# Focused Feasibility Study Report, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey

*Prepared for*

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# Executive Summary

This focused feasibility study (FFS) presents the development and analysis of remedial alternatives for Impoundments 1 and 2 (designated as Operable Unit 8 [OU8]) at the American Cyanamid Superfund Site located in Bridgewater Township, Somerset County, New Jersey. This FFS has been prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the *Administrative Settlement Agreement and Order on Consent for Remedial Design, Operable Unit 4 and Focused Feasibility Study, Operable Unit 8* (U.S. Environmental Protection Agency [USEPA] 2013a); and USEPA guidance, direction, and input. The remedial activities to be selected from those considered in this FFS will be governed by CERCLA and consistent with the intent of the New Jersey Department of Environmental Protection (NJDEP) *Technical Requirements for Site Remediation* (NJDEP 2011a).

## Focused Feasibility Study Objectives and Scope of Work

This FFS presents the development and evaluation of remedial alternatives for OU8 that will reduce or eliminate risks to human health and the environment from exposure to acid tar contained within Impoundments 1 and 2. The FFS was prepared following USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988).

Impoundments 1 and 2 (OU8) are just over 4 acres in size (combined). These impoundments contain approximately 55,000 cubic yards of material (i.e., impoundment material) consisting of acid tar containing volatile organic compounds, primarily benzene. Benzene concentrations, on average, are approximately 6% (60,000 parts per million) by mass. The impoundments are covered with both a synthetic geomembrane and water cap to minimize vapor emissions. The impoundments are lined with an approximately 1-foot-thick clay layer, the base of which sits at approximately 6 feet below surrounding grade, and are constructed with berms that extend approximately 10 feet above grade. The acid tar in the impoundments, also referred to as "OU8 impoundment materials", is considered principal threat waste (PTW) and is the focus of this FFS. It is important to note that groundwater near and beneath Impoundments 1 and 2 is being addressed as part of the Site-wide groundwater remedy as a component of Operable Unit 4.

## Remedial Action Objectives

The remedial action objectives for OU8 are as follows:

- Remove, treat, and/or contain material that is considered PTW
- Prevent human exposure (direct contact) to contaminants of concern (COCs) above cleanup levels in soil
- Minimize or reduce current or future migration of COCs from Impoundments 1 and 2 to groundwater

## Performance Criteria

Because of the complex nature of the COCs found within both impoundments, treatment performance criteria were developed for use in the remedial alternative screening and evaluation process. Performance criteria were established to provide for long-term protectiveness of the remedial alternatives based specifically upon the final destination of treated material.

# Identification and Screening of Remedial Technologies

Multiple investigations were conducted in the field and in the laboratory over the course of several years to identify potential remedial technologies that could effectively treat PTW in OU8. The technologies presented herein are based on the collective scientific findings of previous site studies, a field-scale pilot study, and several bench-scale treatability studies. Potential remedial technologies and process options were screened per the following established criteria:

- Technical effectiveness
- Implementability
- Cost

Remedial technologies and process options that would not effectively address impoundment material in OU8 were eliminated. The technologies and process options that were retained from the initial screening process were carried forward for developing remedial alternatives.

# Development and Screening of Remedial Alternatives

The technologies and process options that passed the screening were then combined to form 11 preliminary alternatives that were screened based on technical effectiveness, implementability, and cost. Based on this preliminary screening, five alternatives were retained and developed for more detailed evaluation. The descriptions of the retained remedial alternatives in this FFS are conceptual and have been developed to a level of detail sufficient for the purposes of evaluating the alternatives against National Contingency Plan (NCP) criteria, developing cost estimates of plus 50% to minus 30% accuracy, and comparing the alternatives. Per the NCP requirement, a no action alternative has been included and is carried through the entire FFS process as the baseline condition against which the performance of the remaining alternatives is evaluated. The alternative selected for the site will be further developed during the remedial design process, and the specific methodologies and construction sequences used may change based on the final design.

The following alternatives were retained for detailed evaluation:

- Alternative 1 – No Action
- Alternative 3 – In-situ Solidification and Stabilization (ISS) Treatment, Inner Hydraulic Barrier Wall (HBW)[1], Protective Cover
  - Alternative 3 involves using ISS to treat OU8 impoundment material and underlying soil and clay impacted by OU8 impoundment material above preliminary remediation goals (PRGs) resulting in COC reduction and constituent sequestration within a solidified matrix. Following treatment, engineering controls, including an HBW and protective cover, will be installed to minimize human exposure to COCs and minimize or reduce migration of COCs to groundwater.
- Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover
  - Alternative 4 involves using steam enhanced ISS to treat OU8 impoundment material and underlying soil and clay impacted by OU8 impoundment material above PRGs resulting in COC reduction and constituent sequestration within a solidified matrix. Following treatment, engineering controls, including an HBW and protective cover, will be installed to minimize human exposure to COCs and minimize or reduce migration of COCs to groundwater.

[1] The term “inner hydraulic barrier wall” or “inner HBW” refers to a proposed HBW to be installed around Impoundments 1 and 2; as distinguished from the existing “downgradient” HBW that was constructed in 2012.

- Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in a Corrective Action Management Unit (CAMU), Protective Cover
  - Alternative 5 involves using steam-enhanced ISS to treat OU8 impoundment material and underlying soil and clay impacted by OU8 impoundment material above PRGs resulting in COC reduction and increased strength to facilitate excavation. Treated OU8 impoundment material will then be excavated and placed in the onsite CAMU. Following removal, a protective cover will be installed to minimize human exposure to COCs and minimize or reduce migration of COCs to groundwater.
- Alternative 6 – Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover
  - Alternative 6 involves the excavation and mechanical dewatering of acid tar, followed by shipping to an offsite facility, preferably a cement kiln, for treatment (destruction). Following acid tar removal, soil and clay impacted by OU8 impoundment material above PRGs will be treated using ISS and a protective cover will be installed to minimize human exposure to COCs and minimize or reduce migration of COCs to groundwater.

# Evaluation of Remedial Alternatives

The NCP defines nine criteria, classified as threshold, balancing, or modifying, to be used for the detailed analysis of remedial alternatives. In this FFS, the remedial alternatives were evaluated against the threshold and balancing categories which include the following seven criteria:

- Threshold criteria
  1. Overall protection of human health and the environment
  2. Compliance with applicable or relevant and appropriate requirements
- Balancing criteria
  3. Long-term effectiveness and permanence
  4. Reduction of toxicity, mobility, or volume through treatment
  5. Short-term effectiveness
  6. Implementability
  7. Cost

The two modifying criteria (state and community acceptance) are used later in the process to evaluate the proposed remedy.

The detailed analysis was performed using a two-step process. During the first step, each alternative was evaluated individually against the NCP criteria. In the second step, a comparative analysis was performed using the same criteria to identify key differences between alternatives. The results of the individual evaluation of the alternatives is presented in Table ES-1 and the comparative analysis is summarized in Table ES-2.

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Table ES-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 1: No Action | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|---|
| ***Threshold Criteria*** | | | | | |
| Protection of Human Health and the Environment | RAOs designed for protection of human health and the environment will not be achieved. | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. |
| Compliance with ARARs | Remedy will not be compliant with ARARs. | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. |
| ***Balancing Criteria*** | | | | | |
| **Long-Term Effectiveness** | | | | | |
| Magnitude of Risk (i.e., risk remaining from untreated material or treated soil and clay impacted by OU8 impoundment material at the conclusion of the remedial activities) | No reduction in risk will be achieved. | OU8 impoundment material will be treated.<br><br>Treated impoundment material will remain in place, but COC leachability will be reduced following ISS treatment.<br><br>Engineered controls will be robust (robust engineered cover, hydraulic barrier wall, long-term vapor control and treatment). | OU8 impoundment material will be treated.<br><br>Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>Treated impoundment material will remain in place, but leachability will be reduced following ISS treatment.<br><br>Engineered controls will be robust (robust engineered cover, hydraulic barrier wall, long-term vapor control and treatment). | OU8 impoundment material will be treated, removed and disposed in CAMU. Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS and capped in place.<br><br>COC leachability will be reduced following ISS treatment.<br><br>Engineered controls will consist of a protective cover. | OU8 impoundment material will be removed from the site and treated offsite.<br><br>Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS. Engineered controls will consist of a protective cover. |
| Adequacy and Reliability of Controls | No additional controls will be implemented. | Treated OU 8 impoundment material will remain in place.<br><br>The hydraulic barrier wall will impede migration of potentially leached COCs to surrounding areas.<br><br>VOCs will be captured by the robust engineered cover and treated to acceptable levels before discharge to the atmosphere. | Treated OU8 impoundment material will remain in place.<br><br>The hydraulic barrier wall will impede migration of potentially leached COCs to surrounding areas.<br><br>VOCs will be controlled by the robust engineered cover and treated to acceptable levels before discharge to the atmosphere. | Treated OU8 impoundment material will be removed from the impoundment areas.<br><br>The existing CAMU will effectively contain waste following thermal-enhanced ISS treatment of the material. | OU8 impoundment material will be removed from the impoundment areas for offsite treatment. |
| **Reduction in Toxicity, Mobility, and Volume** | | | | | |
| Treatment Process Used and Materials Treated | No additional treatment processes will be implemented. | ISS will effectively reduce leachability of COCs, reducing mobility. | Thermal treatment will reduce concentration of predominant COCs, reducing toxicity.<br><br>ISS will effectively reduce leachability of remaining COC mass, reducing mobility. | Thermal treatment will reduce concentration of predominant COCs, reducing toxicity.<br><br>ISS will reduce leachability of remaining COC mass, reducing mobility.<br><br>Treated OU8 impoundment material will be removed from impoundments. | OU8 impoundment material will be removed from impoundments, reducing toxicity, mobility and volume. |
| Amount of Hazardous Materials Destroyed or Treated | No hazardous material will be treated. | OU8 impoundment material will be treated with ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>VOCs will be controlled and treated long-term. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>OU8 impoundment material will be treated with thermal-enhanced ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>VOCs will be controlled and treated long-term. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>OU8 impoundment material will be treated with thermal-enhanced ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>Treated OU8 impoundment material will be removed and placed in CAMU. | OU8 impoundment material will be removed from the site. Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS. |

Table ES-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 1: No Action | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|---|
| Degree of Expected Reductions in Toxicity, Mobility, and Volume | No reduction in toxicity, mobility, or volume will be achieved. | ISS will reduce leachability (mobility) of COCs to a high degree. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>ISS will reduce leachability (mobility) of COCs to a high degree. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>ISS will reduce leachability (mobility) of COCs to a moderate degree (lower reagent dose).<br><br>OU8 impoundment material will be removed. | OU8 impoundment material will be removed for offsite treatment. |
| Degree to Which Treatment is Irreversible | No treatment will be implemented. | ISS treatment is highly irreversible. | Removal of volatile COCs through thermal treatment will be completely irreversible.<br><br>ISS treatment is highly irreversible. | Removal of volatile COCs through thermal treatment will be completely irreversible.<br><br>ISS treatment with lower reagent dose is moderate to highly irreversible.<br><br>Removal of impoundment material to CAMU will be completely irreversible. | Removal of impoundment material to off-site facility will be completely irreversible. |
| Type and Quantity of Residuals Remaining After Treatment | Existing waste will remain in place. | OU8 impoundment material will be treated.<br><br>ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material. | OU8 impoundment material will be treated.<br><br>Thermal-enhanced ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material. | OU8 impoundment material will be treated and excavated.<br><br>Thermal-enhanced ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material.<br><br>Excavation will extend to the depth of the current clay impoundment liner. Semi-stabilized non-principal-threat waste presumed to exist below the impoundments will remain. | OU8 impoundment material will be treated and excavated.<br><br>Excavation will extend to the depth of the current clay impoundment liner.<br><br>Soil and clay above the water table impacted by OU8 impoundment material with concentrations exceeding PRGs, including minor amounts of acid tar, will be treated with ISS. |
| **Short-Term Effectiveness** | | | | | |
| Protection of Community During Remedial Actions | Because no remedial actions will take place, there will be no construction-related impacts on the community due to remedy implementation. Existing threats will remain. | Engineered controls implemented during ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk.<br><br>Equipment can easily be removed and the water cap restored to protect the impoundments during short-term flooding events.<br><br>Engineered controls will provide a high degree of protection. |

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|---|---|---|---|---|---|
| Protection of Workers During Remedial Actions | Because no remedial actions will take place, there will be no construction-related impacts to workers due to remedy implementation. Existing threats will remain. | Engineered controls implemented during ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk. Engineered controls will provide a high degree of protection. |
| Environmental Impacts | Because no remedial actions will take place, there will be no environmental impacts due to remedy implementation. Existing threats will remain. | Engineered controls implemented during ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk. Engineered controls will provide a high degree of protection. |
| Time Until Remedial Action Objectives are Achieved | RAO will not be achieved. | Approximately 20 months. | Approximately 24 months. | Approximately 30 months. | Approximately 38 months. |
| **Implementability** | | | | | |
| Ability to Construct and Operate the Technology | No additional construction or operation will be required. | The primary remedial action (ISS treatment) is a proven and highly implementable technology. | The primary remedial action (ISS treatment) is a proven and highly implementable technology.<br><br>The addition of thermal enhancement is less proven, but still expected to have a moderately high implementability. | The primary remedial action (ISS treatment) is a proven and highly implementable technology.<br><br>Implementation of Alternative 5 would be challenging since there are multiple processes involved with in-place treatment, removal, additional treatment at the CAMU, then placement of the material in the CAMU. Fewer contractors are available with experience implementing steam-enhanced ISS. Excavation equipment is readily available; however, emission controls at the point of excavation and placement may be challenging. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2.<br><br>Emission controls at the point of excavation may be challenging; however effective control using spray foam was demonstrated during the OU8 pilot study. |
| Reliability of the Technology | Not applicable. | The primary remedial action (ISS treatment) is a highly reliable technology. | The primary remedial action (ISS treatment) is a highly reliable technology.<br><br>Thermal enhancement of ISS has a moderately high reliability. | The primary remedial action (ISS treatment) is a highly reliable technology.<br><br>Thermal enhancement of ISS has a moderately high reliability.<br><br>Excavation of stabilized material is a highly reliable technology. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2.<br><br>Emission controls at the point of excavation may be challenging; however effective control using spray foam was demonstrated during the OU8 pilot study. |
| Ease of Undertaking Additional Remedial Actions, if Necessary | High ease of undertaking additional actions. | Stabilization of impoundment material will physically impede the ability to undertake additional remedial actions. | Stabilization of impoundment material will physically impede the ability to undertake additional remedial actions. | Moderately high ease of undertaking additional actions (difficult to undertake additional action on material placed in CAMU, but easy to take additional actions in impoundment area). | High ease of undertaking additional actions in the impoundment area. |

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| Criteria | Alternative 1: No Action | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|---|
| Ability to Monitor Effectiveness of Remedy | High ability to monitor remedy effectiveness. | High ability to monitor remedy effectiveness on decreasing leached COC concentrations.<br><br>Moderate ability to monitor effectiveness of remedy against performance criteria in the field. | High ability to monitor remedy effectiveness on decreasing leached COC concentrations.<br><br>Moderate ability to monitor effectiveness of remedy against performance criteria in the field. | High ability to monitor remedy effectiveness. | High ability to monitor remedy effectiveness. |
| Ability to Coordinate and Obtain Approvals From Other Agencies | No approvals necessary. | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderate administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. Additional approvals will be required for transporting principal threat waste to off-site treatment facility. |
| Availability of Off-site Treatment, Storage, and Disposal Services and Capacity | Not applicable. | Not applicable. | Not applicable. | Not applicable. | A number of off-site treatment facilities are available. |
| Availability of Necessary Equipment and Specialists | None required. | Necessary equipment and specialists to implement ISS are highly available. | Necessary equipment and specialists to implement thermal-enhanced ISS have a moderately high availability. | Necessary equipment and specialists to implement thermal-enhanced ISS have a moderately high availability.<br><br>Equipment and specialist for excavation of treated material are highly available. | Necessary equipment is highly available. |
| Availability of Prospective Technologies | None required. | ISS is a highly available technology. | ISS is a highly available technology. The addition of thermal enhancement to this technology is slightly less available. | ISS is a highly available technology. The addition of thermal enhancement to this technology has a moderately high availability. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2. |
| **Cost** | | | | | |
| Total Cost | $0 | $48,000,000 | $60,000,000 | $65,000,000 | $74,000,000 |

Table ES-2. Summary of Comparative Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 1: No Action | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|---|
| ***Time to Achieve RAOs*** | | | | | |
| Time (years) | - | 2 | 2 | 3 | 3 |
| ***Threshold Criteria*** | | | | | |
| Protection of Human Health & Environment | X | ● | ● | ● | ● |
| Compliance with ARARS | X | ● | ● | ● | ● |
| ***Balancing Criteria*** | | | | | |
| Long-Term Effectiveness | ○ | ● | ● | ● | ● |
| Reduction in TMV | ○ | ● | ● | ● | ● |
| Short-Term Effectiveness | ○ | ● | ● | ◑ | ◑ |
| Implementability | ● | ● | ◑ | ○ | ◑ |
| Estimated Cost (US Dollars) | $0 | $48,000,000 | $60,000,000 | $65,000,000 | $74,000,000 |

Legend:

- X Does not meet NCP criterion
- ○ Low (Alternative is expected to perform poorly against criterion)
- ◑ Moderate (Alternative is expected to perform moderately well against criterion)
- ● High (Alternative is expected to perform very well against criterion)

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# Acronyms and Abbreviations

| | |
|---|---|
| % | percent |
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| A/W | air/water |
| ACO | Administrative Consent Order |
| ANSI | American National Standards Institute |
| ARAR | applicable or relevant and appropriate requirement |
| ASTM | American Society for Testing and Materials |
| BBL | Blasland, Bouck, & Lee |
| BEA | baseline Site-wide endangerment assessment |
| BERA | baseline ecological risk assessment |
| BTEX | benzene, toluene, ethylbenzene, xylenes |
| BTU | British thermal units |
| Btu/lb | British thermal units per pound |
| CA | coal aggregate |
| $CaOH_2$ | calcium hydroxide |
| CAMU | Corrective Action Management Unit |
| CD | Consent Decree |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CH2M | CH2M HILL, Inc. |
| CKD | cement kiln dust |
| CL | clay-like |
| cm/s | centimeters per second |
| COC | contaminant of concern |
| ECM | erosion control matting |
| EIPT | Environmental Improvement Pilot Test |
| FEMA | Federal Emergency Management Agency |
| FFS | focused feasibility study |
| FS | feasibility study |
| GAC | granular activated carbon |
| GRA | general response action |
| GWTF | groundwater treatment facility |

| | |
|---|---|
| HBW | hydraulic barrier wall |
| HC | hard crumbly |
| HDPE | high-density polyethylene |
| HHRA | human health risk assessment |
| I-287 | Interstate Highway 287 |
| in/yr | inches per year |
| ISS | in-situ solidification and stabilization |
| ISTT | in-situ thermal treatment |
| ITRC | Interstate Technology and Regulatory Council |
| kg | kilogram |
| lb/gal | pounds per gallon |
| LKD | lime kiln dust |
| mg | milligram |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| MPE | multiphase extraction |
| NAPL | nonaqueous phase liquid |
| NAVD88 | North American Vertical Datum of 1988 |
| NCP | National Contingency Plan |
| NJDEP | New Jersey Department of Environmental Protection |
| NJGWQS | New Jersey Ground Water Quality Standards |
| O&M | operation and maintenance |
| OBG | O'Brien & Gere |
| OU | Operable Unit |
| PCB | polychlorinated biphenyl |
| pg/g | picograms per gram |
| psi | pounds per square inch |
| PRG | preliminary remediation goal |
| PTW | principal threat waste |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| Removal Action ACO | Administrative Settlement Agreement and Order on Consent for Removal Action |
| ROD | Record of Decision |
| Site | American Cyanamid Superfund Site in Bridgewater Township, Somerset County, New Jersey |

| | |
|---|---|
| SPLP | synthetic precipitation leaching procedure |
| SSL | sand and silt-like |
| STS | Somerset Tire Service |
| SU | standard unit |
| SVOC | semivolatile organic compound |
| TBC | to be considered |
| TBD | to be determined |
| TCLP | toxicity characteristic leaching procedure |
| TMV | toxicity, mobility, or volume |
| TOC/g | total organic carbon per gram |
| UCS | unconfined compressive strength |
| USEPA | U.S. Environmental Protection Agency |
| VGAC | vapor-phase granular activated carbon |
| VOC | volatile organic compound |
| VR | viscous rubbery |
| WH | Wyeth Holdings LLC |
| $yd^3$ | cubic yards |

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SECTION 1

# Introduction

## 1.1 Purpose and Report Organization

This focused feasibility study (FFS) report has been developed on behalf of Wyeth Holdings LLC (WH) for Impoundments 1 and 2 (designated as Operable Unit 8 [OU8]) at the American Cyanamid Superfund Site in Bridgewater Township, Somerset County, New Jersey (Site). This FFS report is submitted in accordance with Section X.71 of the *Administrative Settlement Agreement and Order on Consent for Remedial Design, Operable Unit 4 and Focused Feasibility Study, Operable Unit 8*, which was effective as of March 18, 2013 (U.S. Environmental Protection Agency [USEPA] 2013a).

This FFS report presents an evaluation of remedial alternatives for Impoundments 1 and 2. The remedial alternatives presented herein are based on the collective scientific findings of previous site studies, including an impoundment characterization program (O'Brien & Gere [OBG] 2010a), a field-scale pilot study, and several bench-scale treatability studies. This FFS report follows the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988) and is consistent with implementation of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. This FFS will be used to support the selection of a final remedy for Impoundments 1 and 2. Subsequent to this FFS, the preferred remedy will be presented by USEPA in a Proposed Plan, and the selected remedy will be documented in a Record of Decision (ROD) by USEPA.

This FFS report is organized as follows:

- **Section 1 – Introduction:** Provides an outline for the FFS document and presents the general Site history, regulatory framework, current Site status, and potential future use of the Site.
- **Section 2 – Background:** Describes the general Site setting and presents the remedial investigation results including physical characterization and nature, and extent of the conditions of Impoundments 1 and 2; provides summaries of Impoundments 1 and 2 topographies, geology, hydrogeology, and surface water interaction; and summarizes ecological and human health risks, interim remedial measures and the results of bench-scale and pilot studies.
- **Section 3 – Remediation Goals**: Identifies media and volumes that will be addressed during the remedy and establishes remedial action objectives (RAOs) and preliminary remediation goals (PRGs), and provides an analysis of applicable or relevant and appropriate requirements (ARARs).
- **Section 4 – Identification and Screening of Alternatives:** Identifies the general response actions (GRAs) and presents the screening of technologies and process options based on effectiveness, technical implementability, and relative cost. Preliminary remedial alternatives are assembled and screened based on effectiveness, implementability, and cost. This section also presents the performance criteria and identifies the remedial alternatives retained for detailed analysis.
- **Section 5 – Detailed Analysis of Alternatives:** Presents detailed descriptions of the retained alternatives and individual and comparative analyses of each using the threshold and balancing criteria, defined by the National Contingency Plan (NCP) and promulgated under CERCLA.
- **Section 6 – References**: Provides the references cited in this report. The report appendixes provide supporting information as follows:

  A Performance Criteria Memorandum
  B Technology Screening Memorandum
  C USEPA Approval of Performance Criteria and Technology Screening Memorandum
  D In-Situ Stabilization Pilot Study Summary

E Bench Study Reports
F Acid Tar Site in NY - Air Emission and Odor Control Techniques
G Alternative Cost Evaluation

# 1.2 Site History and Description

## 1.2.1 Site History

The Site is in the southeastern section of Bridgewater Township, Somerset County, in the north-central portion of New Jersey (Figure 1-1). The Site was used for more than eight decades to manufacture a range of products including rubber-based chemicals, dyes, pigments, chemical intermediates, petroleum-based products, and pharmaceuticals. Previous investigations have identified that soil and groundwater within several areas of the Site have been impacted. Most of these impacts occur within the footprint or in the immediate vicinity of Site-related surface impoundments.

The Calco Chemical Company, which started operations in 1915 manufacturing chemical intermediates and dyes, originally owned the Site. In 1929, American Cyanamid Company acquired the Calco Chemical Company and continued the manufacturing operations at the Site. During the following decades, the American Cyanamid facility expanded to meet the nation's demands during and immediately after World War II. As production increased from the 1930s through the 1970s, expansion of buildings and support services, as well as untreated material and waste management activities were conducted.

In the late 1970s and early 1980s, the facility experienced a significant downsizing. Organics and dye production at the Site was phased out by the early 1980s. The manufacturing of bulk pharmaceuticals continued until all operations at the facility ceased by 1999.

Throughout the operational years, 27 surface impoundments were constructed on the Site for various uses, including the storage of wastes generated from the manufacturing operations, wastewater treatment residuals, and river silts from the onsite river water treatment operations. Six impoundments have already been closed under CERCLA (Impoundments 11, 14, 18, 19, 20, and 26), and an additional 10 impoundments are being addressed under CERCLA (Impoundments 1, 2, 3, 4, 5, 13, 15, 16, 17, and 24). The remaining 11 impoundments were either never used (Impoundments 9, 10, and 12), used to contain river silt from the facility's former river water settling operation (Impoundments 22 and 23), used to contain emergency fire water (Impoundment 21), have been closed under the Resource Conservation and Recovery Act (RCRA) (Impoundments 9A and 25; Lagoon 6), or are in the process of being closed under RCRA (Lagoon 7 and Impoundment 8).

## 1.2.2 Site Layout

The Site is divided into five areas: North Area, South Area, West Area, East Area, and the Impoundment 8 Facility Area in the northwestern corner of the Site across Polhemus Lane. The Corrective Action Management Unit (CAMU) is located in the Impoundment 8 Facility Area. Impoundments 1 and 2 are in the South Area, which is west of Interstate Highway 287 (I-287) between the Port Reading (i.e., Conrail) rail line and the Raritan River (Figures 1-2 and 1-3).

# 1.3 Regulatory Framework

USEPA is the lead CERCLA regulatory agency for this Site, with the New Jersey Department of Environmental Protection (NJDEP) providing support. The remedial activities to be selected from this FFS will be governed by CERCLA and consistent with the intent of NJDEP's *Technical Requirements for Site Remediation* (NJDEP 2011a).

### 1.3.1 Operable Unit History and Current Organization

The American Cyanamid Company entered into Administrative Consent Orders (ACOs) related to investigation and remediation at the Site with NJDEP in 1982 and again in 1988 (which was amended in 1994). In 1983, USEPA listed the Site on the National Priorities List, and environmental remediation and restoration activities have been ongoing at the Site since this time under the CERCLA process. The 1982 ACO required that all impoundments at the Site be evaluated for their potential to impact groundwater. Site impoundments were initially characterized through investigations conducted in the late 1980s and early 1990s. Sixteen of the 27 Site impoundments ultimately were identified by this evaluation for remediation and subsequent closure under the CERCLA process.

The 16 impoundments identified for remediation under CERCLA were identified as having been used for storing wastewater treatment residuals and manufacturing byproducts originating from production of rubber intermediates and products, organic dyes, and coal tar distillation. Historical waste storage and disposal practices, along with other potential releases typically associated with the normal operations of a manufacturing facility with such a long, diverse history, are understood to have resulted in onsite soil and groundwater impacts.

Through the 1988 ACO, American Cyanamid Company agreed to perform a Site-wide feasibility study (FS) and corrective actions for the 16 CERCLA impoundments. At that time, those 16 impoundments were organized into three groups according to contents, location, and potential remedial alternatives. A ROD followed for each of the three groups:

- Group I – Impoundments 11, 13, 19, and 24
- Group II – Impoundments 1, 2, 15, 16, 17, and 18
- Group III – Impoundments 3, 4, 5 (wet and dry portions), 14, 20, and 26

Initial remedial actions were completed at Impoundments 11, 18, and 19. Because of the complex nature of material within Impoundments 1 and 2, it was decided to move them into Group III.

The ROD for the revised listing of Group III impoundments (1, 2, 3, 4, 5, 14, 20, and 26) was finalized in September 1998. However, a pilot study confirmed that the selected 1998 remedy for Impoundments 1 and 2 (low-temperature thermal treatment and placement of material in the CAMU) was technically infeasible and could not be performed as originally scoped. This finding resulted in the suspension of some remediation activities for Group III impoundments. However, Impoundments 5 Dry, 14, 20, and 26 have since been remediated, with their contents being treated and placed in the CAMU.

As noted, remediation of the remaining Group III impoundments (1, 2, 3, 4, and the remainder of 5) presents significant technical challenges based on their physical setting and complex characteristics. In 2004, WH, NJDEP, and USEPA recognized the complexity of these impoundments and agreed that a comprehensive Site-wide FS should be initiated to re-evaluate feasible remedial alternatives. Following initial development of the Site-wide FS, project stakeholders, including USEPA and NJDEP, determined that additional data specific to Impoundments 1 and 2 materials were needed to complete development of remedial alternatives for these impoundments. Therefore, in mid-2009, USEPA moved the remedial evaluation of Impoundments 1 and 2 into a separate FFS, and continued with preparing a Site-wide FS for the remainder of the Site (USEPA 2009).

Under the revised approach, six impoundments (3, 4, 5, 13, 17, and 24) were grouped into Operable Unit 4 (OU4) along with the Site-wide contaminated soil and groundwater. In 2012, the Site-wide FS was completed (OBG 2012a) and led to the final OU4 ROD, which was issued on September 27, 2012 (USEPA 2012a). The OU4 ROD addresses the entire Site except for Impoundments 1 and 2, also referred to as OU8. Under a December 8, 2015 Consent Decree (CD) or OU4 CD (U.S. District Court 2015) between USEPA (along with NJDEP) and WH, the remediation of OU4 and the remainder of Impoundments 15 and 16 is underway, and the FFS for OU8 has been completed, per approval of this document.

The location of Impoundments 1 and 2 within the Raritan River floodplain, along with the acidity and the complex nature of the material, make addressing Impoundments 1 and 2 very different from addressing materials elsewhere at the Site. The evaluation and selection of remedial alternatives for Impoundments 1 and 2 (OU8) therefore proceeded as described in this FFS report and in subsequent decision documents prepared in support of final remedy selection.

### 1.3.2 Groundwater Control and Treatment

Shallow groundwater south of Impoundments 1 and 2 is approximately 5 feet deep. During remedial investigation activities, sampling and analysis of groundwater collected from overburden monitoring wells and piezometers immediately south of Impoundments 1 and 2 and north of the Raritan River indicated benzene concentrations were above the New Jersey Ground Water Quality Standards (NJGWQS) (ranging from 0.22 to 388 milligrams per liter [mg/L]) in each monitoring well sampled during the investigations completed in February 2006, April 2007, and October 2010 (USEPA 2011). Other contaminants of concern (COCs) were detected in groundwater samples collected from this area, including toluene (ranging from nondetect to 29.3 mg/L); 1,2-dichlorobenzene (0.00045 to 9.95 mg/L); naphthalene (0.00047 to 4.46 mg/L); nitrobenzene (nondetect to 5.95 mg/L); and concentrations of aluminum (0.2 to 349 mg/L), iron (1.69 to 629 mg/L), and manganese (0.38 to 28.5 mg/L) were detected above NJGWQS in each monitoring well sampled.

In addition, wells and piezometers adjacent to Impoundments 1 and 2 were evaluated for the presence of nonaqueous phase liquid (NAPL). NAPL was observed and sampled in one piezometer (PZ-12-4).

In fall 2010, seeps along the banks of the Raritan River were discovered and sampled. Laboratory analysis of the seeps reported benzene concentrations up to 20 mg/L. In the short term, activated carbon-filled sand bags were installed along the banks of the river in early 2011 at the seep discharge points to mitigate river water impacts.

In 2011, WH entered into an Administrative Settlement Agreement and Order on Consent for Removal Action (Removal Action ACO) with USEPA, which required constructing a groundwater containment and treatment system downgradient of Impoundments 1 and 2 (USEPA 2011). This system subsequently was installed and consists of a groundwater collection trench and hydraulic barrier wall (HBW) constructed down to bedrock downgradient of Impoundments 1 and 2 and upgradient of Cuckel's Brook and the Raritan River. An interim groundwater treatment system also was installed to treat groundwater from the collection trench and subsequently discharge treated groundwater to Cuckel's Brook under a New Jersey Pollutant Discharge Elimination System permit equivalent. The Removal Action ACO was terminated with the issuance of the OU4 CD, and the interim groundwater treatment system, which continues to operate, ultimately will be incorporated into the Site-wide groundwater treatment facility (GWTF) that will be installed as part of the OU4 work.

The existing bedrock groundwater collection system also will be incorporated into the Site-wide GWTF and will undergo modifications, including adding new bedrock extraction wells. In addition, a recovery system will be constructed for collecting overburden groundwater. Extracted bedrock and overburden groundwater will be treated at the GWTF and injected into the bedrock aquifer under an NJDEP discharge to groundwater permit equivalent. Additional details on the groundwater extraction, treatment, and injection systems are being developed during the OU4 remedial design.

SECTION 2

# Background

The following subsections provide background details for OU8 regarding:

- Physical setting
- Hydrogeologic setting
- Impoundment history
- Nature and extent
- Interim remedial measures
- Treatability and pilot study summary

Table 2-1 summarizes the extensive previous investigation activities conducted at the Site and in particular Impoundments 1 and 2.

## 2.1 Physical Setting

The Site is in the southeastern section of Bridgewater Township, Somerset County, New Jersey. The Site encompasses approximately 435 acres and is bounded by the New Jersey Transit Railroad to the north, the Raritan River to the south and west, and the Somerset Tire Service (STS) property and I-287 to the east (Figure 1-2). Residential and commercial properties are north, east, and northeast of the Site. As discussed in Section 1.2.2, the Site has been divided into five main portions (Figure 1-2).

According to the Federal Emergency Management Agency (FEMA), the entire Site, except for the Impoundment 8 Facility Area, lies within a Special Flood Hazard Area designated as Zone AE (FEMA 2015). Zone AE is a zone where the base flood elevations are established based on a 100-year flood event. Because of the proximity of the Site to the Raritan River and frequency of flooding, a flood control dike was constructed around the entire North Area (former Main Plant area). The flood control dike is at an elevation of 36.8 feet North American Vertical Datum of 1988 (NAVD88).

Impoundments 1 and 2 are in the South Area, approximately 700 feet north of the Raritan River and within the 100-year floodplain (Figure 1-3). I-287 is approximately 850 feet east of Impoundment 1, and a local business (specifically the STS property) is approximately 400 feet north of both impoundments. The nearest residential area is approximately 1,800 feet east of the Site.

Local topography varies significantly near Impoundments 1 and 2. Generally, the surrounding grade at the base of the impoundment berms is at an elevation of approximately 26.1 feet NAVD88.

## 2.2 Hydrogeologic Setting

The Site is underlain by a shallow overburden aquifer system and a deeper semi-confined bedrock aquifer system, including the area beneath Impoundments 1 and 2. A zone of weathered bedrock separates the two aquifers.

### 2.2.1 Overburden

Overburden at the Site consists of a combination of fabricated fill and Quaternary alluvial deposits exhibiting a fining upward sequence. The overburden aquifer consists of two water-producing and water-transmitting units – an unconfined surficial fabricated fill unit and an underlying confined to semi-confined sand and gravel zone. A low-permeability silt and clay unit generally separates the two units. Where the silt and clay were physically removed by Site operations, the fill material is in contact with underlying sand and gravel, and the two units are hydraulically connected.

In the vicinity of Impoundments 1 and 2, groundwater is generally encountered at an elevation of 20 feet NAVD88 (approximately 6 feet below ground surface) and flow is to the south toward the Raritan River. The existing groundwater extraction trench, groundwater treatment system, and HBW installed as part of the Site-wide (OU4) remedy are effectively protecting surface waters (i.e., Cuckel's Brook and the Raritan River) and performing as designed.

### 2.2.2 Bedrock

The Site is located in the Newark Basin section of New Jersey's Piedmont province and is underlain by the Passaic Formation. The Passaic Formation is a Late Triassic to Early Jurassic-age reddish-brown shale, siltstone, and mudstone with green and brown shale interbeds. Bedrock near the Site strikes northeast-southwest and dips gently to the northwest.

Near Impoundments 1 and 2, bedrock is generally encountered at an elevation of 11 feet NAVD88 (approximately 15 feet below ground surface). Groundwater flow in the bedrock aquifer near Impoundments 1 and 2 is largely controlled by bedding planes and fracture systems (OBG 2012b; Golder 2014a, 2014b).

## 2.3 Impoundment 1 and 2 History

### 2.3.1 Coal Oil Refining Process

Between 1947 and 1965, the American Cyanamid facility produced, among other things, benzene, toluene, and xylene from coal light oil refining. The residual byproduct of refining coal light oil was acid tar. The byproducts were managed and stored onsite using Impoundments 1 and 2. These impoundments were constructed to hold these materials in a manner consistent with waste management practices of the era.

### 2.3.2 Impoundment Construction Details

In 1956, Impoundment 1 was constructed and used until 1965 to store waste from the coal light oil refining process (OBG 2010a). Impoundment 1 encompasses 2.1 acres and is approximately 15 feet deep from the top of the impoundment berm to its lowest extent (approximately 6 feet below the existing grade (Figure 2-1). Soil borings completed within the berms indicate they are constructed of sand, silt, and fine-grained gravel. A 1-foot-thick layer of clay and silt reportedly was placed at the bottom of the impoundment (OBG 1982). The base of the clay layer is located within approximately 1 foot of the overburden aquifer.

Impoundment 2 was constructed in 1947 and used until 1956. It is 2.3 acres in size, and was also used to store waste from the coal light oil refining process (OBG 2010a). The depth of Impoundment 2 is approximately 15 feet from the top of the impoundment berms and extends approximately 6 feet below the surrounding grade. The berms of Impoundment 2 also are constructed of sand, silt, and fine-grained gravel, and a 1-foot-thick layer of clay and silt reportedly was placed at the bottom of the impoundment (OBG 1982). Similar to Impoundment 1, the bottom of the clay layer is located within approximately 1 foot of the overburden aquifer.

Table 2-1. Summary of Historical Documents

| Issued By | Issued Date | Document Title |
|---|---|---|
| O'Brien & Gere (OBG) | 1982 | *Source Assessment and Remedy Programs Lagoons 1 and 2, Bound Brook, N.J. Plant, American Cyanamid Company, Wayne, New Jersey* |
| Zorex Corporation | 1982 | *Sludge Characterization Report - Physical and Chemical Properties of Sludges in Lagoons 1 and 2* |
| O'Brien & Gere (OBG) | 1984 | *Letter dated March 6, 1984 - Re: Lagoon 1 and 2 Closure Summary* |
| New Jersey Department of Environmental Protection (NJDEP) | 1988 | *Administrative Consent Order, In the Matter of American Cyanamid Company* |
| Blasland & Bouck Engineers, P.C. (Blasland, Bouck, & Lee) | 1993<br>Rev 1994 | *Group II Impoundments Corrective Measures Study / Feasibility Report (Volume 1, 2, and 3), American Cyanamid Company, Bound Brook, New Jersey* |
| New Jersey Department of Environmental Protection (NJDEP) | 1994 | *Administrative Consent Order Amendment, In the Matter of Bound Brook Site and American Cyanamid Company* |
| O'Brien & Gere (OBG) | 1995 | *Impoundments 1 and 2 Pre-Design Testing Work Plan, Bound Brook, New Jersey Site, American Home Products Corporation, Madison, New Jersey* |
| O'Brien & Gere (OBG) | 1997 | *Group III Impoundments Corrective Measures Study / Feasibility Report (Volume 1, 2, 3 and 4), American Home Products Corporation, Madison, New Jersey* |
| O'Brien & Gere (OBG) | 1997 | *Impound 8 Facility Basis of Design. American Home Products Corporation Parsippany, New Jersey.* |
| New Jersey Department of Environmental Protection (NJDEP) | 1998 | *Superfund Record of Decision for Group III Impoundments (1, 2, 3, 4, 5, 14, 20 &26). American Cyanamid Site. American Home Products Corporation, Bridgewater Township, Somerset County, New Jersey.* |
| O'Brien & Gere (OBG) | 2000 | *Basis of Design Group III Impoundments Work Plan, American Home Products Corporation, Madison, New Jersey* |
| O'Brien & Gere (OBG) | 2001 | *Group III Impoundments Field Demonstration Test, American Home Products Corporation, Madison, New Jersey* |
| O'Brien & Gere (OBG) | 2005 | *Impoundment Remedy Appropriateness Evaluation, Wyeth Holdings Corporation, Bound Brook, New Jersey* |
| U.S. Environmental Protection Agency (USEPA) | Approval Date:<br>July 13, 2009 | *Approval Letter - Re: American Cyanamid Superfund Site, Bridgewater Township, Somerset County, New Jersey (transfer of leading regulatory agency from NJDEP to USEPA)* |
| O'Brien & Gere (OBG) | 2010 | *Former American Cyanamid Site Impoundments 1 and 2 Characterization Program Summary Report, Wyeth Holdings Corporation, Bound Brook, New Jersey* |
| Focus Environmental, Inc. (Focus) | 2011 | *Treatment Alternatives Evaluation, American Cyanamid Superfund Site Impoundments No. I and 2* |

Table 2-1. Summary of Historical Documents

| Issued By | Issued Date | Document Title |
|---|---|---|
| O'Brien & Gere (OBG) | 2011 | *Former American Cyanamid Site Impoundments 1 and 2 Focused Feasibility Study Work Plan, Wyeth Holdings Corporation, Bridgewater, New Jersey* |
| U.S. Environmental Protection Agency (USEPA) | 2011 | *Administrative Settlement Agreement and Order on Consent for Removal Action* |
| CH2M HILL, Inc. | 2012 | *Material Collection Work Plan for Impoundments 1 and 2, American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2012 | *Laboratory Studies Work Plan for Impoundments 1 and 2 Material, American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2012 | *Quality Assurance Project Plan Impoundments 1 and 2 Laboratory Treatability Study, American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2012 | *Focused Feasibility Study Work Plan for Impoundments 1 and 2 Laboratory Treatability Study, American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2012 | *100 Percent Design of Pilot Study for Operable Unit 8, American Cyanamid Superfund Site* |
| O'Brien & Gere (OBG) | 2012 | *Technical Memorandum - Bedrock Evaluation Results* |
| O'Brien & Gere (OBG) | 2012 | *Site-wide Feasibility Study American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| U.S. Environmental Protection Agency (USEPA) | 2012 | *Record of Decision, American Cyanamid Superfund Site Operable Unit 04, Bridgewater Township, Somerset County, New Jersey. September* |
| Woodard and Curran | 2012 | *Flood Emergency Procedures Plan, Control Copy, Former American Cyanamid Site 1100 West Main Street, Bound Brook, NJ* |
| Woodard and Curran | 2012 | *Impoundment 2 Liner Installation and Inspection, American Cyanamid Superfund Site, Bridgewater, NJ* |
| CH2M HILL, Inc. | 2013 | *Sampling and Analysis Plan for Operable Unit 8 Pilot Study - American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Draft Technical Memorandum Soil Erosion and Sediment Control Plan for Operable Unit 8 Pilot Study, American Cyanamid Superfund Site. July 10.* |
| CH2M HILL, Inc. | 2013 | *Health and Safety Plan, American Cyanamid Superfund Site, Impoundments 1 and 2, In Situ Thermal Treatment and In-Situ Stabilization and Solidification, Pilot Study for Operable Unit 8* |
| CH2M HILL, Inc. | 2013 | *Waste Management Plan for Operable Unit 8 Impoundments 1 and 2 Pilot Study - American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Perimeter Air Monitoring Plan for Operable Unit 8 Pilot Study – American Cyanamid Superfund Site* |

Table 2-1. Summary of Historical Documents

| Issued By | Issued Date | Document Title |
|---|---|---|
| CH2M HILL, Inc. | 2013 | *Addendum to Flood Emergency Procedures Plan Impoundments 1 and 2 Pilot Study for Operable Unit 8 - American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Emergency Preparedness and Contingency Plan. In-Situ Thermal Treatment and In-Situ Stabilization and Solidification Pilot Study for Operable Unit 8. American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Caisson Placement and Impoundment Material Characterization Impoundment 1 and 2 Pilot Study Operable Unit 8 - American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Technical Memorandum - Sampling and Analysis Plan Addendum, Impoundment 1 and 2 Pilot Study, Operable Unit 8 - American Cyanamid Superfund Site* |
| CH2M HILL, Inc. | 2013 | *Environmental Improvement Pilot Test Permit Equivalency Application, OU 8 FFS Pilot Study, In-Situ Stabilization/Solidification* |
| CH2M HILL, Inc. | 2013 | *Environmental Improvement Pilot Test Permit Equivalency Application, OU 8 FFS Pilot Study, In-Situ Thermal Treatment* |
| CH2M HILL, Inc. | 2013 | *Flood Hazard Are Permit Equivalent Application, OU 8 FFS Pilot Study* |
| U.S. Environmental Protection Agency (USEPA) | 2013 | *Administrative Settlement Agreement and Order on Consent for Remedial Design, Operable Unit 4 and Focused Feasibility Study, Operable Unit 8* |
| New Jersey Department of Environmental Protection (NJDEP) | Approval Date: March 12, 2013 | *Approval Letter - Re: Permit Equivalences Application for Flood Hazard Area (Land Use Restrictions) for Impoundments 1 and 2 (Operable Unit-OU 8) Pilot Study* |
| New Jersey Department of Environmental Protection (NJDEP) | Approval Date: May 9, 2014 Expiration Date: August 7, 2014 | *Air Pollution Control Preconstruction Permit and Certificate to Operate Environment Improvement Pilot Test. Permit Activity Number: EIP130002* |
| CH2M HILL, Inc. | 2014 | *Revised Impoundments 1 and 2 Treatability Study Results. American Cyanamid Superfund Site* |
| Golder Associates, Inc. | 2014 | *Impoundment 2 Baseline Groundwater Monitoring Program Final Report. American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| Golder Associates, Inc. | 2014 | *Draft Pre-Design Investigation Summary Report for the Site-Wide Remedy, Module 1 – Groundwater Extraction System Monitoring and Investigations. American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| CH2M HILL, Inc. | 2015 | *Field-Scale Demonstration Study Results Report for Operable Unit 8 Pilot Study. American Cyanamid Superfund Site* |

Table 2-1. Summary of Historical Documents

| Issued By | Issued Date | Document Title |
|---|---|---|
| CH2M HILL, Inc. | 2015 | *Technical Memorandum – Proposed Performance Criteria for Remedial Alternatives for Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| CH2M HILL, Inc. | 2015 | *Technical Memorandum - Technology and Alternative Screening Memo for Alternatives Development, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| CH2M HILL, Inc. | 2016 | *Technical Memorandum - Bench-Scale Liner Compatibility Study for the Impoundment 8 Facility, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey* |
| CH2M HILL, Inc. | 2016 | *Technical Memorandum - Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Test Results, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey* |

### 2.3.3 Impoundment Contents

The current contents of the two impoundments are similar in that the material is generally acidic (average pH of 1.5 standard units [SU]) with a solid to semi-solid consistency and contains volatile organic compounds (VOCs) (primarily benzene, toluene, xylene, and naphthalene) and semivolatile organic compounds (SVOCs). Malodorous sulfur compounds, including hydrogen sulfide, sulfur dioxide, mercaptans, and carbon disulfide, also are present in these materials.

