLAY WITH GRAVEL (CL), Brown, Dry, Firm, Fill	NW
1–5	SANDY GRAVELLY CLAY, trace gravel, (CL), Brown, moist-wet, Stiff (native)	

Depth marks: 1, 2, 3, 4, ▽ (water, ~4.5), 5

Test Pit Investigation

Shelby Horizons AOC

PHOTOGRAPH 1
John Deere 75D Used for Test Pitting Activities

PHOTOGRAPH **2**
TP-1 Completed

PHOTOGRAPH 3

Shelby TP-2 Excavation

PHOTOGRAPH 4

Shelby TP-2 Completed

PHOTOGRAPH 5

Placing Excavation Spoils on Plastic Sheeting

PHOTOGRAPH 6

Backfill and Compaction of Shelby TP-2

PHOTOGRAPH 7

Grading Shelby TP-1 and TP-2 Area

PHOTOGRAPH 8

Shelby TP-3 Burnt Waste Material

PHOTOGRAPH 9

Shelby TP-3 Burnt Waste Fill

PHOTOGRAPH 10

Shelby TP-3 Completed

PHOTOGRAPH 11

Shelby TP-4 Burnt Waste Observed

PHOTOGRAPH 12

Shelby TP-4 Completed

PHOTOGRAPH 13

Shelby TP-5 Excavation

PHOTOGRAPH 14

Shelby TP-5 Completed

PHOTOGRAPH 15

Shelby TP-6 Excavation

PHOTOGRAPH 16

Shelby TP-6 Completed

PHOTOGRAPH 17

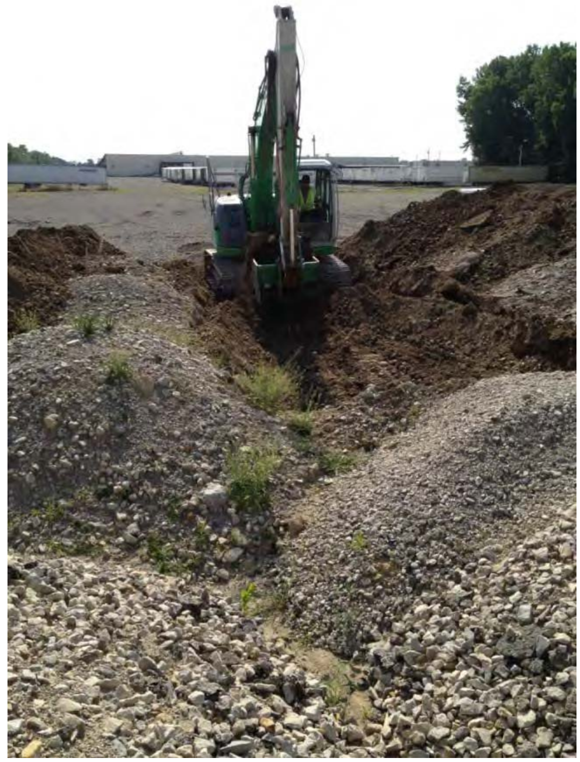
Shelby TP-7 Completed

Site Preparation

Shelby Horizons AOC

PHOTOGRAPH 1
Removal of Large Debris Pile Oriented N-S over Shelby Horizons AOC.

PHOTOGRAPH 2
Removal of Smaller Debris Pile Oriented E-W near MW-12 at Shelby Horizons AOC.



Appendix C
Cost Estimates

COMPARISON OF TOTAL COST OF DIFFERENT OPTIONS

Site:	Shelby Horizons AOC	**Base Year:**	**2012**
Location:	Shelby,Ohio	**Date:**	**9/10/2012**
Phase:	Feasibility Study		

Alternative:	**Alternative 1**	**Alternative 2**	**Alternative 3**
Scope:	**No Action**	**Land Use Controls**	**Excavation and Offsite Disposal**
Capital Cost	$0	$19,800	$724,000
Total Annual O&M Cost Year (1 and 2)	$0	$0	$0
Total Annual O&M Cost Year (3 through 5)	$0	$9,057	$0
Total Annual O&M Cost Year (6 through 30)	$0	$33,979	$0
Total Periodic Cost	$0	$60,000	$0
Total Present Value of Alternative (30 years)	**$0**	**$62,800**	**$724,000**

Disclaimer: The information in this cost estimate is based on the best available information regarding the anticipated scope of the alternatives. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the alternatives. This is an order-of-magnitude cost estimate that is expected to be within +50 to -30 percent of the actual project costs.