The acid tar contained within each impoundment is approximately 8 feet thick extending from the base of the water cap to the top of the clay liner. The contents of the two impoundments differ in the proportion and distribution of specific materials present in each one. Descriptions for the impoundment materials identified during a 2010 investigation are as follows (OBG 2010a):

- **Viscous rubbery (VR) material:** This material is black and tar-like and characterized by its tackiness and lack of matrix. This material also exhibits an oily sheen; in some instances, the surface appeared glass-like. Generally, this material is acidic (pH near 1 SU) and contains VOCs and SVOCs. The consistency of this material varies with temperature.
- **Hard crumbly (HC) material:** The HC material is black, often with an oily sheen, and resembles bits of broken asphalt. The HC material generally is acidic and contains VOCs and SVOCs. It is not cohesive and can be broken easily into small pieces.
- **Coal aggregate (CA) material:** The CA material is grey and fine-grained. While this material is reported to have been placed on the surface of Impoundment 1 in the 1980s, it has shifted deeper into the impoundment. This material has not been observed in Impoundment 2.
- **Clay-like (CL) material:** CL material is generally grey, cohesive, and fine-grained. It is mostly found in the upper portion of Impoundment 1 and has not been observed in Impoundment 2.
- **Sand and silt-like (SSL) material:** This material is brown, fine-grained, and non-cohesive that is in the middle to lower portion of Impoundment 1; it has not been observed in Impoundment 2.

Based on the most recent characterization (OBG 2010a), the specific impoundment material volume distribution is summarized in Table 2-2.

Table 2-2. Impoundment Composition

| Material Type | Impoundment 1 | Impoundment 2 |
|---|---|---|
| VR (upper Layer) | 900 $yd^3$ | 10,900 $yd^3$ |
| Mixed VR and HC (middle layer) | - | 6,500 $yd^3$ |
| HC (lower layer) | 13,700 $yd^3$ | 12,900 $yd^3$ |
| CL (mixed) | 2,700 $yd^3$ | - |
| SSL (mixed) | 1,900 $yd^3$ | - |
| CA (mixed) | 5,000 $yd^3$ | - |
| Total Volume | 24,200 $yd^3$ | 30,300 $yd^3$ |

$yd^3$ – cubic yards

## 2.4 OU8 Designation

OU8 comprises Impoundments 1 and 2, including the berms to the toe of the slope, impoundment material contained within the berms, and the material underlying the impoundments (soil and clay) down to the groundwater table. Groundwater and the area outside the toe of the berms of

Impoundments 1 and 2 are considered part of OU4 and are subject to the Site-wide remedy selected as part of the OU4 ROD (USEPA 2012a).

### 2.4.1 Impoundment Material

In the last 30 years, Impoundments 1 and 2 have been the subject of comprehensive study through multiple Site investigations and treatability studies targeting the management, treatment, and remediation of the materials within each impoundment**.** Samples collected prior to 2010 generally were obtained from non-specific sampling locations or areas near the impoundment berms that were more accessible.

In 2010, a comprehensive investigation to characterize impoundment materials was completed (OBG 2010a). Unlike previous data collection efforts, the sampling plan was designed to characterize each impoundment as a whole by collecting samples from a representative horizontal grid as well as multiple depth intervals and various depths within each impoundment. In total, 53 spatially distributed samples were collected from Impoundments 1 and 2 and subjected to a comprehensive range of analytical testing. Sample results confirmed the presence of VOCs, SVOCs, and metals. In decreasing order, benzene, toluene, and naphthalene were the predominant compounds encountered in samples analyzed from both impoundments and are considered the most important COCs.

In Impoundment 1 samples, benzene, toluene, and naphthalene account for more than 83% of the COC mass. Other VOCs and SVOCs were detected in the Impoundment 1 samples; however, their individual contribution to total COC mass is considered minor in comparison to benzene, toluene, and naphthalene. To streamline data presentation and future discussion of remedial alternatives in this report, summary sampling results of 25 samples obtained from the 2010 characterization effort were parsed to determine compounds that accounted for more than 0.2% of total COC mass detected in Impoundment 1 materials (OBG 2010a). In total, 20 compounds exceeding the 0.2% threshold (and accounting for 96.3% of the total COC mass) were identified in Impoundment 1 materials. A selected summary of these VOCs and SVOCs detected in Impoundment 1 samples is in Table 2-3a.

Similar to Impoundment 1, benzene, toluene, and naphthalene are the top three COCs present in Impoundment 2 samples. Collectively, these three compounds account for nearly 70% of the total COC mass in samples analyzed. Summary results from 28 samples collected from Impoundment 2 in 2010 were parsed as previously described using an identical mass threshold (0.2%) (OBG 2010a). The Impoundment 2 data evaluation returned 21 compounds exceeding the 0.2% threshold, which accounted for 96.7% of the total COC mass identified in Impoundment 2 materials. A selected summary of VOCs and SVOCs detected in Impoundment 2 samples is in Table 2-3b.

Comparison of Impoundment 1 and 2 sampling results summarized in Tables 2-3a and 2-3b indicate both strong similarities and subtle differences with respect to chemical composition. In general, the mean concentration values of benzene, toluene, and naphthalene are consistent between Impoundment 1 and 2 samples analyzed.

Although differences are noted in the speciation and concentration of organic compounds detected in the impoundment materials, the chemical composition of Impoundments 1 and 2 materials is similar and of comparable concentration magnitude. As previously indicated, the three primary COCs are benzene, toluene, and naphthalene, with benzene concentrations often an order of magnitude higher. Because benzene and toluene are similar in chemical structure and physical properties, and because benzene is considered more toxic (i.e., has a lower regulatory standard) than toluene, benzene is often used as a surrogate when discussing VOC treatment. Alternatives assembled and evaluated by the FFS will be capable of addressing the range of VOCs and SVOCs detected in the impoundment materials. However, based on the proportion of benzene and naphthalene detected in the impoundment materials, the technical feasibility of the alternatives considered by this FFS will depend on each alternative's ability to effectively address these compounds. Furthermore, since benzene and naphthalene represent the typical environmental behavior of VOCs and SVOCs subjected to remediation, these compounds are considered

representative of VOCs and SVOCs in subsequent discussions regarding technology application and the overall feasibility and efficacy of assembled alternatives.

The 2010 characterization efforts represent the most thorough data set summarizing the chemical content of the impoundment materials. Previous investigations addressed physical material properties and the application of specific technologies considered by this FFS. The sampling from those previous investigations, including pertinent parameters such as calorific value, sulfur content, moisture content, density, corrosivity, flash point, etc. also were compiled to support evaluation of technologies and alternatives developed herein. Table 2-4 presents a statistical summary of the most representative Site characterization and treatability data. Data are segregated by impoundment location and material type.

### 2.4.2 Groundwater

A conceptual site model has been developed for Impoundments 1 and 2 to depict the spatial relationship between potential sources and potential receptors including the configuration of the impoundments, which exist above the groundwater table. Based on available information, the preliminary conceptual site model is shown on Figures 2-2 and 2-3. Although the impoundments were constructed with berms and a clay liner, over time, infiltration from rainwater and surface water has likely contributed to groundwater impacts near Impoundments 1 and 2. Because Site-wide groundwater (including that which is downgradient of the impoundments) is being addressed under OU4, this FFS addresses only the waste materials deposited in Impoundments 1 and 2 (impoundment materials) and not groundwater downgradient from the impoundments.

## 2.5 Summary of Ecological and Human Health Risks

The NCP indicates that USEPA shall generally consider treatment to address the principal threats posed by a site, wherever practicable (40 Code of Federal Regulations [CFR] 300.430). USEPA has defined principal threat waste (PTW) as highly toxic or highly mobile source materials that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur (USEPA 1991a). For example, the PTW in Impoundments 1 and 2 may act a source of COCs to groundwater. Therefore, a formal risk assessment focused on OU8 alone is not necessary to justify the need for remedial action of the PTW or acid tar in the impoundments. Notwithstanding the above, as part of developing the Site-wide remedy, several baseline risk assessments have been conducted which have included the South Area, where Impoundments 1 and 2 are located. Relevant information associated with these risk assessments is summarized below.

### 2.5.1 Ecological Risk Assessments

As summarized in the OU4 ROD (USEPA 2012a), ecological risks assessments for the Site are presented in the 1992 *Baseline Site-wide Endangerment Assessment* (BEA; Blasland, Bouck, & Lee 1992) and the 2005 *Baseline Ecological Risk Assessment* (BERA; OBG 2005). In the qualitative ecological assessment section of the BEA, the results of a Site-wide habitat survey, as well as evidence from direct field observations, were compared to the Natural Heritage Data Base maintained by NJDEP. The BEA indicated that, with the exception of the great blue heron, the onsite habitat does not support threatened or endangered species (BBL 1992). The most significant potential exposure pathway identified in the BEA involves aquatic biota exposure in the Raritan River. This pathway was subsequently addressed by installing the groundwater collection trench and hydraulic barrier wall (HBW) constructed downgradient of Impoundments 1 and 2 and upgradient of Cuckel's Brook and the Raritan River.

The BERA identified potential ecological risks associated with exposure to soils in an isolated portion of the West Area and exposure to sediment and surface water in Cuckel's Brook (OBG 2005). No potential risks were identified for exposure to soil in the South Area.

### 2.5.2 Human Health Risk Assessments

Several human health risk assessments have been completed for the Site including the South Area, excluding impoundment materials. The 1992 BEA (BBL 1992) evaluated exposure pathways and potential noncarcinogenic hazards and carcinogenic risks. In 2003, USEPA completed a RCRA Environmental Indicator Determination focused on evaluating human exposure scenarios. Exposure pathways and potential noncarcinogenic hazards and carcinogenic risks were evaluated in the 2006 *Human Health Risk Assessment* (HHRA; OBG 2006). In 2010, USEPA also evaluated additional exposure pathways and potential noncarcinogenic hazards and carcinogenic risks through a streamlined HHRA (USEPA 2010a), which was summarized in the OU4 ROD (USEPA 2012a).

The 1992 BEA indicated that volatile emissions from Impoundments 1 and 2 posed a potential risk to offsite receptors (BBL 1992). The potential cancer risk associated with emissions from Impoundments 1 and 2 for offsite receptors was calculated to be $2.4 \times 10^{-6}$, which is within the USEPA acceptable risk range of $10^{-4}$ to $10^{-6}$. Thus, risks associated with volatile emissions are not expected to be significant (USEPA 2003).

The 2003 RCRA Environmental Indicator Determination was a Site-wide human exposures evaluation that included surface soil, subsurface soil, surface water, sediment, groundwater, and indoor and outdoor air (USEPA 2003). Potential receptors evaluated included residents, workers, day care, construction, trespasser, recreation, and food (by indirect pathway). The evaluation identified potentially complete exposure pathways for residents via surface water, sediment, and outdoor air; construction workers via groundwater, surface water, sediment, subsurface soil, and outdoor air; trespassers via surface water, sediment, and outdoor air; recreational users via surface water; and indirect food sources via surface water and sediment. The 2003 evaluation concluded that the current human exposures were under control by assigning the facility a "YE" code in the Resource Conservation and Recovery Information System.

The 2003 evaluation identified a potential for migration of volatiles to outdoor air from impoundments 1 and 2 (USEPA 2003). Impoundments 1 and 2 are located within an area where remedial workers are present; however, remedial workers are expected to perform work under health and safety plans in accordance with Occupational Safety and Health Administration regulations and guidelines. The Site's Master Health and Safety Plan includes provisions to conduct routine ambient air monitoring when remedial activities are being performed at the Site (CH2M HILL, Inc. [CH2M] 2013a). If indicated, appropriate personal protective equipment also would be used during activities in this area of the site, thus managing the potential exposures. In addition, there is a synthetic liner over the acid tar within Impoundments 1 and 2 and a water cap over the impoundments to control volatile emissions. Thus, potential exposure for onsite and offsite receptors to volatiles in outdoor air is not expected to be significant (USEPA 2003).

The 2006 HHRA (OBG 2006) evaluated exposure risks for the South Area and indicated only minor excursions of reference values for potential human health receptors (i.e., patrol worker, Site worker, adolescent trespasser, recreational visitor). It was concluded that Site conditions in these areas do not represent a significant risk to these receptors, either on or off the Site. This assessment included evaluating West and South Area air, West and South Area soil, Cuckold's Creek (also known as Cuckel's Brook), and the Raritan River. Except for the unlikely scenario of a future resident using Cuckel's Brook for potable water, cancer risks for the exposure scenarios did not exceed the acceptable range of $10^{-4}$ to $10^{-6}$, although some risk values were greater than $10^{-6}$ or above the noncancer hazard threshold of 1. Chromium was identified as the primary constituent of potential concern for the patrol worker, Site worker, adolescent trespasser, and recreational visitor receptors. This determination was based on the assumption that chromium (measured as total chromium) was present entirely in the hexavalent form; given this, it is likely that the calculated risks are biased high.

Table 2-3a. Impoundment 1 Organics Summary

| Parameter | CAS # | Valid Samples | Unique Samples | Detects | Units | Minimum Detected | Maximum Detected | Mean | Standard Deviation | Mean + 1 Std. Dev |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | 71-43-2 | 25 | 24 | 25 | µg/kg | 78,500 | 207,000,000 | 47,762,304 | 58,054,409 | 105,816,713 |
| Toluene | 108-88-3 | 25 | 25 | 25 | µg/kg | 1,440 | 40,700,000 | 11,425,122 | 12,264,223 | 23,689,345 |
| Naphthalene | 91-20-3 | 25 | 25 | 25 | µg/kg | 5,010 | 12,600,000 | 3,111,321 | 3,172,052 | 6,283,373 |
| Xylene (Total) | 1330-20-7 | 25 | 25 | 25 | µg/kg | 4,500 | 6,910,000 | 2,400,192 | 2,142,678 | 4,542,870 |
| Nitrobenzene | 98-95-3 | 25 | 23 | 23 | µg/kg | 29 | 6,600,000 | 1,169,016 | 1,599,540 | 2,768,556 |
| 1,2-Dichlorobenzene | 95-50-1 | 25 | 24 | 25 | µg/kg | 3,390 | 2,550,000 | 761,381 | 687,954 | 1,449,335 |
| Aniline | 62-53-3 | 25 | 25 | 25 | µg/kg | 189 | 36,707 | 672,158 | 1,237,244 | 1,909,402 |
| Chlorobenzene | 108-90-7 | 25 | 16 | 17 | µg/kg | 233 | 2,400,000 | 499,194 | 640,422 | 1,139,616 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 25 | 24 | 24 | µg/kg | 2,300 | 1,110,000 | 347,202 | 320,227 | 667,429 |
| Isopropylbenzene | 98-82-8 | 25 | 25 | 25 | µg/kg | 6,580 | 1,710,000 | 531,564 | 531,072 | 1,062,636 |
| Benzoic acid | 65-85-0 | 25 | 18 | 18 | µg/kg | 285 | 1,410,000 | 298,767 | 410,639 | 709,406 |
| 1,3-Dichlorobenzene | 541-73-1 | 25 | 5 | 5 | µg/kg | 153 | 1,200,000 | 292,545 | 332,982 | 625,527 |
| Cyclohexane | 1735-17-7 | 25 | 2 | 2 | µg/kg | 1,000 | 1,200,000 | 301,640 | 328,184 | 629,824 |
| Acetophenone | 98-86-2 | 25 | 25 | 25 | µg/kg | 94 | 1,190,000 | 275,708 | 341,652 | 617,360 |
| MethylCyclohexane | 108-87-2 | 25 | 6 | 6 | µg/kg | 2,400 | 1,200,000 | 303,129 | 326,802 | 629,931 |
| 1,4-Dichlorobenzene | 106-46-7 | 25 | 18 | 18 | µg/kg | 197 | 850,000 | 195,197 | 283,453 | 478,650 |
| Carbon Disulfide | 75-15-0 | 25 | 14 | 14 | µg/kg | 100 | 1,200,000 | 195,466 | 262,019 | 457,485 |
| Methanol | 67-56-1 | 25 | 2 | 2 | µg/kg | 2,000 | 275,000 | 154,504 | 83,508 | 238,012 |
| 2-Methylnaphthalene | 91-57-6 | 25 | 25 | 25 | µg/kg | 506 | 678,000 | 174,110 | 171,242 | 345,352 |
| Ethylbenzene | 100-41-4 | 25 | 25 | 25 | µg/kg | 1,480 | 529,000 | 168,443 | 155,607 | 324,050 |

Data excerpt from O'Brien & Gere (OBG). 2010a. Former American Cyanamid Site Impoundments 1 and 2 Characterization Program Summary Report. November.

Table 2-3b. Impoundment 2 Organics Summary

| Parameter | CAS # | Valid Samples | Unique Samples | Detects | Units | Minimum Detected | Maximum Detected | Mean | Standard Deviation | Mean + 1 Std. Dev |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | 71-43-2 | 28 | 28 | 28 | µg/kg | 16,700,000 | 183,000,000 | 52,246,429 | 39,882,369 | 92,128,798 |
| Toluene | 108-88-3 | 28 | 28 | 28 | µg/kg | 3,930,000 | 40,200,000 | 11,867,857 | 8,700,937 | 20,568,794 |
| Naphthalene | 91-20-3 | 28 | 28 | 28 | µg/kg | 1,040,000 | 13,700,000 | 4,879,643 | 3,408,717 | 8,288,360 |
| Chlorobenzene | 108-90-7 | 28 | 13 | 28 | µg/kg | 18,200 | 13,000,000 | 823,157 | 2,407,139 | 3,230,296 |
| Methyl Acetate | 79-20-9 | 28 | 4 | 4 | µg/kg | 55,000 | 6,500,000 | 597,929 | 1,254,329 | 1,852,258 |
| Xylene (total) | 1330-20-7 | 28 | 25 | 27 | µg/kg | 970,000 | 6,950,000 | 2,344,286 | 1,442,152 | 3,786,438 |
| Acetone | 67-64-1 | 28 | 1 | 1 | µg/kg | 110,000 | 12,500,000 | 842,536 | 2,302,436 | 3,144,972 |
| Cyclohexane | 1735-17-7 | 28 | 4 | 4 | µg/kg | 23,000 | 6,500,000 | 413,786 | 1,202,826 | 1,616,612 |
| Chloromethane | 74-87-3 | 28 | 11 | 11 | µg/kg | 24,600 | 6,500,000 | 384,021 | 1,206,098 | 1,590,119 |
| 1,3-Dichlorobenzene | 541-73-1 | 28 | 19 | 19 | µg/kg | 15,300 | 6,500,000 | 359,782 | 1,216,478 | 1,576,260 |
| Carbon Disulfide | 75-15-0 | 28 | 27 | 27 | µg/kg | 37,100 | 6,500,000 | 330,771 | 1,211,285 | 1,542,056 |
| 1,2-Dichlorobenzene | 95-50-1 | 28 | 24 | 27 | µg/kg | 500,000 | 6,500,000 | 1,863,429 | 1,169,362 | 3,032,791 |
| Isopropylbenzene | 98-82-8 | 28 | 26 | 27 | µg/kg | 163,000 | 6,500,000 | 634,107 | 1,191,127 | 1,825,234 |
| MethylCyclohexane | 108-87-2 | 28 | 6 | 6 | µg/kg | 65,000 | 6,500,000 | 485,429 | 1,207,970 | 1,693,399 |
| 1,3,5-Trimethylbenzene | 108-67-8 | 28 | 24 | 27 | µg/kg | 102,000 | 6,500,000 | 487,071 | 1,188,025 | 1,675,096 |
| 1,4-Dichlorobenzene | 106-46-7 | 28 | 23 | 27 | µg/kg | 50,800 | 6,500,000 | 376,336 | 1,202,024 | 1,578,360 |
| Ethylbenzene | 100-41-4 | 28 | 25 | 27 | µg/kg | 74,600 | 1,250,000 | 225,339 | 237,350 | 462,689 |
| 2-Methylnaphthalene | 91-57-6 | 28 | 27 | 28 | µg/kg | 65,600 | 656,000 | 246,050 | 155,315 | 401,365 |
| Acetophenone | 98-86-2 | 28 | 28 | 28 | µg/kg | 34,600 | 652,000 | 241,450 | 129,977 | 371,427 |

Data excerpt from O'Brien & Gere (OBG). 2010a. Former American Cyanamid Site Impoundments 1 and 2 Characterization Program Summary Report. November.

Table 2-4. Historical Analytical Data Summary - Focus Environmental, Inc.

| Waste Stream | Analyte | Units | Reporting Basis | Impoundment 1 Avg (a) | Impoundment 1 Max (a) | Impoundment 1 Min (a) | Impoundment 1 # Data Points | Impoundment 2 Avg (a) | Impoundment 2 Max (a) | Impoundment 2 Min (a) | Impoundment 2 # Data Points |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hard Crumbly Material (HC) | Alcohols | µg/kg | Wet | (b) (c) | | (b) (c) | | | (b) (c) | | |
| | Aldehydes and Explosives | mg/kg | Wet | (b) (c) | | (b) (c) | | | (b) (c) | | |
| | Calorific Value | Btu/lb | Wet | **7,155.44** | 9,745.98 | 5,234.00 | 9 | **10,702.56** | 12,702.01 | 8,500.00 | 9 |
| | Calorific Value | Btu/lb | Dry | **13,497.12** | 16,010.50 | 10,039.70 | 5 | **13,805.97** | 16,651.30 | 9,007.00 | 7 |
| | Chloride | mg/kg | | **1,123.75** | 2,270.00 | 56.30 | 11 | **1,507.75** | 7,010.00 | 43.10 | 14 |
| | Corrosivity, agitated conditions | in/yr | | **0.08** | 0.08 | 0.08 | 1 | **0.08** | 0.08 | 0.08 | 1 |
| | Corrosivity, quiescent conditions | in/yr | | **0.03** | 0.03 | 0.03 | 1 | **0.03** | 0.03 | 0.03 | 1 |
| | Cyanide | mg/kg | | **10.60** | 10.60 | 10.60 | 1 | **0.44** | 0.44 | 0.44 | 1 |
| | Density | lb/gal | Wet | **10.09** | 10.10 | 10.07 | 3 | **9.61** | 9.64 | 9.60 | 3 |
| | Flash Point | °F | | **68.00** | 68 | 68 | 1 | **68.00** | 68.00 | 68.00 | 1 |
| | Metals-TAL | mg | Wet | (d) (c) | | | | | (d) (c) | | |
| | Metals-Arsenic | mg/kg | Wet | **8.79** | 15.80 | 3.90 | 10 | **3.86** | 7.10 | 2.40 | 12 |
| | Metals-Barium | mg/kg | Wet | **48.10** | 48.10 | 48.10 | 1 | | (d) (c) | | |
| | Metals-Beryllium | mg/kg | Wet | **0.49** | 0.73 | 0.25 | 2 | | (d) (c) | | |
| | Metals-Cadmium | mg/kg | Wet | (d) (c) | | | | | (d) (c) | | |
| | Metals-Chromium | mg/kg | Wet | **10.85** | 50.20 | 2.70 | 13 | **5.64** | 16.10 | 1.00 | 14 |
| | Metals-Lead | mg/kg | Wet | **65.28** | 126.00 | 8.20 | 13 | **43.95** | 84.40 | 9.00 | 14 |
| | Metals-Mercury | mg/kg | Wet | **1.03** | 1.90 | 0.06 | 13 | **1.75** | 20.90 | 0.05 | 14 |
| | Metals-Selenium | mg/kg | Wet | **8.80** | 13.00 | 3.00 | 12 | **6.31** | 10.50 | 2.10 | 14 |
| | Metals-Silver | mg/kg | Wet | (d) (c) | | | | | (d) (c) | | |
| | Metals-Sodium | mg/kg | Wet | **2,533.33** | 3,090.00 | 1,860.00 | 6 | **3,200.71** | 11,400.00 | 1,020.00 | 14 |
| | Nitrogen - ammonia | mg/kg | | **68.66** | 147.00 | 18.90 | 7 | **17.37** | 25.50 | 5.20 | 3 |
| | PCB-Aroclors | µg/kg | Wet | (d) (c) | | | | | (d) (c) | | |
| | PCB-Congeners | pg/g | Wet | (b) (c) | | | | | (d) (c) | | |
| | pH | pH | Wet | **2.91** | 8.96 | 0.56 | 11 | **1.29** | 2.33 | 0.30 | 12 |
| | Phenolics | mg/kg | | **179.12** | 444.00 | 52.90 | 11 | **92.77** | 279.00 | 14.80 | 14 |
| | Proximate Analysis | % | | | | | | | | | |
| | Ash | % | Dry | **2.10** | 4.10 | 1.00 | 4 | **2.98** | 4.50 | 1.70 | 5 |
| | Ash | % | Wet | **1.01** | 1.56 | 0.56 | 4 | **2.18** | 3 | 1 | 5 |
| | Fixed Carbon | % | Dry | **57.76** | 65.20 | 47.70 | 5 | **36.56** | 44.90 | 29.90 | 5 |
| | Fixed Carbon | % | Wet | **31.38** | 39.17 | 24.78 | 5 | **26.79** | | | |
| | Moisture | % | Wet | **44.80** | 62.00 | 32.00 | 5 | **26.10** | 33.50 | 21.50 | 5 |
| | Volatile Matter | % | Dry | **37.78** | 50.80 | 24.90 | 5 | **60.46** | 68.30 | 51.00 | 5 |
| | Volatile Matter | % | Wet | **21.23** | 34.54 | 11.67 | 5 | **44.92** | 53.62 | 33.92 | 5 |
| | Solids | % | | (f) | | | | **44.90** | 44.90 | 44.90 | 1 |
| | Sulfur-Inorganic | % | | **7.49** | 8.17 | 6.90 | 3 | **2.87** | 3.77 | 1.97 | 2 |
| | Sulfur-Sulfate | mg/kg | | (f) | | | | **260,000.00** | 260,000.00 | 260,000.00 | 1 |
| | Sulfur-Sulfide | mg/kg | | **47.62** | 66.20 | 21.50 | 5 | **144.54** | 512.00 | 30.60 | 5 |
| | Sulfur-Sulfite | mg/kg | | **256.42** | 755.00 | 76.30 | 5 | **409.75** | 1,030.00 | 45.40 | 11 |
| | Sulfur-Total | % | Dry | **12.36** | 20.60 | 6.10 | 5 | **11.64** | 14.90 | 8.80 | 5 |
| | Sulfur-Total | % | Wet | **5.95** | 11.22 | 1.85 | 10 | **7.53** | 11.00 | 1.97 | 10 |
| | SVOC-TAL | mg/kg | Wet | (c) | | | | | (c) | | |
| | Total Organic Carbon | mg TOC/g | | | | | | **44.00** | 44.00 | 44.00 | 1 |
| | Ultimate Analysis | % | | | | | | | | | |
| | Chloride | % | Wet | **0.26** | 0.40 | 0.10 | 5 | **0.30** | 0.30 | 0.30 | 5 |
| | Hydrogen | % | Wet | **8.54** | 10.20 | 4.80 | 5 | **8.48** | 9.30 | 8.10 | 5 |
| | Nitrogen | % | Wet | **0.36** | 0.70 | 0.20 | 5 | **0.22** | 0.30 | 0.20 | 5 |
| | VOC-TAL | mg/kg | Wet | (c) | | | | | (c) | | |
| | BTEX-Benzene | µg/kg | Wet | **78,948,333.33** | 207,000,000.00 | 5,680,000.00 | 12 | **64,378,571.43** | 183,000,000.00 | 19,000,000.00 | 14 |
| | BTEX-Ethylbenzene | µg/kg | Wet | **217,662.50** | 529,000.00 | 2,150.00 | 12 | **200,976.92** | 591,000.00 | 84,300.00 | 13 |
| | BTEX-Toluene | µg/kg | Wet | **16,712,315.38** | 40,700,000.00 | 70,100.00 | 13 | **13,400,000.00** | 40,200,000.00 | 4,870,000.00 | 14 |
| | BTEX-Xylene (total) | µg/kg | Wet | **2,592,526.56** | 6,910,000.00 | 6,083.99 | 16 | **2,460,000.00** | 6,950,000.00 | 1,070,000.00 | 13 |
| Viscous Rubbery Material (VR) | Alcohols | µg/kg | Wet | (b) (c) | | | | | (b) (c) | | |
| | Aldehydes and Explosives | µg/kg | Wet | (b) (c) | | | | | (b) (c) | | |
| | Calorific Value | Btu/lb | Dry | **13,455.58** | 15,801.90 | 8,542.40 | 5 | **14,676.68** | 16,246.40 | 10,258.10 | 5 |
| | Calorific Value | Btu/lb | Wet | **8,364.81** | 10,604.00 | 5,040.02 | 10 | **10,490.40** | 12,266.03 | 7,950.03 | 10 |
| | Chloride | mg/kg | | **742.20** | 1,790.00 | 158.00 | 5 | **211.29** | 680.00 | 40.90 | 13 |
| | Corrosivity, agitated conditions | in/yr | | **0.08** | 0.08 | 0.08 | 1 | **0.08** | 0.08 | 0.08 | 1 |
| | Corrosivity, quiescent conditions | in/yr | | **0.03** | 0.03 | 0.03 | 1 | **0.03** | 0.03 | 0.03 | 1 |
| | Cyanide | mg/kg | | **7.70** | 7.70 | 7.70 | 1 | **0.95** | 1.30 | 0.59 | 2 |
| | Density | lb/gal | Wet | **9.80** | 9.80 | 9.80 | 3 | **9.19** | 9.20 | 9.18 | 3 |
| | Flash Point | °F | | **68.00** | 68.00 | 68.00 | 1 | **68.00** | 68.00 | 68.00 | 1 |
| | Metals-TAL | mg | Wet | (d) (c) | | | | | (d) (c) | | |
| | Metals-Arsenic | mg/kg | Wet | **7.84** | 13.80 | 2.50 | 5 | **3.23** | 5.80 | 1.90 | 13 |
| | Metals-Barium | mg/kg | Wet | **51.25** | 65.10 | 37.60 | 4 | | (d) (c) | | |
| | Metals-Beryllium | mg/kg | Wet | **0.68** | 0.94 | 0.35 | 4 | | (d) (c) | | |

Table 2-4. Historical Analytical Data Summary - Focus Environmental, Inc.

| Waste Stream | Analyte | Units | Reporting Basis | Impoundment 1 Avg (a) | Impoundment 1 Max (a) | Impoundment 1 Min (a) | Impoundment 1 # Data Points | Impoundment 2 Avg (a) | Impoundment 2 Max (a) | Impoundment 2 Min (a) | Impoundment 2 # Data Points |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metals-Cadmium | mg/kg | Wet | (d) (c) | | | | | (d) (c) | | |
| | Metals-Chromium | mg/kg | Wet | **17.58** | 56.20 | 2.40 | 8 | **2.69** | 7.70 | 1.20 | 13 |
| | Metals-Lead | mg/kg | Wet | **25.45** | 35.70 | 14.20 | 8 | **66.35** | 235.00 | 21.40 | 13 |
| | Metals-Mercury | mg/kg | Wet | **0.63** | 1.30 | 0.20 | 7 | **0.27** | 0.79 | 0.04 | 12 |
| | Metals-Selenium | mg/kg | Wet | **4.18** | 5.50 | 3.40 | 5 | **6.38** | 13.30 | 3.60 | 13 |
| | Metals-Silver | mg/kg | Wet | (c) | | | | | (c) | | |
| | Metals-Sodium | mg/kg | Wet | **3,115.00** | 4,500.00 | 1,730.00 | 2 | **2,746.15** | 5,810.00 | 1,470.00 | 13 |
| | Nitrogen - ammonia | mg/kg | | **25.58** | 43.80 | 16.50 | 4 | **29.50** | 57.60 | 8.70 | 5 |
| | PCB-Aroclors | µg/kg | Wet | (d) (c) | | | | | (d) (c) | | |
| | PCB-Congeners | pg/g | Wet | (b) (c) | | | | | (d) (c) | | |
| | pH | pH | Wet | **3.74** | 12.36 | 1.04 | 7 | **1.64** | 2.20 | 1.09 | 12 |
| | Phenolics | mg/kg | | **114.87** | 319.00 | 8.60 | 6 | **108.13** | 275.00 | 21.50 | 13 |
| | Proximate Analysis | % | | | | | | | | | |
| | Ash | % | Dry | **3.78** | 9.30 | 1.20 | 5 | **1.64** | 2.30 | 1.00 | 5 |
| | Ash | % | Wet | **2.17** | 4.98 | 0.74 | 5 | **1.22** | 2 | 1 | 5 |
| | Fixed Carbon | % | Dry | **50.86** | 62.60 | 42.90 | 5 | **33.60** | 36.30 | 31.90 | 5 |
| | Fixed Carbon | % | Wet | **30.31** | 36.93 | 27.93 | 5 | **25.10** | 26.45 | 24.08 | 5 |
| | Moisture | % | Wet | **40.10** | 46.50 | 34.00 | 5 | **25.20** | 29.00 | 22.50 | 5 |
| | Volatile Matter | % | Dry | **45.36** | 54.70 | 33.20 | 5 | **64.80** | 66.70 | 61.50 | 5 |
| | Volatile Matter | % | Wet | **26.53** | 36.10 | 19.59 | 5 | **40.20** | 51.69 | 2.12 | 5 |
| | Solids | % | | (g) | | | | **33.10** | 33.10 | 33.10 | 1 |
| | Sulfur-Inorganic | % | | **1.53** | 1.75 | 1.30 | 2 | **1.54** | 2.10 | 0.97 | 2 |
| | Sulfur-Sulfate | mg/kg | | (g) | | | | **10,800.00** | 10,800.00 | 10,800.00 | 1 |
| | Sulfur-Sulfide | mg/kg | | **39.42** | 54.10 | 24.10 | 6 | **78.85** | 225.00 | 26.20 | 4 |
| | Sulfur-Sulfite | mg/kg | | **534.33** | 990.00 | 128.00 | 3 | **297.29** | 453.00 | 163.00 | 7 |
| | Sulfur-Total | % | Dry | **12.64** | 20.30 | 6.50 | 5 | **8.40** | 9.20 | 7.60 | 5 |
| | Sulfur-Total | % | Wet | **7.46** | 13.40 | 2.41 | 9 | **8.00** | 21.00 | 5.40 | 10 |
| | SVOC-TAL | mg/kg | Wet | (c) | | | | | (c) | | |
| | Ultimate Analysis | % | | | | | | | | | |
| | Chloride | % | Wet | **0.26** | 0.40 | 0.10 | 5 | **0.28** | 0.40 | 0.20 | 5 |
| | Hydrogen | % | Wet | **8.64** | 10.00 | 8.00 | 5 | **8.54** | 9.90 | 8.00 | 5 |
| | Nitrogen | % | Wet | **0.28** | 0.50 | 0.10 | 5 | **0.22** | 0.30 | 0.20 | 5 |
| | VOC-TAL | mg/kg | Wet | (c) | | | | | (c) | | |
| | BTEX-Benzene | µg/kg | Wet | **15,557,762.50** | 69,800,000.00 | 99,100.00 | 8 | **29,500,000.00** | 70,000,000.00 | 6,900,000.00 | 13 |
| | BTEX-Ethylbenzene | µg/kg | Wet | **76,818.75** | 387,000.00 | 1,480.00 | 8 | **1,049,576.47** | 7,390,000.00 | 74,600.00 | 17 |
| | BTEX-Toluene | µg/kg | Wet | **4,198,942.50** | 21,000,000.00 | 1,440.00 | 8 | **9,298,181.82** | 19,500,000.00 | 3,930,000.00 | 11 |
| | BTEX-Xylene (total) | µg/kg | Wet | **1,212,700.00** | 6,210,000.00 | 4,500.00 | 8 | **2,133,636.36** | 5,130,000.00 | 970,000.00 | 11 |
| **Coal Aggregate (CA)** | Alcohols | µg/kg | Wet | (d) (c) | | | | | (e) | | |
| | Aldehydes and Explosives | µg/kg | Wet | (b) (c) | | | | | | | |
| | Chloride | mg/kg | | **921.33** | 1,340.00 | 374.00 | 3 | | | | |
| | Metals-TAL | mg | Wet | (d) (c) | | | | | | | |
| | Metals-Arsenic | mg/kg | Wet | **5.28** | 5.70 | 4.70 | 4 | | | | |
| | Metals-Barium | mg/kg | Wet | **81.50** | 81.50 | 81.50 | 1 | | | | |
| | Metals-Beryllium | mg/kg | Wet | **0.73** | 0.73 | 0.73 | 1 | | | | |
| | Metals-Cadmium | mg/kg | Wet | (d) (c) | | | | | | | |
| | Metals-Chromium | mg/kg | Wet | **5.45** | 7.30 | 3.00 | 4 | | | | |
| | Metals-Lead | mg/kg | Wet | **104.58** | 168.00 | 7.80 | 4 | | | | |
| | Metals-Mercury | mg/kg | Wet | **1.52** | 2.60 | 0.07 | 4 | | | | |
| | Metals-Selenium | mg/kg | Wet | **8.78** | 12.90 | 2.80 | 4 | | | | |
| | Metals-Silver | mg/kg | Wet | (d) (c) | | | | | | | |
| | Metals-Sodium | mg/kg | Wet | **3,515.00** | 4,160.00 | 2,870.00 | 2 | | | | |
| | Nitrogen - ammonia | mg/kg | | **137.40** | 207.00 | 31.20 | 3 | | | | |
| | PCB-Aroclors | µg/kg | Wet | (d) (c) | | | | | | | |
| | PCB-Congeners | pg/g | Wet | (d) (c) | | | | | | | |
| | pH | pH | Wet | **4.70** | 7.63 | 1.01 | 4 | | | | |
| | Phenolics | mg/kg | | **393.67** | 766.00 | 166.00 | 3 | | | | |
| | Sulfur-Sulfide | mg/kg | | **78.63** | 106.00 | 36.70 | 3 | | | | |
| | Sulfur-Sulfite | mg/kg | | **84.85** | 116.00 | 53.70 | 2 | | | | |
| | SVOC-TAL | mg/kg | Wet | (c) | | | | | | | |
| | VOC-TAL | mg/kg | Wet | (c) | | | | | | | |
| | BTEX-Benzene | µg/kg | Wet | **40,633,333.33** | 53,600,000.00 | 18,000,000.00 | 3 | | | | |
| | BTEX-Ethylbenzene | µg/kg | Wet | **148,142.50** | 249,000.00 | 1,570.00 | 4 | | | | |
| | BTEX-Toluene | µg/kg | Wet | **8,694,100.00** | 15,800,000.00 | 36,400.00 | 4 | | | | |
| | BTEX-Xylene (total) | µg/kg | Wet | **2,211,125.00** | 3,430,000.00 | 24,500.00 | 4 | | | | |
| **Yellow Oily Liquid** | Chloride | mg/kg | Wet | **704.50** | 869.00 | 540.00 | 2 | | (f) | | |
| | Nitrogen - ammonia | mg/kg | Wet | **64.30** | 64.30 | 64.30 | 1 | | | | |
| | Sulfur-Sulfite | mg/kg | Wet | **186.00** | 186.00 | 186.00 | 1 | | | | |
| **Sludge Composite (0 - 0.5 feet)** | Flash Point | °F | | **67.60** | 67.60 | 67.60 | 1 | **55.00** | 55.00 | 55.00 | 1 |

Table 2-4. Historical Analytical Data Summary - Focus Environmental, Inc.

| Waste Stream | Analyte | Units | Reporting Basis | Impoundment 1 Avg (a) | Impoundment 1 Max (a) | Impoundment 1 Min (a) | Impoundment 1 # Data Points | Impoundment 2 Avg (a) | Impoundment 2 Max (a) | Impoundment 2 Min (a) | Impoundment 2 # Data Points |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sludge Composite (1 - 2 feet)** | Flash Point | °F | | **45.00** | 45.00 | 45.00 | 1 | **59.00** | 59.00 | 59.00 | 1 |
| **Sludge Composite (2 - 3 feet)** | Flash Point | °F | | **45.00** | 45.00 | 45.00 | 1 | **57.00** | 57.00 | 57.00 | 1 |
| **Sludge Composite** | Sodium | mg/kg | | (g) | | | | **5,870.00** | 5,870.00 | 5,870.00 | 1 |
| **Aqueous Phase-Water Cap** | Biochemical Oxygen Demand | mg/L | Wet | **5.60** | 5.60 | 5.60 | 1 | **13.10** | 13.10 | 13.10 | 1 |
| | Chemical Oxygen Demand | mg/L | Wet | **64.70** | 64.70 | 64.70 | 1 | **100.00** | 100.00 | 100.00 | 1 |
| | pH | pH | Wet | **8.73** | 8.73 | 8.73 | 1 | **2.73** | 8.00 | 0.10 | 3 |
| | Total Dissolved Solids | mg/L | Wet | **46.00** | 46.00 | 46.00 | 1 | **79.00** | 79.00 | 79.00 | 1 |
| | Total Organic Carbon | mg/L | Wet | **14.50** | 14.50 | 14.50 | 1 | **22.00** | 22.00 | 22.00 | 1 |
| | Total Suspended Solids | mg/L | Wet | **6.00** | 6.00 | 6.00 | 1 | **15.00** | 15.00 | 15.00 | 1 |

(a) Averages, maximums, and minimums calculated only from verified analytical detections. Nondetects were not entered into database.
(b) Minimal analyte detections.
(c) Full target analyte list available in "Former American Cyanamid Site Impoundments 1 & 2 Characterization Program Summary Report", OBG, November 16, 2010.
(d) Analyte below detection limit in samples.
(e) Coal aggregate material only present in Lagoon 1.
(f) Yellow oily liquid only encountered in Lagoon 1.
(g) Material from Lagoon 1 not analyzed.
Note: If extensive analytical data were available in the 2010 OBG Report, historical data were not entered or included in this summary. In the event of a data gap in the OBG 2010 data, a compilation of valid historical data was used. See Table 2-5, which identifies data gaps that currently exist.

µg/kg = micrograms per kilogram
°F = degrees Fahrenheit
% = percent
BTEX = benzene, toluene, ethylbenzene, xylenes
Btu/lb = British thermal units per pound
in/yr = inches per year
lb/gal = pounds per gallon
mg = milligrams
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyl
pg/g = picograms per gram
SVOC = semivolatile organic compound
TAL = target analyte list
TOC/g = total organic carbon per gram
VOC = volatile organic compound

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The objective of the 2010 streamlined HHRA was to evaluate the potential cancer risks and noncancer hazards associated with exposure to surface soil, groundwater, and Site impoundments (USEPA 2010a). Since the Site's current zoning is industrial, the streamlined HHRA evaluated the following receptors/pathways: Site workers and trespassers exposed to surface soil and impoundments at the Site. Groundwater is a designated potable water supply; therefore, the residential exposure pathway also was evaluated. In general, the industrial worker's exposure to surface soil and Site impoundments, including Impoundments 1 and 2, was considered to exceed the acceptable risk range and the noncancer hazard threshold of 1. For Impoundments 1 and 2, the primary risk drivers are VOCs.

The 2010 streamlined assessment also determined that exposure to Site-related impacts in groundwater under OU4, including groundwater in the vicinity of Impoundments 1 and 2, presented a potential unacceptable human health risk to current and potential future receptors based on the USEPA acceptable risk range and the NJDEP acceptable cancer risk level (USEPA 2010a). Cancer risks and noncancer health hazards were identified for resident's exposure to groundwater (overburden and bedrock). Risk drivers for groundwater included VOCs.

# 2.6 Interim Remedial Measures

## 2.6.1 Previous Remedial Efforts

Multiple technologies for treating materials contained within Impoundments 1 and 2 have been evaluated in the past (Table 2-1, Figure 2-4)**.** Early evaluations focused on fuel blending and resulted in the removal of a light oil sludge layer from the impoundments during the 1960s and 1980s. Subsequent technology evaluations included various forms of chemical, physical, biological, and ex-situ thermal treatment approaches as well as removal, containment, and recycling. Based on these previous evaluations, removal followed by low-temperature thermal treatment was initially selected as the final remedy in the 1998 ROD (NJDEP 1998). However, because of the challenges involved with physical handling and the unanticipated potential for air emissions encountered during removal, the 1998 ROD remedy was determined to be inappropriate.

## 2.6.2 Recent Remedial Measures

Over time, the solid and semi-solid materials generated by light oil refining separated into three distinct layers in the impoundments: a light oily sludge layer on the top, VR material in the middle, and HC layer at the bottom. The uppermost light oily sludge layer has been removed from both impoundments and transported offsite for energy recovery.

Water caps have been placed on both impoundments and are maintained for odor control. In addition, a synthetic geomembrane covers both impoundments (located below each water cap), which serves to protect the surface of the impoundment materials from scouring during flooding and assists in odor control. The depth of the water cap on top of the impoundment materials fluctuates but is generally maintained at 2 feet or greater.

In 2010, a comprehensive inspection of the impoundment berms was completed and subsequent maintenance items including removal of deep-rooted vegetation, rodent removal, and filling of burrows was conducted (OBG 2010b). In 2014, erosion control matting (ECM) was installed on the berms surrounding the impoundments. The ECM is a high-strength, ultraviolet-stabilized, multi layered, three-dimensional synthetic matting with fiber matrix material to permanently control erosion and reinforce vegetation. The ECM will provide additional stabilization to protect the impoundment berms in the event of future flooding.

### 2.6.3 Downgradient Groundwater and Surface Water

Downgradient groundwater and surface water impacts identified during remedial investigation activities have been addressed, first through activated carbon-filled sand bags installed along the banks of the Raritan River in early 2011 and then with the construction of a groundwater removal system, containment trench and an interim groundwater treatment system in 2012. Once the OU4 Site-wide GWTF is constructed and fully commissioned, the interim groundwater treatment system will be taken offline and groundwater extracted from the containment system will be routed to the Site-wide GWTF (see Section 1.3.2 for more detail).

## 2.7 Treatability and Pilot Study Summary

To develop an effective remedial approach for addressing Impoundments 1 and 2, several bench-scale treatability studies and a field-scale pilot study were completed between 2012 and 2016 to evaluate technologies that might be effective for remediation of Impoundments 1 and 2 (CH2M 2014a, 2015a). In 2012, CH2M prepared a *Technology Evaluation Work Plan* (CH2M 2012a) that outlined potential treatment technologies for the materials in Impoundments 1 and 2. Two technologies identified in the work plan warranted supplemental evaluation: in-situ solidification and stabilization (ISS) and in-situ thermal treatment (ISTT). Laboratory testing of ISS and ISTT was completed in 2012.

In 2014, a field-scale pilot study was implemented to evaluate the feasibility and efficacy of ISS, ISTT, and a combination of both technologies to treat the impoundment materials in place. The results of the 2014 pilot study were compiled into a summary report, dated November 15, 2015 (CH2M 2015a; USEPA 2015c). Additional laboratory studies were conducted in 2016 to evaluate thermally enhanced ISS and mechanical dewatering followed by treatment or destruction offsite at a cement kiln or incinerator; and to evaluate the compatibility of the CAMU liner with leachate generated from treated impoundment material. These studies are summarized in the following subsections.

### 2.7.1 Initial Laboratory Treatability Studies

Laboratory treatability studies were conducted in 2012 and 2013 to evaluate the use of thermal processes and solidification/stabilization to treat the OU8 impoundment materials. Details of the testing are reported in the *Revised Impoundments 1 and 2 Treatability Study Results Report* (CH2M 2014a). The following subsections summarize the tests and associated results.

#### 2.7.1.1 Material Collection for Testing

Impoundment material samples for the treatability study were collected from Impoundments 1 and 2 in January and February 2012 (CH2M 2012a). Samples were collected from a pontoon barge using a vibracore to advance a stainless-steel core barrel into the impoundment materials. The cores collected were logged and photographed to document their contents, and then the different impoundment materials (VR, HC, SSL, CL, and CA) were segregated into separate containers for shipment to the treatability laboratories for thermal, homogenization, pH adjustment, and solidification/stabilization testing.

#### 2.7.1.2 Thermal Treatment Testing

From June to August 2012, laboratory testing was completed to determine the effect of heating on the chemical composition and physical properties of VR and HC materials. The thermal treatability testing consisted of heating a known mass of sample in a sealed reactor installed within a temperature-controlled oven. Samples were heated to 90 degrees Celsius (°C) and 100°C, and liquid and vapor effluents produced during heating were monitored and chemically characterized. The impoundment

materials were heated for approximately 24 days during the 90°C test and 14 days during the 100°C test. In total, four thermal treatment evaluations were performed in support of the treatability study:

- VR material heated at 90°C
- HC material heated at 90°C
- VR material heated at 100°C
- HC material heated at 100°C

Routine vapor screening (daily) consisted of measuring VOCs, hydrogen sulfide, and sulfur dioxide obtained through direct-reading handheld instruments equipped with parameter-specific detectors. Periodic vapor samples for VOCs, acid gases, aldehydes, and malodorous compounds also were collected for analysis by a third-party laboratory.

In general, treatability testing showed that heating of VR and HC test samples reduced VOC and SVOC concentrations. Malodorous compounds including hydrogen sulfide, mercaptan, and carbon disulfide were liberated from the impoundment materials upon heating. The vapor effluent from the heated reaction cell was highly acidic, and heating of impoundment material caused significant corrosion within the steel reaction cell, aluminum lining, and stainless-steel thermocouples used during the thermal treatment.

Physical properties also were evaluated during the treatability test. Testing confirmed that VR liquefied upon heating and that this liquefaction was reversible. Even after thermal treatment, reheated VR material exhibited liquid behavior as temperatures approached 65°C. Testing also revealed that VR material, when heated, undergoes significant volume expansion in an unconfined system. Overall, the results of the laboratory study indicated the following (CH2M 2014a):

- Reduction in VOC concentration occurred between pre- and post-treatment samples, suggesting thermal treatment promoted reducing VOC and malodorous compounds from impoundment material. Benzene experienced the most significant decrease in concentration with greater than 90% reduction in the VR material treated at 100°C.
- An increase in the compressive strength of HC to 38.4 pounds per square inch (psi) (90°C test) and 80.1 psi (100°C test) occurred following thermal treatment.
- Increases in VR compressive strength following thermal treatment was minimal (less than 10 psi).
- Toxicity characteristic leaching procedure (TCLP) testing for treated VR and HC materials indicated thermal treatment as performed under laboratory conditions can reduce TCLP VOCs to the extent that some of the post-treatment material passes the TCLP criteria for hazardous waste; however, several compounds remained above TCLP limits. Chromium exceeded the corresponding TCLP criteria in VR material treated at 100°C and HC material treated at 90°C, which is attributed to corrosion of material components. Also, benzene and pyridine exceeded the corresponding TCLP criteria in VR material treated at 100°C, which is attributed to the treatment being ended before complete VOC reduction.

#### 2.7.1.3 Solidification/Stabilization Testing

Homogenization, pH adjustment, and solidification/stabilization treatability studies were performed to evaluate different mixing methodologies and mix ratios of pH adjustment materials and pozzolan recipes for solidification/stabilization. Pozzolans are generally fine powdered materials that can be added to cement mixtures to increase durability. Testing was performed using both thermally treated and untreated impoundment materials. The basic objectives of this portion of the treatability study were to:

- Evaluate if the impoundment materials could be homogenized with mechanical mixing
- Determine if the pH of the impoundment material could be raised to at least 5 to 6 SU
- Evaluate if the impoundment materials could be stabilized/solidified using pozzolan mixtures

**Homogenization Assessment**

Impoundments 1 and 2 contain distinct layers of materials with different physical properties (i.e., VR, HC, SSL, CL, and CA). During a full-scale ISS treatment scenario, the various material layers would be mixed together within the impoundment. To mimic this layered-impoundment structure in the laboratory, layered models of each impoundment were created. The mass of each layer in the model was based on data collected as part of the 2010 impoundment materials characterization (OBG 2010a). Four 18-kilogram (kg) models were created, as follows:

- Impoundment 1 Untreated Material
- Impoundment 2 Untreated Material
- Impoundment 1 Thermally Treated Material
- Impoundment 2 Thermally Treated Material

The models were constructed using 5-gallon buckets with tight-fitting lids to simulate mixing in a sealed system. Auger-column mixing of the layers was simulated using a mixing blade on a shaft that extended through a gasket-sealed aperture in the lid.

Untreated material from Impoundment 1 was completely homogenized using the mixing apparatus, while untreated material from Impoundment 2 was only somewhat blended with the top layer of VR congealing and remaining separate from the other layers.

Difficulties were encountered when attempting to homogenize thermally treated material because of its vitrified physical nature. Mixing of thermally treated material resulted in incomplete homogenization. It therefore was concluded that a de-emulsification step was needed to successfully homogenize the thermally treated materials. The de-emulsification procedure involved using the exothermic heat of hydration and chemistry of quicklime (HiCal Lime Kiln Dust [LKD]) to soften and breakdown the thermally treated impoundment materials. This de-emulsification procedure also combined the pH adjustment step with the homogenization step and resulted in the thermally treated models becoming pH adjusted.

**pH Adjustment Assessment**

Various pH adjustment reagents were assessed for untreated impoundment material only, since pH adjustment of thermally treated material was combined with the homogenization step in the de-emulsification procedure discussed above. For thermally treated material, adding the HiCal LKD for de-emulsification concurrently raised the pH to greater than 10 SU.

For the untreated impoundment material, the pH changes resulting from increasing additions of six pH adjustment compounds were evaluated to determine the amount needed to raise the impoundment materials to a pH of 5 SU and the amount needed to reach a pH of greater than 8 SU but less than 11 SU. The six compounds evaluated as part of the pH adjustment testing were:

- Montague hydrated lime (calcium hydroxide [$CaOH_2$]) source from Montague, Michigan
- Carmeuse hydrated lime ($CaOH_2$) source sold by Carmeuse
- Terrabond SC
- Lafarge Ravena Plant reclaimed (landfilled) cement kiln dust (CKD)
- Sodium hydroxide laboratory grade
- Mintek (spent lime)

Carmeuse hydrated lime was selected as the pH adjustment reagent to be used in the pozzolan screening because the dosage rates were approximately one-half of other products tested.

The results of pH adjustment studies indicated homogenized Impoundment 1 raw material would be treated with a 4% by weight of Carmeuse hydrated lime and homogenized Impoundment 2 raw material

with a 6% by weight addition of Carmeuse hydrated lime to adjust the pH of the impoundment materials to a pH range of 11 SU for subsequent pozzolan screening.

**Solidification/Stabilization Assessment**

The solidification/stabilization assessment consisted of evaluating various reagent mixtures that can be added to homogenized and pH adjusted impoundment material to increase strength, reduce hydraulic conductivity, and reduce leaching in the treated material.

Reagents initially were screened using a pocket penetrometer to assess strength gain. Pozzolans that achieved the greatest strength gains were carried through to optimization studies. Based on a review of the pocket penetrometer screening results, two reagent mixes were developed and tested for each of the four types of material types (i.e., untreated and thermally treated Impoundment 1 and 2 material). Subsequent testing was performed to evaluate secondary stabilization, which may be needed for placing excavated material in a landfill cell and to evaluate the potential for additional reductions in VOC mass, hydraulic conductivity, and COC leaching by optimizing reagent blends.

The study results indicate that untreated and thermally treated impoundment materials can be successfully homogenized, pH adjusted, and solidified. Adding various reagent blends to the homogenized and pH adjusted impoundment material resulted in strength gains ranging from 59.0 psi to greater than 62.5 psi after only 7 days of curing.

Results from testing of crushed materials simulating excavation from the impoundments and placement in a landfill cell indicated significant strength (more than 40 psi) was achieved. These results validated the effectiveness of additional mixing.

Optimization testing for untreated impoundment material indicated the following recipe is expected to perform the best:

- pH adjustment with 6% hydrated lime and 15% water
- Initial ISS using 33% clay, 22.5% LaFarge NewCem, and 15% OMNI fluidized bed combustion ash
- Remixing after 7 days of curing using a slurry of 10% LaFarge Portland cement and 8% water

The highest performing solidification/stabilization recipe for the thermally treated material is as follows:

- De-emulsify and pH buffer using 30% HiCal LKD and 30% water
- Initial mixing using 10% LaFarge NewCem and 15% water
- Remixing after 7 days of curing using 10% LaFarge Portland cement and 8% water

### 2.7.2 Field-Scale Pilot Study

Based on the laboratory testing results, a field-scale pilot study was implemented to further evaluate the efficacy of ISTT and ISS technologies in treating the acidic impoundment material under actual field conditions. The pilot study design was developed using results of laboratory testing performed in 2012 and 2013 (*100 Percent Design of Pilot Study for Operable Unit 8* [CH2M 2013b]). Appendix D contains a detailed summary of the ISS pilot study results. The following paragraphs provide a brief background of pilot study components and the results.

The pilot study operated between February and June 2014 with oversight performed by USEPA. The pilot study was completed using three 7-foot-diameter steel caissons, which were supported from a Flexifloat floating platform on the water surface in the northwestern portion of Impoundment 2. This location was selected based on the relatively equal proportions of VR and HC. An outer shroud was used for each test cell to capture organic vapors and malodorous compounds generated during treatment operations. The inner caisson was advanced down to the clay layer at the bottom of the impoundment to control the influx of water and untreated tar into the test cell. Each caisson was fitted with a vacuum-tight cover that allowed for vapor capture within the headspace of the caisson and support heating,

extraction, and monitoring equipment. The captured vapor from all caissons was conveyed to a thermal oxidizer to destroy the organic compounds and oxidize the reduced sulfur compounds, and then to a caustic scrubber to reduce the concentrations of acid gases. Additional information pertaining to the system and operations is discussed in detail in the USEPA-approved *Field-Scale Demonstration Study Results Report* (CH2M 2015a).

Testing and objectives within the three test cells (caissons) were completed as follows:

- Caisson 1 – ISS only, the overall objectives were to reduce VOC mass, increase pH, increase strength, decrease hydraulic conductivity, and decrease leachability.
- Caisson 2 – ISTT only, the overall objectives were to reduce VOC mass and reduce leachability.
- Caisson 3 – ISTT followed by ISS, the overall objectives were to reduce VOC mass, increase pH, increase strength, decrease hydraulic conductivity, and decrease leachability. This test also provided information on ISTT since ISTT was performed first, followed by ISS.

Because of the potential for fire and explosion posed by high-temperature thermal treatment of the impoundment material, the vapor headspace in the caissons and vapor phase collection systems, prior to thermal oxidation, was inerted with nitrogen throughout the ISTT phase.

Because of the risk of a catastrophic flood overtopping Impoundments 1 and 2 during the pilot study, the caissons were secured with 14 high-strength nylon mooring lines that were anchored in the ground outside the impoundments via helical screw anchors. The mooring system for the Flexifloat platform was designed to withstand wind forces created during a Category 2 hurricane and a floodwater velocity up to 6 feet per second.

#### 2.7.2.1 In-situ Thermal Treatment Phase

Following completion of infrastructure construction, mobilization and installation of the ISTT system was conducted through February 2014. Installation of the ISTT system components consisted of the following activities:

- Installing and testing the thermal oxidizer and caustic scrubber system
- Installing and testing the zeolite secondary vapor treatment system
- Installing and testing the pH neutralization and sorption liquid treatment system
- Installing the heater wells and multiphase extraction (MPE) wells
- Installing and testing the caisson temperature monitoring and control systems
- Installing the nitrogen and propane supply tanks
- Installing additional components for the thermal treatment system (such as blowdown tanks, scrubber, boiler, etc.)
- Installing and testing piping for water, steam, and nitrogen extending from the Flexifloat platform to the equipment bench
- Installing and testing various system components and sensors, including oxygen sensors, water flow control interlocks, overall electrical system, and flammability lower explosive limit analyzer
- Installing the corrosion coupons for material capability testing
- Installing and integrating software and control system for thermal treatment components

The ISTT system comprised of heater wells, vapor extraction wells, MPE wells, temperature monitoring points, nitrogen injection wells, and steam injection wells. After completing system construction,

component integration, testing, and installation troubleshooting were conducted through system startup on February 28, 2014. Specific tasks included the following:

- Pressure testing system piping and vacuum extraction lines
- Testing and verifying interlocks and controls
- Setting up and calibrating system monitoring instruments
- Integrating and testing nitrogen injection system
- Heat tracing and insulating scrubber conveyance lines, caisson piping, and cover
- Installing condensate collection system
- Installing temperature monitoring system in boiler room and hydronic heating circuits

ISTT operations were conducted in accordance with an Environmental Improvement Pilot Test (EIPT) permit equivalent issued by NJDEP on January 15, 2014 (EIP130001) (NJDEP 2014a) and a second EIPT permit equivalent issued on April 15, 2014 (EIP140001) (NJDEP 2014b). The second EIPT was terminated on May 9, 2014, with the conclusion of the ISTT portion of the pilot study.

#### 2.7.2.2 In-situ Solidification/Stabilization Phase

Before implementing ISS activities in Caissons 1 and 3, ISTT operations were completed in Caissons 2 and 3. After an approximately 70-day heating period, the thermal treatment operations were concluded on May 9, 2014, and the in-situ thermal heaters were shut down and removed from Caissons 2 and 3. Primary ISS mixing operations for Caissons 1 and 3 were completed over a 2-day period between May 29 and May 30, 2014. Secondary mixing was performed approximately 1 week after primary mixing to evaluate supplemental increases in compressive strength.

Stabilization operations were completed in each caisson using auger-based soil mixing equipment. Pilot study operations were completed using a Bauer rotary drilling rig (BG 28H and BS 80B base carrier), a hollow-stem Kelly bar, and a 6-foot-diameter mixing auger. Injection ports on the mixing auger were used to deliver reagents to the caissons in a slurry form. In Caisson 1, dry clay compounds were added through the opened caisson lids as outlined in the *100 Percent Design of Pilot Study for Operable Unit 8* (CH2M 2013b).

Vapor controls were implemented during ISS mixing operations in accordance with the EIPT permit equivalent issued by NJDEP (EIP130002) (NJDEP 2014c).

The ISS implementation sequence for Caisson 1 (containing untreated impoundment materials) is summarized below:

- Impoundment material homogenization
- pH buffering with a hydrated lime slurry
- Primary ISS mixing with pozzolan reagents
- Material excavation to a rolloff container
- Secondary mixing of excavated material with Portland cement in the rolloff container
- Transfer of stabilized material from an unlined rolloff to a lined rolloff container with a tight-fitting cover for shipping

The ISS implementation sequence for Caisson 3 (containing the previously ISTT treated materials) is summarized below:

- Homogenization of thermally treated material
- pH buffering with a LKD slurry
- Primary ISS mixing using pozzolan reagents
- Material excavation to a rolloff container
- Secondary mixing of excavated material with Portland cement in a rolloff container

- Transfer of stabilized material from an unlined to lined rolloff container with a tight-fitting cover for shipping

Demobilization of ISS equipment commenced on June 10, 2014. Site activities included removing and decontaminating unlined rolloffs used for secondary mixing, equipment, and other infrastructure located on or near the equipment bench. Final demobilization of ISS equipment and personnel was completed on June 19, 2014. Caisson removal and decontamination activities also commenced during the week of June 9, 2014, and were completed by June 27, 2014.

Material samples were collected at various stages throughout the pilot study, including before and after thermal treatment, after removing the ISS-treated material from the caisson, and after secondary ex-situ stabilization/solidification. Selected samples were analyzed for one or more of the following parameters:

- VOCs (standard, TCLP, synthetic precipitation leaching procedure [SPLP], and monolithic leaching testing [American National Standards Institute {ANSI}])
- SVOCs (standard, TCLP, SPLP, and ANSI testing)
- Metals (standard, TCLP, SPLP, and ANSI testing)
- Physical characteristics (pH, moisture content, bulk density, dry density, unconfined compressive strength [UCS], hydraulic conductivity, and loss on ignition)

Sampling and analysis was conducted in accordance with the USEPA-approved *Sampling and Analysis Plan for Operable Unit 8 Pilot Study* (CH2M 2013a) and the *Sampling and Analysis Plan Addendum, Impoundment 1 and 2 Pilot Study, Operable Unit 8* (CH2M 2014b).

#### 2.7.2.3 Pilot Study Findings

During the application of ISTT, excessive corrosion occurred in two carbon steel heater cans from Caisson 2. Inspection of the damaged heater revealed perforations in multiple locations, and roughly 3 linear feet of the wall of a second heater can had been completely corroded. Similar, but less severe, corrosion was observed in carbon steel components removed from Caisson 3. These observations indicate that special design considerations would be required for a potential full-scale implementation.

The results summarized below and presented in Table 2-5 were derived from the data collected and analyzed during the field-scale implementation of the pilot study (CH2M 2015b). In general, the results indicated that controls for fugitive VOCs and sulfide compounds would be anticipated for handling of impoundment material following ISS treatment as it was conducted in the pilot study.

- ISS Results Summary (Caisson 1):
  - Raised the pH of the impoundment materials from less than 2 SU to greater than 10 SU.
  - Reduced the mass of VOCs as follows:
    - Total VOCs: 27% reduction
    - Total benzene: 26% reduction
    - Naphthalene: 72% reduction
  - Decreased leachability of COCs by more than 90%.
  - Increased UCS to greater than 40 psi.
  - Decreased hydraulic conductivity to less than 1 x $10^{-6}$ centimeters per second (cm/s).
  - After ISS treatment, the following average concentrations were measured:
    - Benzene: 23,450 milligrams per kilogram (mg/kg)
    - Benzene TCLP: 439 mg/L

    - Naphthalene: 3,375 mg/kg (naphthalene TCLP was not analyzed)
  - Controls for fugitive VOCs and sulfide compounds will be anticipated for handling of impoundment material following ISS treatment as it was conducted in the pilot study.

- ISTT Results Summary (Caisson 2):
  - Though ISTT was effective in reducing the VOC concentrations, the pH of the treated material remained acidic in nature.
  - An overall comparison of chemical analytical results for untreated and post-ISTT impoundment material is as follows:
    - Total VOCs: 90% to 93% mass reduction
    - Total benzene: 90% to 94% mass reduction
    - Naphthalene: 83% to 86% mass reduction
  - Decreased leachability of COCs by more than 90%.
  - After ISTT, the following average concentrations were measured:
    - Benzene: 5,775 mg/kg
    - Benzene TCLP: 106 mg/L
    - Naphthalene: 3,817 mg/kg (naphthalene TCLP was not analyzed)
  - Isolated increases in UCS were observed; however, thermal treatment did not consistently increase UCS characteristics.
  - The significant corrosion of two heater elements in Caisson 2 clearly limited the overall operating temperature in this location. In addition, these results suggest the heated impoundment material in both ISTT caissons presented an aggressive environment for carbon steel that must be considered when selecting materials for design and construction of ISTT.
  - Treatment progress was affected by a flooding event.
- ISTT/ISS Results Summary (Caisson 3):
  - Raised the pH of the impoundment materials from less than 2 SU to greater than 10 SU.
  - Reduced the mass of VOCs as follows:
    - Total VOCs: 94% reduction
    - Total benzene: 94% reduction
    - Naphthalene: 55% reduction
  - Decreased leachability of COCs by more than 90%.
  - Increased UCS to greater than 40 psi.
  - Decreased hydraulic conductivity to less than $1 \times 10^{-6}$ cm/s.
  - After treatment, the following average concentrations were measured:
    - Benzene: 2,310 mg/kg
    - Benzene TCLP: 85 mg/L
    - Naphthalene: 2,485 mg/kg (naphthalene TCLP was not analyzed)
  - Treatment progress was affected by a flooding event.

Table 2-5. Field-scale Pilot Study Post Treatment Caisson Data Summary

| Criteria | Units | Caisson 1 (ISS) | Caisson 2 (ISTT) | Caisson 3 (ISTT / ISS) |
|---|---|---|---|---|
| pH | SU | 10 - 12 | 2 | 12 - 13 |
| Total VOC Mass Reduction | % | 27 | 93 | 99 / 94*** |
| Benzene Mass Reduction | % | 26 | 95 | 99 / 94*** |
| Average Benzene Concentration | mg/kg* | 23,500 | 5,780 | 2,310 |
| Average Benzene TCLP | mg/L** | 439 | 106 | 85 |
| Unconfined Compressive Strength | psi | 121 - 249 | 23 - 148 | 63 - 168 |
| Hydraulic Conductivity | cm/s | $1.4x10^{-8}$ to $1.5x10^{-7}$ | $7.4x10^{-6}$ to $3.2x10^{-5}$ | $3.5x10^{-7}$ to $1.6x10^{-6}$ |
| Benzene Leachability Reduction | % | 98 | 98 | 99 |

Note:
*Land Disposal Restrictions Universal Treatment Standard = 10 mg/kg
**Toxicity Characteristic Leaching Procedure = 0.5 mg/L
***First number data result represents combined ISS and ISTT treatment. The second data number represents ISTT only results (prior to ISS treatment).

Several instances of TCLP exceedances in post-treatment material were observed in the field-scale study, which showed that each of six TCLP samples from the caisson that underwent ISTT exceeded the 0.5 mg/L "hazardous waste TCLP characteristic" criterion for benzene. A greater reduction in leachable benzene was observed in the caisson that underwent ISTT followed by ISS (ISTT/ISS), which is attributed to be the result of greater success in maintaining consistent, higher, treatment temperatures throughout the ISTT phase. However, even in the ISTT/ISS caisson with higher temperatures, two of six TCLP results exceeded the RCRA criterion.

## 2.7.3 Additional Laboratory Studies

Additional laboratory studies were conducted in 2016 to evaluate the feasibility and effectiveness of three more options for treating and/or disposing of the impoundment materials: disposal of impoundment material in the CAMU, thermally enhanced ISS, and mechanical dewatering followed by offsite treatment at a cement kiln or incinerator (CH2M 2016a). Appendix E presents the results for these treatability studies.

### 2.7.3.1 CAMU Liner Compatibility Testing

Several remedial alternatives considered by this FFS include the potential use of the CAMU for final deposition of treated materials from Impoundments 1 and 2. Bench-scale testing was conducted to evaluate the compatibility of the high-density polyethylene (HDPE) geomembrane, which lines the CAMU, with simulated leachate generated from treated impoundment material from the OU8 pilot study (CH2M 2013b, 2015b). The full results of this testing are presented in the *Bench-Scale Liner Compatibility Study for the Impoundment 8 Facility* (CH2M 2016b), which is included as Appendix E1.

Liner compatibility testing was conducted on HDPE geomembrane matching the material used in the CAMU's existing liner. The compatibility testing consisted of immersing liner coupons in leachate generated from solid-phase treated materials. The coupons were tested over 120 days to assess changes in physical and mechanical properties of the geomembrane. The influence of leachate on the liner

material was tested using American Society for Testing and Materials (ASTM) standardized methods (ASTM 2008, 2009). Details are provided here on the following elements of the testing program:

- Liner material acquisition and coupon generation
- Leachate generation from treated impoundment materials
- Compatibility testing of the liner material
- Chemical control study

**Liner Material Acquisition and Coupon Generation**

The liner material that was tested for this study matches the liner product used in the construction of the Cells 3 and 4 bottom liners of the CAMU. Virgin HDPE geomembrane was provided from a liner supplier and installer to a geosynthetics testing firm. Upon receipt, the material was logged, conditioned in the laboratory (bringing to laboratory temperature and humidity), and prepared by cutting it into 8-inch by 10-inch coupons for use in the compatibility test. Sets of four coupons were then drilled and clipped together for each of the benchmark time pulls.

**Leachate Generation from Treated Impoundment Materials**

The *FFS Work Plan Addendum* (CH2M 2015c) originally specified that the compatibility tests would be conducted using leachates from treated materials generated during the 2014 field-scale pilot study to simulate the range of leachate concentrations potentially generated from treated material placed in the CAMU. These consisted of treated materials from Caisson 1, where ISS was applied, and Caisson 2, where ISTT was applied. However, when the material from Caissons 1 and 2 was collected in September 2015 to generate leachate for this study, chemical screening results showed that COC concentrations were much lower than the 2014 pilot study results (CH2M 2015a, 2015b). To compensate and better simulate a range of possible liner exposure scenarios, the leachate generated from Caisson 2 (which exhibited the highest COC concentrations during the September 2015 chemical screening tests) was spiked with pure, laboratory-grade chemical stocks to bring the COC concentrations up to comparable levels observed in SPLP samples collected from the treated materials during the 2014 pilot study.

Two 30-gallon batches of leachate were generated from the Caisson 2 material. The leachate was first generated using USEPA Method 1312, *Synthetic Precipitation Leaching Procedure* (USEPA 1994), analyzed for COC concentrations, and then shipped in laboratory-certified clean carboys to the geosynthetics testing firm where the compatibility testing was performed.

**Leachate Spiking and Confirmatory Testing**

Before initiating compatibility testing, the leachate was spiked in the test tanks to achieve target concentrations that were observed in the 2014 OU8 pilot study (CH2M 2015b) for material treated by ISS and ISTT. These target concentrations were established for seven COCs. Two sets of target concentrations were created to simulate leachate from material treated by ISS only and the leachate from material treated by ISTT only. Following the spiking step, leachate samples were collected and submitted for laboratory analysis to confirm that the target concentrations were reached. The leachate tanks also were sampled periodically during bench-scale testing to monitor COC concentration changes over time. Re-spiking was performed as needed following sampling to maintain target concentrations over the 120-day compatibility testing period.

**Compatibility Testing**

The tests were conducted in accordance with ASTM procedures (ASTM 2008, 2009) using simulated leachate batches that mimicked SPLP leachate concentrations observed under two scenarios during the 2014 OU8 pilot study. The first scenario used leachate with a benzene concentration of 500 mg/L, which was approximately equal to the average leachate concentrations of benzene observed in SPLP samples from Caisson 1 material following ISS (471 mg/L). The average concentration of benzene in the corresponding solid material as measured during the pilot study was 23,450 mg/kg. The leachate also

was similar to leachate concentrations observed in SPLP samples from untreated material from Caissons 1 and 3 before starting testing, which exhibited an average benzene concentration of 457 mg/L. The benzene concentration in typical untreated solid material is approximately 65,000 mg/kg.

The second scenario was a lower concentration (100 mg/L) leachate, which was observed in SPLP samples from Caisson 3 material following ISS and thermal treatment. The average concentration of benzene in the corresponding solid material as measured during the pilot study was 2,485 mg/kg. The SPLP results are not representative of leachate conditions expected to come from a monolith, because the test involves particle size reduction resulting in higher concentration leachate. The SPLP tests are standard tests for evaluating leaching potential for material that is relocated without the added step of stabilization and solidification.

The bench-scale study results indicate that HDPE liner material used in the CAMU is compatible with leachates potentially generated from treated OU8 material, even under high leachate concentration scenarios.

#### 2.7.3.2 Steam-Enhanced ISS Testing

To assess the potential use of steam-enhanced mixing to promote VOC reduction followed by ISS to increase pH and compressive strength, a bench-scale test was performed using material collected from Impoundment 2. The results are detailed in the *Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Test Results* (CH2M 2016b), which is included as Appendix E2.

The study evaluated the effectiveness of VOC reduction using steam-enhanced mixing to heat the materials to 70°C and 90°C while mixing, and material characteristics following the subsequent addition of several ISS amendments to improve physical handling properties and adjust pH.

The testing program was completed in three phases:

- Phase I: Preliminary testing (method refinement)
- Phase II: Initial testing (evaluation of various treatment conditions)
- Phase III: Confirmatory testing (replicate testing of most favorable treatment conditions)

Detailed methods for each phase of the testing program, including apparatus refinement, are provided in the *Steam Mixing and Solidification Study Report* (Kemron Environmental Services 2016) and are summarized below.

**Phase I: Preliminary Testing**

The preliminary testing phase was conducted to develop and refine test methods to best simulate full-scale treatment of impoundment materials using the dual-phase treatment approach. For this, specialized equipment capable of mixing steam and hot air directly into the impoundment materials was designed and fabricated in the laboratory. The archived impoundment material used in the preliminary phase was a 1:1 composite (by weight) of two types of material from Impoundment 2. The following ISS reagents were evaluated during the preliminary phase to determine candidate amendment reagents for subsequent testing phases:

- Type I Portland cement
- Calciment
- LKD
- CKD
- Granulated blast furnace slag
- No. 1 corn cobb grit

For these tests, archived Impoundment 2 material (1:1 HC:VR, by weight) was first heated to 70°C to simulate conditions following thermal treatment, and then ISS reagents were mixed into the material by hand. Visual observations of material stability were used to select ISS reagents for further testing. Based

on the preliminary results, Type I Portland cement, LKD, and CKD were selected for further testing in Phase II.

**Phase II: Initial Testing**

The initial testing phase consisted of four thermally enhanced mixing simulations. Before and during the thermally enhanced mixing process, material aliquots were collected and submitted for laboratory analysis of VOCs to determine baseline conditions and changes to VOC concentrations during treatment. An initial simulation was completed primarily to verify the experimental setup. During subsequent simulations, time course samples were collected at 20-minute intervals over the course of 2 hours after the target temperature was achieved. Sampling operations were supplemented with monitoring of extracted vapor with a flame ionization detector. Temperature in the mixing apparatus was monitored using thermocouples placed in contact with the impoundment materials and within the vapor collection and conveyance tubing.

After thermally enhanced mixing operations were complete, thermally treated material from simulations run at 90°C was removed from the reactor body and subjected to simulated ISS using a number of ISS reagents. Detailed evaluation of the selected ISS reagents (Type I Portland cement, LKD, and CKD) was performed using material treated in thermally enhanced mixing simulations. Before adding a reagent, the thermally treated material was reheated to approximately 70 to 80°C. Reagents were then added at doses of 10% to 15% by weight. Reagents were added dry and in some cases as a slurry prepared with an equivalent mass of water. Materials and reagents were mixed by hand and then compacted into plastic cylindrical molds. Materials were tested to determine post-treatment pH and 21-day UCS.

**Phase III: Confirmatory Testing**

Based on the results of initial testing in Phase II, the following conditions were identified to be repeated during confirmatory testing:

- Treatment of HC/VR material without a preliminary neutralization step
- Thermally enhanced mixing at 90°C
- Simulated ISS treatment with a 15% dose of Type I Portland cement added as a slurry

Two additional test simulations were completed in the confirmatory phase to replicate the most favorable treatment conditions. Methods and analyses were analogous to those described under Phase II: Initial Testing.

Overall, treatment was found to be viable, resulting in reduced benzene concentrations and improved physical properties, including increased compressive strength and pH adjustment to a non-corrosive value. The extent of benzene reduction was a function of temperature and mixing time; treatment at 90°C resulted in a bulk benzene half-life of 1.3 hours. Based on this half-life, 41% reduction of benzene in impoundment material is predicted after 1 hour of mixing time, and 66% reduction is predicted after 2 hours of mixing time. Additional benzene concentration reduction due to dilution is expected following reagent addition. Type I Portland cement at a 15% dose by weight performed the best of the amendments tested, resulting in post-treated materials exhibiting a 21-day UCS ranging from 18.0 to 26.4 psi and pH ranging from 6.64 to 10.54 SU. Reagent performance was not affected by temperature of the heated impoundment material; rapid (flash) setting of the stabilized material, which could complicate application of steam-enhanced ISS at the field scale, was not observed.

#### 2.7.3.3 Mechanical Dewatering Testing

A bench-scale study was performed to evaluate the feasibility of mechanical dewatering to prepare impoundment materials for offsite treatment at a cement kiln or incinerator. This subsection summarizes the results, which are detailed in the *Mechanical Dewatering Bench-Scale Testing Report* (OBG 2016), which is included as Appendix E3. The objectives of this testing included evaluating the

dewatering potential of impoundment material, the potential for shipping the dewatered material as a solid, and options for offsite treatment.

Bench-scale dewatering tests were conducted on material collected from Impoundment 2, including HC and VR material, as well as various VR/HC mixtures. Dewatering was simulated by processing the sampled material through a single-screw meat grinder with an extrusion plate and extrusion tube. Dewatering was evaluated by comparing moisture content of raw and dewatered sample (as analyzed by the Karl Fischer method). The goals of the dewatering tests were to achieve dewatered material that passes a paint filter test (to confirm the material may be classified as a solid) and a moisture content of less than 30%. In addition to the dewatering tests, material was sent to three potential treatment and disposal outlets for evaluation of acceptance criteria and acceptance rates. Testing was performed in OBG's Applied Technology Development Laboratory in Liverpool, New York. To optimize dewatering and handling of raw VR and HC following initial screening, the two materials were mixed at various ratios to evaluate changes in material handling and dewatering efficiency. The primary components of the test are as follows:

- Screening tests
- Dewatering for outlets
- Dewatering of mixed materials

**Screening Tests**

To perform screening tests, the weight of raw material fed to the equipment was recorded. Raw material was fed to the equipment, and dewatered material from the discharge was collected and weighed. The dewatering equipment discharge included a stainless-steel knife, extrusion plate, and 1-1/8-inch-diameter extrusion tube. This configuration was noted as "D1". The dewatering tests utilized this discharge, except for initial screening of VR. During the first screening test of VR, three discharge configurations were used:

- Stainless-steel knife, extrusion plate, 1-1/8-inch-diameter extrusion tube
- Stainless-steel knife, 3/8-inch plate
- Stainless-steel knife, 3/16-inch plate

The data indicated the D1 discharge configuration resulted in the lowest moisture content. The weight and volume of separated aqueous phase was recorded, and the weight of residual material defined as material that remains in the equipment following testing was recorded. With these weight data, and accounting for samples collected during testing, a test recovery (e.g., mass balance) was calculated.

Complete recovery would result in 100%. Recoveries from screening tests were generally greater than 90%. SGS Accutest in Dayton, New Jersey, evaluated moisture content of raw and dewatered material for each test. Screening tests were performed using material at room temperature (62 degrees Fahrenheit [°F] to 67°F) and refrigerated material (46 to 51°F).

**Dewatering for Outlets**

The HC material was successfully dewatered, and the moisture content of the dewatered material ranged from 3.7% to 8.1%. The dewatered HC material passed paint filter testing. The VR material was dewatered with a moisture content ranging from 2% to 4%. The VR material did not pass paint filter testing; however, the moisture content is low, and it may be feasible to remove free liquid using sorbents.

Once it was determined that dewatering the material was feasible, three potential outlets requested representative samples of material for evaluation to develop preliminary acceptance rates. Each 2-gallon sample of dewatered material was generated as a single dewatering test. Similar to the screening trials, weights of material fed and collected from the equipment were recorded to develop a test recovery percentage. Two raw and two dewatered samples were collected for moisture analysis

from each as well as one dewatered sample analysis of flash point. Raw VR material was provided to potential outlets. The moisture content of raw VR (less than 15%) suggests VR may be shipped in the raw form but may require some surface absorbents to manage potential free liquid.

**Dewatering of Mixed Material**

Mixed material generated from the mixing tests (Tests 1, 2, and 3) was dewatered in the same manner as the dewatering for outlet tests. Material from each mixing test (approximately 24 pounds) was dewatered as one dewatering test. The mixed material was successfully dewatered, and the moisture content of the dewatered material ranged from 2.2% to 11.6%. The dewatered material passed paint filter testing. Dewatered material was collected in a plastic-lined tote and then transferred to a 2.5-gallon bucket suitable for shipment to outlets.

Overall, the bench-scale testing and the evaluation of treatment and disposal outlets determined that HC, VR, and mixed materials can be effectively dewatered via standard mechanical methods to produce a material suitable for offsite shipment and acceptance at treatment outlets. If this technology were to be implemented in full-scale, an air monitoring and air emissions management plan would be required so that remedial activities were implemented in an appropriate manner.

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SECTION 3

# Remediation Goals

The following subsections identify the overall remedial objectives used to develop and screen alternatives.

## 3.1 Remedial Action Objectives

In developing RAOs for OU8, the performance result of the selected remedy is to address potential risks associated with the acid tars, or PTW, within a timeframe that is reasonable given the characteristics of the Site. The RAOs for OU8 have been developed to satisfy these expectations with respect to the prevention of exposure to contaminated soil via direct contact, ingestion, or inhalation. RAOs and PRGs will be finalized in the ROD for the Site.

The following are the RAOs:

- Remove, treat, and/or contain material that is considered PTW
- Prevent human exposure (direct contact) to COCs above cleanup levels in soil
- Minimize or reduce current or future migration of COCs from Impoundments 1 and 2 to groundwater

### 3.1.1 Principal Threat Waste

The concept of "principal threats" at a site was established as a part of the NCP (40 CFR 300.430) to help guide the remedy selection process. PTW is generally defined as

> "…those source materials that are considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (*e.g.*, solvents) or materials having high concentrations of toxic compounds."

The acid tars, also referred to as OU8 impoundment materials, within Impoundments 1 and 2 have been identified as PTW.

### 3.1.2 Identification of Areas and Media Volume

The OU8 media targeted for treatment are the materials placed in Impoundments 1 and 2, which have been identified as PTW. The contents of the impoundments include a combination of VR, HC, and other materials. Table 3-1 presents a summary of the information, including approximate volumes of the earthen berm materials.

Table 3-1. Treatment Volume Summary

| | **Impoundment 1** | **Impoundment 2** |
|---|---|---|
| Size | 2.1 acres | 2.3 acres |
| Approximate Depth (feet below surrounding grade) | 5 feet | 5 feet |
| Approximate Height of Berm (feet above surrounding grade) | 10 feet | 10 feet |
| Approximate Water Cap Volume (assuming 3-foot depth) | 2.1 million gallons | 2.3 million gallons |
| Approximate volume of Impoundment Material to be Treated (PTW) | 24,200 $yd^3$ | 30,300 $yd^3$ |
| Approximate Volume of Berm Material | 35,000 $yd^3$ | 35,000 $yd^3$ |

### 3.1.3 Preliminary Remediation Goals for Soil and Clay Impacted by OU8 Impoundment Material

PRGs are Site-specific, quantitative goals that define the extent of remediation required to achieve the established RAOs. In general, PRGs are conservative, media-specific concentrations of COCs that are protective of human health and the environment. In-place closure remedies are designed to be protective of human health and the environment by solidifying material into a monolith and thus eliminating exposure. However, under a removal scenario, soil and clay impacted by OU8 impoundment material containing COCs or even PTW may be encountered within the berms or underlying the impoundments. To make sure remedial alternatives are protective of human health and the environment, PRGs have been developed to determine when soil and clay impacted by OU8 impoundment material require treatment.

PRGs for Site-wide soil have been established under the OU4 ROD and were found to also be applicable for OU8 to address potential exposure to receptors. Soil and clay impacted by OU8 impoundment material exceeding PRGs identified in Table 3-2 will be treated using ISS and managed in place with engineering controls (i.e., capping). Soil and clay impacted by OU8 impoundment material with COC concentrations below the PRGs identified in Table 3-2 can be managed in place with engineering controls, but without treatment. Therefore, Table 3-2 summarizes the PRGs for COCs in soil and clay impacted by OU8 impoundment material within the physical limits (i.e., toe of the berms) of Impoundments 1 and 2.

Table 3-2. PRGs for Soil and Clay Impacted by OU8 Impoundment Material

| Contaminant of Concern | Preliminary Remediation Goal |
|---|---|
| Benzene | 4,460 mg/kg |
| Nitrobenzene | 12,300 mg/kg |
| Naphthalene | 6,180 mg/kg |
| Toluene | 460,000 mg/kg |
| Xylene | 25,000 mg/kg |

## 3.2 Identification of ARARs and To Be Considered Criteria

The following subsections describe the identification of ARARs and “to be considered” (TBC) criteria relevant to this FFS.

### 3.2.1 Potential ARARs and TBC Criteria

Section 121 of CERCLA provides that site cleanups attain or obtain waivers of federal ARARs, or with state ARARs in cases where these requirements are more stringent than federal requirements. Under CERCLA, permits are not required for actions conducted onsite; however, the substantive requirements of the associated ARARs will generally be applicable to remedial actions. ARARs are derived from both federal and state laws. Under CERCLA Section 121(d)(2), the federal ARARs for remedial action could include requirements under any of the federal environmental laws. Federal and state regulators are provided the opportunity to review this document and comment on the applicability, relevance, or appropriateness of the potential ARARs.

As indicated in USEPA’s guidance for conducting remedial investigations, ARARs may be either “applicable” or “relevant and appropriate.” Distinct from ARARs, USEPA’s regulations also acknowledge

TBC criteria, which may be helpful in evaluating remedies, but for which compliance is not required (USEPA 1988). Definitions of ARARs and TBC criteria are as follows:

- "Applicable" requirements are defined in 40 CFR 300.5 as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable." A requirement is applicable if the specific terms of the statute or regulation directly address the circumstances at the site. If not applicable, a requirement may be relevant and appropriate if circumstances at the site are sufficiently similar to the circumstances regulated by the requirement. How ARARs are developed is discussed in 40 CFR 430.
- "Relevant and appropriate" is defined in 40 CFR 300.5 as "those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate." The relevance and appropriateness of a requirement can be judged by comparing a number of factors including the characteristics of the remedial action, the items in question, or the physical circumstances of the site, with those addressed in the requirement. If there is sufficient similarity between the requirements and circumstances at the site, determination of the requirement as relevant and appropriate may be made. Determining whether a requirement is both relevant and appropriate is a two-step process. First, to determine relevance, a comparison is made between the response action, location, or chemicals covered by the requirement and related conditions at the site, release, or potential remedy. A requirement is relevant if it generally pertains to these conditions. Second, to determine whether the requirement is appropriate, the comparison is further refined by focusing on the nature of the items, the characteristics of the site, the circumstances of the release, and the proposed response action. The requirement is appropriate if, based on such comparison, its use is well suited to the particular site. The facility must comply with requirements that are determined to be both relevant and appropriate. How ARARs are developed is discussed in 40 CFR 430.
- TBC criteria, defined in 40 CFR 300.400(g)(3), are advisories, criteria, or guidance developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies. They are neither promulgated nor enforceable; however, they may be useful for determining protectiveness or how a remedial action could be performed. A requirement may not meet the definition of an ARAR as previously described, but might still be useful in determining whether to take action at a site or to what degree action is necessary. This can be particularly true when there are no ARARs for a site, action, or COC. Although TBC criteria do not have the status of ARARs, they are considered together with ARARs to establish the required level of cleanup for protection of health or the environment. The critical difference between a TBC criterion and an ARAR is that the responsible party is not required to comply with or meet a TBC criterion when choosing a remedial action.

ARARs that govern actions at CERCLA sites fall into three broad categories based upon the COCs present, site characteristics, and alternatives proposed for cleanup. These three categories (action-specific, location-specific, and chemical-specific) are described as follows:

- Action-specific ARARs define acceptable treatment and disposal procedures for hazardous substances (USEPA 1988). These ARARs generally set performance, design, or other similar action-

specific controls or restrictions on particular kinds of remedial activities. An example might be a state air quality management authority that sets limitations on fugitive dust generated because of grading and excavation activities during a remedial action.