Project Name:	**Shelby Horizons AOC**		
Scope:	**No Action**		
Site:	Shelby Horizons AOC	**Description:**	Under the No Action Alternative, there would be no activities completed at the Shelby Horizons AOC to change the current conditions. Additionally, no action would be taken to restrict potential exposures to buried debris and waste if excavation were to occur within the AOC. This alternative does not provide for ICs restricting future site use, such as an environmental covenant or a deed restriction. Alternative 1 is retained as a baseline alternative, as required by the National Oil and Hazardous Substances Pollution Contingency Plan, as required by the NCP.
Location:	Shelby,Ohio		
Phase:	Feasibility Study		

CAPITAL COSTS						
	DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Establish Land Use Controls						
	Env Cov Filing Fees	0	LS	$0.00	$0	
	SUBTOTAL				$0	
	Contingency	0%			$0	
	SUBTOTAL				$0	
	TOTAL CAPITAL COST				**$0**	

OPERATIONS AND MAINTENANCE COST (Annual Cost)						
DESCRIPTION	**YEAR**	**QTY**	**UNIT**	**COST**	**TOTAL**	**NOTES**
Annual O&M			hrs		$0	
TOTAL O&M COST					**$0**	

PERIODIC COSTS						
DESCRIPTION	**YEAR**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Renewals & Replacements	5	1	LS	$0	$0	
Renewals & Replacements	10	1	LS	$0	$0	
Renewals & Replacements	15	1	LS	$0	$0	
Renewals & Replacements	20	1	LS	$0	$0	
Renewals & Replacements	25	1	LS	$0	$0	
Renewals & Replacements	30	1	LS	$0	$0	
			Total		$0	
TOTAL PERIODIC COST					**$0**	

PRESENT VALUE ANALYSIS (30-year)			Discount Rate =	2.0%		
End Year	**COST TYPE**	**Total Cost**	**Periodic Cost**	**TOTAL COST/YEAR**	**DISCOUNT FACTOR**	**PRESENT VALUE**
0	CAPITAL COST	$0		$0	1.000	$ -
1	ANNUAL COST - O&M	$0		$0	0.980	$ -
2	ANNUAL COST - O&M	$0		$0	0.961	$ -
3	ANNUAL COST - O&M	$0		$0	0.942	$ -
4	ANNUAL COST - O&M	$0		$0	0.924	$ -
5	ANNUAL COST - O&M	$0	$0	$0	0.906	$ -
6	ANNUAL COST - O&M	$0		$0	0.888	$ -
7	ANNUAL COST - O&M	$0		$0	0.871	$ -
8	ANNUAL COST - O&M	$0		$0	0.853	$ -
9	ANNUAL COST - O&M	$0		$0	0.837	$ -
10	ANNUAL COST - O&M	$0	$0	$0	0.820	$ -
11	ANNUAL COST - O&M	$0		$0	0.804	$ -
12	ANNUAL COST - O&M	$0		$0	0.788	$ -
13	ANNUAL COST - O&M	$0		$0	0.773	$ -
14	ANNUAL COST - O&M	$0		$0	0.758	$ -
15	ANNUAL COST - O&M	$0	$0	$0	0.743	$ -
16	ANNUAL COST - O&M	$0		$0	0.728	$ -
17	ANNUAL COST - O&M	$0		$0	0.714	$ -
18	ANNUAL COST - O&M	$0		$0	0.700	$ -
19	ANNUAL COST - O&M	$0		$0	0.686	$ -
20	ANNUAL COST - O&M	$0	$0	$0	0.673	$ -
21	ANNUAL COST - O&M	$0		$0	0.660	$ -
22	ANNUAL COST - O&M	$0		$0	0.647	$ -
23	ANNUAL COST - O&M	$0		$0	0.634	$ -
24	ANNUAL COST - O&M	$0		$0	0.622	$ -
25	ANNUAL COST - O&M	$0	$0	$0	0.610	$ -
26	ANNUAL COST - O&M	$0		$0	0.598	$ -
27	ANNUAL COST - O&M	$0		$0	0.586	$ -
28	ANNUAL COST - O&M	$0		$0	0.574	$ -
29	ANNUAL COST - O&M	$0		$0	0.563	$ -
30	ANNUAL COST - O&M	$0	$0	$0	0.552	$ -
				TOTAL PRESENT VALUE OF ALTERNATIVE		**$ -**