- Location-specific ARARs govern activities in certain environmentally sensitive areas (USEPA 1988). These requirements are triggered by the particular location and the proposed activity at the site. Location-specific ARARs, e.g., focus on wetland or floodplain protection areas, or on archaeologically significant areas.
- Chemical-specific ARARs include those environmental laws and regulations that regulate the release to the environment of materials with certain chemical or physical characteristics or that contain specified chemical compounds (USEPA 1988). These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances by media. Chemical-specific ARARs are triggered by the specific COCs found at a particular site.

## 3.2.2 ARARs and TBC Criteria Considered in this FFS

The ARARs and TBC criteria for this FFS were identified by reviewing federal and state regulations for hazardous waste, air, surface water, and soil; federal and state regulations relating to activities within a designated 100-year floodplain, as well as wetlands, and activities in areas requiring permits (or equivalents), such as the Nationwide Permit Program under Section 404 of the federal Clean Water Act; and the requirements of the Administrative Settlement Agreement (USEPA 2013a). Action-specific, location-specific, and chemical-specific ARARs and TBCs are discussed in the following sections along with regulations specific to the CAMU.

### 3.2.2.1 Action-Specific ARARs and TBCs

Most action-specific ARARs and TBC information address treatment, transportation, and disposal of hazardous waste. Table 3-3a includes descriptions of action-specific ARARs that may be associated with potential remedial actions. A discussion of ARAR compliance for specific remedial alternatives is included in Section 5.

### 3.2.2.2 Location-Specific ARARs and TBCs

The location-specific ARARs and TBCs were developed based on consideration of the following:

- Floodplains and Wetlands - The majority of remediation activities in OU8 would be conducted in the floodplain, much of which are classified as wetlands (Figure 3-1). The federal and state ARARs and TBC materials associated with protecting floodplains and wetlands during remedial activities are listed in Table 3-3b.
- Historic and Cultural Resources - Cultural resources were reviewed, and it has been concluded that no cultural resources existed on the property.
- Rare, Threatened, or Endangered Species - The 1992 BEA (BBL 1992) concluded that there are no threatened or endangered species onsite.

### 3.2.2.3 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs define concentration limits for environmental media. Chemical-specific ARARs are listed in Table 3-3c. The treatment performance criteria developed for use in the alternative screening process are characterized as TBC criteria and discussed in further detail in Section 4.5.

### 3.2.2.4 Corrective Action Management Unit

In 1998, USEPA designated the Impoundment #8 Facility as a CAMU (NJDEP 1998; American Home Products Corporation 1995a, 1995b, 1996; USEPA 1995). The 1998 OU3 ROD states that the CAMU was to be used for consolidation of wastes of the Group III impoundments which included Impoundments 1

and 2. Ultimately, most of the OU3 ROD was not implemented because of concerns regarding the generation of toxic air emissions during the performance of the various remedies. Nonetheless, the CAMU has continued to be used for consolidation of treated materials from the Group III impoundments since the implementation of the OU3 ROD stopped. The CAMU, therefore, remains operative (see Section 1.3.1).

After review of the CAMU operating criteria, the CAMU remains subject to the 1993 regulations for CAMUs, which were in effect at the time the CAMU was designated. Although the 1993 regulations were revised in 2002, USEPA has advised that all pre-existing (built prior to the 2002 ruling) CAMUs remain subject to the 1993 CAMU rule for the life of the CAMU ‘‘so long as the waste, waste management activities, and design of the CAMU remain within the general scope of the CAMU as approved’’ (USEPA 2002). Since the CAMU was designated for the consolidation of wastes from the Group III impoundments, which included Impoundments 1 and 2, placement of wastes from these impoundments remains within the scope of USEPA’s prior designation as a CAMU.

Based on an assessment of the 1998 OU3 ROD and 40 CFR 264.551, the ARARs for placing material from Impoundments 1 and 2 into the CAMU are treatment prior to placement and liner compatibility. ARARs specific to use of the CAMU are included in Table 3-3a. These ARARs were the basis for establishing the performance criteria for alternatives involving placement of treated impoundment material into the CAMU discussed in this FFS; refer to Appendices A and C and see Section 4.3.

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**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| ***FEDERAL*** | | | | | | | | |
| Air Emissions | National Emissions Standards for Hazardous Air Pollutants (NESHAP): Site Remediation<br>40 CFR 63 Subpart G | X | X | X | X | Relevant and Appropriate | Provides specific design and operating requirements for tanks, process vents, surface impoundments, oil/water and organic/water separators, and transfer systems for site remediations that emit hazardous air pollutants (HAPS) including benzene. Also includes requirements for performance testing, site-specific air monitoring, and records. | Incorporate air emissions controls into the design of the remediation system and into moving materials to the treatment systems. Also incorporate performance testing, air monitoring system, and required records. |
| Air Emissions | National Emissions Standards for Hazardous Air Pollutants (NESHAP): Benzene Waste Operations<br>40 CFR 61 Subpart F | X | X | X | X | Relevant and Appropriate | Provides specific design and operating requirements for tanks, surface impoundments, containers, individual drain systems, oil/water separators, treatment process, closed vent systems and control devices. Also includes requirements for specific monitoring of carbon adsorption units, thermal treatment, by-pass lines, vacuum systems, etc. Monthly samples and continuous emissions monitoring are required depending on the design. | Incorporate requirements into the design of the remediation system, including the air emissions treatment system. Also incorporate equipment monitoring requirements, and required records. |
| Air Emissions | NSPS for Compression Ignition Engines<br>40 CFR 60 Subpart I<br>NSPS for Spark Ignition Engines<br>40 CFR 60 Subpart J<br>NESHAP for Stationary Reciprocating Internal Combustion Engines<br>40 CFR 63 Subpart Z | X | X | X | X | Applicable if stationary engines of a certain size are used during remediation | Specific emissions limitations and fuel requirements apply to engines of a certain size and after certain manufacturing dates. | Generators and similar engines may be used during remediation. Design specifications should state that any engines used on site should comply with these regulations. |
| Hazardous Waste Accumulation | Hazardous Waste Generator Standards<br>40 CFR 262, adopted by NJAC 7:26G-6.1 | X | X | X | X | Applicable, if hazardous wastes are generated | Provides specific requirements for generator hazardous waste management in tanks, containers, and containment buildings. Includes items such as labeling, inspections, emergency preparedness/response, coordination with local response agencies, etc.<br><br>Also includes requirement to comply with the RCRA air emissions control regulations for tanks and containers in 40 CFR 265 Subpart CC. | The remedial action specifications will require hazardous waste generated will be stored in a manner that meets the hazardous waste generator requirements. |
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and<br>Disposal Facilities (TSDFs) – General Facility Standards<br>40 CFR 264.10–264.19, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are generated | Provides general facility requirements including general waste analysis, security measures, inspections, and training requirements. | Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained. |
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Preparedness and Prevention<br>40 CFR 264.30–264.37, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are managed | Outlines the requirements for safety equipment and spill control. | Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site. |
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Contingency Plan and Emergency Procedures<br>40 CFR 264.50–264.56, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are managed | Outlines the requirements for emergency procedures to be used following explosions, fires, etc. | Contingency and Emergency Procedures Plans will be developed and implemented during remedial action. Copies of the plans<br>will be kept on site. |
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Use and Management of Containers<br>40 CFR 264.170–264.179, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are managed | Outlines the requirements for managing hazardous waste in containers, including inspections, containment, closure, and air emissions requirements. | |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Tank Systems<br>40 CFR 264.190–264.200, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are managed | Outlines the requirements for managing hazardous waste in tanks, including specific design, installation, and PE certification of new tank systems; containment and detection of releases; general operating requirements; inspections (such as weekly visual inspections of all hazardous waste piping); response to leaks or spills or unfit equipment; closure/post-closure care; special requirements for ignitable wastes; and air emissions standards. | Approximately 300,000 gallons of NAPL will be generated and recycled. This material will probably be a hazardous waste and will probably need to be accumulated in tanks. Contract specifications will address hazardous waste tank design requirements. |
| Hazardous Waste Management | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Air Emissions Standards for Process Vents<br>40 CFR 264 Subpart AA, adopted by NJAC 7:26G-8.1<br>Air Emissions Standards for Equipment Leaks<br>Air Emissions Standards for Process Vents<br>40 CFR 264 Subpart BB, adopted by NJAC 7:26G-8.1<br>Air Emissions Standards for Tanks, Surface Impoundments, and Containers<br>40 CFR 264 Subpart CC, adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if hazardous wastes are managed | Requires specific emissions control and monitoring requirements for various types of equipment, tanks, containers, and surface impoundments managing hazardous wastes with volatile organic compounds at certain levels. | Incoporate requirements in design of treatment systems |
| Onsite Storage of Excavated Soil/Wastes | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Staging Piles<br>40 CFR 264.554 | X | X | X | X | Applicable if hazardous wastes are managed | A stockpile is a more temporary solution for stocklpiling and handling hazardous remediation waste before offsite disposal or before movement to a CAMU. A staging pile is defined as "an accumulation of solid, non-flowing remediation waste that is not a containment building and is used only during remedial operations for temporary storage at a facility. Wastes stored in a staging pile do not need to meet LDRs, and staging piles are not a RCRA unit subject to minimum technological requirements. For the purposes of staging piles, "storage" includes mixing, sizing, blending, or other similar physical operations as long as they are intended to prepare the wastes for subsequent management or treatment. Wastes are only temporarily stored in a staging pile and once removed from a staging pile become subject to LDR treatment standards unless moved to a CAMU. Specific staging pile design standards include: 2 year limit from first use, preventing runoff and air emissions from the pile, PE certification of the design, clean closure after operation is complete (if located in an uncontaminated area), etc. | |
| Hazardous Waste Disposal | Land Disposal Restrictions (LDRs)<br>40 CFR 268, adopted by NJAC 7:26G-11.1 | X | X | X | X | Applicable, if hazardous wastes are generated | Restricts land disposal of hazardous wastes by establishing treatment standards that must be achieved prior to land disposal. | As indicated in the CAMU regulations, LDRs do not apply to hazardous wastes placed in CAMUs (see 40 CFR 264.551[a][1] and 264.552[a][4]).<br><br>If hazardous wastes are managed and sent offsite for disposal, LDRs must be met before wastes can be land disposed of offsite. |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Hazardous Waste Sent for Recycling | Hazardous Secondary Material<br>40 CFR 261.4(a)(23) and 261 Subpart M | X | X | X | X | Relevant and Appropriate | Hazardous wastes which are exempt from the hazardous waste rules by being sent for recycling must be stored in a certain manner, and the facility the waste is sent to for recycling must be a "verified" reclamation facility. | The federal regulation goes into effect on July 13, 2015, and must be adopted by NJDEP before it is applicable in New Jersey.<br><br>Alternatives 7 and 8 will send approximately 300,000 gallons of LNAPL for recycling. Any recycler used will be evaluated as a "verfied" reclamation facility before NAPL is sent for recycling. "Verified" reclamation facilities must demonstrate:<br>• financial assurance,<br>• legitimate HSM reclamation,<br>• residuals are properly disposed,<br>• appropriate training and emergency preparedness/response capabilities,<br>• release risk to nearby receptors,<br>• no enforcement actions, and<br>• not be classified as a significant non-complier with RCRA Subtitle C. |
| Transport of Hazardous Materials | Hazardous Materials Transportation<br>49 CFR Subchapter C | | | X | X | Applicable | Transportation of DOT hazardous materials/treated materials from Impoundments 1 and 2 to the CAMU will be within and along a public road bounding the Pfizer facility. 49 CFR Subchapter C (49 CFR 170 through 179) discuss requirements for hazardous materials in transport such as HazMat employee training requirements (49 CFR 172 Subpart H) and design requirements for containers used to ship hazardous materials (49 CFR 178). | Contract specifications will require that personnel who load/unload, and otherwise affect transportation of hazardous materials to be trained to 49 CFR 172 Subpart H and to handle the hazardous materials per the DOT requirements and that containers used for transport meet DOT requirements. (Hazardous wastes do not need to be manifested since the transport is within or along a public round bounding the facility [40 CFR 262.20{f}]). |
| Hazardous Waste Left in Place | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Ground Water Monitoring<br>40 CFR Part 264.90-264.101, as adopted by NJAC 7:26G-8.1 | X | X | X | | Applicable, if hazardous wastes are left in place | Groundwater monitoring is required for hazardous wastes left in place. Ground water protection requirements include:<br>• establishment of a detection monitoring program (264.98)<br>• establishment of a compliance monitoring program (264.99), and<br>• a corrective action monitoring program (264.100) when required by 40 CFR 264.91. All monitoring programs must meet RCRA general ground water monitoring requirements (264.97). | Must demonstrate through treatment, removal and/or leave-in-place option that groundwater is being protected. |
| Hazardous Waste Left in Place | Standards for Owners and Operators of Hazardous Waste TSDFs –<br>Landfill Capping<br>40 CFR Part 264.310, as adopted by NJAC 7:26G-8.1 | X | X | X | | Applicable, if hazardous wastes are left in place | Placement of a cap over waste requires a cover designed to :<br>• provide long-term minimization of migration of liquids through the capped area,<br>• function with minimum maintenance,<br>• promote drainage and minimize erosion or abrasion of the cover,<br>• accommodate settling and subsidence so that the cover's integrity is maintained, and have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. | If treated material is excavated and existing CAMU is utilized or a leave-in-place option is utilized, these alternatives would be subjected to the requirements |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Hazardous Waste Left in Place | Standards for Owners and Operators of Hazardous Waste TSDFs – Surface Impoundment Closure 40 CFR 264.228(a), adopted by NJAC7:26G-8.1 | X | X | X | | Applicable, if hazardous wastes are left in place | Surface impoundments must be closed by:<br>• Eliminate free liquids by removing liquid wastes or solidifying the remaining wastes and waste residues;<br>• Stabilize remaining wastes to a bearing capacity sufficient to support final cover; and<br>• Cover the surface impoundment with a final cover designed and constructed to:<br>- Provide long-term minimization of the migration of liquids through the closed impoundment;<br>- Function with minimum maintenance;<br>- Promote drainage and minimize erosion or abrasion of the final cover;<br>- Accommodate settling and subsidence so that the cover's integrity is maintained; and<br>- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. | The engineered cover will be subjected to design requirements that will meet these requirements. |
| Hazardous Waste Left in Place | Standards for Owners and Operators of Hazardous Waste TSDFs – Closure and Post Closure 40 CFR 264 Subpart G, adopted by NJAC 7:26G-8.1 | X | X | X | | Applicable, if hazardous wastes are left in place | If hazardous wastes are left in place, post-closure care must be conducted for 30-years unless demonstrated otherwise by the owner. Postclosure care includes monitoring and maintaining cover and waste containment system integrity, and performing groundwater monitoring and maintaining the groundwater monitoring system. | |
| Use of CAMU | Standards for Owners and Operators of Hazardous Waste TSDFs – Grandfathered Corrective Action Management Unit (CAMUs) 40 CFR 264.551, adopted by NJAC 7:26G-8.1 | | | X | | Applicable if Impound 8 CAMU is used | Impoundment 8 has been designated a CAMU by EPA and NJDEP. The CAMU is a grandfathered CAMU subject to the requirements of 40 CFR 264.551, and is designed to facilitate remediation at the site. Requirements include treatment, liner compatability, and meeting closure and post closure requirements and groundwater monitoring. The approved Closure Plan includes the requirement to cap the CAMU. | A Closure Plan and a Post Closure Plan for the CAMU have been approved by the regulatory agencies and would be implemented once the CAMU is no longer needed, e.g., sometime after Impoundments 1 and 2 materials were placed in the CAMU. Groundwater monitoring is performed as required in the groundwater monitoring plan that meets Agreed Order requirements. |
| CAMU Cap Design | Standards for Owners and Operators of Hazardous Waste TSDFs – New CAMUs 40 CFR 264.552, as adopted by NJAC 7:26G-8.1 | X | X | X | X | Relevant and Appropriate, if Impound 8 CAMU is used | Under 40 CFR 264.552 regulations CAMUs must have a cap that:<br>(1) Provides long-term minimization of migration of liquids through the closed unit;<br>(2) Functions with minimum maintenance;<br>(3) Promotes drainage and minimize erosion or abrasion of the cover;<br>(4) Accommodates settling and subsidence so that the cover's integrity is maintained; and<br>(5) Has a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present. | The engineered cover for the Impound 8 CAMU will be subjected to design requirements that will meet these relevant and appropriate requirements. |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Solid Waste Cap Design | Solid Waste Closure Cover Design<br>40 CFR 258.60 | X | X | X | X | Relevant and Appropriate, if solid wastes left in place | Solid waste disposal unit caps must be designed and constructed to:<br>• Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less, and<br>• Minimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum 18-inches of earthen material, and<br>• Minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth. | NJDEP is delegated authority for solid waste regulations (see NJAC 7:26-2A below), but has not adopted the Federal solid waste regulations exactly. |
| Solid Waste Left in Place | Solid Waste Post-Closure Care<br>40 CFR 258.61 | X | X | X | | Relevant and Appropriate, if solid wastes are left in place | If solid wastes are left in place, post-closure care must be conducted for 30-years unless demonstrated otherwise by the owner. Postclosure care includes maintaining cover integrity, maintaining gas and leachate collection systems, and groundwater monitoring and maintaining the groundwater monitoring system. | |
| Hazardous Materials Onsite | Hazardous Chemical Reporting Community Right-To-Know<br>40 CFR 370 | X | X | X | X | Applicable, if materials with an MSDS are onsite | Notification of the presence of hazardous chemicals to State Emergency Planning Commissions, and to local Emergency Planning Committees if the hazardous chemical is present in quantities greater than a regulatory specified amount. | |
| Oils Onsite | Spill Prevention Control and Countermeasures Planning<br>40 CFR 112 | X | X | X | X | Applicable, if >1,320 gallons of oils are stored onsite | SPCC Plans are required for a facility whenever there is 1320 gallons or more of oil in 55-gallon or larger containers or equipment. As used in this regulation, the definition of oil is very broad, and the NAPL may meet the definition of oil. Specific requirements in 40 CFR 112 include 100% secondary containment (with allowance for rainfall) with overfill prevention for each oil container/tank, security and adequate lighting, monthly inspections of containers and tanks, general secondary containment for the expected spill for loading and unloading areas (drainage from these areas should be directed away from a water body), etc. If there is more than 10,000 gallons of oil stored, then the Plan has to be stamped by a Professional Engineer. | |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| ***STATE*** | | | | | | | | |
| Air Emissions | Permits and Certifications for Minor Facilities (and Major Facilities without an Operating Permit)<br>NJAC 7:27-8 | X | X | X | X | Applicable | Provides requirements for obtaining a permit for air emissions. Remediation under CERCLA is defined as an exempt activity under this regulation:<br>"Exempt activity" means one of the following:...<br>13. Equipment or a source operation being used in a site remediation process that is being carried out under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 42 U.S.C. §§ 9601 et seq.;"<br><br>Note that NJDEP has said that cement batch plants and associated materials handling equipment at construction sites require a permit (NJDEP Air Quality interpretive memo, January 26, 2010); grout plants are usually considered a type of concrete batch plant.<br>Particulate matter (dust) emissions usually need permit equivalents.<br>Group 1 toxics (TXS) (including benzene) emissions are also regulated and may need a permit equivalent, if the source has the potential to emit more than 0.1 lb/hr of Group 1 and Group 2 TXS. Equipment used to treat "waste soils" is also regulated and may need a permit equivalent.<br>In addition, if excessive odors are expected, a preconstruction permit equivalent and operating certificate equivalent may be needed. | |
| Air Emissions | Ambient Air Quality Standards<br>NJAC 7:27-13.3 | X | X | X | X | Applicable | Provides ambient air quality standards for suspended particulate matter. Primary air quality standards state that, during any 12-consecutive months, the geometric mean value of all 24-hour averages of suspended particulate matter concentrations in ambient air shall not exceed 75 micrograms per cubic meter. And, during any 12-consecutive months, 24-hour average concentrations may exceed 260 micrograms per cubic meter no more than once. | Air emissions could be caused by grading, excavation, etc. Primary air quality standards means an ambient air quality standard intended to protect the public health. |
| Air Emissions | Control and Prohibition of Air Pollution by Toxic Substances<br>NJAC 7:27-17 | X | X | X | X | Relevant and Appropriate | Prohibits discharges of Table 1 toxic substances (including benzene) unless the discharge has an effective stack height is at least 40 feet above grade, is 20 feet higher than any human use (including buildig roofs), is directly upwards, and has no downard wash.<br>Emission must be controlled in accordance with NJDEP source registration requirements.<br>Applies to any transfer operation that exceeds 0.1 lbs/hour emissions. | Toxic substance air emissions could be caused by grading, excavating, and COC removal. |
| Air Emissions | Control and Prohibition of Air Pollution by Volatile Organic Compounds<br>NJAC 7:27-16 | X | X | X | X | Applicable | Any stationary source or group of sources must use reasonably available control technology (RACT) to control VOC emissions. Emissions control and management requirements are specified for tanks, and depend on the size and the type of tank (including addressing tank loading, inspection, and emissions calculations). Additional emissions calculations and control are required for other source operations. | |
| Noise | Noise Control Act<br>NJSA 13:1G<br>NJAC 7:29-1 | X | X | X | X | Applicable | The established sound level standards are 50 decibels during nighttime (10:00 p.m. to 7:00 a.m.) and 65 decibels during daytime. Additional specific decibel limits are provided in the regulation | |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Solid Waste Left in Place | Solid Waste<br>General Engineering Design Requirements<br>NJAC 7:26-2.10 (i) | X | X | X | X | Relevant and Appropriate | A final cover system shall comply with the<br>following performance standards:<br>i. The permeability of the final cover shall be less than or equal to that of the bottom liner system or natural subsoils present, or 1 x 10[-5] cm/sec., whichever is less. The depth of final cover shall be a minimum of 18 inches overlain by a minimum of a six inch erosion layer.<br>ii. If the landfill has a synthetic membrane in the bottom liner system, then the final cover shall include a synthetic membrane.<br>(1) The synthetic membrane of the final cover does not have to be the same type or thickness as the membrane in the bottom liner system. However, a minimum thickness of 30 mils shall be used. In the case of High Density Polyethylene, a minimum thickness of 60 mils is required to ensure proper seaming of the synthetic membrane.<br><br>Side slopes must no more than 3:1, except as specified in the regulations. The final grades of the final cover system shall have a surface drainage system capable of conducting run-off across the final grades without the development of erosion rills or gullies. The cover shall accommodate initial settlement so that the integrity of the impermeable liner is maintained throughout the closure and post-closure period. | |
| Solid Waste Left in Place | NJDEP Solid Waste Regulations (e.g. closure and post closure care of sanitary landfills)<br>NJAC 7:26 -2A.9 | X | X | | | Relevant and Appropriate, if solid wastes left in place | Requires preparation of a Closure and Post-Closure Plan that includes a soil erosion and sediment control plan, a final cover design, final cover vegetation, maintenance plan, ground water monitoring, and facility access control. | Similar to past closures of other impoundments on site, Impoundments 1 and 2 would be subject to similar requirements. This is not specific to a CAMU, but many of the specifics wuld be similar |
| Storm Water Discharges | Storm Water Permit Requirements<br>NJAC 7:14A-24.7 | X | X | X | X | Applicable, if the area disturbed is ≥ 1 acre | Specific stormwater management procedures (e.g., a stormwater pollution prevention plan [SPPP], stormwater best management practices [BMPs]) must be implemented to minimize the potential for erosion and sediment to migrate to a water body. The SPPP should include a construction site waste control component, addressing material management to prevent or reduce waste, waste handling, and spills, discharges of hazardous substances, and federally reportable releases (see Seciton J.2 through J.4 of General Permit No. NJ0088323). A NPDES construction stormwater permit equivalent should be obtained | If more than 1 acre is disturbed during remedial activities, a stormwater permit equivalent will be obtained. |
| Construction Storm Water | Soil Erosion and Sediment Control Act<br>NJAC 2:90, et-seq, and 4:24 | X | X | X | X | Applicable | Provides soil erosion and sediment control measures, including vegetative, engineering, and runoff treatment standards to prevent or limit soil erosion and promote sediment control on and off-site. | This act will be considered during the development of alternatives. A soil erosion and sediment control plan may be developed and filed with Somerset County Soil Conservation District, if required. |
| Hazardous Materials Onsite | Hazardous Chemical Reporting Community Right-To-Know<br>NJAC 7:1G-5.1 | X | X | X | X | Applicable, if ≥10,000 lbs of materials with an MSDS are onsite | Notification of the presence of hazardous chemicals by March 1 electronically to NJDEP, and by hard copys to the local Police Department, Fire Department, County Right-to-Know Lead, and the local Emergency Planning Committee | |
| Site Investigation / Remediation | Technical Requirements for Site Remediation<br>NJAC 7:26E | X | X | X | X | Applicable | Provides minimum technical requirements to remediate contamination. Administrative requirements, including specific wording of deed notices, is provided in NJAC 7:26C | NJDEP is involved in the site as a state regulator. |

**Table 3-3a. Summary of Action-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Activity | Requirement / Citation | Alternative 3 ISS Treatment, Inner HBW, Protective Cover | Alternative 4 Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5 Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6 Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| Hazardous Materials Onsite | Spill Compensation and Control Act<br>NJSA 58:10-23.11<br>NJAC 7:1E | X | X | X | X | Applicable | The facility could be considered a major facility if there are more than 20,000 gallons of hazardous material stored at any one time; the NAPL may collected may exceed this quantity. A discharge prevention, control, and countermeasure (DPCC) Plan reviewed and certified by a Professional Engineer is required for major facilities. This Plan is similar to an SPCC Plan (see Federal requirement above) Requirements include testing and inspection of aboveground storage tanks, secondary containment, high level alarms, trainign employees, maintaining security, lkeeping required records, developing standard operating procedures, and related requirements.<br><br>A discharge response, cleanup, and removal contingency plan is also required, which includes having trained personnel and adequate quantities of emergency equipment should an incident occur.<br><br>NJAC 7:1E-5 requires that discharges of hazardous substances must be reported by calling the NJDEP emergency line, 1-877-927-6337) within 15 minutes of discovery. A written discharge confirmation report must also be submitted to NJDEP. Surface water quality criteria non-compliances must also be reported to the NJDEP emergency line. | |
| ***LOCAL*** | | | | | | | | |
| Soil Disturbance | Township of Bridgewater, NJ Code<br>Chapter 126, Land Use<br>Article XXXVI, Soil Erosion | X | X | X | X | Applicable | Disturbance of more than 5,000 square feet of soil requires a Soil Erosion and Sediment Control Plan approved and certified by the Bridgewater Township Engineer or by Somerset-Union Soil Conservation District. | |

**Table 3-3b. Summary of Location-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Location | Requirement / Citation | Alternative 3<br>ISS Treatment, Inner HBW, Protective Cover | Alternative 4<br>Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5<br>Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6<br>Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| ***FEDERAL*** | | | | | | | | |
| Surface Water/ Wetlands | CWA Section 404<br>40 CFR 230, Guidelines for Specifications of Disposal Sites for Dredged or Fill Materials, and 33 CFR 322, Permits for Structures in or Affecting Navigable Waters of the US | X | X | X | X | Relevant and Appropriate, if wetlands are disturbed in non-delegable waters | Section 404 regulates the discharge of dredged or fill material into waters of the United States, including wetlands. If Impoundments 1 and 2 are located in wetlands areas, they may be subject to the requirements discussed in Nationwide General Permits NWP-33 Temporary Construction, Access, and Dewatering, an NWP-38 Cleanup of Hazardous and Toxic Waste.<br><br>Enhancement, restoration, creation, or replacement of wetlands should be based on functional equivalence. Mitigation should be based on an EPA assessment of the values provided by the wetland.<br><br>NJDEP is responsible for administering the Section 404 Program for delegable freshwaters in NJ under the NJ Freshwater Wetlands Protection Act. Projects in non-delegable waters are required to meet the requirements of both Section 404 and NJ Freshwater Wetlands Protection permit equivalent. | Determine if Impoundments 1 and 2 are within non-delegable waters.<br><br>NWP-33: fill must be placed in a manner that it will not be eroded by expected high flows. Affected areas must be restored to pre-construction elevations to the extent practicable, and revegetated as appropriate.<br>NWP-38: follow regulatory-approved remedial action plans. |
| Historic Area | National Historic Preservation Act<br>16 USC 470 and<br>New Jersey Municipal Land Use Law | X | X | X | X | Applicable, if a historic resource is present | Action required to preserve historic properties, planning of actions to minimize harm to National Historic Landmarks. Avoid impacts on culturate resources. Where impacts are unavoidable, mitigate through design and data recovery. | The ERA concluded no cultural resources existed on the property. |
| Endangered Species or Critical Habitat | Endangered Species Act<br>16 USC Sec. 1536(a)(2 and(c), 1538(a)(1);<br>Fish and Wildlife Coordination Act<br>16 USC 661 et seq.<br><br>50 CFR 17.11-17.12<br>50 CFR 402 | X | X | X | X | Applicable, if listed species or critical habitat is identified | Remedial activities must not threaten endangered or threatened species or critical habitat. If remedial actions may impact listed species or critical habitat, a consultation should be held with the Department of Interior.<br><br>Though on-site actions are not required to meet the administrative/procedural requirements of the Act (e.g., consultation), consultation will be completed as needed to verify compliance with substantive requirements if listed species or critical habitat is identified. | The ERA concluded that there are no endangered species on the site. Incorporated in the BERA. |
| Migratory Bird Habitat | Migratory Bird Treaty Act<br>16 USC 703-712 | X | X | X | X | Applicable, if migratory birds are identified during the action | Prohibits the taking, possessing, buying, selling, or batering of any migratory bird, including feathers or other parts, nests, eggs, or products except as allowed by regulations. This includes disturbing nesting birds. | |
| Treated Impoundment Material Placement Location | Location Standards for New Hazardous Waste Facilities<br>40 CFR 264.18, adopted by NJAC 7:26G-8 | X | X | X | X | Relevant and Appropriate, if a hazardous wastes are left in place | Hazardous waste facilities must not be located within 200' of a fault that has moved in Holocene times and, if located within the 100 year floodplain, must be designed, constructed, and maintained to prevent washout of any hazardous waste by a 100-year flood. | This ARAR would be met by specifying the substantive requirements in the remedial design and by maintaining compliance with the requirements through remedial action monitoring |
| Hazardous Waste Accumulation Area | Hazardous Waste: Use And Management of Containers, Special Requirements for Ignitable and Reactive Wastes<br>40 CFR 264.176, adopted by NJAC 7:26G-8 | X | X | X | X | Applicable, if ignitable hazardous wastes are generated | Hazardous waste accumulation areas holding ignitable or reactive wastes must be more than 50' from the property line. | Any hazardous wastes generated would be accumulated or stored more than 50' from the property line. |

**Table 3-3b. Summary of Location-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Location | Requirement / Citation | Alternative 3<br>ISS Treatment, Inner HBW, Protective Cover | Alternative 4<br>Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5<br>Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6<br>Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| ***STATE*** | | | | | | | | |
| Wetlands | Freshwater Wetlands Protection Act Rules<br>NJAC 7:7A | X | X | X | X | Applicable | Flood hazard area is defined as land, and the space above that land, which lies below the flood hazard area design flood elevation. The flood hazard design flood is equal to the 100-year flood plus an additional amount of water in fluvial are. Any disturbance, dredging, fill, construction, plant life destruction, or similar activity in freshwater wetlands is required to have a Freshwater Wetlands Protection Act permit equivalent.<br><br>A permit equivalent issued under the Freshwater Wetlands Protection Act Rules is also considered a CWA 401 Water Quality Certification. | NJDEP provided a wetlands letter of interpretation dated December 12, 2011. The letter identified wetlands of intermediate value and wetlands of exeptional value in the area of Impoundments 1 and 2. The transition area of these wetlands extends across most of the northern, all of the eastern, and most of the southern berm of Impoundments 1 and 2. Regulated activities such as construction in the wetlands and transition areas require a permit equivalent. |
| Floodplains | Flood Area Hazard Control Act Regulations<br>NJAC 7:13 | X | X | X | X | Applicable | A Stream Encroachment and Sediment Control (SESC) permit equivalent is needed for construction within a flood hazard area.<br><br>NJAC 7:13-15.5 address engineering calculations and requirements to be documented in an Environmental Report | The regulations define the entire extent of the Impoundment 2 berms and the northern- and northeastern-most corners of the Impoundment 1 berms to be in the flood fringe. The remainder of the Impoundment 1 berm is in the floodway. Armoring (Alt 6) can be permitted. Construction that requires greater than 5 cubic yards of fill materials in the flood fringe requires an individual permit equivalent. A permit-by-rule permit equivalent is applicable to construction activities at or below the existing grade. |
| Endangered Species or Critical Habitat | New Jersey Endangered and Nongame Species Conservation Act<br>NJSA 23:2A<br>NJAC 7:25-4 | X | X | X | X | Applicable | This act protects and conserves endangered and nongame species. | The ERA concluded that there are no endangered species on the site. Incorporated in the BERA. |
| Endangered Species or Critical Habitat | New Jersey Endangered Plant Species List<br>NJAC 7:5B | X | X | X | X | Applicable | This act protects endangered plant species. | The ERA concluded that there are no endangered species on the site. Incorporated in the BERA. |
| ***LOCAL*** | | | | | | | | |
| Floodplains | Township of Bridgewater, NJ Code<br>Chapter 126, Land Use<br>Article XXXIX, Specific Floodplain Requirements | X | X | X | X | TBC | Specifies requirements for development in a floodplain. Provides performance standards for evaluation of land use. Requires flood-proofing requirements for structures constructed in the flood fringe. | Coordinate with Bridgewater Township |
| Floodplains | Township of Bridgewater, NJ Code<br>Chapter 126, Land Use<br>Article XXXVIII, Site Plan and Permit Requirements In Floodplain Areas | X | X | X | X | TBC | Drawings must have specific information and be at a scale of not less than 1:50. | Coordinate with Bridgewater Township |

**Table 3-3c. Summary of Chemical-Specific ARARs**

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Medium | Requirement / Citation | Alternative 3<br>ISS Treatment, Inner HBW, Protective Cover | Alternative 4<br>Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5<br>Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Soil Cover | Alternative 6<br>Excavation, Dewatering, Treatment/Disposal Offsite, Soil Cover | Status | Synopsis of Requirement | Comments |
|---|---|---|---|---|---|---|---|---|
| ***FEDERAL*** | | | | | | | | |
| Generated wastes (including water, soil, sediment) | Identification and Listing of Hazardous Waste 40 CFR Part 261, as adopted by NJAC 7:26G-5.1 | X | X | X | X | Applicable, if hazardous wastes are generated | Identifies those solid wastes which are regulated as hazardous wastes, including chemical concentrations (TCLP), if the waste is not a listed hazardous waste | Action-specific and location-specific ARARs would apply if hazardous wastes are generated |
| ***STATE*** | | | | | | | | |
| Air | Prohibition of Air Pollution<br>NJAC 7:27-5 | X | X | X | X | Applicable | States that no one "shall cause,<br>suffer, allow or permit to be emitted into the outdoor atmosphere substances in quantities<br>which shall result in air pollution". | Design and construct the remedial action to minimize the potential for air emissions. |
| Air | Ambient Air Quality Standards<br>NJAC 7:27-13 | X | X | X | X | Applicable | NJDEP's air quality objective is for air within the State to meet the ambient air quality standards. Standards exist for particulates, sulfur dioxide, carbon monoxide, ozone, lead, and nitrogen dioxide (criteria pollutants). | Design and construct the remedial action to minimize the potential for air emissions. If an engineered cap is placed over treated impoundment materials in a leave-in place option, the cap will be required to contain residual COCs to comply with air quality standards. Perform air monitoring (e.g., including fenceline monitoring) to show that the air shed is not impacted by remedial activities. |
| Air | Air Pollution Control Regulations<br>NJAC 7:27-22 (Operating Permits) and NJAC 7:27-8 (Permits and Certificates for Minor Facilities) | X | X | X | X | Applicable | Provides regulations that govern activities that result in emissions that introduce contaminants into the ambient atmosphere. | Obtain permit equivalent for air emission units with associated limits; design emissions treatments, containment and monitoring program to meet the limits |

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SECTION 4

# Identification and Screening of Alternatives

## 4.1 General Response Actions

GRAs are general categories of actions that are typically combined together to form remedial alternatives and satisfy RAOs. For each GRA, several remedial technologies may be available which can be further broken down into a number of process options. The GRAs that were used to develop the OU8 remedial alternatives include:

- No action
- Containment
- Treatment
- Removal
- Disposal

A discussion of these GRAs and the remedial technologies and process options identified is presented in the sections below and in Table 4-1.

### 4.1.1 No Action

Under the no action response, no remedial actions would be performed to reduce the toxicity, mobility, or volume (TMV) of PTW or COCs within the impoundments nor to address RAOs. The following activities will still be conducted under the overall site-wide activities and not specifically for OU8: operation of the groundwater collection trench downgradient of Impoundments 1 and 2, operation of the groundwater treatment system, periodic inspections and maintenance of the berms, maintenance of fencing and site security, maintenance of the water cap to suppress emissions, maintenance of berm armoring for flood resistance, maintenance of a geosynthetic cover over the materials for further flood resistance, and periodic ambient air and nearby surface water monitoring. The NCP requires that the no action alternative be developed and evaluated to serve as a baseline against which the performance of other GRAs may be compared. Therefore, the no action response will be retained for further evaluation.

### 4.1.2 Containment

Containment options typically are not aimed at reducing the volume or toxicity of contaminants but rather at preventing direct exposure and controlling the spread of contaminants to existing or potential future receptors. Containment technologies relevant to OU8 include capping and groundwater gradient control. These technologies contain the impacted medium in its current location preventing its migration and potentially allowing for subsequent removal. The technology classes and associated process options screened under this GRA are described below.

#### 4.1.2.1 Cap/Cover

Capping envisioned for OU8 involves placing a protective cover over the treated COCs to isolate the underlying material in place, thereby preventing exposure to remaining and/or controlling the infiltration of water through contaminated media and preventing the leaching of contaminants into surface water or groundwater. The capping material is selected based on the intended purpose of the cap.

For example, a protective cover may be constructed as a multi-layered, low-permeability engineered cover used to prevent physical contact with subsurface materials and prevent infiltration of precipitation. This technology is sometimes coupled with subsurface vapor collection systems. This

technology would likely be applied within a remedial alternative that includes in-situ treatment technologies.

#### 4.1.2.2 Groundwater Gradient Control

The goal of groundwater gradient control would be to minimize the spread of COCs due to groundwater migration. Identified groundwater gradient control process options are defined below.

**Hydraulic Barriers**. A physical barrier that reduces the lateral migration of groundwater, waste materials (treated or untreated) and if present, NAPL within Impoundments 1 and 2. Barriers may be constructed using a wide variety of techniques (e.g., sheet piles, soil bentonite slurry walls). This technology would likely be applied within a remedial alternative in conjunction with in-situ treatment technologies.

**Extraction Wells**. An imposed barrier, developed by groundwater extraction that can reduce the lateral and vertical migration of groundwater, NAPL, or waste materials away from the boundary of Impoundments 1 and 2. This does not include groundwater extraction associated with OU4 (Site-wide groundwater), which already occurs downgradient of OU8. This technology would likely be applied within a remedial alternative in conjunction with in-situ treatment technologies.

### 4.1.3 Treatment

Treatment refers to processes that use physical or chemical means to change the character of the PTW or COCs. Treatment technologies relevant to OU8 are in-situ treatment, ex-situ treatment, and emissions treatment as described below.

#### 4.1.3.1 In-Situ Treatment

The goal of in-situ treatment would involve treating PTW and/or COCs in place. Identified in-situ treatment technologies/process options are defined below.

**In-Situ Chemical Oxidation**. Subsurface addition of an oxidizing agent to promote abiotic in-situ oxidation of organic compounds. Oxidant can be delivered using fixed injection points or mixed in-situ using augers or equipment designed for soil mixing.

**Vapor Extraction**. Vapor extraction is a physical reduction technology that uses a vacuum system to reduce vapors from the subsurface. This technology is frequently coupled with vapor treatment processes that are applicable for site-related COCs prior to atmospheric discharge. Can be used to control vapor emissions during implementation of other technologies; may also be used more passively after ISS or other technology. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS.

**Air Sparging**. Air is injected into the impoundment material to reduce COCs through volatilization and air stripping. May also be used at lower airflow rates to promote biodegradation. Often coupled with vapor extraction for collection and treatment of displaced VOCs at higher flow rates. Can be implemented via injection wells, during ISS, or after ISS or another pretreatment technology.

**In-Situ Bioremediation**. For nonchlorinated VOCs, electron acceptors (e.g., oxygen, nitrate, sulfate) are added via injection wells to support microbial activity that degrades the COCs. The COCs are used as an electron donor (a food source) to support metabolic activity.

**In-Situ Stabilization/Solidification**. Target contaminants are physically bound or encapsulated within a stabilized mass (solidification). A wide variety of technical strategies can be applied for ISS, which may incorporate large-diameter mixers and augers or specialty equipment for reagent blending with impoundment materials. The blending process can also be applied for homogenization and neutralization of impoundment materials through addition of alkaline reagents to buffer the material. This technology would likely be applied within a remedial alternative in conjunction with other

technologies, such as implementation of an engineered cover and subsurface hydraulic barrier or as a treatment prior to removal activities.

**In-Situ Thermal Treatment**. Uses heat to enhance volatilization of VOCs/SVOCs. Heat is applied via thermal conduction, resistive heating, or through other methods using electrodes or heaters placed in the treatment zone. The type of heating used (e.g., resistive, conductive) depends on the physical characteristics of materials being treated. Fluids (vapor and liquids) are collected from the treatment zone using MPE wells and treated prior to discharge. Pretreatment, e.g. ISS, is required to neutralize acidity and provide strength. Note for this evaluation, steam heating is discussed separately. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS.

**Steam-Enhanced COC Reduction**. Steam and compressed air are introduced into the impoundment materials through injection points (wells or augers). Heating of the impoundment materials enhances volatilization and stripping of COCs. Fluids recovered are removed via MPE wells and collected for aboveground treatment and destruction. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. May be combined with an engineered cover and subsurface hydraulic barrier or possibly excavation and disposal.

**Freezing**. Impoundment materials are cooled to the point they become solid (frozen); solidified materials are directly excavated and transported to a facility for ex-situ treatment and disposal.

**Surfactant/Co-solvent Flushing (Soil Flushing)**. In-situ delivery of chemical reagents including water, surfactants, co-solvents, or other facilitators to enhance the physical displacement, solubilization, or desorption of target contaminants. Mobilized contaminants in the flushing solution are extracted and treated.

#### 4.1.3.2 Ex-Situ Treatment

The goal of ex-situ treatment would involve treating COCs after removal from impoundments. Identified ex-situ treatment process options are defined below.

**Bioremediation**. Use of land farming, composting, or slurry bioreactors to treat material removed from the impoundments. Aerobic processes would be used for the COCs of interest (e.g., benzene and naphthalene). Neutralization would be required, as well as significant dilution or conditioning to make the material suitable for biodegradation to occur.

**Co-Burning Cement Kiln**. Impoundment materials are excavated, transported, blended and fed to a cement kiln as fuel. The cement kiln operates at 2,500 to 2,900°F, and organic compounds are destroyed at these temperatures. Sulfur compounds are partially removed by pulverized limestone used in the process, are incorporated into the cement product, and remaining sulfur compounds are maintained below regulatory limits.

**Hazardous Waste Incineration**. Excavated impoundment materials or treated soil and clay impacted by OU8 impoundment materials above PRGs are excavated and sent through an onsite incinerator, or transported offsite and fed directly to a permitted hazardous waste incinerator. The high temperature combustion destroys the organic content of the wastes, and the sulfur compounds are liberated as sulfur gases, which are removed by scrubbing processes. If onsite incineration is selected, subsequent disposal would be required.

**Thermal Desorption**. Thermal desorbers treat waste by heating the materials in a rotating drum (or other types of reactors) in an oxygen-deficient atmosphere. Typically, treatment is performed onsite. Vapors produced are treated and in some applications, can be processed into usable fuel.

**Asphalt Recycling**. Excavated impoundment materials or treated soil and clay impacted by OU8 impoundment materials above PRGs are transported offsite and fed directly to the asphalt mix during the manufacturing process. The materials can be added to either a hot-mix or cold-mix asphalt process.

#### 4.1.3.3 Emissions Treatment

Emissions treatment would involve the treatment of emissions during remedial actions. Identified emissions treatment process options are defined below.

**Granular Activated Carbon (GAC)**. Vapor generated from material treatment or handling is captured and adsorbed on vapor phase GAC beds to reduce VOCs. This method can also be used to treat liquid streams if condensate is generated by the selected treatment option(s).

**Thermal Oxidizer**. Vapor generated from material treatment or handling is heated and destroyed by thermal oxidation in a controlled combustion chamber. The carbon from the VOCs is bound to oxygen and released as carbon dioxide; acid gasses and sulfur-bearing compounds generated during combustion processes are removed from oxidizer exhaust by caustic scrubbing.

**Catalytic Oxidizer**. Vapor generated from material treatment or handling is heated and destroyed in the presence of a catalyst. The oxidation occurs through a chemical reaction between the VOC hydrocarbon molecules and a precious-metal catalyst bed that is internal to the oxidizer system. The catalyst accelerates the rate of a chemical reaction, allowing the oxidation and VOC destruction to occur at a lower temperature range (typically 550 to 650°F).

### 4.1.4 Removal

The goals of the removal GRA are generally to reduce contaminated material to limit exposure to contaminants, control contaminant migration, and prevent recontamination of previously remediated areas. Removal GRAs for OU8 would be completed through direct mechanical excavation. Removal is a common approach used in mitigating contaminated media. In most cases the removed material requires treatment prior to disposal. In addition, containment is commonly used in conjunction with removal actions to control remaining contaminants and, to restore the disturbed surface.

#### 4.1.4.1 Hydraulic Removal

In hydraulic removal impoundment material would be removed as a fluid mixture. Identified hydraulic removal process options are defined below.

**Hydraulic Dredging**. Removal of impoundment material as a liquid slurry suspended by mixing with water. The slurry suspension is subsequently conveyed to a dewatering system, where solids are separated from the liquid. The slurry is moved through piping from the excavation area to treatment area using an enclosed auger.

**Heat and Pump**. Removal of impoundment material as a liquid slurry produced following heating with a noncontact heat exchanger placed directly in the impoundments. Through circulation of hot heat transfer fluids to the exchanger, a portion of the impoundment materials will liquefy. The resulting liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for recovery and further processing.

**Liquefaction**. Use of a diluent (e.g., fuel oil) to help dissolve tar materials in place, followed by pumping of the liquid slurry. The liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for diluent recovery and further processing/treatment.

#### 4.1.4.2 Mechanical Removal

In mechanical removal impoundment material would be removed as-is, or once an in-situ treatment technology has been completed, by mechanical means. The identified mechanical removal process option is defined below.

**Excavation**. Excavation of impoundment materials (either untreated or treated) using a trackhoe, crane, bucket excavator, or similar equipment. Excavated materials are dewatered and placed in a container for storage, transport, additional treatment, or disposal. In-situ treatment may be required prior to excavation to control emissions. Alternatively, untreated acid tar may be excavated at low production rates using active vapor control measures (e.g. foam) to reduce emissions to acceptable levels.

### 4.1.5 Disposal

Disposal, in this case, refers to the final dispositional endpoint of PTW and/or soil and clay impacted by OU8 impoundment material above PRGs following in-situ treatment. Disposal options relevant to OU8 are onsite disposal and offsite disposal.

#### 4.1.5.1 Onsite Disposal

There are two identified onsite disposal options. Both options necessitate in-situ treatment prior to disposal. Once treatment is completed and the material meets the performance criteria (Section 4.3), one of two options for final disposal are available.

**Closure-in-place**. Following completion of an in-situ treatment, the materials would remain in place. A protective cover would be installed over the impoundments to prevent direct contact with treated material, control vapors as needed, and protect against flooding. This capping would permanently close the impoundments in place.

**CAMU**. Following completion of an in-situ treatment response action, the treated materials would be excavated and transported to the onsite CAMU for final disposition.

#### 4.1.5.2 Offsite Disposal

While there are two typical options for offsite disposal (i.e. nonhazardous and hazardous waste landfills), neither disposal option is viable as noted:

**Nonhazardous Waste Landfill**. Following completion of an in-situ treatment alternative, treated OU8 impoundment materials would be excavated and transported offsite to a nonhazardous landfill for final disposition. TCLP concentrations are not expected to be met nor will this material meet the performance criteria. Therefore, this option is not considered acceptable.

**Hazardous Waste Landfill**. Following completion of an in-situ treatment alternative, treated OU8 impoundment materials would be excavated and transported offsite to a hazardous waste landfill for final disposition where land disposal restriction concentrations must be met. Even with the implementation of the various available technologies along with potentially meeting the performance criteria, land disposal restrictions cannot be met and as such, this option is not considered acceptable.

## 4.2 Screening of Technologies and Process Options

Following USEPA guidance (USEPA 1988), technology types and process options were identified and screened for each GRA. For the “Treatment” GRA, the process options were organized by “in-situ” and “ex-situ” treatment technologies, along with technologies to treat process vapor emissions. The evaluation of technology and process option screening was submitted to and approved by USEPA. Details of the evaluation are reported in the *Technical Memorandum – Technology Screening*

*Memorandum to Support Alternatives Development* (CH2M 2015c). The evaluation and associated findings are summarized below.

The technologies and process options for each GRA were initially screened using the criteria of effectiveness, implementability, and cost (USEPA 1988), as follows:

- Effectiveness: Considers the ability to handle the estimated areas or volumes of media and meet the remediation goals identified in the RAOs; the potential impacts to human health and the environment during the construction and implementation phase; and how proven and reliable the process is with respect to the contaminants and conditions at the site. The scoring used for the relative effectiveness assessment is Low (1); Low-Moderate (2); Moderate (3); Moderate-High (4); High (5).
- Implementability: Considers the technical and administrative feasibility of implementing a technology or process option. This includes the ability to obtain necessary permits for offsite actions, availability of treatment, storage and disposal services (including capacity), and availability of necessary equipment and skilled workers to implement the technology or process option. The scoring used for the relative implementability assessment is Low (1); Low-Moderate (2); Moderate (3); Moderate-High (4); High (5).
- Cost: Relative capital and operation and maintenance (O&M) cost assessments are made based on engineering judgment; costs are evaluated relative to other process options in the same technology type. The scoring used for the relative cost assessment is Low (5); Low-Moderate (4); Moderate (3); Moderate-High (2); High (1).

The screening was conducted to assess the process options within a given technology type. For instance, if multiple process options are equally effective, a process option that is more challenging to implement may be screened out. Table 4-1 identifies the GRAs, technologies and process options that were screened based on effectiveness, implementability, and cost and provides rationale for retaining or discarding (grey shaded).

The process options presented and screened in Table 4-1 are meant to be combined with other process options and engineering controls into full spectrum remedial alternatives to achieve RAOs. Table 4-2 summarizes the process options that were retained for development of remedial alternatives.

# 4.3 Performance Criteria

Treatment performance criteria were developed for use in the alternative screening and evaluation process (Table 4-3). They were selected to support the RAOs discussed above and were based on the final depositional endpoints since those endpoints will have different physical features that have the potential to impact achieving the RAOs (Appendices A and C). The performance criteria established for the three most likely scenarios for remediating OU8 are summarized below and further discussed in the following subsections.

## 4.3.1 Hydraulic Conductivity

Hydraulic conductivity of a porous medium is a function of both the physical properties of the solid matrix and the fluid passing through the medium. Hydraulic conductivity has emerged as a standard performance criteria parameter used to measure the effectiveness of ISS. The results of a literature review show that the majority of sites evaluated have established hydraulic conductivity performance criteria for ISS.

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| No Action | No Action | No Action | No additional activities beyond what is currently conducted will be implemented. The following activities will still be conducted: operation of the removal action groundwater collection trench and treatment system, periodic inspections and maintenance of the berms, maintenance of fencing and site security, maintenance of the water cap to suppress emissions, maintenance of berm armoring for flood resistance, maintenance of a geosynthetic cover over the materials for further flood resistance, and periodic ambient air monitoring. | **Low-Moderate (2).** While no activities are planned to treat the principal threat waste, the groundwater pathway to the river is eliminated, preventing exposure. | **Low (1).** While there are no challenging technologies to implement, it is unlikely to be accepted. | **Low (5).** | **Retain.** This option is retained per the FFS process. |
| Containment | Cap/Cover | Soil Cover | Use of clean soil/fill to create a physical barrier and prevent physical contact with subsurface materials. Surface would be graded and vegetated to promote runoff and help prevent erosion. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Low-Moderate (2).** Can be effective for limiting physical contact with waste materials and limited effectiveness minimizing physical mobility of impacted media; does not prevent infiltration/ leaching. Underlying materials must have adequate strength to support a soil cover. Effective technology when combined with other in-situ remediation technologies; however, it is not expected to reduce the toxicity, mobility, or volume of impacts as a stand-alone remedy. | **High (5).** While impoundment material must be strengthened before a soil cover can be adequately supported, soil cover materials are readily available and easily placed. | **Low (5).** Soil covers are generally inexpensive to design and construct. | **Retain.** This option is retained for assembly with other process options that treat PTW and increase impoundment material compressive strength through treatment operations. |
| | | Low-Permeability Engineered Cover | A multi-layered, low-permeability engineered cover used to prevent physical contact with subsurface materials and prevent infiltration of precipitation. This technology is frequently coupled with subsurface vapor collection systems. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3).** Can be effective for limiting contact with wastes and mobility of underlying media; prevents infiltration/leaching. Is not expected to reduce the toxicity or volume of impacts as a stand-alone remedy. | **Moderate-High (4)**. While impoundment material must be strengthened before a low-permeability engineered cover can be adequately supported, cover materials are readily available and easily placed. This receives a lower implementability rating than the soil cover because installation of an impermeable cover is more complicated than installing a simple soil cover. | **Moderate (3).** Low-permeability covers are more expensive to design and construct than soil covers.-Based on the impoundments' location within a floodplain, costs may be higher than a typical low-permeability engineered cover. | **Retain.** This option is retained for assembly with other process options that increase impoundment material compressive strength through treatment operations. |
| | Groundwater Gradient Control | Hydraulic Barriers | A physical barrier which reduces the lateral migration of groundwater, waste materials (treated or untreated) and if present, nonaqueous phase liquid (NAPL) within Impoundments 1 and 2. Barriers may be constructed using a wide variety of techniques (e.g., sheet piles, soil bentonite slurry walls). This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3)**. Barriers can be effective for limiting lateral migration of groundwater and site-related contaminants; effectiveness can be increased when site conditions allow barriers to be sealed vertically by anchoring in underlying low-permeability strata. Establishing a vertical seal at the bedrock contact could be difficult, but feasible. | **Moderate (3).** Construction materials and equipment are readily available. Subsurface conditions below the impoundments are composed of gravel overtop of shallow bedrock. These conditions may challenge sheet pile installation or slurry-based trenching. Barrier wall construction may disturb neighboring wetlands. | **Moderate (3)**. Barrier construction costs are influenced by subsurface conditions. The presence of gravel and shallow bedrock may increase total cost to install a barrier suitable for hydraulic containment of Impoundments 1 and 2. | **Retain.** This process option is retained for assembly with other process options that reduce toxicity, mobility, or volume through in-situ treatment. |
| | | Extraction Wells | An imposed barrier, developed by groundwater extraction which can reduce the lateral and vertical migration of groundwater, NAPL, or waste materials away from the boundary of Impoundments 1 and 2. This does not include groundwater extraction associated with OU4 (sitewide groundwater), which already occurs downgradient of OU8. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3).** Can be effective for limiting lateral and vertical mobility of groundwater and NAPL from Impoundment 1 and 2. This technology can reduce the toxicity, mobility, and volume of site contaminants by reducing mobility, but it must be coupled with ex-situ treatment operations. | **Moderate (3)**. Groundwater extraction is currently employed downgradient of Impoundments 1 and 2 for recovery of dissolved phase contaminants. However, extraction efforts adjacent to impoundments must be capable of NAPL collection and extraction. Although extraction wells are readily installed and often used for hydraulic control, the collection, removal, conveyance, and treatment of multiple fluid types by this approach presents greater technical challenges over groundwater extraction alone. | **Moderate (3).** Capital installation costs for extraction well installation are low relative to hydraulic barriers like sheet piles or slurry walls. However, O&M costs are higher based on the volume of water or NAPL which must be extracted and the complexity of operations needed for water treatment prior to discharge. The incremental equipment and O&M costs for NAPL removal, treatment, and disposal (if needed) are significant. | **Retain.** This option is retained for assembly with other process options that reduce toxicity, mobility, or volume through in-situ treatment. |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment | In-Situ | In-Situ Chemical Oxidation (ISCO) | Subsurface addition of an oxidizing agent to promote abiotic in-situ oxidation of organic compounds. Oxidant can be delivered using fixed injection points or mixed in-situ using augers or equipment designed for soil mixing. | **Low (1).** This technology can be effective for COC treatment in soil and groundwater when adequate oxidant can be supplied and good contact between contaminant and reagent is achieved. The oxidant demand posed by impoundment contents will be extremely high given the nature of impoundment contents and in particular the very high organic content of the acid tar; as such, the mass of reagents needed to impart significant reduction of contaminant toxicity and volume is likely prohibitive for this technology. | **Low-Moderate (2).** Oxidants and mixing equipment are readily available. Oxidant addition to impoundment materials through large-diameter mixers or augers can be readily implemented. Elevated temperatures of reaction are likely; therefore, active recovery and treatment of volatile emissions would be needed during implementation. Impoundment materials lack compressive strength capable of supporting mixing equipment; as such, provisions to increase impoundment material bearing strength or strategies for oxidant delivery over water must also be developed for effective implementation of this technology. | **High (1)**. Extremely large quantities of chemical oxidants will be needed to impart significant reduction of contaminant toxicity and volume given the presence of highly concentrated waste material within Impoundments 1 and 2. In addition, the presence of the water cap and absence of material, which can support mixing equipment, will significantly increase implementation costs for this technology. | **Discard.** Elevated high organic content requires an extremely high oxidant demand and consequently the effectiveness and implementability of this technology for treatment of acid tar in the impoundments is questionable. |
| | | Vapor Extraction | Vapor extraction is a physical removal technology that uses a vacuum system to remove vapors from the subsurface. This technology is frequently coupled with vapor treatment processes that are applicable for site-related COCs prior to atmospheric discharge. Can be used to control vapor emissions during implementation of other technologies; may also be used more passively after ISS or other technology. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. | **Moderate (3).** Physical and chemical characteristics of the constituents in the impoundment materials will influence the effectiveness of this technology. Permeability of the materials is required to facilitate vapor flow through the materials to be treated. The integration of supplemental processes to improve mass transfer of volatile components such as mixing, heating, or permeability enhancements can significantly enhance technology efficacy and ability to reduce toxicity and volume of materials contained within Impoundments 1 and 2. May be effectively combined with other process options as part of an alternative. | **Moderate (3).** Vapor extraction is a full-scale technology and is commercially available. This process may be implementable as a secondary treatment process, after initial treatment using other methods to improve material strength, neutralize pH, and increase permeability characteristics. Treatment processes for extracted vapors would be required to protect workers and the community in the near term. | **Low (5).** Overall costs for vapor extraction may be low when combined with other active in-situ technologies. Offgas treatment is expected to be the primary cost driver. | **Retain.** This option is capable of reducing toxicity and volume of COCs contained within the impoundments. Vapor extraction is retained for assembly with other technologies, which can enhance contaminant removal, reduce future mobility, and prevent direct contact with impoundment contents. |
| | | Air Sparging | Air is injected into the impoundment material to remove compounds of concern through volatilization and air stripping. May also be used at lower airflow rates to promote biodegradation. Often coupled with vapor extraction for collection and treatment of displaced VOCs at higher flow rates. Can be implemented via injection wells, during ISS, or after ISS or other pretreatment. | **Low (1).** This technology can be very effective when sufficient permeability is present for injected air to contact COCs that reside within a water saturated solid matrix. Overall, permeability of the tar contained within the impoundments is very low; although some of the impoundment material is porous, the majority lack the requisite physical characteristics needed to impart efficient removal of COCs. | **Moderate (3).** Numerous full-scale operations have been implemented to treat groundwater and soil contaminated by VOCs using vertically or horizontally drilled wells. May be implementable as a secondary treatment process, after initial treatment using other methods to improve material strength, neutralize pH, and increase permeability characteristics. Treatment processes for extracted vapors would be required to protect workers and the community in the near term. | **Low (5).** Overall costs for air sparging are low when compared to other active in-situ technologies. Offgas treatment is expected to be the primary cost driver. | **Discard**. As a stand-alone technology, air sparging is not expected to be as effective as other approaches for physical removal of COCs. Similarly, in a combined approach, other technologies will be more effective in reducing the toxicity and volume of COCs present in the impoundment materials. |
| | | In-Situ Bioremediation (ISB) | For non-chlorinated VOCs, electron acceptors (e.g., oxygen, nitrate, sulfate) are added via injection wells to support microbial activity that degrades the COCs. The COCs are used as an electron donor (a food source) to support metabolic activity. | **Low (1).** While benzene and other VOCs in groundwater have been successfully remediated via ISB, it is not expected that acid tars would be successfully remediated. Successful bioremediation requires a more moderate pH range (e.g., 5 to 8 SU). In addition, the COCs must be in an aqueous phase to be accessible to microbes. Effective transfer of electron acceptor is also required. Air sparing is typically the most cost-effective approach of electron acceptor delivery, and its effectiveness is limited, as discussed above. | **Low (1).** ISB typically is easily implemented; however, with the acidic conditions and tar material, implementation would be very challenging. | **High (1).** ISB is often a lower-cost in-situ process option. However, due to the challenges associated with the physical nature of the impoundment materials, it would be expensive to make ISB an effective option. | **Discard.** ISB is discarded because of its ineffectiveness and implementability challenges relative to other in-situ process options. |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | In-Situ (continued) | In-Situ Stabilization/ Solidification (ISS) | Target contaminants are physically bound or encapsulated within a stabilized mass (solidification). A wide variety of technical strategies can be applied for ISS, which may incorporate large-diameter mixers and augers or specialty designed equipment for reagent blending with impoundment materials. The blending process can also be applied for homogenization and neutralization of impoundment materials through addition of alkaline reagents to buffer the material. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as implementation of an engineered cover and subsurface hydraulic barrier. | **Moderate-High (4).** The OU8 pilot test demonstrated that ISS can reduce the VOC mass by approximately 25 percent, reduce the physical mobility of tar materials, and reduce the leachability of COCs, specifically benzene and naphthalene, by more than 90 percent. The treated material possessed high compressive strength. ISS also was effective in neutralization of acidity. The total volume of material increased due to the addition of pozzolanic reagents. | **Moderate-High (4).** Overall implementability of ISS for treatment of impoundment material is moderate to high. There are numerous vendors and equipment capable of reagent addition. Amendments (e.g., neutralization agents and pozzolans) to achieve desired properties are readily available. As demonstrated during the pilot testing, ISS operations are expected to increase material temperature, which enhances VOC removal during mixing. Vapors must be captured and treated prior to discharge. Air monitoring is required to ensure protection of workers and the community during implementation. | **Moderate-High (2).** Stabilization costs are moderate when compared to other technologies. The costs are driven primarily by equipment and labor; bench-scale testing can be performed to optimize reagent addition and reduce amendment costs. Treatment of Impoundments 1 and 2 will require collection and treatment of vapors. | **Retain.** This option is capable of reducing toxicity and mobility of COCs contained within the impoundments. Optimization of the stabilization reagents is recommended during design to mitigate volume expansion if this process option is utilized. Optimization will also be required if ISS is used as a pretreatment process for ISTT. This option will be combined with other options to form remedial alternatives. |
| | | In-Situ Thermal Treatment (ISTT) | Uses heat to enhance volatilization of VOCs/SVOCs. Heat is applied via thermal conduction, resistive heating, or through other methods using electrodes or heaters placed in the treatment zone. The type of heating used (e.g., resistive, conductive,) depends on the physical characteristics of materials being treated. Fluids (vapor and liquids) are collected from the treatment zone using multiphase extraction wells (MPE) and treated prior to discharge. Pretreatment, e.g. ISS, is required to neutralize acidity and provide strength. Note for this evaluation, steam heating is discussed separately. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. | **High (5).** Heating was demonstrated to be effective for removal of VOCs (greater than 90 percent benzene removal) during the 2014 pilot study. In addition, leaching was demonstrated to be reduced by greater than 90 percent. Corrosion of heaters in the pilot study resulted in inconsistent heating and treatment. Additional treatment (e.g., neutralization) was required following heating in the pilot study to neutralize residual acidity in the acid tars to make them non-corrosive. | **Moderate (2).** Numerous full-scale operations have been implemented for VOC removal; however, none has treated acid tar. Several commercial providers of this technology are available. The low pH of impoundment material presents a significant challenge to heating operations as corrosion processes are strongly accelerated at increased temperature. Fluid extraction and treatment concurrent with heating system operation is a technology requisite; air monitoring is required to ensure protection of workers and the community during implementation. There are safety challenges and concerns associated with operating ISTT in a floodplain over an extended period because of the presence of hot tars and high VOC vapor concentrations. In addition, the equipment could not be demobilized safely/quickly in the event of a flood. | **High (1).** ISTT will require the greatest construction and operating costs relative to other in-situ process options. In addition to the high cost of constructing and operating the thermal treatment system, the need for pretreatment and high efficiency vapor treatment further increase the cost associated with this technology. | **Retain.** Field demonstrated technology in the reduction of COCs present within the impoundment material. Based on lessons learned during the 2014 pilot study, ISTT would be performed only after ISS/neutralization to help minimize heater corrosion and address technical feasibility concerns for impoundment vapor cover construction during heating. This process option will be combined with other treatment and engineering control options to form remedial alternatives. |
| | | Steam-Enhanced COC Removal | Steam and compressed air are introduced into the impoundment materials through injection points (wells or augers). Heating of the impoundment materials enhances volatilization and stripping of COCs. Fluids recovered are removed via MPE and collected for aboveground treatment and destruction. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. May be combined with an engineered cover and subsurface hydraulic barrier or possibly excavation and disposal. | **Moderate (3).** Can be an effective technology for treatment of VOCs in high concentration source areas where adequate contact between the VOCs and steam is achieved. Construction materials must be resistant to acidic conditions and high VOC concentrations. Would need to be combined with other technologies to neutralize acidity and achieve the required contact. | **Moderate (3)**. Shallow depth, specifically the absence of overburden pressure, make it challenging to effectively distribute steam; similarly, low permeability of the impoundment material will limit radial influence of injection points. Delivery using augers, as supplied for stabilization operations, would increase overall implementability for heating impoundment materials during mixing. A steam generation plant and vapor-liquid treatment and NAPL recovery systems would be necessary. Like other in-situ technologies, significant offgas treatment will be required. | **Moderate-High (2).** As a standalone technology, steam injection costs are projected to be similar to ISTT costs. However, when considered as a process to enhance stabilization, equipment to implement steam injection is projected to impart only minor cost escalation to stabilization efforts. Costs are largely dependent on system size, energy cost, mass of steam injected to impart desired treatment results, and production rates. | **Retain.** This option can potentially reduce concentrations of VOCs in the waste materials and render materials more amenable to supplemental treatment processes or removal. Limited SVOC treatment within the waste materials may occur. Bench-scale laboratory testing may be required. This option will be retained and combined with other process options to form remedial alternatives. |
| | | Freezing | Impoundment materials are cooled to the point they become solid (frozen); solidified materials are directly excavated and transported to a facility for ex-situ treatment and disposal. | **Low (1).** Freezing the impoundment materials would limit the production of VOC and odor emissions during excavation; however, the approach requires adding supplemental treatment to reduce COC mass. Overall, freezing would produce a material that is more solid than the raw impoundment materials; but even in a chilled state, the potential for high vapor phase emissions will exist. | **Low (1).** This technology likely would be difficult to implement because of the challenge of removing enough heat to solidify the impoundment materials. The potential for freezing of the acid tar is unknown, and with few commercial providers, overall implementability of this technology is considered low. | **High (1)**. Infrastructure and resources to implement this alternative would be high. Strategies to implement in the presence of the existing water cap would further add logistical complexity and overall cost. | **Discard.** This option is untested for the proposed application and is impractical to implement. In addition, it would require cold storage facilities to await ex-situ treatment or refrigerated transport to offsite facilities, which would add further to logistical complexity and overall cost. |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | In-Situ (continued) | Surfactant/Co-solvent Flushing (Soil Flushing) | In-situ delivery of chemical reagents including water, surfactants, co-solvents, or other facilitators to enhance the physical displacement, solubilization, or desorption of target contaminants. Mobilized contaminants in the flushing solution are extracted and treated. | **Low (1).** Not demonstrated to be a viable technology for the impoundment materials because of the high VOC content and immiscible properties exhibited by the tar fraction contained in within Impoundment 1 and 2. | **Low (1)**. Soil flushing is a technology that has had limited use in site remediation. The availability of qualified contractors capable of implementing the technology is very limited, and extensive laboratory testing would be needed to confirm efficacy and selection of appropriate reagents to solubilize site COCs. | **High (1).** This option is projected to have high capital and operations costs. The site-specific aspects of application necessitates extensive pre-design data collection and treatability studies. Full-scale operation requires the management of multiple chemicals, treatment of multi-component fluid streams and disposal of complex aqueous phase waste mixtures. | **Discard.** This option is untested for the proposed application and is believed to be impractical to implement. Process option has not been demonstrated for impoundment materials. |
| | Ex-Situ | Bioremediation | Use of land farming, composting, or slurry bioreactors to treat material removed from the impoundments. Aerobic processes would be used for the COCs of interest (e.g., benzene and naphthalene). Neutralization would be required, as well as significant dilution or conditioning to make the material suitable for biodegradation to occur. | **Low (1).** While bioremediation of benzene is a demonstrated technology/process option, the effectiveness of bioremediation for the impoundment materials is projected to be low based on extremely high COC concentration and the characteristics of excavated materials (e.g., nonaqueous nature, tackiness, and the presence of salts). In addition, bioremediation technologies are most effective when the pH range is 5 to 8 SU. | **Low (1).** Not easily implemented at the site because of the high concentrations of VOCs, physical nature of the materials and low pH, as bioremediation technologies are most effective when the pH range is 5 to 8 SU. In addition, excavation and land farming of untreated impoundment materials is not recommended due to the high VOC concentrations and potential for unacceptable exposures to site workers or the surrounding community. | **Moderate-High (2).** This option is projected to have high capital and operations costs. The site-specific aspects of application necessitates extensive pre-design data collection and treatability studies. Full-scale operation requires the management of multiple chemicals, treatment of multi-component fluid streams to maintain biological activity. | **Discard.** This option is untested for the proposed application and is impractical to implement. Process option has not been demonstrated for the impoundment materials. Elevated concentration of VOCs, SVOCs, and very low pH in the waste materials will be toxic to microbes. |
| | | Co-Burning Cement Kiln | Impoundment materials are excavated, dewatered, transported, blended and fed to a cement kiln as fuel. The cement kiln operates at 2,500 to 2,900 °F, and organic compounds are destroyed at these temperatures. | **Moderate-High (4).** The heat of a cement kiln would destroy the organic content of the impoundment materials, and the cement kiln dust would neutralize the acidic portion of the wastes. The treated waste materials become incorporated into the cement mixture. The acceptance rate at the cement kiln may be limited by the amount of sulfur compounds in the material. | **Moderate (3).** The use of cement kilns to treat waste materials is well documented. Cement kilns maintain Resource Conservation and Recovery Act (RCRA) and Clean Air Act permits. The acceptance throughput rate of impoundment materials by kiln may control removal rate and project timeline. | **Moderate-High (2).** Treatment costs for cement kiln co-burning are higher than some ex-situ process options and lower than other options. | **Retain.** This option is viable for treating OU8 impoundment material following excavation and dewatering. It will be retained and combined with other process options to form remedial alternatives. |
| | | Hazardous Waste Incineration | Impoundment materials are excavated and treated in an onsite incinerator, or transported offsite and fed directly to a permitted hazardous waste incinerator. The high temperature combustion destroys the organic content of the wastes, and the sulfur compounds are liberated as sulfur gases, which are removed by scrubbing processes. If onsite incineration were used, subsequent disposal would be required. | **High (5).** The heat of the incinerator would destroy the organic content of the impoundment materials. Treatment would reduce the volume of impoundment material, but management and disposal of combustion ash is still required. | **Moderate (3).** The use of incinerators to treat waste materials is well documented; qualified facilities are regulated by RCRA and Clean Air Act permits. Implementation of onsite incineration would require a significant approval process. Acceptance rates for offsite facilities may control removal rates and the project timeline. Throughput rates per facility for offsite incineration are approximately an order of magnitude higher than those for cement kilns. ISS-treated materials from the 2014 pilot study were sent to the Heritage hazardous waste incinerator for final treatment. | **High (1)**. Costs for treatment by incineration are high. This option also requires disposal of residuals after incineration, which would be handled by the hazardous waste incineration facility if treatment were performed offsite. | **Retain.** This option may be applicable for treatment of material after removal from the impoundments. Because of the anticipated regulatory and public constraints, only offsite (not onsite), incineration is being retained for further consideration. This option will be retained and combined with other process options to form remedial alternatives. |
| | | Thermal Desorption | Thermal desorbers treat waste by heating the materials in a rotating drum (or other types of reactors) in an oxygen-deficient atmosphere. Typically, treatment is performed onsite. Vapors produced are treated and in some applications can be processed into usable fuel. | **Moderate (3).** Heat from the thermal desorption units rapidly drive off VOCs and SVOCs present within the impoundment material. Treatment will reduce the overall volume of material and produce friable solid materials with limited compressive strength. Heating is projected to have limited effect on pH neutralization, and supplemental neutralization and stabilization may be needed to fulfill landfill requirements. Previous testing on raw impoundment materials at the site showed that land disposal restriction (LDR) concentrations could not be achieved (New Jersey Department of Environmental Protection 1998).[c] | **Moderate (3).** The use of thermal desorption to treat waste materials is well documented. Throughput (desorbed residence time) for desired impoundment material treatment may control removal rate and project timeline. Significant air treatment and permitting is required for these systems, which limits the effectiveness and implementability for full-scale use. | **Moderate-High (2).** Treatment costs for thermal desorption are higher than some ex-situ process options and lower than options. Disposal of the treatment residuals will still be required. | **Discard.** Once material is removed from the impoundments, the preference would be to place material in the CAMU or if additional treatment is required, to send material offsite to minimize potential exposure during treatment. Therefore, other ex-situ treatment options are retained rather than thermal desorption. |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | Ex-Situ (continued) | Asphalt Recycling | Excavated impoundment materials are transported offsite and fed directly to the asphalt mix during the manufacturing process. The materials can be added to either a hot-mix or cold-mix asphalt process. | **Low-Moderate (2).** Some VOC reduction is likely and SVOCs would be integrated into the asphalt matrix. | **Low (1).** Implementability challenges are likely associated with approval to use characteristically hazardous waste in asphalt recycling. | **Moderate-High (2).** Costs are likely comparable to using a cement kiln. | **Discard.** This option is not a proven technology for impoundment materials; additionally, the high VOC content may limit reuse of material after treatment. |
| | Emissions Treatment | Granular Activated Carbon (GAC) | Vapor generated from material treatment or handling is captured and adsorbed on vapor phase GAC beds to remove VOCs. This method can also be used to treat liquid streams if condensate is generated by the selected treatment option(s). | **Moderate (3)**. The use of GAC to remove VOCs from air and water is well documented with numerous studies and full-scale treatment operations. Not an effective technology for initial treatment of air emissions during ISS or ISTT because of the high VOC and SVOC content expected during treatment. May be more effective technology as secondary treatment processes, after VOC content has been reduced or as part of a passive venting system. | **High (5).** This technology could be readily implemented at the site for low concentration vapor streams, as there are numerous suppliers of equipment and GAC services. This technology is not feasible for very high concentration vapor streams because of safety concerns, specifically the potential for vapor phase carbon bed fires. | **Moderate (3); High (1).** When applied for low concentration vapor streams, this technology is cost effective. However, application of GAC for highly concentrated, high volume treatment is inefficient and costly because of excessive GAC consumption and increased O&M requirements. The moderate cost rating is applicable for use on low concentration vapor streams. | **Retain.** Treatment of high concentration vapor streams with GAC is not feasible because of safety concerns. Use of the technology will be considered for treatment of low concentration, low volume vapor streams where alternative technologies are not considered feasible. This option will be combined with other process options to form remedial alternatives. |
| | | Thermal Oxidizer | Vapor generated from material treatment or handling is heated and destroyed by thermal oxidation in a controlled combustion chamber. The carbon from the VOCs is bound to oxygen and released as carbon dioxide; acid gasses and sulfur-bearing compounds generated during combustion processes are removed from oxidizer exhaust by caustic scrubbing. | **High (5).** Thermal oxidizer offgas treatment is a proven technology; the concepts, theory, and engineering aspects of the technology are well developed. Pilot testing completed onsite demonstrated the ability to effectively handle sulfur and acidic exhaust gasses using a caustic scrubber. | **High (5).** There are multiple suppliers of thermal oxidizers capable of treating vapor phase emissions generated during handling or treatment of impoundment materials. As with all air treatment technologies, emission control and air permitting will be required. A thermal oxidizer was used during the 2014 pilot study and effectively treated vapors generated via ISS and ISTT. | **Moderate-High (2).** Capital costs are higher when compared to other air treatment technologies. However, given the mas of VOCs present operations life-cycle cost of the oxidizer compared to alternate approaches like carbon adsorption is projected to be lower. | **Retain.** This option is projected to be the most effective approach for the treatment of high concentration, high volume vapor streams generated during treatment or handling of impoundment materials. This option will be combined with other process options to form remedial alternatives. |
| | | Catalytic Oxidizer | Vapor generated from material treatment or handling is heated and destroyed in the presence of a catalyst. The oxidation occurs through a chemical reaction between the VOC hydrocarbon molecules and a precious-metal catalyst bed that is internal to the oxidizer system. The catalyst accelerates the rate of a chemical reaction, allowing the oxidation and VOC destruction to occur at a lower temperature range (typically 550 to 650 °F). | **Low (2).** Catalytic thermal oxidation is a developed, refined, and proven technology for VOC destruction; the concepts, theory, and engineering aspects of the technology are well documented. However, the precious metal catalyst are easily poisoned by sulfur-bearing compounds. Once deactivated by sulfur, catalyst bed replacement is needed, which is very costly. | **High (5).** There are multiple suppliers of catalytic oxidizers capable of treating vapor phase emissions generated during handling or treatment of impoundment materials. However, the presence of sulfur compounds prohibits the use of this treatment technology. | **High (1)**. Sulfur is present in the impoundment materials at appreciable concentration. As a selective and irreversible poison for the platinum-based catalysts used in these systems, application of this option could result in extraordinary operations costs for vapor treatment by this option. | **Discard.** This option is incompatible with process vapor conditions anticipated during treatment or handling of impoundment materials. |
| Removal | Hydraulic Removal | Hydraulic Dredging | Removal of impoundment material as a liquid slurry suspended by mixing with water. The slurry suspension is subsequently conveyed to a dewatering system, where solids are separated from the liquid. The slurry is moved through piping from the excavation area to treatment area using potential created by turning an enclosed auger. | **Moderate (3).** Hydraulic dredging is effective at removing large volumes of sediment and can be implemented without removing the water cap from the impoundments. | **Moderate (3).** Dredging of material is considered implementable using a number of approaches. Dewatering of liquid slurry, however, is considerably more difficult given the VOC content of the material and the high liquid to solid ratio stream that must be managed. The approach will require extensive dewatering facilities with active vapor control. Dewatered material must be subsequently treated before offsite disposal or onsite consolidation in the CAMU. | **High (1).** Equipment and operating costs for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** This option may be moderately effective at removing impoundment materials prior to ex-situ treatment. However, the cost and complexity of treating the process streams generated by this option would be very high and require multiple material handling steps that increase the potential for unacceptable exposures for site workers and surrounding communities. |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Removal (continued) | Hydraulic Removal (continued | Heat and Pump | Removal of impoundment material as a liquid slurry produced following heating with a noncontact heat exchanger placed directly in the impoundments. Through circulation of hot heat transfer fluids to the exchanger, a portion of the impoundment materials will liquefy. The resulting liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for recovery and further processing. | **Low (2).** Effectiveness is predicated on viscosity reduction of the impoundment materials following heating. If the viscosity of the impoundment materials can be lowered, pumping could be effective at removing large volumes of materials without water cap removal. Material heating would increase vapor emissions even higher than those seen with just ambient removal methods. The approach has not been demonstrated onsite and would require extensive testing to fully evaluate potential efficacy onsite. | **Moderate (3).** Thermally enhanced removal of petroleum-derived sludges is a demonstrated technology and commercial suppliers are available to implement this option. However, it is unknown if physical and chemical properties of the impoundment materials can be pumped after heating. In addition, pumping materials through a pipeline may be difficult; heat loss from the pipeline may cause increase viscosity and pipes to clog. Relocation of the heat exchangers and pump head will be required as the materials are removed. | **High (1).** Equipment and operating cost for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** Other removal options provide a better combination of effectiveness and implementability. |
| | | Liquefaction | Use of a diluent (e.g., fuel oil) to help dissolve tar materials in place, followed by pumping of the liquid slurry. The liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for diluent recovery and further processing/treatment. | **Low (2).** Effectiveness is predicated on viscosity reduction of the impoundment materials following diluent additional and mixing. If the viscosity of the impoundment materials can be lowered, pumping could be effective at removing the impoundment material as a liquid. Removal of the water cap is needed for this approach; provisions for the containment collection and destruction of organic vapors is necessary. The approach has not been demonstrated onsite and would require extensive testing to fully evaluate potential efficacy onsite. | **Low (2).** The use of diluents to liquefy and recover acid tar from an open surface impoundment has not been demonstrated; similarly, the availability of services and equipment to implement this approach is limited. | **High (1).** Equipment and operating costs for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** Other removal options provide a better combination of effectiveness and implementability. |
| | Mechanical Removal | Excavation | Excavation of impoundment materials using a trackhoe, crane, bucket excavator, or similar equipment. Excavated materials are dewatered and placed in a container for storage, transport, treatment, or disposal. To protect workers and the community from exposure to VOC vapor concentrations, in-situ treatment will be required prior to excavation. Alternatively, it may be possible to excavate untreated acid tar at low production rates using active vapor control measures (e.g. foam) to reduce emissions to acceptable levels. | **Moderate (3).** Mechanical excavation is effective for removing materials from the impoundments. Depending on the alternative/approach, the water cap may be maintained, and water management may be required. Because of the potential for elevated VOC concentrations, air monitoring will be required during excavation. | **Moderate (3).** Equipment is readily available for mechanical excavation and dewatering. However, conventional strategies to control vapor phase emissions during removal at typical production rates are impracticable. Effective control of vapor phase emissions during the excavation and dewatering process may result in lower production rates. | **Moderate (3).** Equipment and operating cost for this method of removal are projected to be moderate. Controlling emissions by minimizing production rates may result in higher costs. | **Retain**. This option is retained for potential application and will be combined with process options that involve treatment and disposal. |
| Disposal | Onsite | Closure in Place | Following completion of an in-situ treatment alternative, treated materials would be capped, the treated area reinforced to withstand floods, and permanently closed in place. | **Moderate-High (4).** When coupled with an appropriate treatment alternative capable of reducing toxicity and mobility of impoundment materials in place closure is considered an effective remedial approach. An effective closure in place can be engineered in the floodplain. | **Moderate-High (4).** In-place closure is implementable. Design and construction provisions to permanently encapsulate treated materials are readily available. A closure in place strategy precludes the exposure potential associated with excavation, ex-situ treatment, and transportation/disposal. | **Moderate-High (2).** Cost of in-place closure is predicated on the individual costs of elements applied for in-situ treatment and capping. | **Retain**. This disposal option is retained for further consideration when combined with in-situ treatment process options. In-situ treatment and capping when properly selected and performed can achieve the remedial action objectives proposed for Impoundments 1 and 2. |
| | | Impoundment 8 Facility Corrective Action Management Unit (CAMU) | Following completion of an in-situ treatment alternative, residuals would be excavated and transported to the onsite CAMU for final disposition. | **High (5).** When coupled with an appropriate treatment alternative capable of reducing toxicity of impoundment materials, onsite disposal in the CAMU is considered an effective remedial approach. This process option receives a slightly higher score than Closure in Place option because the materials are physically removed from the floodplain. | **Moderate (3).** Excavation following in-situ treatment is implementable. The Impoundment 8 Facility CAMU was designed and purposed for placement of treated residuals from the site. While LDR or TCLP concentrations do not apply to materials placed in the CAMU, concentrations must be such that excavation/ disposal in the CAMU does not create an exposure hazard. Production rate of excavation, supplemental treatment (if needed), and spreading at the CAMU may be limited, which would extend the project duration. | **High (1)**. Cost for CAMU disposal following in-situ treatment are projected to be high given the level of VOC removal needed for safe excavation of the treated residuals. | **Retain.** This disposal option will be retained for analysis with treatment alternatives that can appreciably reduce impoundment material toxicity (e.g., total VOC content). |

Table 4-1. Technology and Process Option Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[a] | Implementability[a] | Cost[b] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Disposal (continued) | Offsite | Nonhazardous Waste Landfill | Following completion of an in-situ treatment alternative, residuals would be excavated and transported offsite to a nonhazardous landfill for final disposition. TCLP concentrations must be met. | **Low (1).** Based on bench and pilot tests conducted to date, remedial technologies have not consistently achieved TCLP concentrations that would allow for nonhazardous disposal. | **Low (1).** Achieving the required treatment standards for offsite disposal in Subtitle C landfill with a nonhazardous classification is unlikely. | **High (1)**. The cost and technical feasibility to achieve treatment levels suitable for nonhazardous disposal are unknown and projected to be prohibitively high. | **Discard**. This disposal option lacks technical feasibility; the type and cost of process options needed to achieve nonhazardous disposal requirements renders the option impractical to implement. |
| | | Hazardous Waste Landfill | Following completion of an in-situ treatment alternative, residuals would be excavated and transported offsite to a hazardous waste landfill for final disposition. LDR concentrations must be met. | **Low (1).** Based on bench and pilot tests conducted to date, remedial technologies have not achieved LDR concentrations. | **Low (1).** Achieving the required treatment standards for offsite disposal in a hazardous waste landfill would present significant technical challenges for all treatment strategies contemplated. | **High (1)**. The cost and technical feasibility to achieve treatment levels suitable for hazardous landfill disposal are unknown and projected to be high. | **Discard.** This disposal option lacks technical feasibility; the type and cost of process options needed to achieve LDRs (required for hazardous waste disposal) renders this option impractical to implement. |

Notes:

*Gray shading indicates technology has been screened out*

a. Screening scores for Effectiveness and Implementability are as follows:

Low: 1 (worst)
Low-Moderate: 2
Moderate: 3
Moderate-High: 4
High: 5 (best)

b. Screening scores for Cost are as follows:

Low Cost: 5 (best)
Low-Moderate Cost: 4
Moderate Cost: 3
Moderate-High Cost: 2
High Cost: 1 (worst)

c. LDRs are not expected to be achieved for any of the process options evaluated.

CAMU – Corrective Action Management Unit
FFS – Focused Feasibility Study
ISB – in-situ bioremediation
ISS – in-situ stabilization/solidification
LDR – land disposal restriction
NAPL – nonaqueous phase liquid
OU – operable unit
SU – standard unit
VOC – volatile organic compound
COC – contaminant of concern
GAC – granular activated carbon
ISCO – in-situ chemical oxidation
ISTT – in-situ thermal treatment
MPE – multiphase extraction
O&M – operation and maintenance
RCRA – Resource Conservation and Recovery Act
SVOC – semivolatile organic compound

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Table 4-2. Summary of Retained Process Options

| General Response Action | Technology | Retained Process Option |
|---|---|---|
| No Action | None | Not Applicable |
| Containment | Capping | Soil Cover |
| | | Engineered Cover |
| | Groundwater Gradient Control | Hydraulic Barriers |
| | | Extraction Wells |
| Treatment | In-Situ Treatment | Vapor Extraction |
| | | ISS |
| | | ISTT |
| | | Steam-enhanced COC Reduction |
| | Ex-Situ Treatment | Treatment/Destruction at an Offsite Cement Kiln[1] |
| | | Offsite Hazardous Waste Incineration |
| | Process vapor treatment | Granular Activated Carbon |
| | | Thermal Oxidation |
| Removal | Mechanical Removal | Excavation (Including Mechanical Dewatering)[1] |
| Disposal | Onsite Disposal | Closure-in-Place |
| | | CAMU |

1 – Table modified from Technology Screening Memo (CH2M 2015c)

Table 4-3. Performance Criteria Overview

| Performance Criteria Parameter | Closure-in-Place | CAMU | Offsite Cement Kiln |
|---|---|---|---|
| Hydraulic Conductivity | $<1\times10^{-6}$ cm/s | Not Applicable | Not Applicable |
| Unconfined Compressive Strength | >50 psi (average); >40 psi (minimum) | TBD | Not Applicable |
| Leachability Reduction (benzene) | >90% | Not Applicable | Not Applicable |
| CAMU Liner Compatibility | Not Applicable | Pass Compatibility Testing | Not Applicable |
| Water Content | Not Applicable | Not Applicable | <40 % |
| Heat Content | Not Applicable | Not Applicable | >3,000 BTU |
| Sulfur Content | Not Applicable | Not Applicable | <10% |

TBD – To be determined during detailed design to support an engineered cover.
BTU – British thermal units

The approved hydraulic conductivity performance criterion for an ISS-only remedy for OU8 where treated materials are closed-in-place is $1\times10^{-6}$ cm/s. This value was selected based on industry guidance documents and hydrogeologic properties of the surrounding soil. This value is consistent with performance criteria applied to other operable units at this site (i.e., OU4) and other ISS projects nationwide (Superfund and other regulatory programs), including in USEPA Region 2. Fourteen of the ISS projects reviewed adopted this value as the performance criteria; ISS performance criteria established at five additional sites reviewed accepted the use of a higher ($1 \times 10^{-5}$ cm/s) hydraulic conductivity criterion. The rationale for adoption of a hydraulic conductivity performance criterion of $1\times10^{-6}$ cm/s for an ISS-only remedy where treated materials are closed-in-place is supported as follows:

- The Interstate Technology and Regulatory Council (ITRC) guidance document, *Development of Performance Specifications for Solidification/Stabilization* (ITRC 2011), indicates hydraulic

conductivity values of many successfully implemented ISS projects did not exceed $1 \times 10^{-6}$ cm/s; therefore, this value has become an industry best practice for implementing ISS projects.

- It is common among ISS projects to treat material such that the resulting hydraulic conductivity is one to two orders of magnitude lower than surrounding soil material (ITRC 2011). Based on the *Pre-Design Investigation Summary Report for the Site-Wide Remedy* (Golder 2014b), the hydraulic conductivity in the vicinity of Impoundments 1 and 2 is approximately $3.3 \times 10^{-2}$ cm/s. By comparison, the proposed performance criterion of $1 \times 10^{-6}$ cm/s is four orders of magnitude lower than that of the surrounding soil.
- The proposed hydraulic conductivity value is also consistent with the OU4 ROD at the Site, which specifies a hydraulic conductivity performance criterion value of $1 \times 10^{-6}$ cm/s for the selected ISS remedy. In addition, this value has been used for other USEPA-approved RODs and/or ISS designs.
- The OU8 pilot study results demonstrated that the proposed hydraulic conductivity value can be obtained for post ISS treated material, further supporting the proposed value.