Inflation is considered to 2.1 percent
Discount Rate Per: OMB Circular A-94 Appendix C (FS guidance). http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Project Name:	**Shelby Horizons AOC**		
Scope:	**Land Use Controls**		
Site:	Shelby Horizons AOC	**Description:**	The LUCs Alternative would rely upon containment and environmental covenant to restrict the future use of the Shelby Horizons AOC by documenting the presence of buried debris/waste, prohibiting intrusive activities without following protocols established by the covenant, and restricting the use of groundwater within the footprint of the fill area.
Location:	Shelby,Ohio		
Phase:	Feasibility Study		

CAPITAL COSTS						
	DESCRIPTION	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
Deed Restriction						
	Environmental Covenant Filing Fees	1	LS	$500.00	$500	Engr's estimate
	Environmental Covenant Filing Labor hours	40	hr	$150.00	$6,000	Engr's estimate. It is assumed that bulk of the work needed for developing the environmental covenants will be completed by USACE. The hours indicated here are primarily for review.
	Site Survey & Development of Plat Map	1	EA	$10,000	$10,000	Land survey of AOC boundary. Preparation of Plat Map to support Environmental Covenant
	SUBTOTAL				$16,500	
	Contingency	20%			$3,300	
	TOTAL CAPITAL COST				**$19,800**	

PERIODIC COSTS							
	DESCRIPTION	**YEAR**	**QTY**	**UNIT**	**UNIT COST**	**TOTAL**	**NOTES**
	Site Inspection/ 5 Year Review Report	5	1	LS	$10,000	$10,000	
	Site Inspection/ 5 Year Review Report	10	1	LS	$10,000	$10,000	
	Site Inspection/ 5 Year Review Report	15	1	LS	$10,000	$10,000	
	Site Inspection/ 5 Year Review Report	20	1	LS	$10,000	$10,000	
	Site Inspection/ 5 Year Review Report	25	1	LS	$10,000	$10,000	
	Site Inspection/ 5 Year Review Report	30	1	LS	$10,000	$10,000	
				Total		$60,000	
	TOTAL PERIODIC COST					**$60,000**	

PRESENT VALUE ANALYSIS (30-year)			Discount Rate =	2.0%		
End Year	**COST TYPE**	**Total Cost**	**Periodic Cost**	**TOTAL COST/YEAR**	**DISCOUNT FACTOR**	**PRESENT VALUE**
0	CAPITAL COST	$19,800		$19,800	1.000	$ 19,800
1	ANNUAL COST - O&M	$0		$0	0.980	$ -
2	ANNUAL COST - O&M	$0		$0	0.961	$ -
3	ANNUAL COST - O&M	$0		$0	0.942	$ -
4	ANNUAL COST - O&M	$0		$0	0.924	$ -
5	ANNUAL COST - O&M	$0	$10,000	$10,000	0.906	$ 9,057
6	ANNUAL COST - O&M	$0		$0	0.888	$ -
7	ANNUAL COST - O&M	$0		$0	0.871	$ -
8	ANNUAL COST - O&M	$0		$0	0.853	$ -
9	ANNUAL COST - O&M	$0		$0	0.837	$ -
10	ANNUAL COST - O&M	$0	$10,000	$10,000	0.820	$ 8,203
11	ANNUAL COST - O&M	$0		$0	0.804	$ -
12	ANNUAL COST - O&M	$0		$0	0.788	$ -
13	ANNUAL COST - O&M	$0		$0	0.773	$ -
14	ANNUAL COST - O&M	$0		$0	0.758	$ -
15	ANNUAL COST - O&M	$0	$10,000	$10,000	0.743	$ 7,430
16	ANNUAL COST - O&M	$0		$0	0.728	$ -
17	ANNUAL COST - O&M	$0		$0	0.714	$ -
18	ANNUAL COST - O&M	$0		$0	0.700	$ -
19	ANNUAL COST - O&M	$0		$0	0.686	$ -
20	ANNUAL COST - O&M	$0	$10,000	$10,000	0.673	$ 6,730
21	ANNUAL COST - O&M	$0		$0	0.660	$ -
22	ANNUAL COST - O&M	$0		$0	0.647	$ -
23	ANNUAL COST - O&M	$0		$0	0.634	$ -
24	ANNUAL COST - O&M	$0		$0	0.622	$ -
25	ANNUAL COST - O&M	$0	$10,000	$10,000	0.610	$ 6,095
26	ANNUAL COST - O&M	$0		$0	0.598	$ -
27	ANNUAL COST - O&M	$0		$0	0.586	$ -
28	ANNUAL COST - O&M	$0		$0	0.574	$ -
29	ANNUAL COST - O&M	$0		$0	0.563	$ -
30	ANNUAL COST - O&M	$0	$10,000	$10,000	0.552	$ 5,521
				TOTAL PRESENT VALUE OF ALTERNATIVE		**$ 62,800**