### 4.3.2 Unconfined Compressive Strength

UCS is a measure directly related to the material's ability to support loads such as an engineered cover, which would be required to meet the RAOs for alternatives involving a closure-in-place remedy. Untreated material in Impoundments 1 and 2 possess limited to no UCS and, therefore, cannot support equipment or an engineered cover in their current physical state, although ISS treatment would increase UCS. Alternatives that involve placement in the onsite CAMU must consider UCS because the material in the CAMU must be capable of supporting a final cover.

The approved UCS performance criteria for ISS only and closure-in-place is an average of 50 psi, with a minimum value of 40 psi, as measured at the 28-day cure. The 50 psi UCS value is an industry standard and is used as a measure of durability of the solidified matrix. This proposed UCS criteria for solidified material is also more than sufficient for supporting an engineered cover.

For alternatives that involve placing treated material in the onsite CAMU, a minimum UCS value is required to ensure long-term stability and support the final engineered cover that would be placed upon closure of the CAMU. This UCS value will be based on the configuration of placed materials within the CAMU and will be determined in the design phase for the selected remedy.

According to the 1997 *Impound 8 Facility Basis of Design* (OBG 1997), a minimum 28-day UCS value of 42 psi (21 psi shear strength) was determined to meet the minimum factors of safety for the CAMU; however, this value was applied to material being solidified during placement and then allowed to cure in the CAMU. In addition, the 1997 value assumed a CAMU height greater than 100 feet and over one million cubic yards ($yd^3$) of material placed in the CAMU. Approximately 400,000 $yd^3$ of material have been placed in the CAMU to date and an additional 100,000 $yd^3$ from OU8 would be placed if this alternative were selected. Because the total volume of material to be placed in the CAMU under this alternative would be less than what was assumed in 1997, the UCS requirement for placing treated materials in the CAMU is expected to be less than the 42 psi previously calculated. Therefore, it is proposed that the UCS requirement for alternatives that use the onsite CAMU be developed during design.

### 4.3.3 Leachability Reduction

Leachability is an indicator of the potential for COCs to diffuse into infiltrating water and potentially impact groundwater. The performance criterion selected for alternatives that include closure-in-place is a greater than 90% leachability reduction of benzene. This indicator compound was selected since it makes up at least 80% of the total VOC mass and is the most soluble/mobile of the COCs within the untreated impoundment material. Leachability reduction evaluations should be based on monolithic leach tests, not tests that require crushing of the sample before analysis. Note that a leachability

performance criterion is not proposed for alternatives that use the CAMU for final material disposition because the CAMU incorporates robust engineering and administrative controls to manage leachate (e.g., multiple liners, leachate collection, regular monitoring, etc.).

### 4.3.4 CAMU Liner Compatibility

For alternatives where treated impoundment materials will be excavated and placed in the CAMU, the material being placed must be physically and chemically compatible with the CAMU liner. As discussed in Section 2.6.3.1, a liner compatibility test was conducted to support evaluation of potential alternatives that involve placement of treated materials in the CAMU. Test results (Appendix E1, CH2M 2016a) indicate that HDPE liner material used in the CAMU is compatible with leachates potentially generated from treated OU8 material, even under high concentration (benzene at 500 mg/L) leachate scenarios.

### 4.3.5 Other Considerations

While the performance criteria presented above for hydraulic conductivity, strength, leachability reduction, and liner compatibility are considered the primary criteria against which to evaluate an alternative's ability to meet the RAOs, other factors also were considered when evaluating alternatives (as well as when designing and implementing the remedy), including pH of treated materials and air emissions associated with treating and moving impoundment materials. These considerations are discussed in more detail below.

#### 4.3.5.1 pH

The pH of the material in Impoundments 1 and 2 is typically less than 2 SU, which is below the pH range of a noncorrosive liquid (2 to 12.5 SU). Therefore, it is recognized that leachate generated by water contacting untreated impoundment materials may be highly acidic which can make handling the leachate or material more difficult. As such, it is proposed that the pH of the treated material range from 4 to 12 SU.

ISS remedies typically involve using alkaline reagents, such as cement or lime kiln dust, to achieve the primary performance criteria of reduced hydraulic conductivity, increased UCS, and reduced COC leachability. Adding alkaline reagents to achieve performance goals results in treated materials (solids) being in the alkaline range, often between 10 and 12 SU. If the circumstances and depositional endpoint of an alternative do not require the treated material to achieve all three primary goals (e.g., reduced hydraulic conductivity is unnecessary if materials are excavated and placed in the CAMU), then less reagents can be used and the resultant pH may be lower, though typically still above 8 SU. While pH is not a performance parameter for ISS remedies, an alkaline, noncorrosive, pH is expected for alternatives that involve ISS.

The following considerations are identified for pH values:

- A noncorrosive pH range (4 to 12 SU).
- An alkaline pH range (8 to 12 SU) is anticipated for ISS-treated materials.

#### 4.3.5.2 Air Emissions Thresholds

Emission of VOCs from impoundment materials will be controlled as necessary to protect human health and limit nuisance odors during implementation of the remedial action. A robust air monitoring program will be established during the design phase and will be tailored to the specific activities being implemented so that air emissions are being controlled in an appropriate manner. Air monitoring programs of this type are usually based on conservative exposure scenarios and typically include an integrated system that allows for real time monitoring and worker notifications if levels reach notification or stop work limits.

Achieving air emissions thresholds that are protective of human health are potential ARARs for implementing the remedy. Typical criteria for controlling VOC emissions are based on the $10^{-6}$ to $10^{-4}$ target cancer risk range and noncancer hazard index of less than 1, as described by USEPA (1991a), however constituent-specific noncancer indexes may be developed.

Air emissions, often estimated in pounds per day, are a function of the COC concentrations in the material being managed, physical/chemical characteristics of the COC (e.g., Henry's constant; air diffusion coefficient), environmental conditions (such as temperature), construction means and methods, engineering controls, and production rate (i.e., how many $yd^3$ or tons of material are moved each day). The combination of COC concentrations, construction means and methods, engineering controls, and production rate must be carefully managed so air emissions do not pose an unacceptable risk.

# 4.4 Identification and Summary of Preliminary Alternatives

The principles summarized below were considered in the development of remedial alternatives for OU8, with the exception of the no action alternative:

- **Use treatment to address principal threats and achieve PRGs wherever practicable.** In-situ and ex-situ treatment options were incorporated into the alternatives for the impoundments.
- **Use a combination of methods, as appropriate, to achieve protection of human health and the environment.** The remedial alternatives comprise various combinations of in-situ treatment, capping, and offsite treatment in conjunction with source control options, long-term monitoring, and institutional controls.
- **Use institutional controls as needed to supplement engineering controls to prevent or limit exposure.** Institutional controls will be incorporated into the remedy for the impoundments as needed to assist in maintaining the long-term integrity of the remedy.
- **Prevent migration and exposure of contaminants to groundwater.** Closure-in-place alternatives for the impoundments include source control measures and robust hydraulic containment and treatment systems that will address migration of contamination to groundwater.

Eleven preliminary remedial alternatives, including no action, were developed for OU8 using various combinations of the remedial technologies retained in the screening evaluation in Section 4.2. All of the alternatives (except no action) meet the threshold criteria of "Overall Protection of Human Health and the Environment" and "Compliance with ARARs." The eleven preliminary remedial alternatives are briefly described below.

## 4.4.1 Alternative 1 – No Action

In accordance with the NCP requirement, the no action alternative is carried through the entire FFS process as the baseline condition against which the performance of the remaining alternatives is evaluated.

## 4.4.2 Alternative 2 – ISS Treatment, Inner HBW, Soil Cover

Alternative 2 involves ISS to reduce contaminant mass, reduce hydraulic conductivity, reduce leachability, increase pH, and increase strength, followed by installing an inner HBW[2] and a vegetated soil cover to allow for closure-in-place.

[2] As noted previously, the term "inner hydraulic barrier wall" or "inner HBW" refers to a barrier that immediately surrounds Impoundments 1 and 2, in order to distinguish this proposed HBW from the existing HBW downgradient from Impoundments 1 and 2.

### 4.4.3 Alternative 3 – ISS Treatment, Inner HBW, Protective Cover

Alternative 3 involves ISS to reduce contaminant mass (primarily due to volatilization during mixing), reduce hydraulic conductivity, reduce leachability, increase pH, and increase strength. Other steps include installing an inner HBW and a protective cover over the impoundment area.

### 4.4.4 Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover

Alternative 4 involves using steam while homogenizing impoundment materials to enhance contaminant mass reduction followed by ISS to reduce hydraulic conductivity and leachability, increase pH, and increase strength. Other steps include installing an inner HBW and a protective cover over the impoundment area.

### 4.4.5 Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover

Alternative 5 involves using steam while homogenizing impoundment materials to enhance contaminant mass reduction followed by ISS to increase strength. Other steps include excavating and placing treated material at the onsite CAMU, backfilling the excavation with berm materials not requiring treatment, and installing a protective cover over the former impoundment area.

### 4.4.6 Alternative 6 – Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover

Alternative 6 involves excavating and mechanical dewatering impoundment material, followed by shipping to an offsite facility, preferably a cement kiln, for treatment (destruction), ISS of soil and clay impacted by OU8 impoundment materials above PRGs, backfilling the excavation with berm materials not requiring treatment, and installing a protective cover over the former impoundment area.

### 4.4.7 Alternative 7 – ISS and Soil Vapor Extraction Treatment, Excavation and Placement in CAMU, Soil Cover

Alternative 7 involves using ISS to increase strength and reduce contaminant mass, followed by in-situ soil vapor extraction to enhance contaminant mass reduction. Treated material would be excavated and disposed in the onsite CAMU, berm materials would be backfilled in the excavation area, and a vegetated soil cover would be installed over the former impoundment area.

### 4.4.8 Alternative 8 – ISS Treatment, ISTT, Inner HBW, Protective Cover

Alternative 8 involves using ISS to increase strength and reduce contaminant mass, followed by ISTT to enhance contaminant mass reduction, installing an inner HBW, and installing a low-permeability engineered cover with active vapor control over the impoundment area.

### 4.4.9 Alternative 9 – ISS Treatment, ISTT, Excavation and Placement in CAMU, Soil Cover

Alternative 9 involves using ISS to increase strength and reduce contaminant mass, followed by ISTT to enhance contaminant mass reduction, excavating treated material and placement in the onsite CAMU, backfilling the excavation with berm materials, and installing a vegetated soil cover over the former impoundment area.

### 4.4.10 Alternative 10 – ISS Treatment, Excavation and Treatment at Offsite Incinerator, Soil Cover

Alternative 10 involves ISS to increase strength and reduce contaminant mass, followed by excavating treated material and shipping to an offsite incinerator, backfilling the excavation with berm materials, and installing a vegetated soil cover over the former impoundment area.

### 4.4.11 Alternative 11 – ISS Treatment, ISTT, Excavation and Treatment at Offsite Incinerator, Soil Cover

Alternative 11 involves using ISS to increase strength and reduce contaminant mass, followed by ISTT to enhance contaminant mass reduction, excavating treated material and shipping to an offsite incinerator, backfilling the excavation with berm materials, and installing a vegetated soil cover over the former impoundment area.

## 4.5 Screening of Preliminary Alternatives

The 11 preliminary alternatives were screened based on effectiveness, implementability, and cost so that the most promising alternatives were carried forward in the detailed analysis. All alternatives, with the exception of Alternative 1—No Action, met threshold criteria related to overall protection of human health and the environment and compliance with ARARs. The following criteria were considered in the screening:

- Effectiveness
  - Reduction in TMV and ability to meet RAOs
  - Potential impacts to human health and the environment during the construction and implementation phase
  - Demonstration and reliability of the process
- Implementability
  - Technical and administrative feasibility
  - Ability to obtain necessary permits for offsite work
  - Availability of treatment, storage and disposal services
  - Availability of necessary equipment and skilled workers
- Cost
  - Design
  - Capital Improvements
  - Implementation and oversight
  - O&M
  - Long-term monitoring
  - Assessments made based on sound engineering principles

Table 4-4 summarizes the logic considered during the screening process and provides the detailed rationale for either retaining or discarding preliminary alternatives.

Table 4-4. Alternative Screening

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Alternative | Description | Screening Component | | | Screening Result |
|---|---|---|---|---|---|
| | | Effectiveness | Implementability | Cost | |
| **Alternative 1 – No Action** | In accordance with the NCP guidance, the No Action alternative is carried through the entire FFS process as the baseline condition against which the performance of the remaining alternatives is evaluated. | Not effective as it will not achieve RAOs.<br><br>○ | There are no increased short-term risks associated with implementation.<br><br>Duration – 0 years<br><br>● | Low<br>(< $50,000,000)<br><br>● | Retained<br>(per NCP guidance) |
| **Alternative 2 – ISS Treatment, Inner HBW, Soil Cover** | ISS of impoundment material, installation of an inner hydraulic barrier wall, and installation of a vegetated soil cover to allow for closure-in-place. | OU8 impoundment material treated: pH increased; leachability reduced >90%; VOC mass removed (~25%).<br><br>Additional protection/improvement of groundwater quality due to engineering controls.<br><br>Minimized exposure with in-place treatment.<br><br>● | Alternative is implementable.<br><br>Duration - 3 years<br><br>● | Low<br>(< $50,000,000)<br><br>● | Not retained.<br>Similar endpoint to Alternative 3, but less robust. |
| **Alternative 3 – ISS Treatment, Inner HBW, Protective Cover** | ISS of impoundment material, installation of an inner HBW, and installation of a low permeability engineered cover with berm armoring and active vapor control to allow for closure-in-place. | OU8 impoundment material treated: pH increased; leachability reduced >90%; VOC mass removed (~25%).<br><br>Additional protection/improvement of groundwater quality due to engineering controls. Engineered cover and armoring provide additional protection of treated material.<br><br>Enhanced VOC removal will be achieved through the operation and maintenance of an active vapor collection system.<br><br>Minimized exposure with in-place treatment.<br><br>● | Alternative is implementable.<br><br>Duration – 2 years<br><br>● | Medium<br>(> $50,000,000)<br><br>◑ | Retained |
| **Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover** | ISS with heating via steam injection to enhance contaminant mass removal, installation of an inner HBW, and installation of an engineered cover with berm armoring and active vapor control to allow for closure in-place. | OU8 impoundment material treated: pH increased; leachability reduced >90%; VOC mass removed (~75%).<br><br>Additional protection/improvement of groundwater quality due to engineering controls. Engineered cover and armoring provide additional protection of treated material.<br><br>Enhanced VOC removal will be achieved through the operation and maintenance of an active vapor collection system.<br><br>Minimized exposure with in-place treatment<br><br>● | Alternative is implementable.<br><br>Duration – 2 years<br><br>● | Medium<br>(> $50,000,000)<br><br>◑ | Retained |

Table 4-4. Alternative Screening
*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Alternative | Description | Screening Component | | | Screening Result |
|---|---|---|---|---|---|
| | | Effectiveness | Implementability | Cost | |
| **Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover** | Steam enhanced ISS to treat OU8 impoundment material and underlying soil and clay impacted by OU8 impoundment material resulting in COC reduction and increased strength to facilitate excavation. Treated OU8 impoundment material will then be excavated and placed in the onsite CAMU. Following removal, a protective cover will be installed to minimize future migration of COCs. | OU8 impoundment material treated to CAMU requirements. In addition, pH increased; VOC mass removed (~75%).<br><br>Material removed from floodplain.<br><br>Lower effectiveness rating due to potential for exposure during excavation/placement at CAMU.<br><br>◑ | Implementation of Alternative 5 would be challenging since there are multiple processes involved with in-place treatment, removal, additional treatment at the CAMU, then placement of the material in the CAMU. Fewer contractors are available with experience implementing steam-enhanced ISS. Excavation equipment is readily available; however, emission controls at the point of excavation and placement may be challenging.<br><br>Duration – 3 years<br><br>○ | Medium<br>(> $50,000,000)<br><br>◑ | Retained |
| **Alternative 6 – Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover** | Excavation and mechanical dewatering of acid tar (OU8 impoundment material), followed by shipping to an offsite facility, preferably a cement kiln, for treatment (destruction). Following acid tar removal, soil and clay impacted by OU8 impoundment material above PRGs will be treated using ISS and a protective cover will be installed to minimize future migration of COCs. | OU8 impoundment material removed from floodplain and treated offsite.<br><br>Lower effectiveness rating due to challenges associated with excavation and off-site transport.<br><br>◑ | Alternative is implementable.<br><br>Engineering controls needed to manage vapors/emissions during removal.<br><br>Duration – 3 years<br><br>◑ | Medium<br>(> $50,000,000)<br><br>◑ | Retained |
| **Alternative 7 – ISS and SVE Treatment, Excavation and Placement in CAMU, Soil Cover** | ISS followed by soil vapor extraction to enhance contaminant mass removal, followed by excavation of treated material to the onsite CAMU, berms backfilled into excavation area, and installation of a soil cover over the backfilled Impoundment area. | OU8 impoundment material treated to CAMU requirements. In addition, pH increased; VOC mass removed.<br><br>Material removed from floodplain.<br><br>Requires engineering controls for managing soil and clay impacted by OU8 impoundment material.<br><br>Lower effectiveness rating due to potential for exposure during excavation/placement at CAMU.<br><br>◑ | Numerous technical challenges associated with infrastructure for SVE and management of vapor emissions. SVE requires longer implementation time than Thermally-enhanced ISS included in Alternatives 4 and 5.<br><br>SVE infrastructure requires additional robust control measures to manage potential flooding of the system.<br><br>Duration – 8 years<br><br>◑ | Medium<br>(> $50,000,000)<br><br>◑ | Not Retained.<br>Same CAMU endpoint as Alternative 5, but longer duration. |
| **Alternative 8 – ISS Treatment, ISTT, Inner HBW, Protective Cover** | ISS followed by ISTT to enhance contaminant mass removal, installation of an inner HBW, and installation of an engineered cover with active vapor control to allow for closure-in-place | OU8 impoundment material treated: pH increased; leachability reduced >90%; VOC mass removed (~90%).<br><br>Additional protection/improvement of groundwater quality due to engineering controls.<br><br>Enhanced VOC removal will be achieved through the operation and maintenance of an active vapor collection system.<br><br>Minimized exposure with in-place treatment.<br><br>● | Numerous technical challenges associated with infrastructure for ISTT. ISTT infrastructure requires additional robust control measures to manage potential flooding of the system. Equipment is not readily mobilized in the event of a flood/storm incident.<br><br>Duration – 5 years<br><br>○ | High<br>(> $100,000,000)<br><br>○ | Not Retained.<br>Significant implementation challenges associated with ISTT in the floodplain. High costs. |

Table 4-4. Alternative Screening
*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Alternative | Description | Screening Component | | | Screening Result |
|---|---|---|---|---|---|
| | | Effectiveness | Implementability | Cost | |
| **Alternative 9 – ISS Treatment, ISTT, Excavation and Placement in CAMU, Soil Cover** | ISS followed by ISTT to enhance contaminant mass removal, excavation of treated material to onsite CAMU. Berms backfilled into excavation area and installation of a soil cover over the backfilled impoundment area | OU8 impoundment material treated to CAMU requirements. In addition, pH increased; leachability reduced >90%; VOC mass removed (~90%).<br><br>Material removed from floodplain<br><br>● | Numerous technical challenges associated with infrastructure for ISTT. ISTT infrastructure requires additional robust control measures to manage potential flooding of the system. Equipment is not readily mobilized in the event of a flood/storm incident.<br><br>Duration – 7 years<br><br>○ | High<br>(> $100,000,000)<br><br>○ | Not Retained.<br>Significant implementation challenges associated with ISTT in the floodplain. High costs. |
| **Alternative 10 – ISS Treatment, Excavation and Treatment at Offsite Incinerator, Soil Cover** | ISS, removal of treated material to offsite incinerator, and installation of a soil cover over the remaining Impoundment area. | OU8 impoundment material treated: pH increase; VOC mass removed.<br><br>Material removed from floodplain and treated offsite.<br><br>Lower effectiveness rating due to potential for exposure during excavation and off-site transport.<br><br>◑ | Numerous technical challenges associated with the installation of infrastructure that would be required for vapor control during removal.<br><br>Duration – 7 years<br><br>◑ | High<br>(> $100,000,000)<br><br>○ | Not Retained.<br>Same off-site endpoint as Alternative 6, but longer duration and higher cost. |
| **Alternative 11 – ISS Treatment, ISTT, Excavation and Treatment at Offsite Incinerator, Soil Cover** | ISS followed by ISTT to enhance contaminant mass removal, excavation of treated material to offsite incinerator. Berms backfilled into excavation area and installation of a soil cover over the backfilled Impoundment area. | OU8 impoundment material treated.<br><br>Material removed from floodplain and treated offsite.<br><br>● | Numerous technical challenges associated with infrastructure for ISTT. ISTT infrastructure requires additional robust control measures to manage potential flooding of the system. Equipment is not readily mobilized in the event of a flood/storm incident.<br><br>Duration – 11 years<br><br>○ | High<br>(> $200,000,000)<br><br>○ | Not Retained.<br>Significant implementation challenges associated with ISTT in the floodplain. High costs. |

Notes:
CAMU – Corrective Action Management Unit
COC – contaminant of concern
FFS – Focused Feasibility Study
HBW – hydraulic barrier wall
ISS – In-Situ Stabilization/ Solidification
ISTT – In-Situ Thermal Treatment
PTW - Principle Threat Waste
SVE – soil vapor extraction

Legend:
○ Low (Alternative is expected to perform poorly against criterion)
◑ Moderate (Alternative is expected to perform moderately well against criterion)
● High (Alternative is expected to perform very well against criterion)

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# 4.6 Alternatives Retained for Detailed Analysis

Based on the preliminary screening assessment, the following alternatives from Section 4.4 were retained for detailed analysis. The alternatives selected for further evaluation preserve the range of treatment and containment technologies initially developed (USEPA 1988). Although, several ISTT alternatives were developed and were carefully considered in this FFS, these alternatives were screened out based on the technical challenges associated with treating acid tar and the significant infrastructure needed to safely implement this technology in an area prone to flooding. The alternatives retained for detailed analysis are as follows:

- Alternative 1 – No Action
- Alternative 3 – ISS Treatment, Inner HBW, Protective Cover
- Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover
- Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover
- Alternative 6 – Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover

Table 4-5 summarizes the primary elements of each retained alternative. Each of the retained alternatives is described in more detail in Section 5.1.

Table 4-5. Summary of Major Components of Retained Alternatives

| Component | Alternative | | | | |
|---|---|---|---|---|---|
| | ***1*** | ***3*** | ***4*** | ***5*** | ***6*** |
| ISS Treatment of OU8 Impoundment Material | | X | X | X | |
| ISS Treatment of Soil and Clay Impacted by OU8 Impoundment Material above PRGs | | X | X | X | X |
| Steam-Enhanced ISS Treatment | | | X | X | |
| Inner HBW | | X | X | | |
| Protective Cover | | X | X | X | X |
| Closure-In-Place | | X | X | | |
| Excavation and Placement in CAMU | | | | X | |
| Excavation, Dewatering, and Treatment Offsite | | | | | X |

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SECTION 5

# Detailed Analysis of Retained Alternatives

This section presents a detailed analysis of the retained remedial alternatives. The purpose of this analysis is to present relevant details, evaluations, and comparisons of the retained alternatives in order to inform remedy selection. As part of this analysis, the alternatives have been developed to a sufficient degree to facilitate analysis and comparison. The developed alternatives have then been evaluated according to seven of the nine evaluation criteria—classified as threshold and balancing criteria—defined by the NCP. The two modifying criteria (state and community acceptance) will be evaluated after the FFS public comment period.

## 5.1 Detailed Descriptions of Alternatives

This section presents detailed descriptions of each of the retained alternatives.

### 5.1.1 Alternative 1 – No Action

Under Alternative 1, no remedial actions would be performed to further reduce the TMV of PTW or COCs within the impoundments and RAOs would not be addressed. Routine site maintenance and periodic monitoring activities would still be conducted.

In accordance with the NCP requirement, the no action alternative is carried through the entire FFS process as the baseline condition against which performance of the remaining alternatives are evaluated.

### 5.1.2 Alternative 3 – ISS Treatment, Inner HBW, Protective Cover

Alternative 3 involves ISS to provide for permanent, long-term treatment and reduction of contaminant mass and solidification of impoundment material including pH adjustment, installation of an HBW and a low-permeability engineered cover with active vapor control and berm armoring, and infrastructure upgrades to allow for closure-in-place. For FFS costing purposes, several assumptions have been made in the following description that may be modified in detailed design. The anticipated duration of field activities for Alternative 3 is 20 months. Figures 5-1 and 5-2 present conceptual diagrams showing the treatment process and post-treatment closure conditions, respectively. A comprehensive health and safety program and perimeter air monitoring program would be developed to ensure worker and community protection. This alternative consists of three major components:

- ISS treatment of impoundment material
- Installation of an inner HBW
- Installation of a protective cover

ISS would be applied to provide for permanent, long-term reduction of contaminant mass and solidification of impoundment material. Treatment would result in pH adjustment, increased material strength to support construction equipment and the engineered cover, and create a low-permeability monolith that reduces leaching of COCs.

Based on treatability and pilot study findings (CH2M 2014a, 2015a), ISS of material in both Impoundments 1 and 2 can meet the required ISS performance criteria goals established for OU8 (CH2M 2015b), which are:

- Hydraulic conductivity: less than $10^{-6}$ cm/s
- UCS: greater than 40 psi
- Benzene leachability reduction: greater than 90%

- pH: 4 to 12 SU

ISS would be completed using large-diameter mixing augers to incorporate ISS reagents into the impoundment material creating a series of overlapping, treated columns. Columns would extend to a depth of approximately 2 feet below the clay layer lining the bottom of the impoundments. During the treatment process, the clay liner would be incorporated in the solidified matrix and would no longer be required for containment since the impoundment materials would become solidified. For each ISS alternative presented in this FFS report, an ISS reagent mixture similar to that used in the pilot study is assumed, although the reagents and dosing may be adjusted and vary by alternative. The final reagent mixture and dosing would be selected during the detailed design phase.

For ISS operations, 10-foot-diameter mixing augers would be used. Based on impoundment dimensions, there would be 810 ten-foot-diameter columns in Impoundment 1 and 918 ten-foot-diameter columns in Impoundment 2. It is assumed that two ISS rigs would be operated simultaneously during treatment (one at each impoundment), with each rig creating overlapping lines of stabilized material. It is anticipated that 1 week of curing is required for the treated materials to exhibit sufficient strength to support remediation equipment (i.e., to support the ISS rig driving on the treated material). Before advancing ISS operations on the next row of columns, a layer of granular stone fill, with vapor control as needed would be placed on top of the treated material to serve as the working platform for the next row of columns to be treated. Using this sequence, a working platform would be created on top of the impoundments as materials are treated. Assuming one shift per day, a 5-day work week and 90% operating time (to account for severe weather and holidays), it would take approximately 8 months to complete the ISS mixing process in both impoundments.

During mixing operations, vapors would be controlled using a vented outer shroud on the mixing augers. Each vented shroud would be used to actively collect (via vacuum) and direct vapors to a thermal oxidizer and caustic scrubber (two units, one per ISS rig). A water cap would be maintained on untreated material within the impoundments to minimize VOC emissions. The water cap would be lowered from its current elevation, but would be maintained at a level sufficient to minimize flux of VOCs to the atmosphere. Water extracted during mixing operations would be conveyed to the existing equipment bench (a higher elevation staging area near the impoundments), treated, and then returned directly to the impoundment. Vapors generated by air stripper operation would be combined with those recovered during mixing operations and those extracted from the vapor collection system installed over ISS-treated material; the combined vapor streams would be treated with thermal oxidizers.

An inner HBW would be installed to minimize contact of upgradient groundwater with the treated monolith. Details of the HBW (e.g., construction, materials, monitoring etc.) would be determined during design.

Following completion of ISS operations, curing, and removal of the temporary vented cover, a protective cover would be installed over the impoundments to prevent direct contact with treated material, control vapors as needed, and protect against flooding. For the purposes of this FFS, it has been assumed that this would consist of a low-permeability engineered cover with a vapor control component, however, the specific cover design would be established during the design phase. It is assumed that enhanced VOC reduction would be achieved through the O&M of an active vapor collection and treatment system. Active vapor collection would consist of a blower that is connected to a pipe manifold that would serve both impoundments. Extracted vapor would be drawn through an air/water (A/W) separator and then treated by vapor-phase granular activated carbon (VGAC) treatment. It is projected that, in the long term, the gravel vent layer would create an environment with elevated oxygen levels which would help biodegrade benzene vapors (if present), and the VGAC would not be necessary. When contaminant concentrations decline enough for direct discharge to the atmosphere, the powered blower would be replaced with a passive vent. For costing purposes, this is assumed to be after 10 years of active vapor treatment. O&M activities during that treatment would

include measuring vapor flows and vacuums, measuring COC concentrations before and after VGAC, checking the amount of liquid in the A/W separator, and checking for condensation throughout the conveyance system. Maintenance would be performed semiannually and would involve blower inspection and repair, piping inspection and repair, and VGAC replacement as necessary.

The engineered cover would be maintained through routine inspections and implementation of corrective measures, as necessary. Vegetated areas would be maintained once annually, or as needed. Site inspections would include evaluating the site for evidence of erosion, cracking, sloughing, animal burrows, stressed vegetation, etc. Maintenance for the engineered cover during post-closure care would be performed semiannually for an assumed 30 years.

### 5.1.3 Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover

This alternative involves heating the OU8 impoundment materials via steam injection to provide for permanent, long-term, enhanced reduction of contaminant mass and ISS treatment including pH adjustment, installation of an HBW and a low-permeability engineered cover with active vapor control and berm armoring, and infrastructure upgrades to allow for closure-in-place. For FFS costing purposes, several assumptions have been made in the following description that may be modified in detailed design. The anticipated duration of field activities for Alternative 4 is 24 months. Figures 5-3 and 5-2 present conceptual diagrams showing the treatment process and post-treatment closure conditions, respectively. A comprehensive health and safety program and perimeter air monitoring program would be developed to ensure worker and community protection. This alternative consists of four major components:

- Steam-enhanced injection into impoundment materials
- ISS treatment of impoundment material
- Installation of an inner HBW
- Installation of a protective cover

Steam-enhanced ISS would be applied to increase VOC mass reduction, adjust the pH of the impoundment material, increase material strength to support construction equipment and the engineered cover, and create a low-permeability monolith that reduces leaching of COCs to groundwater. Steam enhancement is expected to increase mass reduction rates compared to ISS alone (Appendix E2) (CH2M 2015a, 2016a).

Based on treatability and pilot study findings (CH2M 2014a, 2015a), ISS of OU8 impoundment material can meet the selected ISS performance criteria goals established for OU8 (CH2M 2015b), which are:

- Hydraulic conductivity: less than $10^{-6}$ cm/s
- UCS: greater than 40 psi
- Benzene leachability reduction: greater than 90%
- pH: 4 to 12 SU

Steam-enhanced ISS would be completed using large-diameter mixing augers. During the initial mixing operations, steam infused with compressed air would be injected by the mixing equipment to heat the impoundment material and promote contaminant volatilization during homogenization. Following steam-enhanced mixing, ISS reagents would be mixed into the impoundment material creating a series of overlapping, treated columns. Columns would extend to a depth of approximately 2 feet below the clay layer lining the bottom of the impoundments. During the treatment process, the clay liner would be incorporated in the solidified matrix (it would no longer be required for containment since the impoundment materials would become solidified). For each of the ISS alternatives presented in this FFS report, an ISS reagent mixture similar to that used in the pilot study is assumed, although the reagents

and dosing may be adjusted and vary by alternative. The final reagent mixture and dosing would be selected during the detailed design phase.

For ISS mixing, a 10-foot-diameter mixing auger would be used. Based on impoundment dimensions, there would be 810 ten-foot-diameter columns in Impoundment 1 and 918 ten-foot-diameter columns in Impoundment 2. It is assumed that two ISS rigs would be operated simultaneously during treatment (one at each impoundment), with each rig creating overlapping lines of stabilized material. It is anticipated that 1 week of curing is required for the treated materials to exhibit sufficient strength to support remediation equipment (i.e., to support the ISS rig driving on the treated material). Before advancing ISS operations, a layer of granular stone fill, vented as needed, would be placed on top of the treated material to serve as the working platform for the next row of columns to be treated. Using this sequence, a working platform would be created on top of the impoundments as materials are treated. Assuming one shift per day, a 5-day work week and 90% operating time (to account for severe weather and holidays), it would take approximately 12 months to complete the ISS mixing process in both impoundments.

During mixing operations, vapors would be controlled using a vented outer shroud on the mixing augers. Each vented shroud would be used to actively collect (via vacuum) and direct vapors to a thermal oxidizer and caustic scrubber (two units, one per ISS rig). A water cap would be maintained on untreated material within the impoundments to minimize VOC emissions. The water cap would be lowered from its current elevation, but would be maintained at a level sufficient to minimize flux of VOCs to the atmosphere. Water extracted during mixing operations would be conveyed to the existing equipment bench, treated, and then returned directly to the impoundment. As necessary, vapors generated by air stripper operation would be combined with those recovered during mixing operations and those extracted from the vapor collection system installed over ISS-treated material; the combined vapor streams would be treated with thermal oxidizers.

An inner HBW would be installed to minimize contact of upgradient groundwater with the treated monolith. Details of the HBW (e.g., construction, materials, monitoring etc.) would be determined during design.

Following completion of ISS operations, curing, and removal of the temporary vented cover, a protective cover would be installed over the impoundments to prevent direct contact with treated material, control vapors as needed, and protect against flooding. For the purposes of this FFS, it has been assumed that this would consist of a low-permeability engineered cover with a vapor control component, however, the specific cover design would be established during the design phase.

Enhanced VOC reduction would be achieved through the O&M of an active vapor collection system. Active vapor collection would consist of a blower that is connected to a pipe manifold that would serve both impoundments. Extracted vapor would be drawn through an A/W separator and then treated by VGAC. As vapors decline, the active vapor treatment would be replaced with passive venting. It is projected that, in the long term, the shallow gravel layer would create an environment with elevated oxygen levels which would help biodegrade benzene vapors (if present), and the VGAC would not be necessary. When contaminant concentrations decline enough for direct discharge to the atmosphere, the powered blower would be replaced with a passive vent.

For costing purposes, this is assumed to be after 10 years of active vapor treatment. O&M activities during that treatment would include measuring vapor flows and vacuums, measuring COC concentrations before and after VGAC, checking the amount of liquid in the A/W separator, and checking for condensation throughout the conveyance system. Maintenance would be performed semiannually and would involve blower inspection and repair, piping inspection and repair, and VGAC replacement as necessary.

The engineered cover would be maintained through routine inspections and implementation of corrective measures, as necessary. Vegetated areas would be maintained once annually, or as needed. Site inspections would include evaluating the site for evidence of erosion, cracking, sloughing, animal burrows, stressed vegetation, etc. Maintenance for the engineered cover during post-closure care would be performed semiannually for an assumed 30 years.

### 5.1.4 Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover

This alternative involves using steam enhanced ISS to treat OU8 impoundment material, then removing treated material and placing it in the onsite CAMU. Following removal, a protective cover will be installed over treated soil and clay impacted by OU8 impoundment material above PRGs to minimize future migration of COCs. For FFS costing purposes, several assumptions have been made in the following description that may be modified in detailed design. The anticipated duration of field activities for Alternative 5 is 30 months. Figures 5-4 and 5-5 present conceptual diagrams showing the treatment/removal process and post-removal conditions, respectively. A comprehensive health and safety program and perimeter air monitoring program would be developed to ensure worker and community protection. In-situ treatment would promote contaminant mass reduction, improve material handling properties, and facilitate treated material removal for final disposal in the CAMU. Following reduction of treated impoundment material, the berms would be backfilled and a protective cover would be installed. This alternative consists of three major components:

- Steam-enhanced ISS treatment of impoundment material
- Excavation of treated materials and placement in CAMU
- Backfill with existing berm materials and installation of a protective cover

Steam-enhanced ISS would be applied to increase VOC mass reduction, adjust the pH of the impoundment material, and improve material handling properties to facilitate excavation and placement in the CAMU. Based on treatability study findings presented in Appendix E2 (CH2M 2016a), steam-enhanced ISS is expected to meet these objectives. This alternative also meets the performance criteria of liner compatibility, which is outlined in Table 4-3.

Steam-enhanced ISS would be completed using large-diameter mixing augers. During the mixing operations, steam infused with compressed air would be injected by the mixing equipment to heat the impoundment material and promote contaminant volatilization during homogenization. ISS reagents would then be mixed into the impoundment material creating a series of overlapping, treated columns. Columns would extend to a depth of approximately 2 feet below the clay layer lining the bottom of the impoundments. During the treatment process, the clay liner would be incorporated in the solidified matrix and would no longer be required for containment since the impoundment materials would become solidified. For each of the ISS alternatives presented in this FFS report, an ISS reagent mixture similar to that used in the pilot study is assumed, although the reagents and dosing may be adjusted and vary by alternative. The final reagent mixture and dosing would be selected during the detailed design phase. For this alternative, it is assumed that the ISS reagents would be added at a lower dose than Alternatives 3 and 4 because the strength requirement is only that needed to support equipment and the CAMU cover.

For ISS mixing, a 10-foot-diameter mixing auger would be used. Based on impoundment dimensions, there would be 810 ten-foot-diameter columns in Impoundment 1 and 918 ten-foot-diameter columns in Impoundment 2. It is assumed that two ISS rigs would be operated simultaneously during treatment (one at each impoundment), with each rig creating overlapping lines of stabilized material. It is anticipated that one week of curing is required for the treated materials to exhibit sufficient strength to support remediation equipment (i.e., to support the ISS rig driving on the treated material). Before advancing ISS operations, a layer of granular stone fill would be placed on top of the treated material

and vented as needed to control vapors. An additional stone layer would be placed over the vapor barrier to serve as the working platform for the next row of columns to be treated. Using this sequence, a working platform would be created on top of the impoundments as materials are treated. Assuming a 5-day work week and 90% operating time (to account for severe weather and holidays), it would take approximately 12 months to complete the ISS mixing process in both impoundments.

During mixing operations, vapors would be controlled using a vented outer shroud on the mixing augers. Each vented shroud would be used to actively collect (via vacuum) and direct vapors to a thermal oxidizer and caustic scrubber (two units, one per ISS rig). A water cap would be maintained on untreated material within the impoundments to minimize VOC emissions. The water cap would be lowered from its current elevation, but would be maintained at a level sufficient to minimize flux of VOCs to the atmosphere. Water extracted during mixing operations would be conveyed to the existing equipment bench, treated, and then returned directly to the impoundment. As necessary, vapors generated by air stripper operation would be combined via piping with those recovered during mixing operations and those extracted from venting of the ISS-treated material; the combined vapor streams would be treated with thermal oxidizers.

After ISS operations are completed, treated material would be removed from the impoundments using conventional excavation methods and transported by truck to the onsite CAMU for final deposition. The treated material would be excavated from the impoundments with the berms remaining intact. Material would be excavated to the depth of the clay layer that existed prior to ISS. To access material beyond the initial reach of the excavator, a temporary haul road would be constructed into the impoundment to facilitate excavation and loading operations. A decontamination area would be established where equipment can be decontaminated before leaving the excavation area.

For FFS purposes, it is assumed that treated materials would be excavated and placed at the CAMU at a rate of 500 $yd^3$ per day (approximately 25 trucks). It is also assumed that odor and emissions would be controlled using a temporary fabric structure or suppressing foam, as needed. Stormwater that accumulates in the impoundments during excavation operations would be collected so the active excavation remains as dry as possible. Stormwater (pretreated if necessary) would be sent to the GWTF for treatment.

Following excavation from the Impoundment 1 and 2 areas, treated impoundment materials would be transported approximately 1.5 miles to the onsite CAMU for final deposition. The existing temporary cover at the CAMU would be opened and impoundment material would be placed under a vapor controlled temporary fabric structure, if needed to control emissions. This alternative includes the provision to adjust the UCS at the time of placement by adding Portland cement to further solidify the material and reduce hydraulic conductivity/leaching.

Treated material was determined to be compatible with the existing CAMU liner based on the findings of bench-scale studies (Appendix E1) that evaluated liner compatibility with representative leachate concentrations for ISS and steam-enhanced-ISS treated impoundment materials (CH2M 2016a). As with other alternatives involving ISS or steam-enhanced ISS, the performance criteria for pH of the treated material is a non-corrosive pH (4 to 12 SU).

Following excavation of treated material, the remaining impoundment berms not requiring treatment would be folded down into the void created by material removal. A protective cover would then be installed over the impoundment areas, which would be maintained through routine inspections and implementation of corrective measures, as necessary. Vegetated areas would be maintained once annually, or as needed. Site inspections would include evaluating the site for evidence of erosion, cracking, sloughing, animal burrows, stressed vegetation, etc. Maintenance for the protective cover during post-closure care would be performed semiannually for an assumed 30 years.

### 5.1.5 Alternative 6 –Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover

This alternative involves excavation and mechanical dewatering of OU8 impoundment material, followed by offsite treatment. The anticipated duration of field activities for Alternative 6 is 38 months. For FFS costing purposes, several assumptions have been made in the following description that may be modified in detailed design. Figures 5-6 and 5-5 present conceptual diagrams showing the treatment process and the post-removal conditions, respectively. A comprehensive health and safety program and perimeter air monitoring program would be developed to ensure worker and community protection. Excavated acid tar would be dewatered, loaded into lined dump trailers and transported offsite for treatment (destruction), preferably at a cement kiln. Soil and clay above the water table impacted by OU8 impoundment materials with concentrations exceeding the PRGs, including minor amounts of acid tar, would be treated via ISS and placed beneath a protective cover. Soil and clay not requiring treatment (i.e., concentrations below the PRGs) would be backfilled into the excavated area and placed beneath a protective cover. This alternative consists of the following major components:

- Excavation and dewatering of impoundment material
- Emission and odor control
- Offsite shipment and treatment (destruction)
- Treatment of soil and clay (above water table) impacted by OU8 impoundment material above PRGs via ISS
- Backfill with existing berm materials
- Installation of protective cover

OU8 impoundment material would be excavated to the depth of the existing clay layer using a long-reach tracked excavator. The berms would be stabilized as necessary to support the excavator. The excavator would be positioned on the berms and impoundment material would be allowed to flow toward the area of excavation and temporary haul roads would be constructed as necessary to reach remaining material. The water cap on the impoundments would be pumped down to a minimum level, and the liner covering the surface would be removed within the immediate excavation area. Stormwater that accumulates in the open impoundment during excavation operations would be collected, pretreated as needed, and treated at the onsite GWTF. A decontamination area would be established where equipment can be decontaminated before leaving the excavation area.

Impoundment material (acid tars) would be dewatered to allow for shipment as a solid (OBG 2016). Excavated material would be transferred from the excavator bucket to a dewatering screw conveyor equipped with a conical hopper. The dewatering screw conveyor would be portable and would be located close to the excavator to facilitate unloading directly to the dewatering screw conveyor hopper. Dewatered material discharging from the dewatering screw conveyor would be transferred to a double plastic lined dump trailer using a belt conveyor. Based on the results of bench-scale treatability tests conducted on impoundment materials in 2016 (OBG 2016), it is estimated that the dewatered impoundment material would contain approximately 18% water; an estimated 44,700 tons of dewatered impoundment material would be transported offsite for treatment/destruction, as described below, and an estimated 9,600 tons (2.3 million gallons) of aqueous phase liquid would be collected in a proper containment vessel (i.e., above ground storage tank or tanker truck) and stored prior to onsite treatment (at the GWTF) or transported to an offsite treatment facility. For costing purposes in this FFS, it is assumed that the aqueous phase liquid would be sent offsite for treatment and disposal.

Excavation and dewatering is expected to be performed from March to November, at a rate aligned with acceptance rates at offsite cement kilns. If temperatures remain consistently over 40 degrees Fahrenheit, the production season may be extended and offsite facility capacity would continue to be

evaluated and optimized to potentially shorten the duration of the excavation and dewatering efforts. It is estimated that excavation and dewatering would be conducted at a rate of 100 $yd^3$ per day.

Emissions and odors from excavation activities would be controlled using engineering controls such as suppressing foams, fiber-based sprays, and cement-based spray covers as described in Appendix F (OBG 2018). Foam suppression sprays would be used as needed during active excavation and sprayed on the material in the excavator bucket and the open excavation area. Fiber-based and cement-based spray covers would be used as needed at the end of each workday as a daily cover. The surface of loaded dump trailers would be sprayed with a fiber-based or cement-based spray cover and covered with plastic. The trailer weather cover would then be secured for transport.

Dewatered material in the dump trailers would be shipped by a licensed transporter to an acceptable facility such as a cement kiln. For example, a few cement kilns have been identified to receive material and are located in the Midwestern United States, approximately 750 to 1,000 miles from the Site. Each outlet is permitted to receive waste from CERCLA sites and is permitted to process materials carrying the RCRA hazardous waste codes applicable to the impoundment material (e.g., D018 [benzene]). Based on using multiple kilns with their proposed acceptance rates, it is anticipated that more than 415 tons per week can be sent offsite. Therefore, removal and offsite shipment of impoundment material could be completed in 3 years.

Following excavation and removal of the acid tars, soil and clay above the water table impacted by OU8 impoundment materials with concentrations exceeding the PRGs, including minor amounts of acid tar, would be treated via ISS. The remaining impoundment berms not requiring treatment would be used as backfill for the void created by material removal. A protective cover, either designed to prevent direct contact or similar to the one described in Section 4.1.2.1 and both Alternatives 3 and 4, would then be installed over the impoundment areas. The protective cover would be maintained through routine inspections and implementation of corrective measures, as necessary. Vegetated areas would be maintained annually, or as needed. Site inspections would include evaluating the site for evidence of erosion, cracking, sloughing, animal burrows, stressed vegetation, etc. Maintenance for the protective cover during post-closure care would be performed semiannually for an assumed 30 years.

## 5.2 Evaluation Criteria Description

The NCP defines nine criteria—classified as threshold, balancing, or modifying—to be used for the evaluation and analysis of remedial alternatives. The definitions of these criteria from the USEPA guidance under CERCLA (USEPA 1988) are presented below.