Inflation is considered to 2.1 percent

Discount Rate Per: OMB Circular A-94 Appendix C (FS guidance). http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c

Project Name:	**Shelby Horizons AOC**
Scope:	**Excavation and Offsite Disposal**
Site:	Shelby Horizons AOC
Location:	Shelby,Ohio
Phase:	Feasibility Study

Description: The Excavation and Offsite Disposal Alternative consists of excavating the buried debris/waste from the AOC and transporting it to a facility permitted to accept the material. Upon completion of excavation activities, the site would be backfilled and restored to existing grade. Long-term site management would not be required. A non-hazardous characterization for the waste materials is assumed based upon the conclusions drawn from previous reports, as well as from observations during test pitting/trenching activities conducted in 2012. The limits of buried waste and debris materials determined during the 2012 test pitting/trenching activities have been defined for the purpose of this FS as depicted in Figure 3-1. This corresponds to two areas (one approximately 80 by 40 feet and one 100 by 40 feet) totaling of 7,200 square feet (0.17 acre). Buried debris and waste materials were observed to extend to depths of 4 to 8 feet below ground surface in the middle of the AOC based upon test pitting/trenching activities.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Waste Removal/Disposal					
Mobilization/Demobilization	1	LS	$10,000.00	$10,000	Engr's Estimate
Erosion and Sediment Controls	520	LF	$12.26	$6,375	Means Facilities Construction 2012
Confirmation Trenching to Define Exact Limits of Buried Materials	1	LS	$10,000.00	$10,000	Engr's Estimate
Survey - Topographic	1.00	DAY	$2,400.00	$2,400	Engr's Estimate
Clear and Grub Site	0.17	AC	$3,060.00	$506	Means Facilities Construction 2012
Grubbing Material Disposal	0.83	TON	$50.00	$41	Engr's Estimate
Waste Material Excavation	2,500	CY	$4.51	$11,275	Means Facilities Construction 2012
De-Watering: Vac Truck	4.00	DAY	$520.00	$2,080	Engr's Estimate
Water Characterization Sampling for Disposal	1.00	EA	$900.00	$900	Engr's Estimate
De-Watering: Non-hazardous Water Disposal	4000.00	GAL	$0.50	$2,000	Engr's Estimate
Soil Transportation and Disposal	3,100.00	TON	$100.00	$310,000	Engr's Estimate
Soil Characterization Sampling for Disposal (1 per 500 CY)	7.00	EA	$900.00	$6,300	Engr's Estimate
Sampling and Analysis	10.00	EA	$1,000.00	$10,000	Engr's Estimate
Monitoring Well Abandonment	75.00	FT	$12.00	$900	Engr's Estimate
Survey - Post Excavation	1.00	DAY	$2,400.00	$2,400	Engr's Estimate
SUBTOTAL: Waste Removal/Disposal				**$375,177**	
Backfill/Restoration					
Backfill - Import	3,125	CY	$15.00	$46,875	Engr's Estimate
Backfill - Placement/Compaction	3,125	CY	$4.56	$14,250	Means Facilities Construction 2012
Backfill - Compaction Testing	6	EA	$123.00	$769	Means Facilities Construction 2012
Land Survey - Post Excavation	1.00	DAY	$2,400.00	$2,400	Engr's Estimate
Finish Grading	823	SY	$1.22	$1,004	Means Facilities Construction 2012
Topsoil Placement (6-inch lifts, 6-inch total depth)	137	CY	$27.00	$3,704	Means Facilities Construction 2012
Hydroseeding	0.17	AC	$2,917.68	$496	Means Facilities Construction 2012
SUBTOTAL: Backfill/Restoration				**$69,498**	
SUBTOTAL: CAPITAL COSTS				**$444,675**	
Contingency	20%			$88,935	
SUBTOTAL				**$533,610**	
Project Work Planning (Permitting, Excavation Plan, QA/QC Plans/H&S Requirements)	6%			$32,017	EPA 540-R-00-002/OSWER 9355.0-75 (July 2000) $500K - $2MM capital cost
Remedial Design	12%			$64,033	EPA 540-R-00-002/OSWER 9355.0-75 (July 2000) $500K - $2MM capital cost
SUBTOTAL				**$629,660**	
Construction Management	15%			$94,449	Includes oversight labor
SUBTOTAL				$724,109	
TOTAL CAPITAL COST				**$724,000**	