The detailed analysis is performed using a two-step process. During the first step, each alternative is evaluated individually against the NCP criteria. In the second step, a comparative analysis is performed using the same criteria to identify key differences between alternatives. The detailed analysis presents the significant components of each alternative, the assumptions used, and the uncertainties associated with the assessment.

### 5.2.1 Threshold Criteria

To be eligible for selection, an alternative must meet the threshold criteria described below, or in the case of compliance with ARARs, a waiver, if necessary, must be justified.

#### 5.2.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates whether an alternative is expected to be protective of human health and the environment. It draws on the analyses performed for other evaluation criteria, particularly long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Evaluation of

overall protection of human health and the environment offered by each alternative focuses on the following:

- Determining whether an alternative achieves adequate protection
- Considering how site risks associated with each exposure pathway are either eliminated, reduced, or controlled through treatment, engineering, or institutional controls
- Determining if an alternative will result in unacceptable short-term or cross-media effects

In addition to the above criteria, for this Site, the performance criteria presented in Section 4.3 are also used to evaluate an alternative's ability to achieve overall protection of human health and the environment.

#### 5.2.1.2 Compliance with ARARs

This criterion is used to determine whether an alternative meets the substantive portions of the federal and state ARARs defined in Section 3.2. Also, note that CERCLA actions are exempted from the obligation to obtain permits for actions conducted onsite; however, the substantive requirements of the associated ARARs must be met.

CERCLA authorizes the waiver of an ARAR with respect to a remedial alternative. USEPA has developed guidance to assist in determining the appropriateness of a waiver, which includes the following (USEPA 1988):

- The alternative is an interim measure that will become part of a total remedial action that will attain the ARAR.
- Compliance with the requirement will result in greater risk to human health and the environment.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- 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.
- 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.

### 5.2.2 Balancing Criteria

Alternatives meeting the threshold criteria are further evaluated using the following five primary balancing criteria.

#### 5.2.2.1 Long-Term Effectiveness and Permanence

The assessment against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after the RAOs have been met. A key component of this evaluation is to consider the extent and effectiveness of controls that may be required to manage risk posed by treated soil and clay impacted by OU8 impoundment material above PRGs and/or untreated waste. The long-term effectiveness of an alternative is assessed by considering the following two factors:

- **Magnitude of risk:** Assesses the risk remaining from untreated material or treated soil and clay impacted by OU8 impoundment above PRGs material at the conclusion of the remedial activities.
- **Adequacy and reliability of controls:** Evaluates the capability and suitability of controls, if any, that are used to manage treated soil and clay impacted by OU8 impoundment material above PRGs or untreated materials that remain at the site.

#### 5.2.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion reflects the statutory preference for selecting remedial actions that employ treatment technologies resulting in permanent and significant reductions of TMV of the hazardous substances as their principal element. This criterion is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. The following six factors are considered when evaluating alternatives against this criterion:

- The treatment processes the remedy will employ and the materials they will treat
- The amount of hazardous materials that will be destroyed or treated (including how the principal threats will be addressed)
- The degree of expected reduction in TMV measured as a percentage of reduction (order of magnitude)
- The degree to which the treatment is irreversible
- The type and quantity of treated soil and clay impacted by OU8 impoundment material above PRGs remaining following treatment
- Whether the alternative satisfies the statutory preference for treatment as a principal element

Of particular importance in evaluating this criterion is the assessment of whether treatment is used to reduce principal threats, including the extent to which TMV is reduced either alone or in combination.

#### 5.2.2.3 Short-Term Effectiveness

This criterion assesses the effects of an alternative during its construction and implementation until the RAOs are met. Alternatives are evaluated with respect to potential effects on human health and the environment during their implementation. The following factors are considered when evaluating alternatives against this criterion:

- **Protection of the community during remedial actions:** Addresses risk resulting from the remedy implementation. Examples include dust from excavations, transportation of hazardous materials, and air quality impacts.
- **Protection of workers during remedial actions:** Assesses threats potentially posed to workers and the effectiveness and reliability of protective measures that would need to be taken.
- **Environmental impacts:** Evaluates the environmental impacts potentially resulting from the construction and implementation of the alternative and assesses the reliability of available mitigation measures for preventing or reducing those impacts.
- **Time until RAOs are achieved:** Considers the estimated time required to achieve protection for either the entire site or individual elements associated with specific site areas or threats.

#### 5.2.2.4 Implementability

The implementability criterion assesses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during the remedy implementation. The following factors are considered when evaluating alternatives against this criterion:

- **Technical feasibility,** assesses the following:
  - **Construction and operation:** Potential technical difficulties and unknowns associated with a technology.

  - **Reliability of technology:** Likelihood that technical problems associated with the implementation will result in schedule delays or adverse impacts.
  - **Ease of undertaking additional remedial action:** Consideration of what, if any, future remedial actions may need to be performed and how difficult it would be to implement those actions.
  - **Monitoring considerations:** The ability to monitor the effectiveness of the remedy and includes an evaluation of exposure risk should monitoring be insufficient to detect a failure.
- **Administrative feasibility:** Assesses the activities required to coordinate with other offices, agencies and third-parties (e.g., access, right-of-way).
- **Availability of services and materials:** Evaluates the availability of appropriate offsite treatment, storage capacity, and disposal services; necessary equipment and specialists; services and materials, including the potential for competitive bidding; and the availability of prospective technologies.

#### 5.2.2.5 Cost

This criterion includes the engineering, construction, and O&M costs incurred over the life of the project. The evaluation of cost consists of three principal components:

- **Capital costs:** Includes direct (construction) and indirect (non-construction and overhead) costs. Equipment, labor, and materials required for the installation of the remedy are considered direct costs. Indirect costs consist of those expenses related to the engineering, financial, and other services necessary to complete the remedy installation but are not part of the actual installation or construction activities.
- **Annual O&M costs:** Refers to post-construction expenditures required to ensure continued effectiveness of the remedial action. Components of annual O&M costs include auxiliary materials, monitoring expenses, equipment or material replacement, and 5-year review reporting.
- **Periodic costs:** These costs include the provision for completing 5-year reviews over a period of 30 years.

The level of detail required to analyze each alternative with respect to the cost criteria depends on the nature and complexity of the site, the types of technologies and alternatives being considered, and other project-specific considerations. The analysis is conducted in sufficient detail to understand the significant aspects of each alternative and to identify the uncertainties associated with the evaluation.

The cost estimates presented for each alternative have been developed for the purpose of comparing the alternatives. The final costs of the selected remedy will depend on actual labor and material costs, competitive market conditions, final project scope, the implementation schedule, and other variables. The cost estimates are order-of-magnitude estimates with an intended accuracy range of plus 50% to minus 30%. The range applies only to the alternatives as they are described in this report and does not account for changes in the scope of the alternatives. Selection of specific technologies or processes to configure remedial alternatives is not intended to limit flexibility during remedial design but to provide a basis for preparing cost estimates. The specific details of the selected remedial alternative and the corresponding cost estimate need to be refined during the final remedial design.

### 5.2.3 Modifying Criteria

The two modifying criteria are state acceptance and community acceptance. The evaluation of these criteria cannot be completed until state and public comments are received on the Proposed Plan. Therefore, these two criteria are not considered in any further detail in this FFS report.

# 5.3 Individual Analysis of Alternatives

Each retained alternative has been evaluated individually against the NCP-defined threshold and balancing criteria described in Section 5.2. The purpose of the individual analysis is to provide a detailed analysis of each alternative against the each of the NCP subcriteria in order to assess how and to what extent these subcriteria are met and to inform the comparative analysis presented in Section 5.4.

A detailed individual analysis of the alternatives against each of the NCP threshold and balancing subcriteria is presented in Table 5-1 and in the following subsections.

Table 5-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|
| ***Threshold Criteria*** | | | | |
| Protection of Human Health and the Environment | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. | Remedy was designed to meet RAOs and be protective of human health and the environment. |
| Compliance with ARARs | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. | Remedy was designed to be compliant with ARARs. |
| ***Balancing Criteria*** | | | | |
| **Long-Term Effectiveness** | | | | |
| Magnitude of Risk (i.e., risk remaining from untreated material or treated soil and clay impacted by OU8 impoundment material at the conclusion of the remedial activities) | OU8 impoundment material will be treated.<br><br>Treated impoundment material will remain in place, but COC leachability will be reduced following ISS treatment.<br><br>Engineered controls will be robust (robust engineered cover, hydraulic barrier wall, long-term vapor control and treatment). | OU8 impoundment material will be treated.<br><br>Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>Treated impoundment material will remain in place, but leachability will be reduced following ISS treatment.<br><br>Engineered controls will be robust (robust engineered cover, hydraulic barrier wall, long-term vapor control and treatment). | OU8 impoundment material will be treated, removed and disposed in CAMU. Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS and capped in place.<br><br>COC leachability will be reduced following ISS treatment.<br><br>Engineered controls will consist of a protective cover. | OU8 impoundment material will be removed from the site and treated offsite.<br><br>Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS. Engineered controls will consist of a protective cover. |
| Adequacy and Reliability of Controls | Treated OU 8 impoundment material will remain in place.<br><br>The hydraulic barrier wall will impede migration of potentially leached COCs to surrounding areas.<br><br>VOCs will be captured by the robust engineered cover and treated to acceptable levels before discharge to the atmosphere. | Treated OU8 impoundment material will remain in place.<br><br>The hydraulic barrier wall will impede migration of potentially leached COCs to surrounding areas.<br><br>VOCs will be controlled by the robust engineered cover and treated to acceptable levels before discharge to the atmosphere. | Treated OU8 impoundment material will be removed from the impoundment areas.<br><br>The existing CAMU will effectively contain waste following thermal-enhanced ISS treatment of the material. | OU8 impoundment material will be removed from the impoundment areas for offsite treatment. |
| **Reduction in Toxicity, Mobility, and Volume** | | | | |
| Treatment Process Used and Materials Treated | ISS will effectively reduce leachability of COCs, reducing mobility. | Thermal treatment will reduce concentration of predominant COCs, reducing toxicity.<br><br>ISS will effectively reduce leachability of remaining COC mass, reducing mobility. | Thermal treatment will reduce concentration of predominant COCs, reducing toxicity.<br><br>ISS will reduce leachability of remaining COC mass, reducing mobility.<br><br>Treated OU8 impoundment material will be removed from impoundments. | OU8 impoundment material will be removed from impoundments, reducing toxicity, mobility and volume. |
| Amount of Hazardous Materials Destroyed or Treated | OU8 impoundment material will be treated with ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>VOCs will be controlled and treated long-term. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>OU8 impoundment material will be treated with thermal-enhanced ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>VOCs will be controlled and treated long-term. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>OU8 impoundment material will be treated with thermal-enhanced ISS. Soil and clay to a depth of 2 feet below the existing clay impoundment liner (presumed to be impacted by OU8 impoundment material) will also be treated with ISS.<br><br>Treated OU8 impoundment material will be removed and placed in CAMU. | OU8 impoundment material will be removed from the site. Soil and clay impacted by OU8 impoundment material above PRGs will be treated via ISS. |

Table 5-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|
| Degree of Expected Reductions in Toxicity, Mobility, and Volume | ISS will reduce leachability (mobility) of COCs to a high degree. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>ISS will reduce leachability (mobility) of COCs to a high degree. | Concentrations of predominant COCs will be reduced during thermal treatment.<br><br>ISS will reduce leachability (mobility) of COCs to a moderate degree (lower reagent dose).<br><br>OU8 impoundment material will be removed. | OU8 impoundment material will be removed for offsite treatment. |
| Degree to Which Treatment is Irreversible | ISS treatment is highly irreversible. | Removal of volatile COCs through thermal treatment will be completely irreversible.<br><br>ISS treatment is highly irreversible. | Removal of volatile COCs through thermal treatment will be completely irreversible.<br><br>ISS treatment with lower reagent dose is moderate to highly irreversible.<br><br>Removal of impoundment material to CAMU will be completely irreversible. | Removal of impoundment material to off-site facility will be completely irreversible. |
| Type and Quantity of Residuals Remaining After Treatment | OU8 impoundment material will be treated.<br><br>ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material. | OU8 impoundment material will be treated.<br><br>Thermal-enhanced ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material. | OU8 impoundment material will be treated and excavated.<br><br>Thermal-enhanced ISS treatment will extend to a depth 2 feet below the current clay impoundment liner treating soil and clay presumed to be impacted by OU8 impoundment material.<br><br>Excavation will extend to the depth of the current clay impoundment liner. Semi-stabilized non-principal-threat waste presumed to exist below the impoundments will remain. | OU8 impoundment material will be treated and excavated.<br><br>Excavation will extend to the depth of the current clay impoundment liner.<br><br>Soil and clay above the water table impacted by OU8 impoundment material with concentrations exceeding PRGs, including minor amounts of acid tar, will be treated with ISS. |
| **Short-Term Effectiveness** | | | | |
| Protection of Community During Remedial Actions | Engineered controls implemented during ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Mixing equipment and vapor treatment systems can be staged above the floodplain and/or removed and the water cap restored to protect the impoundments during short-term flooding events.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk.<br><br>Equipment can easily be removed and the water cap restored to protect the impoundments during short-term flooding events.<br><br>Engineered controls will provide a high degree of protection. |

Table 5-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|
| Protection of Workers During Remedial Actions | Engineered controls implemented during ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk. Engineered controls will provide a high degree of protection. |
| Environmental Impacts | Engineered controls implemented during ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection. | Engineered controls implemented during thermally-enhanced ISS treatment will provide a high degree of protection.<br><br>Some risk may be encountered during transport of treated material to on-site CAMU, but the material will have reduced concentrations of predominant COCs (reducing potential VOC emissions) and will be partially stabilized, increasing ease of handling. The transport distance will be short (approximately 1.5 miles). | Excavation, dewatering, and transport of impoundment material will pose a moderate degree of risk. Engineered controls will provide a high degree of protection. |
| Time Until Remedial Action Objectives are Achieved | Approximately 20 months. | Approximately 24 months. | Approximately 30 months. | Approximately 38 months. |
| **Implementability** | | | | |
| Ability to Construct and Operate the Technology | The primary remedial action (ISS treatment) is a proven and highly implementable technology. | The primary remedial action (ISS treatment) is a proven and highly implementable technology.<br><br>The addition of thermal enhancement is less proven, but still expected to have a moderately high implementability. | The primary remedial action (ISS treatment) is a proven and highly implementable technology.<br><br>Implementation of Alternative 5 would be challenging since there are multiple processes involved with in-place treatment, removal, additional treatment at the CAMU, then placement of the material in the CAMU. Fewer contractors are available with experience implementing steam-enhanced ISS. Excavation equipment is readily available; however, emission controls at the point of excavation and placement may be challenging. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2.<br><br>Emission controls at the point of excavation may be challenging; however effective control using spray foam was demonstrated during the OU8 pilot study. |
| Reliability of the Technology | The primary remedial action (ISS treatment) is a highly reliable technology. | The primary remedial action (ISS treatment) is a highly reliable technology.<br><br>Thermal enhancement of ISS has a moderately high reliability. | The primary remedial action (ISS treatment) is a highly reliable technology.<br><br>Thermal enhancement of ISS has a moderately high reliability.<br><br>Excavation of stabilized material is a highly reliable technology. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2.<br><br>Emission controls at the point of excavation may be challenging; however effective control using spray foam was demonstrated during the OU8 pilot study. |
| Ease of Undertaking Additional Remedial Actions, if Necessary | Stabilization of impoundment material will physically impede the ability to undertake additional remedial actions. | Stabilization of impoundment material will physically impede the ability to undertake additional remedial actions. | Moderately high ease of undertaking additional actions (difficult to undertake additional action on material placed in CAMU, but easy to take additional actions in impoundment area). | High ease of undertaking additional actions in the impoundment area. |

Table 5-1. Individual Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|
| Ability to Monitor Effectiveness of Remedy | High ability to monitor remedy effectiveness on decreasing leached COC concentrations.<br><br>Moderate ability to monitor effectiveness of remedy against performance criteria in the field. | High ability to monitor remedy effectiveness on decreasing leached COC concentrations.<br><br>Moderate ability to monitor effectiveness of remedy against performance criteria in the field. | High ability to monitor remedy effectiveness. | High ability to monitor remedy effectiveness. |
| Ability to Coordinate and Obtain Approvals From Other Agencies | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderately high administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. | Remedy has a moderate administrative feasibility. Will require coordination between Federal and state regulatory agencies and other stakeholders. Additional approvals will be required for transporting principal threat waste to off-site treatment facility. |
| Availability of Off-site Treatment, Storage, and Disposal Services and Capacity | Not applicable. | Not applicable. | Not applicable. | A number of off-site treatment facilities are available. |
| Availability of Necessary Equipment and Specialists | Necessary equipment and specialists to implement ISS are highly available. | Necessary equipment and specialists to implement thermal-enhanced ISS have a moderately high availability. | Necessary equipment and specialists to implement thermal-enhanced ISS have a moderately high availability.<br><br>Equipment and specialist for excavation of treated material are highly available. | Necessary equipment is highly available. |
| Availability of Prospective Technologies | ISS is a highly available technology. | ISS is a highly available technology. The addition of thermal enhancement to this technology is slightly less available. | ISS is a highly available technology. The addition of thermal enhancement to this technology has a moderately high availability. | The excavation and dewatering process to be used in this remedy is relatively straightforward and has been successfully implemented in US EPA Region 2. |
| **Cost** | | | | |
| Total Cost | $48,000,000 | $60,000,000 | $65,000,000 | $74,000,000 |

### 5.3.1 Alternative 1 - No Action

Under this alternative, no additional remedial actions beyond the existing containment measures would be performed to reduce the TMV of PTW or COCs within the impoundments nor address RAOs. The following activities will still be conducted under the overall site-wide activities and not specifically for OU8: operation of the groundwater collection trench located downgradient of Impoundments 1 and 2, operation of the groundwater treatment system, periodic inspections and maintenance of the berms, maintenance of fencing and site security, maintenance of the water cap to suppress emissions, maintenance of berm armoring for flood resistance, maintenance of a geosynthetic cover over the materials for further flood resistance, and periodic ambient air and nearby surface water monitoring.

In accordance with the NCP requirement, the no action alternative is carried through the entire FFS process as the baseline condition against which performance of the remaining alternatives are evaluated.

#### 5.3.1.1 Overall Protection of Human Health and the Environment

Alternative 1 would not achieve RAOs designed for protection of human health and the environment. Although contained, PTW would remain in place without further treatment. COCs associated with PTW may migrate from the impoundments and impact groundwater. Humans and ecological receptors could be exposed to COCs contained within the impoundments.

#### 5.3.1.2 Compliance with ARARs

Alternative 1 is unlikely to meet the anticipated ARARs.

#### 5.3.1.3 Long-Term Effectiveness and Permanence

Alternative 1 is not expected to be effective in the long term. PTW would not be actively treated. Existing risks would remain and no additional controls would be implemented to control these risks.

#### 5.3.1.4 Reduction of TMV through Treatment

Alternative 1 is not expected to result in reduction of TMV.

#### 5.3.1.5 Short-Term Effectiveness

Alternative 1 would not cause increased short-term impacts to the community or workers during remedial actions, because no remedial actions would take place. In addition, there would be no additional impacts to the environment associated with remedial actions. Existing potential impacts to the community, workers, and environment would remain.

#### 5.3.1.6 Implementability

As no remedial actions would be implemented, there are no implementability concerns with Alternative 1, other than the fact that the alternative would not be administratively feasible (in terms of coordinating and obtaining approvals from other agencies), because it is not expected to meet the RAOs.

#### 5.3.1.7 Cost

There are no remedial costs associated with Alternative 1.

### 5.3.2 Alternative 3 – ISS Treatment, Inner HBW, Protective Cover

Alternative 3 was developed to treat material in place while protecting human health and the environment. This alternative would employ ISS treatment to permanently reduce COC mass and create a low-permeability monolith to minimize migration (leaching) of COCs to groundwater. In addition, it is proposed that an inner HBW and a protective cover would be installed to provide additional protection.

The inner HBW would limit contact of upgradient groundwater with the treated monolith, further minimizing the potential for leaching of COCs to groundwater. A protective cover would be installed over the impoundments to prevent direct contact with treated material, control vapors as needed, and protect against flooding.

#### 5.3.2.1 Overall Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment and would meet the RAOs since it would:

- Treat PTW by permanently reducing COC mass and limiting COC mobility by creating a low-permeability monolith
- Prevent human exposure (direct contact) to COCs by treating PTW and installing a protective cover over the impoundments
- Minimize or reduce future migration of COCs from Impoundments 1 and 2 to groundwater by transforming PTW into a stable monolith (which significantly reduces leaching) and installing a protective cover over the treated material

#### 5.3.2.2 Compliance with ARARs

Alternative 3 would comply with ARARs, including those that address air emissions and protection of floodplains and wetlands. Air emissions controls, such as use of a shrouded ISS auger, use of a thermal oxidizer, maintenance of a water cap, installation of stone plenum layer, and collected vapor treatment will be incorporated into the final remedial design as needed. Work in wetland areas or in the floodplain would require approval as specified in Table 3-3a, 3-3b, and 3-3c.

#### 5.3.2.3 Long-Term Effectiveness and Permanence

Alternative 3 would provide long-term protection of human health and the environment following achievement of the RAOs. ISS would result in treatment of PTW in the impoundments via reducing the contaminant mass and stabilization. As shown in this FFS and in supporting treatability and pilot studies, ISS treatment of the impoundment materials meets performance criteria selected to ensure long-term protection of human health and the environment. The protective cover would provide additional protection, reduce contact of precipitation with the treated materials, and provide further protection against potential flooding.

#### 5.3.2.4 Reduction of TMV through Treatment

As demonstrated during the pilot study, there would be significant permanent reduction of VOCs during the ISS process (approximately 25% mass reduction). In addition, ISS would effectively and irreversibly reduce the leachability (i.e., mobility) of remaining COCs associated with OU8 impoundment material. ISS would also reduce mobility of COCs potentially present above the PRGs in the inner berm edges and an approximately 2-foot-thick layer of soil located below the existing clay impoundment liners and above the groundwater table.

#### 5.3.2.5 Short-Term Effectiveness

Engineered controls implemented during ISS operations for vapor control would provide a high degree of protection to the community, workers, and the environment. These engineered controls include use of a shrouded auger, maintenance of a water cap, installation of stone plenum layer, vented as needed, and treatment of actively collected vapors with a thermal oxidizer and caustic scrubber. In addition, fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide protection in the case of a catastrophic flood. In the event of such a flood, equipment and reagents staged at lower elevations would be moved. Because treated materials would be closed in place, there is no potential exposure associated with excavation, transportation of treated

material through the community, or placement in the CAMU. In addition, overall air emissions would be lower than with an excavation approach. The time to achieve RAOs is estimated to be approximately 2 years. A significant benefit of Alternative 3 is reduced potential for exposure to the community during the remedial process because the wastes will be effectively treated in place in a controlled manner.

#### 5.3.2.6 Implementability

The primary remedial component in Alternative 3, ISS, is a highly proven, reliable, and implementable technology and its effectiveness can be monitored. ISS has been applied for remediation of VOCs or SVOCs and PTW at more than 30 National Priorities List or New Jersey projects similar to OU8 (CH2M 2015b). Many of these contain PTW and/or NAPL layers and most of the sites were located along water bodies and many were located near residences. Although stabilization would reduce the ease of undertaking additional remedial actions, ISS was effectively demonstrated during the 2014 OU8 pilot study. The engineered cover and inner HBW would help minimize exposure risk. This alternative is administratively feasible, and services and materials are readily available.

#### 5.3.2.7 Cost

A summary of the estimated costs associated with Alternative 3 is presented in Table 5-2. Costs associated with Alternative 3 are primarily associated with capital costs related to implementation of ISS. The total estimated cost for Alternative 3 is $48,000,000. Detailed cost tables are presented in Appendix G.

Table 5-2. Summary of Estimated Costs for Alternative 3

| Description | Value |
|---|---|
| Time to meet RAOs | 20 months |
| Capital Cost | $44,000,000 |
| Operations and Maintenance Cost | $3,900,000 |
| Periodic Cost | $150,000 |
| ***Total Cost of Alternative*** | ***$48,000,000*** |

### 5.3.3 Alternative 4 – Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover

Alternative 4 includes all the components of Alternative 3, but adds steam-enhanced COC reduction to the ISS treatment process. Steam-enhancement would result in additional permanent COC reduction prior to creation of the stabilized monolith. Like Alternative 3, Alternative 4 was developed to treat material in place while protecting human health and the environment. It would employ steam-enhanced ISS treatment to permanently reduce COC mass and create a low-permeability monolith to minimize migration (leaching) of COCs to groundwater. Like Alternative 3, it is proposed that an inner HBW and a protective cover would be installed to provide additional protection. The inner HBW would minimize contact of upgradient groundwater with the treated monolith, further minimizing leaching of COCs to groundwater. The protective cover would be installed over the impoundments to prevent direct contact with treated material, control vapors as needed, and protect against flooding.

#### 5.3.3.1 Overall Protection of Human Health and the Environment

Alternative 4 would be protective of human health and the environment and meet the RAOs since it would:

- Treat PTW by permanently reducing COC mass and limiting COC mobility by creating a low-permeability monolith

- Prevent human exposure (direct contact) to COCs by treating PTW and installing a protective cover over the impoundments
- Minimize or reduce future migration of COCs from Impoundments 1 and 2 to groundwater by transforming PTW into a stable monolith (which significantly reduces leaching) and installing a protective cover over the treated material

#### 5.3.3.2 Compliance with ARARs

Alternative 4 would comply with ARARs, including those that address air emissions and protection of floodplains and wetlands. Air emissions controls, such as use of a shrouded ISS auger, maintenance of a water cap, installation of stone plenum layer, and collected vapor treatment will be incorporated into the final remedial design as needed. Work in wetland areas or in the floodplain would require approval as specified in Table 3-3a, 3-3b, and 3-3c.

#### 5.3.3.3 Long-Term Effectiveness and Permanence

Alternative 4 would provide long-term protection of human health and the environment following achievement of the RAOs. Steam-enhanced ISS would result in treatment of PTW in the impoundments via enhanced reduction of contaminant mass and stabilization of the impoundment materials. As shown in this FFS and in supporting treatability and pilot studies, ISS treatment of the impoundment materials meets performance criteria selected to ensure long-term protection of human health and the environment. The HBW would minimize contact with groundwater and the migration of COCs. The protective cover would provide additional protection, reduce contact of precipitation with the treated materials, and provide further protection against potential flooding.

#### 5.3.3.4 Reduction of TMV through Treatment

As demonstrated during the 2016 bench-scale study, additional VOC mass reduction would occur by using steam during the homogenization/mixing process relative to ISS alone (as in Alternative 3). In addition, ISS would effectively and irreversibly reduce the leachability (i.e., mobility) of remaining COCs associated with OU8 impoundment material. ISS would also reduce mobility of COCs potentially present above PRGs in the inner berm edges and an approximately 2-foot-thick layer of soil located below the existing clay impoundment liners and above the groundwater table.

#### 5.3.3.5 Short-Term Effectiveness

Engineered controls implemented during steam-enhanced ISS operations for vapor control would provide a high degree of protection to the community, workers, and the environment. These engineered controls include use of a shrouded auger, maintenance of a water cap, installation of a stone plenum layer, vented as needed, and treatment of collected vapors with a thermal oxidizer and caustic scrubber. In addition, fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide protection in the case of a catastrophic flood. In the event of such a flood, equipment and reagents staged at lower elevations would be moved. Because treated materials would be closed in place, there is no potential exposure associated with excavation, transportation, and placement. The time to achieve RAOs is estimated to be 2 years. A significant benefit of Alternative 4 is reduced potential for exposure to the community during the remedial process because the wastes will be effectively treated in place in a controlled manner.

#### 5.3.3.6 Implementability

The primary remedial technology in Alternative 4, ISS, is highly proven, reliable, and implementable and its effectiveness can be monitored. Steam-enhanced mixing prior to ISS has not been used as often and would require specialized equipment and operations. Fewer contractors are available with experience implementing steam-enhanced ISS. The engineered cover and inner HBW would help minimize exposure

risk. This alternative is administratively feasible, and services and materials are readily available. Stabilization would reduce the ease of undertaking additional remedial actions, if necessary.

#### 5.3.3.7 Cost

A summary of the estimated costs associated with Alternative 4 is presented in Table 5-3. Costs associated with Alternative 4 are primarily associated with capital costs related to implementation of ISS. The total estimated cost for Alternative 4 is $60,000,000. Detailed cost tables are presented in Appendix G.

Table 5-3. Summary of Estimated Costs for Alternative 4

| Description | Value |
|---|---|
| Time to meet RAOs | 24 months |
| Capital Cost | $56,000,000 |
| Operations and Maintenance Cost | $3,900,000 |
| Periodic Cost | $150,000 |
| ***Total Cost of Alternative*** | ***$60,000,000*** |

### 5.3.4 Alternative 5 – Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover

Alternative 5 was developed to provide protection of human health and the environment by permanently removing OU8 impoundment material for final disposal in the CAMU. Prior to removal, steam-enhanced ISS treatment would be applied to permanently reduce COC mass, adjust material pH to a non-corrosive value, and improve the physical handling properties of the tar to facilitate removal, transportation, and placement in the CAMU. Following treatment and removal of PTW, a protective cover would be installed.

#### 5.3.4.1 Overall Protection of Human Health and the Environment

Alternative 5 would be protective of human health and the environment and would meet the RAOs since it would:

- Treat and remove PTW
- Prevent human exposure (direct contact) to COCs by treating acid tar and placing it in the lined CAMU, and installing a protective cover over ISS-treated soil and clay impacted by OU8 impoundment material above PRGs
- Minimize or reduce future migration of COCs from Impoundments 1 and 2 to groundwater by removing treated PTW and installing a protective cover over ISS-treated soil and clay impacted by OU8 impoundment material above PRGs

#### 5.3.4.2 Compliance with ARARs

Alternative 5 would comply with ARARs, including those that address air emissions; protection of floodplains and wetlands; transport of hazardous materials; and use of the CAMU. Air emissions controls, such as use of a shrouded ISS auger, maintenance of a water cap, installation of stone plenum layer, and collected vapor treatment will be incorporated into the final remedial design as needed. Additional controls might be needed during excavation and transportation of the treated impoundment material to the CAMU. Work in wetland areas or in the floodplain would require approval as specified in Table 3-3a, 3-3b, and 3-3c. Transport of the treated OU8 impoundment material to the CAMU will

comply with applicable treatment, handling, and containment requirements. In addition, use of the CAMU will meet applicable CAMU-specific ARARs.

#### 5.3.4.3 Long-Term Effectiveness and Permanence

Alternative 5 would provide long-term protection of human health and the environment following achievement of the RAOs. OU8 impoundment material would be treated, excavated, and disposed in the CAMU. Steam-enhanced mixing would result in enhanced VOC mass reduction, reducing the concentration of these COCs in the impoundment material. ISS treatment would result in adjustment of the material to a non-corrosive pH and reduce COC leachability. Following treatment, the material would be placed in the CAMU, which would effectively contain the treated waste. The CAMU has a multi-layer leachate collection system and would include an impermeable cover upon closure. Testing demonstrates that the HDPE liner material used in the CAMU is compatible with leachate potentially generated from the treated materials, even assuming high leachate concentrations. Remaining soil and/or clay impacted by OU8 impoundment material above the PRGs would be treated via ISS followed by backfilling and capping.

#### 5.3.4.4 Reduction of TMV through Treatment

As demonstrated during the 2016 bench-scale study, additional VOC mass reduction would occur by using steam during the homogenization/mixing process relative to ISS alone. ISS would also reduce mobility of COCs potentially present above PRGs in the inner berm edges and an approximately 2-foot-thick layer of soil located below the existing clay impoundment liners and above the groundwater table.

#### 5.3.4.5 Short-Term Effectiveness

Engineered controls implemented during steam-enhanced ISS operations for vapor control would provide a high degree of protection to the community, workers, and the environment. These engineered controls include use of a shrouded auger, maintenance of a water cap, installation of a vapor control layer and treatment of collected vapors with a thermal oxidizer and caustic scrubber. Additional engineering controls such as use of vapor suppression foams or temporary fabric structures may be required to protect workers and the community because of increased exposure risks associated with excavation and transport of the treated material to the CAMU. Fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide protection in the case of a catastrophic flood. In the event of such a flood, equipment and reagents staged below at lower elevations would be moved. The time to achieve RAOs is estimated to be 3 years. Some risk may be encountered during transport of treated material to onsite CAMU, but the material would have reduced concentrations of COCs (reducing VOC emissions) and would be partially stabilized, increasing ease of handling. The transport distance would be approximately 1.5 miles.

#### 5.3.4.6 Implementability

The primary remedial technology in Alternative 5, ISS, is highly proven, reliable, and implementable and its effectiveness can be monitored. However, steam-enhanced mixing prior to ISS has not been used as often and would require specialized equipment and operations. Fewer contractors are available with experience implementing steam-enhanced ISS. Implementation of Alternative 5 would be more challenging than the other alternatives since there are multiple processes involved with in-place treatment, removal, additional treatment at the CAMU, then placement of the material in the CAMU. Excavation equipment is readily available; however, emission controls at the point of excavation and placement may be challenging. This alternative is administratively feasible, and services and materials are available.

#### 5.3.4.7 Cost

A summary of the estimated costs associated with Alternative 5 is presented in Table 5-4. Costs associated with Alternative 5 are primarily associated with capital costs related to implementation of ISS

and excavation/placement of treated material at the CAMU. The total estimated cost for Alternative 5 is $65,000,000. Detailed cost tables are presented in Appendix G.

Table 5-4. Summary of Estimated Costs for Alternative 5

| Description | Value |
|---|---|
| Time to meet RAOs | 24 months |
| Capital Cost | $62,900,000 |
| Operations and Maintenance Cost | $1,700,000 |
| Periodic Cost | $150,000 |
| ***Total Cost of Alternative*** | ***$65,000,000*** |

### 5.3.5 Alternative 6 – Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover

Alternative 6 was developed to provide protection of human health and the environment by permanently removing OU8 impoundment material and transporting it offsite for treatment/destruction. The removal process would involve excavation and mechanical dewatering of the impoundment material. Following removal of OU8 impoundment material, soil and clay above the water table impacted by OU8 impoundment materials exceeding PRGs would be treated via ISS. The impoundments would then be backfilled with berm material, and a protective cover would be installed.

#### 5.3.5.1 Overall Protection of Human Health and the Environment

Alternative 6 would be protective of human health and the environment and meet the RAOs since it would:

- Remove acid tar from the impoundments and from the site and treat the material offsite
- Prevent human exposure (direct contact) to COCs through offsite treatment/destruction of OU8 impoundment material, and installing a protective cover over ISS-treated soil and clay impacted by OU8 impoundment material above PRGs
- Minimize or reduce future migration of COCs from Impoundments 1 and 2 to groundwater by removing and treating PTW offsite and installing a protective cover over ISS-treated soil and clay impacted by OU8 impoundment material above PRGs

Alternative 6 would be protective of human health and the environment by meeting the performance criteria outlined in Table 4-3.

#### 5.3.5.2 Compliance with ARARs

Alternative 6 would comply with ARARs, including those that address air emissions; protection of floodplains and wetlands; and transport of hazardous materials. Air emissions controls, such as use of vapor suppression foams will be incorporated into the final remedial design as needed. Work in wetland areas or in the floodplain would require approval as specified in Table 3-3a, 3-3b, and 3-3c. Transport of the excavated/dewatered acid tar to an offsite cement kiln will comply with applicable treatment, handling, and containment requirements.

#### 5.3.5.3 Long-Term Effectiveness and Permanence

Alternative 6 would provide long-term protection of human health and the environment following achievement of the RAOs. OU8 impoundment material would be excavated, removed from the Site, and treated offsite, resulting in a permanent and irreversible remediation of the impoundment materials.

Remaining soil and/or clay impacted by impoundment material above PRGs, including minor amounts of acid tar, would be treated via ISS followed by backfilling and capping.

#### 5.3.5.4 Reduction of TMV through Treatment

Offsite treatment of the OU8 impoundment material at a facility such as a cement kiln would irreversibly destroy not only the VOC mass in the impoundment material, but also SVOC mass and the organic tar material itself. This would result in the greatest possible reduction in TMV. ISS of soil and clay impacted by OU8 impoundment materials above PRGs also would reduce mobility of COCs potentially present below the existing clay impoundment liner and above the groundwater table.

#### 5.3.5.5 Short-Term Effectiveness

Engineering controls would be needed to protect the community, workers, and the environment during implementation because of an increased risk of exposure associated with material excavation, dewatering, and transportation of contaminated materials through the community. Vapor suppression foams would be used on surfaces to control vapor emissions and if needed additional vapor control measures would be implemented. Lined dump trailers would be used to transport dewatered OU8 impoundment material offsite for treatment. It is assumed that fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide protection in the case of a catastrophic flood. In the event of such a flood, equipment staged at lower elevations would be moved, as necessary. The time to achieve RAOs is estimated to be 3 years. Excavation, dewatering, and transport of impoundment materials would pose a moderate degree of risk; however, this risk would be mitigated by a robust emission suppression program and engineering controls.

#### 5.3.5.6 Implementability

While excavation and dewatering, in general, is a common activity, use of this approach on the acid tar impoundment materials is an emerging technology. This alternative is based on the successful dewatering and treatment/destruction offsite at a cement kiln of similar acid tar material at another Superfund site in USEPA Region 2; however, dewatering acid tar is site specific and may require special operational procedures. Several offsite facilities, i.e. cement kilns, have been identified that can accept the dewatered acid tars. Excavation equipment is readily available; however, emission controls at the point of excavation may be challenging. The ease of closing the impoundments is high, as the materials would be removed from the Site. This alternative is administratively feasible, and services are available.

#### 5.3.5.7 Cost

A summary of the estimated costs associated with Alternative 6 is presented in Table 5-5. Costs associated with Alternative 6 are primarily capital costs related to excavation and offsite transportation/treatment. The total estimated cost for Alternative 6 is $74,000,000. Detailed cost tables are presented in Appendix G.

Table 5-5. Summary of Estimated Costs for Alternative 6

| Description | Value |
|---|---|
| Time to meet RAOs | 36 months |
| Capital Cost | $71,700,000 |
| Operations and Maintenance Cost | $1,700,000 |
| Periodic Cost | $150,000 |
| ***Total Cost of Alternative*** | ***$74,000,000*** |

# 5.4 Comparative Analysis of Alternatives

The detailed evaluations made during the individual analysis have informed a comparative analysis of the retained alternatives. The purpose of the comparative analysis is to compare and rank the relative performance of each retained alternative against each NCP criterion. The comparative analysis considers each of the NCP threshold and balancing criteria and the relative performance of each alternative against each. The following subsections present this analysis.

## 5.4.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is a threshold criterion that must be met by the selected remedy. Alternative 1 (no action) would not be protective of human health and the environment since it does not include measures to prevent exposure to PTW and the contaminated soil used as part of the berms. Alternatives 3 through 6 are expected to be protective of human health and the environment by addressing the COCs within the impoundments, which would improve the conditions within the associated floodplain areas. Groundwater and surface water quality would be improved by the removal or treatment of the contaminant source. More specifically, Alternatives 3 and 4 would result in COCs being treated and closed in place with a protective cover. These remedies are expected to comply with the RAOs, meet PRGs, and would allow for the natural ecosystem within the floodplain to recover. Alternatives 5 and 6 also address the RAOs and meet PRGs by allowing treatment at the impoundments and by removing the impoundment materials from the floodplain.

## 5.4.2 Compliance with ARARs

Alternative 1 (no action) would not meet ARARs and does not meet this threshold criterion. Alternatives 3 through 6 have been developed and can be designed to comply with ARARs and therefore meet this threshold criterion. More specifically, the alternatives would comply with ARARs as follows:

- Floodplain – The proposed removal programs would comply with federal and state regulations regarding remediation and filling in floodplains.
- Wetlands – Wetland areas adjacent to the impoundments areas or in access areas impacted by construction activities would be restored following construction. Consultation with federal and state authorities would occur prior to the start of work to establish compliance with substantive requirements.
- Hazardous Waste management and disposal – The processing and disposal of waste material generated during implementation of these alternatives would comply with the requirements of hazardous materials, RCRA (i.e. CAMU-related), CERCLA, Toxic Substances Control Act, and state waste management regulations. This includes activities associated with material left in place or transportation of hazardous materials.
- Air Quality, Air Emissions – Monitoring and controls would be conducted during all phases of the selected remedy including any waste processing to ensure compliance with air emission limits.
- Stormwater – Erosion and sedimentation controls for construction activities would be addressed during the design phase. Consultation with state authorities would occur prior to the start of work to establish compliance with substantive requirements.

Implementation of these alternatives would not address groundwater and drinking water quality ARARs; however, implementation would comply with water quality regulations associated with discharges to surface water or groundwater.

### 5.4.3 Long-Term Effectiveness and Permanence

Alternative 1 is not considered to be effective in the long term because PTW would not be actively treated. No reduction in the magnitude of risk would be achieved, and no additional controls would be implemented to control these risks. Alternative 1 would therefore perform poorly against this criterion. In contrast, all other retained alternatives (Alternatives 3 through 6) would offer high long-term effectiveness and permanence, including protection against potential flooding, as described below.

In Alternatives 3 and 4, ISS would result in treatment of PTW in the impoundments via reduction of contaminant mass and stabilization. The addition of steam enhancement to ISS operations in Alternative 4 would result in additional reduction of contaminant mass. In both alternatives, the stabilized impoundment material would remain in place and each of the performance criteria would be achieved, including adjustment of the material to a non-corrosive pH, reduction in COC leachability by greater than or equal to 90%, hydraulic conductivity less than or equal to $10^{-6}$ cm/s, and compressive strength greater than 40 psi. Compressive strength is an indicator of long-term durability. An engineered cover, which includes vapor control and treatment, would capture vapor phase COCs potentially emitted, and would prevent contact of precipitation with the treated materials. A robust engineered covered would provide further protection against potential flooding.

In Alternative 5, OU8 impoundment material would be treated, excavated, and disposed in the CAMU. Steam-enhanced mixing would result in enhanced VOC mass reduction, reducing the concentration of these contaminants in the impoundment material. ISS treatment would result in adjustment of the material to a non-corrosive pH and significantly reduce COC leachability. Following treatment, OU8 impoundment material would be placed in the CAMU, which would effectively contain the treated material over the long term. The CAMU has a multi-layer leachate collection system and would include an impermeable cover upon closure. Testing demonstrates that the HDPE liner material used in the CAMU is compatible with leachate potentially generated from the treated materials. In this alternative, OU8 impoundment material would be removed from the floodplain. Soil, clay and portions of the berms impacted by OU8 impoundment material that exceed the PRGs would be treated through ISS and the treated materials, along with the materials not requiring treatment, would be graded into the existing impoundment and capped with a protective cover.

In Alternative 6, OU8 impoundment material would be excavated, removed from the site, and treated offsite, resulting in a permanent and irreversible remediation of the impoundment materials. In this alternative, OU8 impoundment material would be removed from the floodplain. Soil and clay impacted by OU8 impoundment material (potentially containing minor amounts of acid tar) above the PRGs would be treated through ISS and the treated materials, along with the materials not requiring treatment, would be graded into the existing impoundment and capped with a protective cover.

### 5.4.4 Reduction of Toxicity, Mobility, and Volume

Aside from natural degradation, Alternative 1 is not expected to result in additional reduction of TMV and would perform poorly against this criterion. In contrast, Alternatives 3 through 6 would all offer a high degree of reduction in TMV as described below.

In Alternatives 3 and 4, ISS would effectively and irreversibly reduce the leachability (i.e., mobility) of COCs associated with PTW in the impoundments. ISS would also reduce mobility of COCs potentially present as non-PTW in the inner berm edges and an approximately 2-foot-thick layer of soil located below the existing clay impoundment liners and above the groundwater table. As demonstrated during the pilot study, Alternative 3 would result in significant permanent reduction of VOCs during the ISS mixing process (approximately 25% mass reduction). Alternative 4 would result in additional VOC mass reduction relative to ISS alone because of the addition of steam during the homogenization/mixing process (as demonstrated during the 2016 bench-scale study).

As in Alternative 4, steam-enhanced ISS in Alternative 5 would result in VOC mass reduction prior to excavation of the treated OU8 impoundment material and placement in the CAMU. ISS would also reduce mobility of COCs potentially present above PRGs in the inner berm edges and an approximately 2-foot-thick layer of soil located below the existing clay impoundment liners and above the groundwater table.

In Alternative 6, OU8 impoundment material would be removed from the site. Treatment of this material at a facility like a cement kiln would irreversibly destroy not only the VOC mass in the impoundment material, but also SVOC mass and the organic tar material itself. This would result in the greatest possible reduction in TMV.

### 5.4.5 Short-Term Effectiveness

Alternative 1 would not provide short-term effectiveness since it does not include any active remediation activities. The time to achieve RAOs for Alternatives 3 through 6 is similar in all cases (2 to 3 years), but the alternatives vary in their degree of protection of the community, workers, and environment during remedial actions. There is increased risk of exposure for alternatives that involve excavation (Alternatives 5 and 6) relative to the alternatives that involve treatment and closure-in-place (Alternatives 3 and 4). Because of this, Alternatives 5 and 6 are expected to provide moderate short-term effectiveness, and Alternatives 3 and 4 are expected to provide high short-term effectiveness. Details are provided below.

For Alternatives 3 through 5, engineered controls implemented during ISS and steam-enhanced ISS operations for vapor control would provide a high degree of protection to the community, workers, and the environment. These engineered controls include use of a shrouded auger, maintenance of a water cap, installation of stone plenum layer (vented as needed), and treatment of actively collected vapors with a thermal oxidizer and caustic scrubber. In addition, fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide protection in the case of a catastrophic flood. In the event of such a flood, equipment and reagents staged at a lower elevation would be moved.

For Alternatives 3 and 4 only, treated materials would be closed in place, and there would be no potential exposure associated with excavation, transportation of contaminated materials through the community, or placement of contaminated materials in the CAMU. In addition, the overall air emissions would be lower than with an excavation approach. A significant benefit of Alternatives 3 and 4 is reduced potential for exposure to the community because the OU8 impoundment materials are treated and closed in-place.