OPERATIONS AND MAINTENANCE COST (Annual Cost)

DESCRIPTION	YEAR	QTY	UNIT	COST	TOTAL	NOTES
Cap Maintenance						
Biannual Inspection		16	HR	$0	$0	
Biannual Mowing		0.00	AC	$0	$0	
Annual Minor Repairs		1	LS	$0	$0	
SUBTOTAL: OPERATIONS AND MAINTENANCE COST (Annual Cost)					**$0**	
Subtotal Annual O&M					**$0**	
Reporting (included elsewhere)						
Contingency		20%			$0	
TOTAL ANNUAL O&M COST					**$0**	

PERIODIC COSTS

DESCRIPTION	YEAR	QTY	UNIT	UNIT COST	TOTAL	NOTES
Renewals and Replacements	5	1	LS	$0	$0	
Renewals and Replacements	10	1	LS	$0	$0	
Renewals and Replacements	15	1	LS	$0	$0	
Renewals and Replacements	20	1	LS	$0	$0	
Renewals and Replacements	25	1	LS	$0	$0	
Renewals and Replacements	30	1	LS	$0	$0	
TOTAL PERIODIC COST				**Total**	**$0**	

PRESENT VALUE ANALYSIS (30-year) Discount Rate = 2.0%

End Year	COST TYPE	Total Cost	Periodic Cost	TOTAL COST/YEAR	DISCOUNT FACTOR	PRESENT VALUE
0	CAPITAL COST	$724,000		$724,000	1.000	$ 724,000
1	ANNUAL COST - O&M	$0	$0	$0	0.980	$ -
2	ANNUAL COST - O&M	$0		$0	0.961	$ -
3	ANNUAL COST - O&M	$0		$0	0.942	$ -
4	ANNUAL COST - O&M	$0		$0	0.924	$ -
5	ANNUAL COST - O&M	$0	$0	$0	0.906	$ -
6	ANNUAL COST - O&M	$0		$0	0.888	$ -
7	ANNUAL COST - O&M	$0		$0	0.871	$ -
8	ANNUAL COST - O&M	$0		$0	0.853	$ -
9	ANNUAL COST - O&M	$0		$0	0.837	$ -
10	ANNUAL COST - O&M	$0	$0	$0	0.820	$ -
11	ANNUAL COST - O&M	$0		$0	0.804	$ -
12	ANNUAL COST - O&M	$0		$0	0.788	$ -
13	ANNUAL COST - O&M	$0		$0	0.773	$ -
14	ANNUAL COST - O&M	$0		$0	0.758	$ -
15	ANNUAL COST - O&M	$0	$0	$0	0.743	$ -
16	ANNUAL COST - O&M	$0		$0	0.728	$ -
17	ANNUAL COST - O&M	$0		$0	0.714	$ -
18	ANNUAL COST - O&M	$0		$0	0.700	$ -
19	ANNUAL COST - O&M	$0		$0	0.686	$ -
20	ANNUAL COST - O&M	$0	$0	$0	0.673	$ -
21	ANNUAL COST - O&M	$0		$0	0.660	$ -
22	ANNUAL COST - O&M	$0		$0	0.647	$ -
23	ANNUAL COST - O&M	$0		$0	0.634	$ -
24	ANNUAL COST - O&M	$0		$0	0.622	$ -
25	ANNUAL COST - O&M	$0	$0	$0	0.610	$ -
26	ANNUAL COST - O&M	$0		$0	0.598	$ -
27	ANNUAL COST - O&M	$0		$0	0.586	$ -
28	ANNUAL COST - O&M	$0		$0	0.574	$ -
29	ANNUAL COST - O&M	$0		$0	0.563	$ -
30	ANNUAL COST - O&M	$0	$0	$0	0.552	$ -
					TOTAL PRESENT VALUE OF ALTERNATIVE	**$ 724,000**

Inflation is considered to 2.1 percent (Global Insight)

Discount Rate Per: OMB Circular A-94 Appendix C (FS guidance). http://www.whitehouse.gov/omb/circulars_a094/a94_appx-c