For Alternative 5, additional engineering controls such as use of vapor suppression foams or temporary fabric structures may be required to protect workers and the community during excavation and transport of the treated material to the onsite CAMU. While some risk may be encountered during transport of treated material to the CAMU, the material would have reduced concentrations of COCs because of prior steam-enhanced ISS treatment (reducing VOC emissions) and would be partially stabilized, increasing ease of handling. The transport distance would be approximately 1.5 miles.

In Alternative 6, engineering controls would be needed to protect the community, workers, and the environment during implementation because of an increased risk of exposure associated with material excavation, dewatering, and transport. Vapor suppression foams would be used on surfaces to control vapor emissions and if needed additional vapor control measures would be implemented. Lined dump trailers would be used to transport dewatered OU8 impoundment material offsite for treatment. Overall, excavation, dewatering, and transport of impoundment materials would pose a moderate degree of risk; however, this risk would be mitigated by a robust emission suppression program and engineering controls. As with Alternatives 3 through 5, it is assumed that fixed equipment would be staged on an equipment bench constructed at an approximate elevation of 42 feet NAVD88 to provide

protection in the case of a catastrophic flood. In the event of such a flood, equipment staged at a lower elevation would be moved.

In summary, because the time to achieve RAOs is similar for Alternatives 3 through 6, the primary differentiator between these alternatives is the degree of risk to the community, workers, and the environment. Engineering controls would be designed and implemented to mitigate these risks for all alternatives.

### 5.4.6 Implementability

Alternatives 1 and 3 are both readily implementable. In the case of Alternative 1, because no remedial actions would be implemented, there would be no challenges associated with contractors, specialty equipment, etc. This alternative, however, is not expected to meet the RAOs and does not meet the threshold criteria. In the case of Alternative 3, the primary remedial component, ISS, is a proven, reliable, and implementable technology and its effectiveness can be monitored. ISS has been applied in the remediation of VOCs, SVOCs and PTW at more than 30 National Priorities List or New Jersey projects similar to OU8 (CH2M 2015b). Many of these sites contain PTW and/or NAPL layers, and most of the sites were located along water bodies as well as near residences. ISS successfully treated the materials in the impoundments during the 2014 OU8 pilot study. The engineered cover and inner HBW would help minimize exposure risk. Alternative 3 is administratively feasible, and services and materials are readily available. A disadvantage is that stabilization would reduce the ease of undertaking additional remedial actions, if necessary.

Alternatives 4 and 6 are also implementable. In the case of Alternative 4, the ISS portion of the alternative would be highly implementable, as described above for Alternative 3. The addition of steam-enhanced mixing prior to ISS, however, has not been used as often and would require specialized equipment and operations. Fewer contractors are available with experience implementing steam-enhanced ISS. As with Alternative 3, a disadvantage is that stabilization would reduce the ease of undertaking additional remedial actions, if necessary.

For Alternative 6, while excavation and dewatering, in general, is a common activity, use of this approach on the acid tar impoundment materials is an emerging technology. This alternative's favorable implementability is based on the dewatering and successful destruction at a cement kiln of similar acid tar material from another Superfund site in USEPA Region 2; however, dewatering acid tar is site specific and may require special operational procedures. Several offsite facilities, i.e., cement kilns, have been identified that can accept the dewatered acid tars. The ease of closing the impoundments is high, as the materials would be removed from the Site. This alternative is administratively feasible, and services are available. Additional remedial actions, if necessary, could be readily undertaken.

Alternative 5 is expected to be implementable but comes with some challenges. The ISS portion of the alternative would be readily implementable, as described for Alternative 3; however similarly to Alternative 4, steam-enhanced mixing prior to ISS has not been used as often and would require specialized equipment and operations. Fewer contractors are available with experience implementing steam-enhanced ISS. Implementation of Alternative 5 would be challenging since there are multiple processes involved with in-place treatment, removal, additional treatment at the CAMU, then placement of the material in the CAMU. Excavation equipment is readily available; however, emission controls at the point of excavation and placement may be challenging. This alternative is administratively feasible, and services and materials are available. Additional remedial actions, if necessary, could be undertaken with ease in the impoundment area, but it would be difficult to undertake additional actions on the material once placed in the CAMU.

### 5.4.7 Cost

A summary of the costs for Alternatives 1, 3, 4, 5, and 6 is presented in Table 5-6 and detailed cost estimates are included in Appendix G. The total estimated cost for each retained alternative is provided below.

- Alternative 1 – $0
- Alternative 3 – $48,000,000
- Alternative 4 – $60,000,000
- Alternative 5 – $65,000,000
- Alternative 6 – $74,000,000

As described in Section 5.3, these cost estimates have been developed based on the design assumptions and are presented primarily for comparing the alternatives. The final costs of the selected remedy will depend on actual labor and material costs, competitive market conditions, final project scope, the implementation schedule, and other variables. Consistent with USEPA guidance, the cost estimates are order-of-magnitude estimates with an intended accuracy range of plus 50% to minus 30%. The range applies only to the alternatives as they are described in this report and does not account for changes in the scope of the alternatives.

### 5.4.8 Alternative Analysis Summary

Table 5-6 presents a summary of the comparative analysis of alternatives including the time to achieve RAOs for each alternative and their performance relative to the NCP threshold and balancing criteria. The performance of each alternative against each criterion is rated as follows:

- Does not meet NCP criterion
- Low (alternative is expected to perform poorly against criterion)
- Moderate (alternative is expected to perform moderately well against criterion)
- High (alternative is expected to perform very well against criterion)

The intent of Table 5-6 is to provide a visualization of the relative performance of each alternative against the entire suite of NCP threshold and balancing criteria.

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Table 5-6. Summary of Comparative Analysis of Alternatives

*Operable Unit 8 Focused Feasibility Study, American Cyanamid Superfund Site, Bridgewater, New Jersey*

| Criteria | Alternative 1: No Action | Alternative 3: ISS Treatment, Inner HBW, Protective Cover | Alternative 4: Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Alternative 5: Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Alternative 6: Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
|---|---|---|---|---|---|
| ***Time to Achieve RAOs*** | | | | | |
| Time (years) | - | 2 | 2 | 3 | 3 |
| ***Threshold Criteria*** | | | | | |
| Protection of Human Health & Environment | X | ● | ● | ● | ● |
| Compliance with ARARS | X | ● | ● | ● | ● |
| ***Balancing Criteria*** | | | | | |
| Long-Term Effectiveness | ○ | ● | ● | ● | ● |
| Reduction in TMV | ○ | ● | ● | ● | ● |
| Short-Term Effectiveness | ○ | ● | ● | ◑ | ◑ |
| Implementability | ● | ● | ◑ | ○ | ◑ |
| Estimated Cost (US Dollars) | $0 | $48,000,000 | $60,000,000 | $65,000,000 | $74,000,000 |

Legend:

- X Does not meet NCP criterion
- ○ Low (Alternative is expected to perform poorly against criterion)
- ◑ Moderate (Alternative is expected to perform moderately well against criterion)
- ● High (Alternative is expected to perform very well against criterion)

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SECTION 6

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# Figures

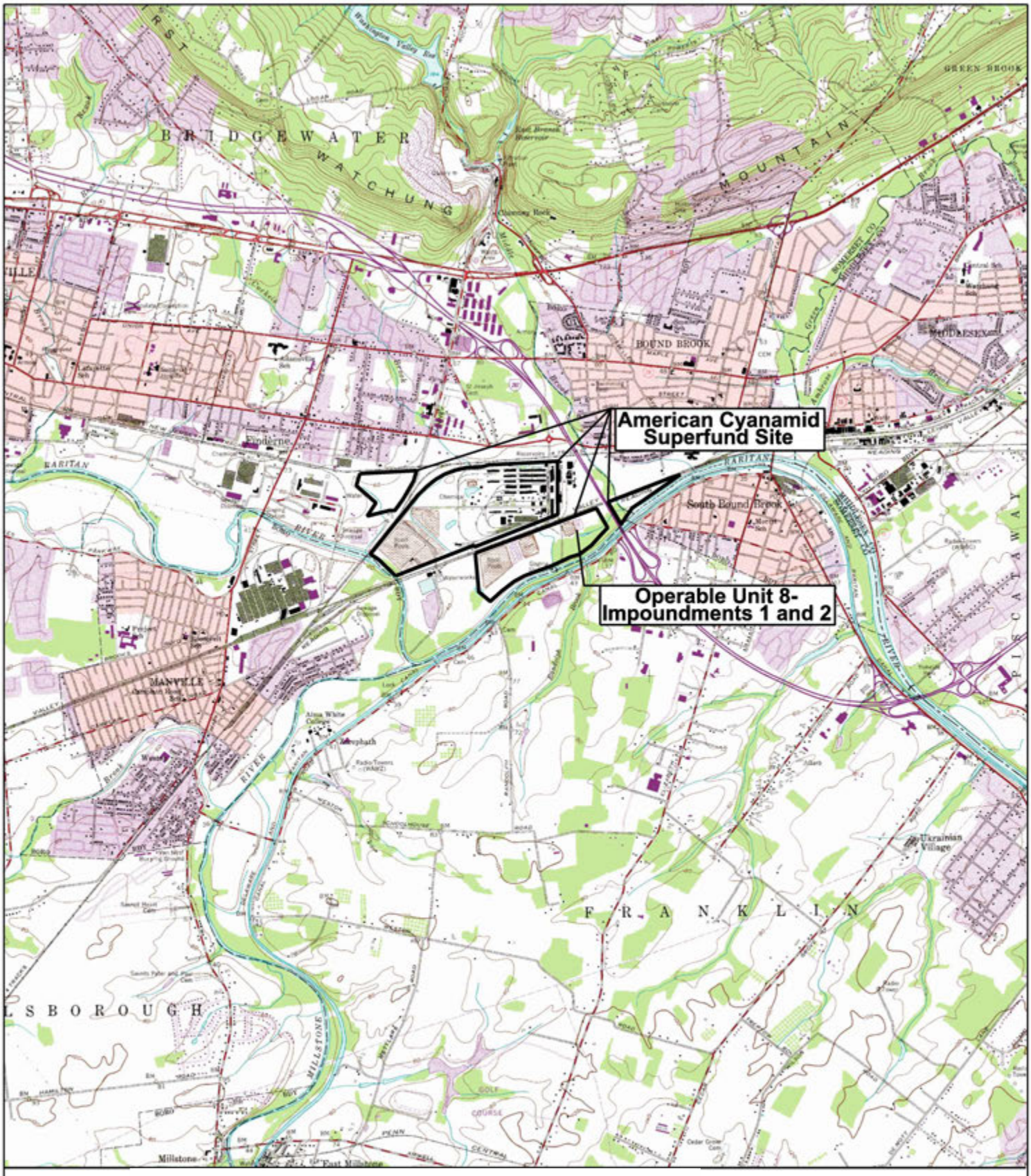



**Figure 1-1. Site Location Map**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site, Bridgewater, NJ*

FIGURE 1-2
**Site Map**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

ch2m

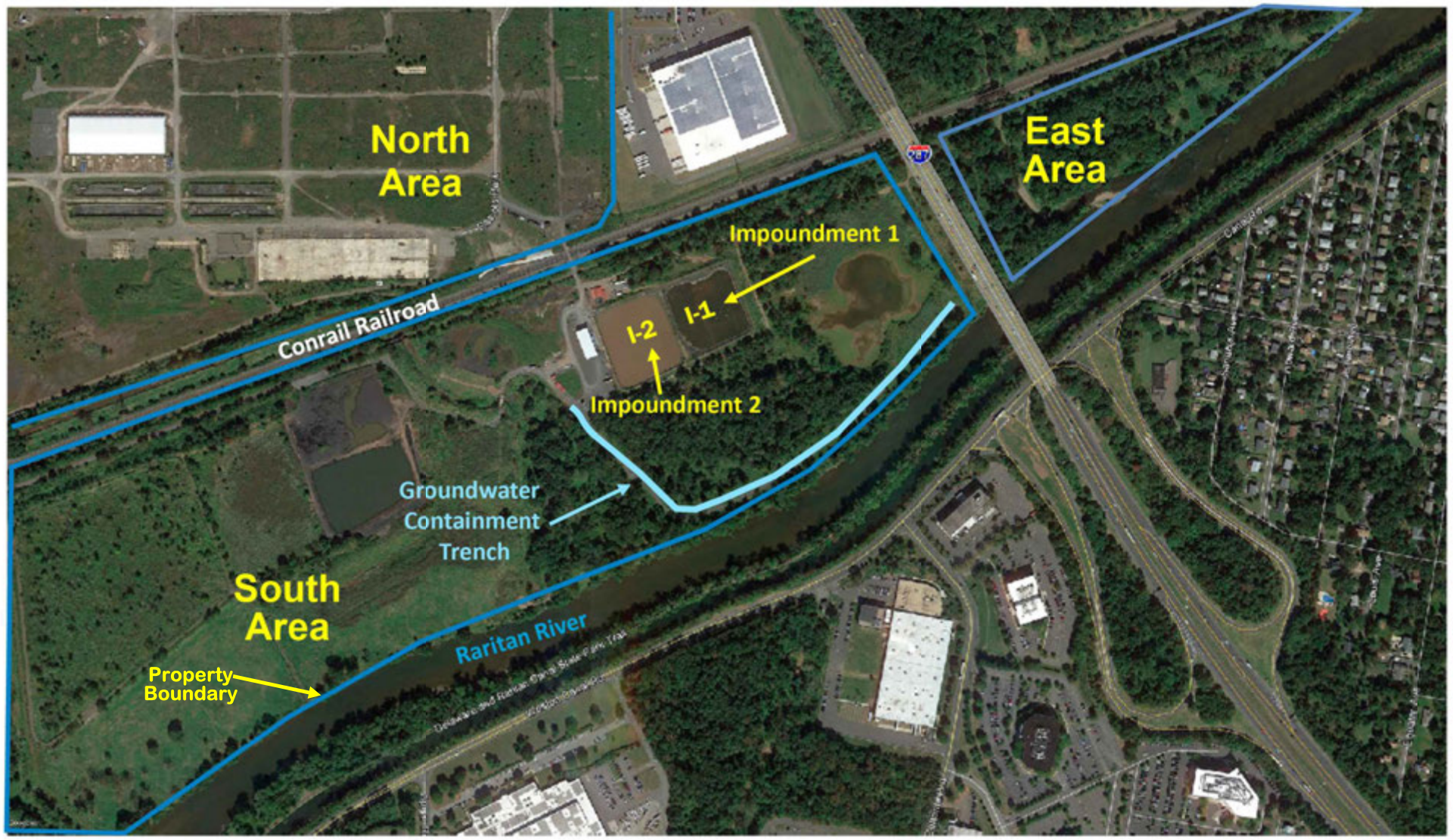
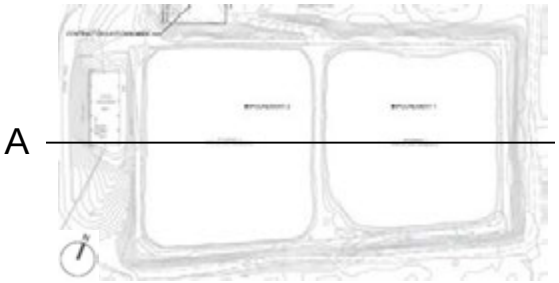
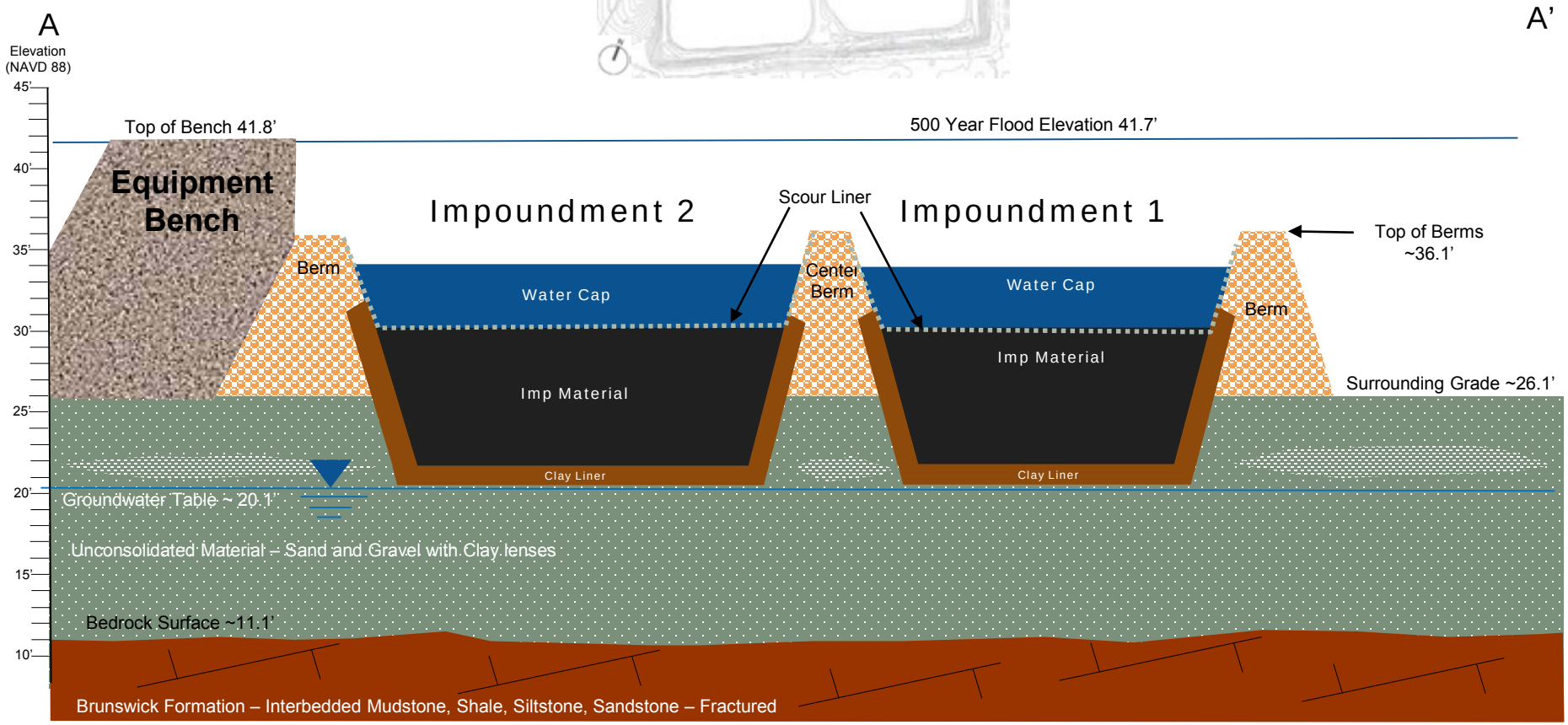



FIGURE 1-3
**Impoundment Location Map**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

ch2m




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

**Figure 2-1. Existing Pre-Treatment Conditions**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site, Bridgewater, NJ*

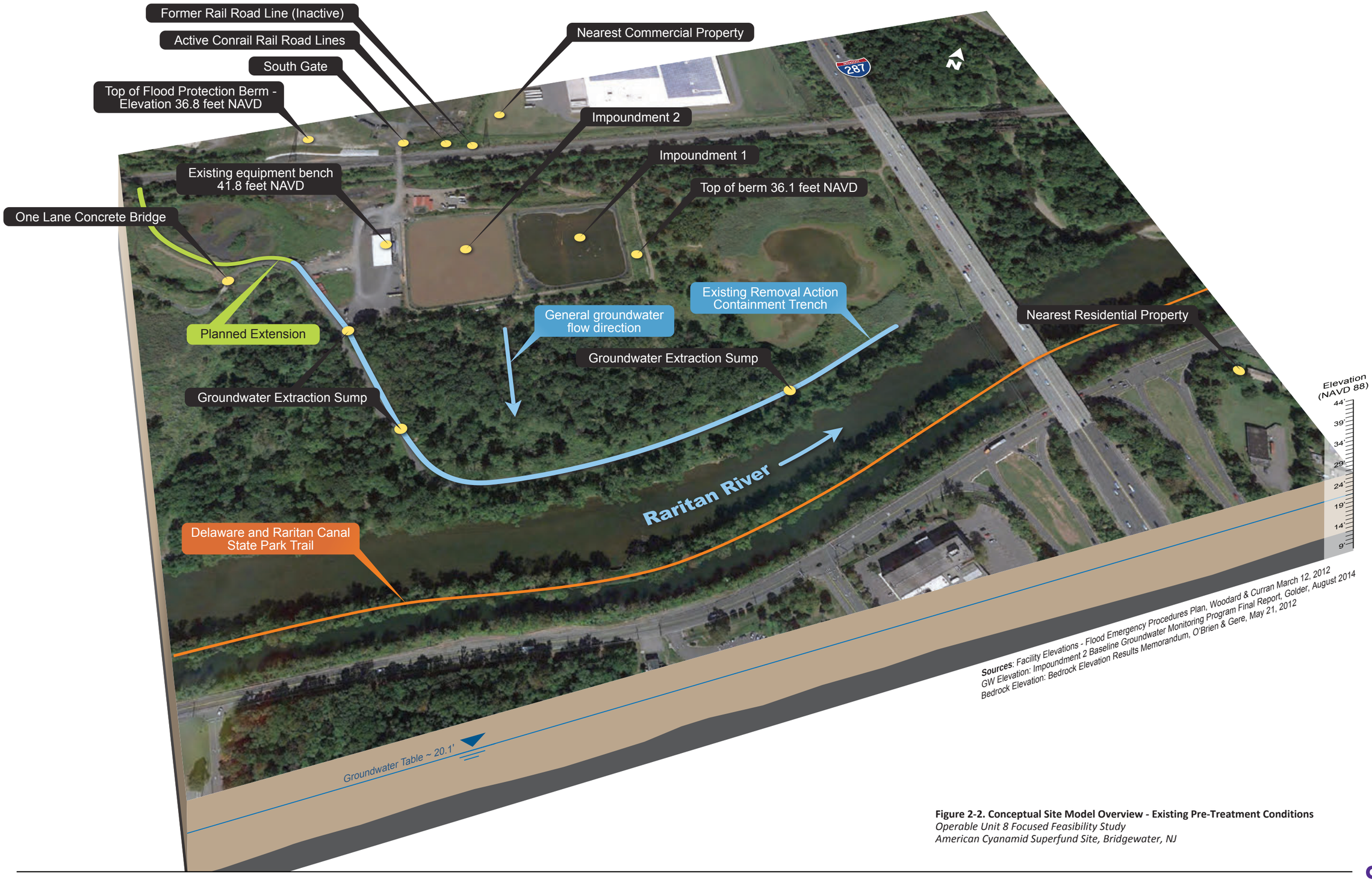



**Figure 2-2. Conceptual Site Model Overview - Existing Pre-Treatment Conditions**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site, Bridgewater, NJ*

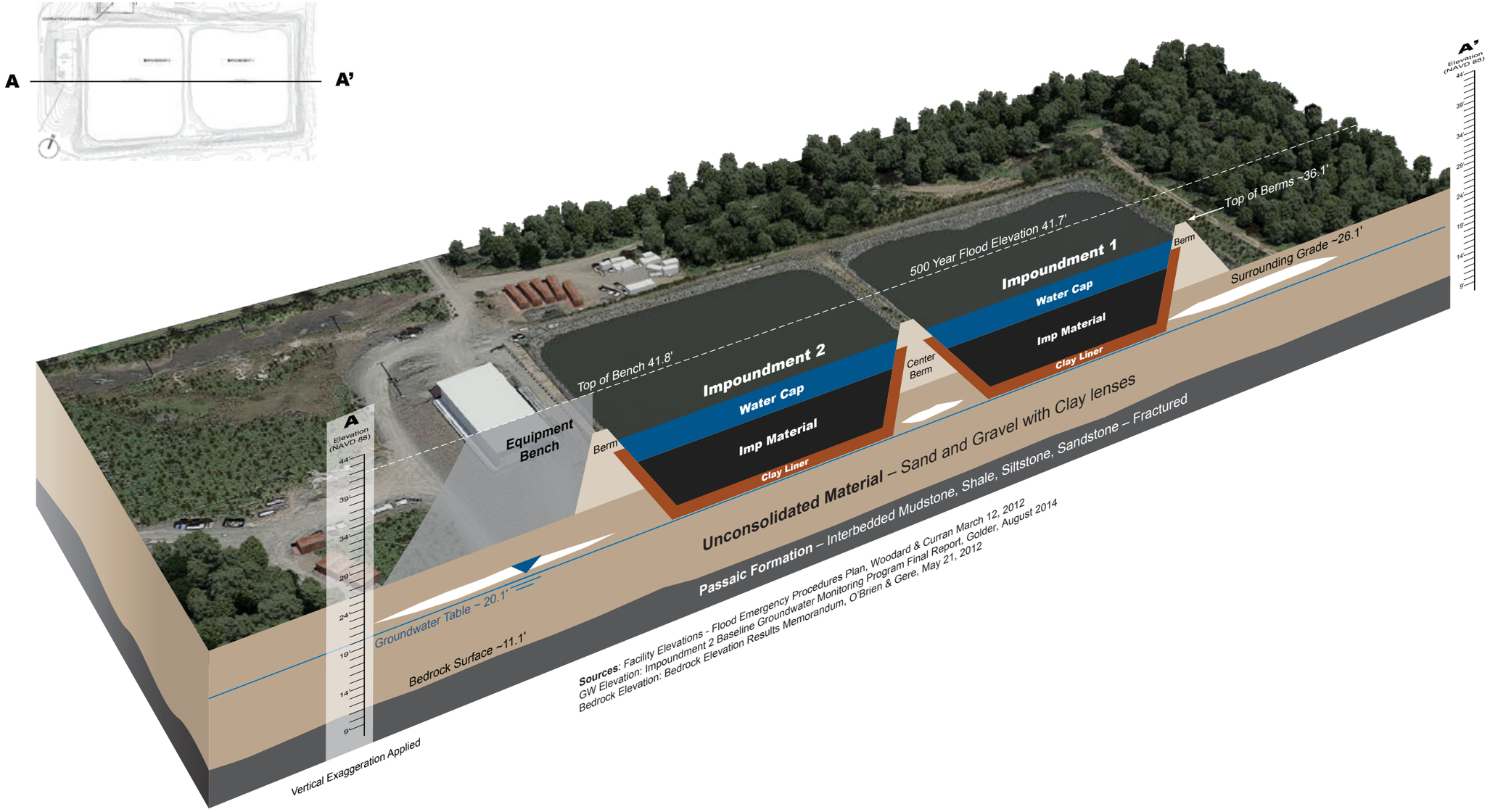



**Figure 2-3. CSM Cross Section A-A' - Existing Pre-Treatment Conditions**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site, Bridgewater, NJ*

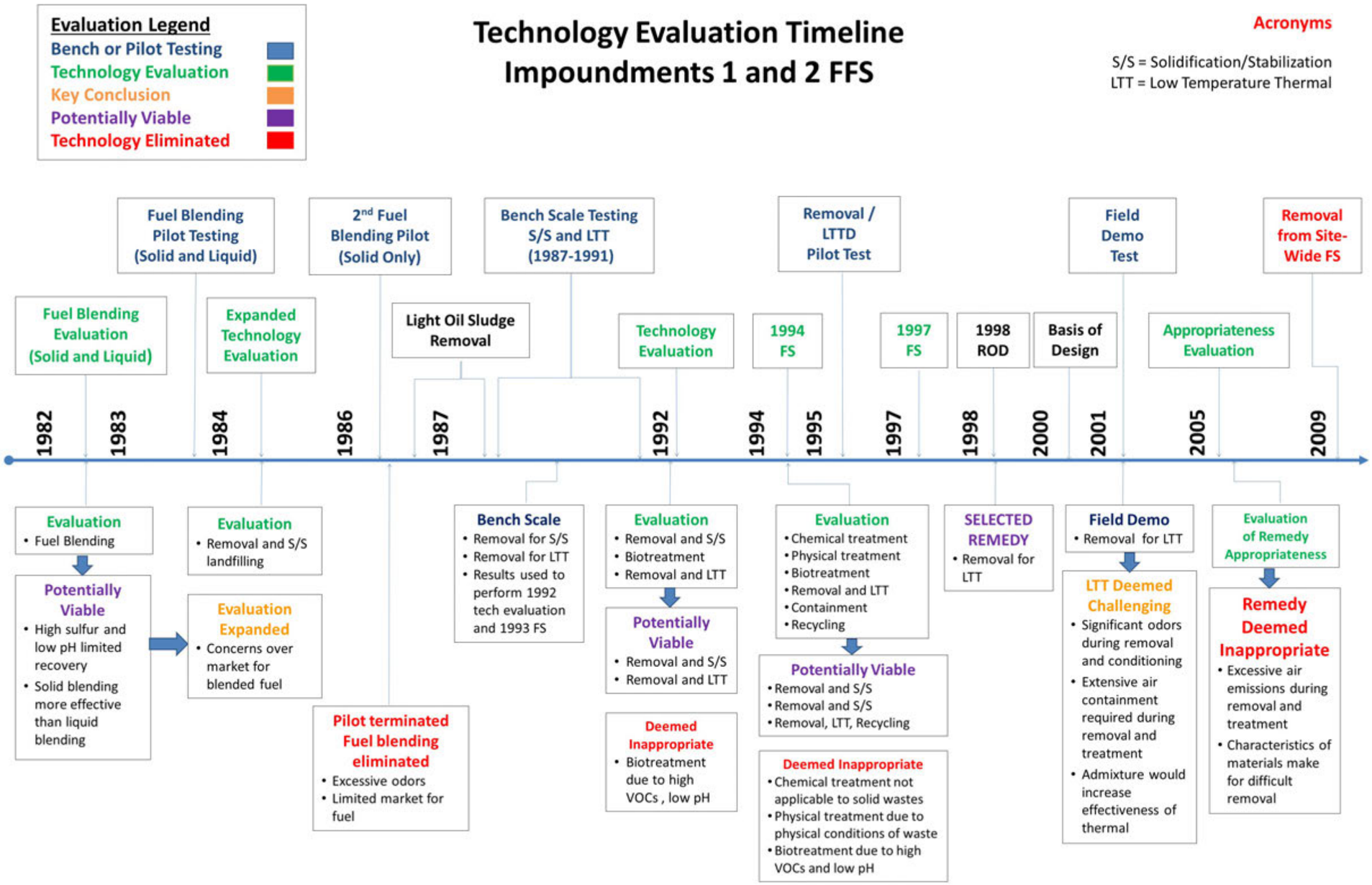



**Figure 2-4. Technology Evaluation Timeline**
*Operable Unit 8 Focused Feasibility Study*
*American Cyanamid Superfund Site, Bridgewater, NJ*

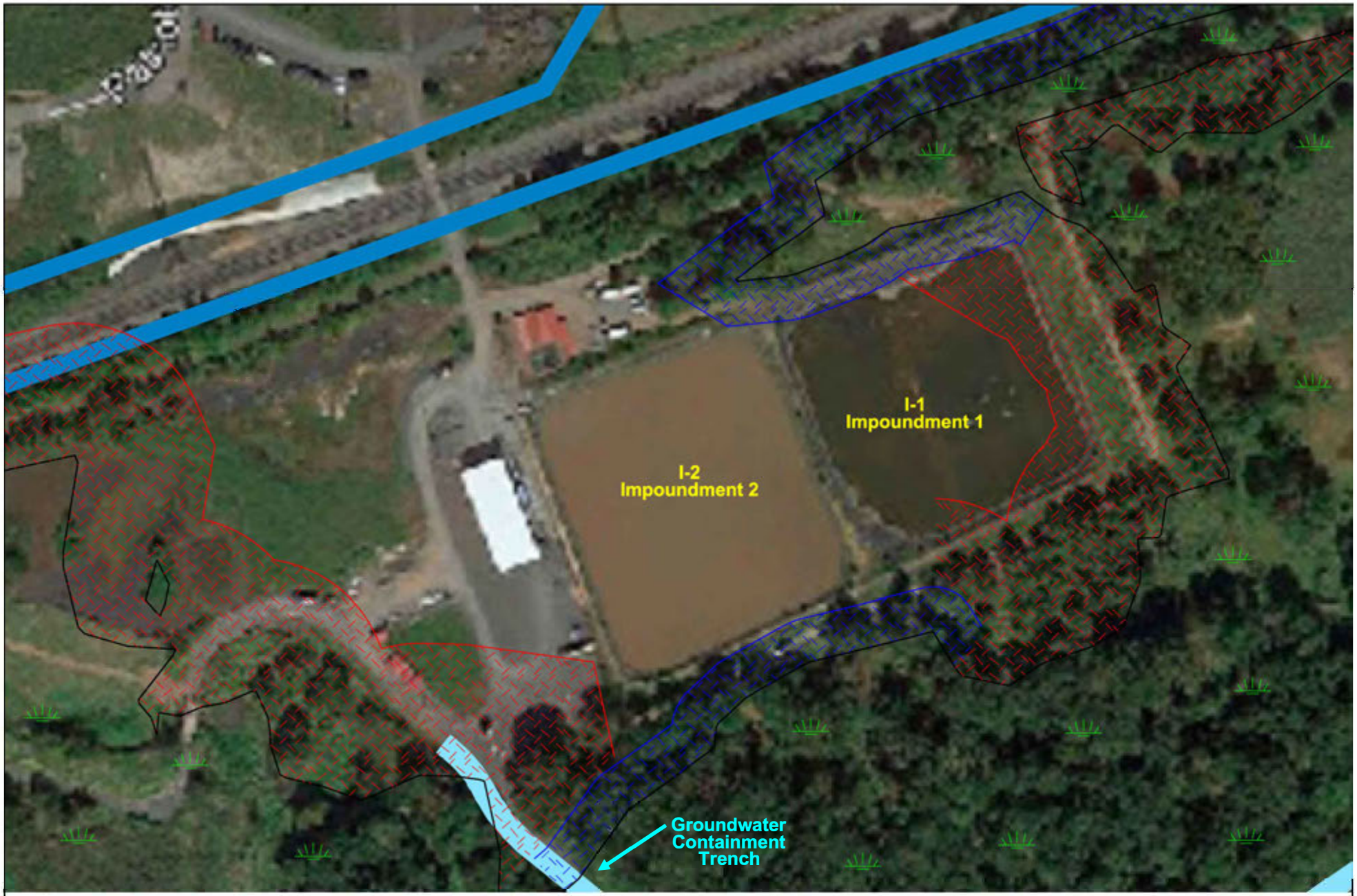



**Figure 3-1. Wetland Boundaries**

*Operable Unit 8 Focused Feasibility Study*

*American Cyanamid Superfund Site, Bridgewater, NJ*

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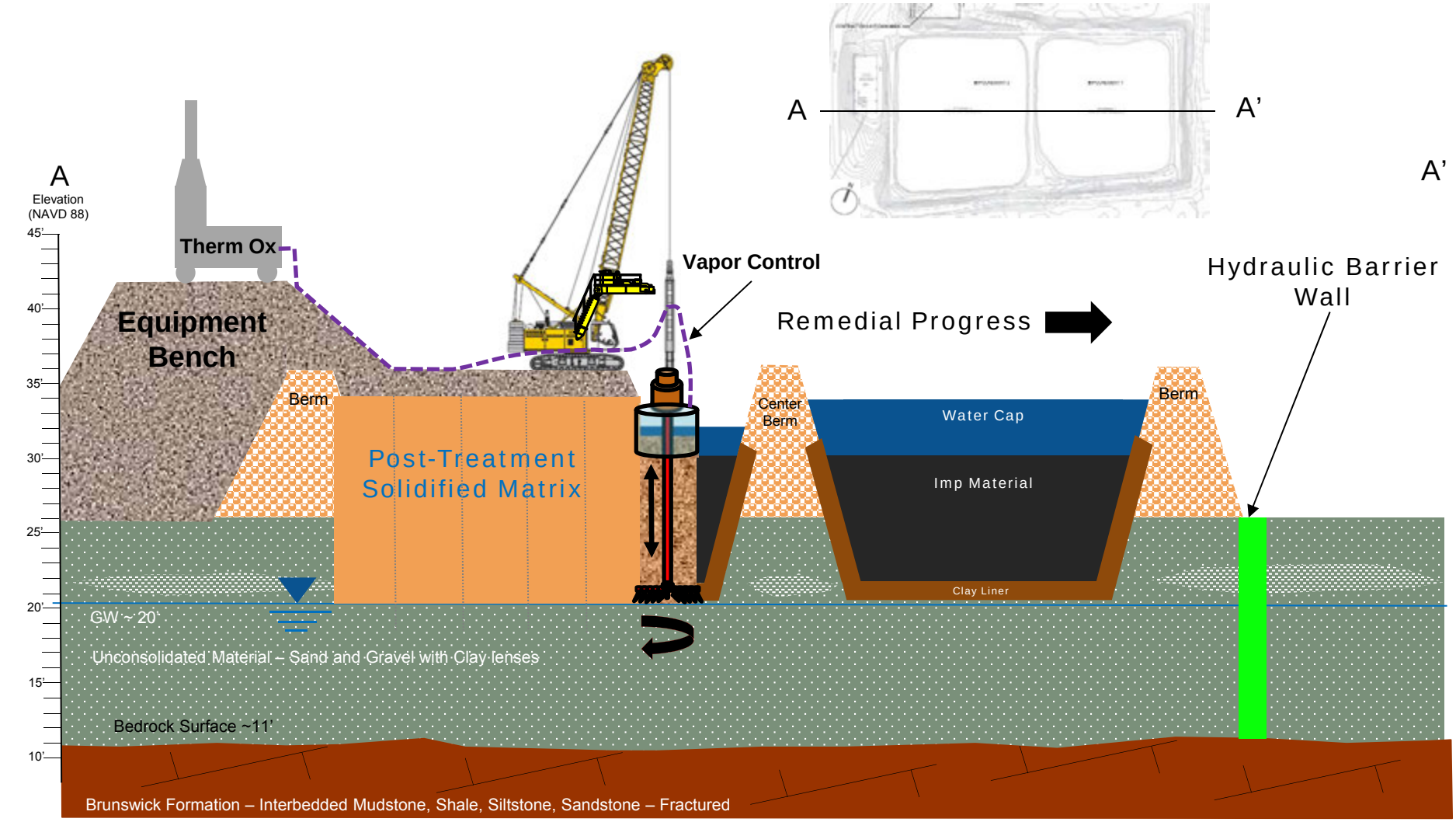
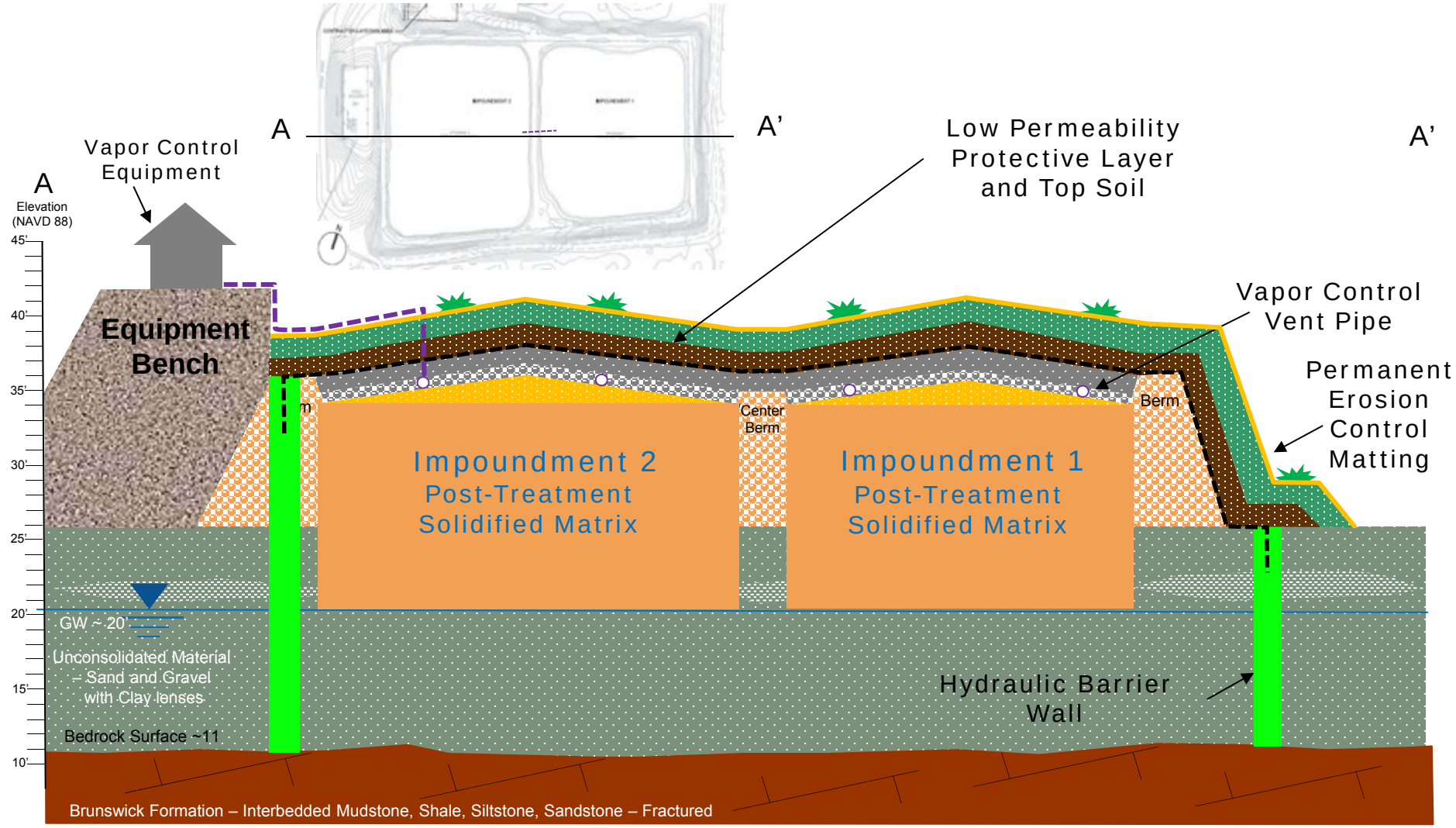



Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report,* Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

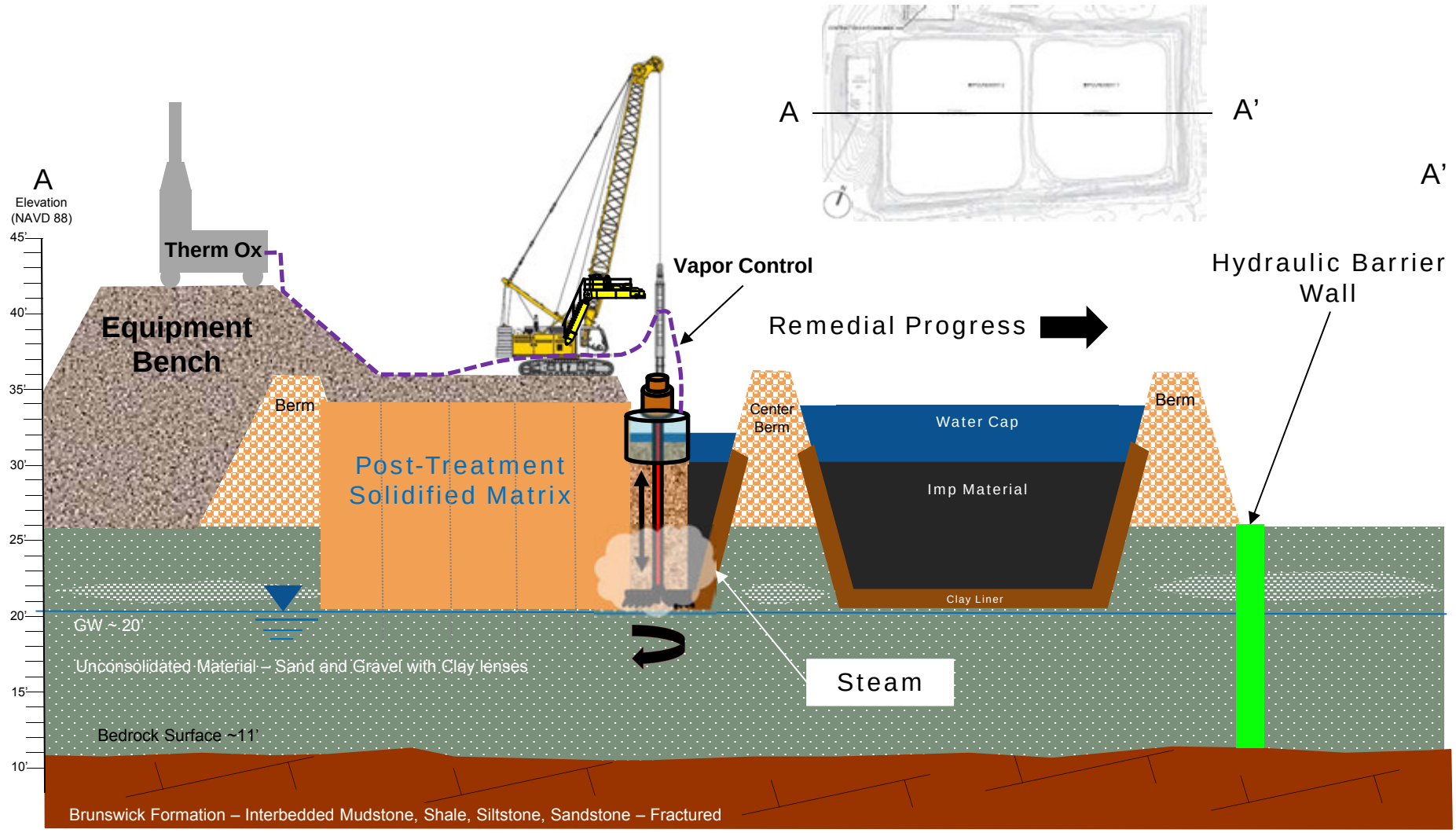
**Figure 5-1. During ISS Treatment (Alternative 3)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

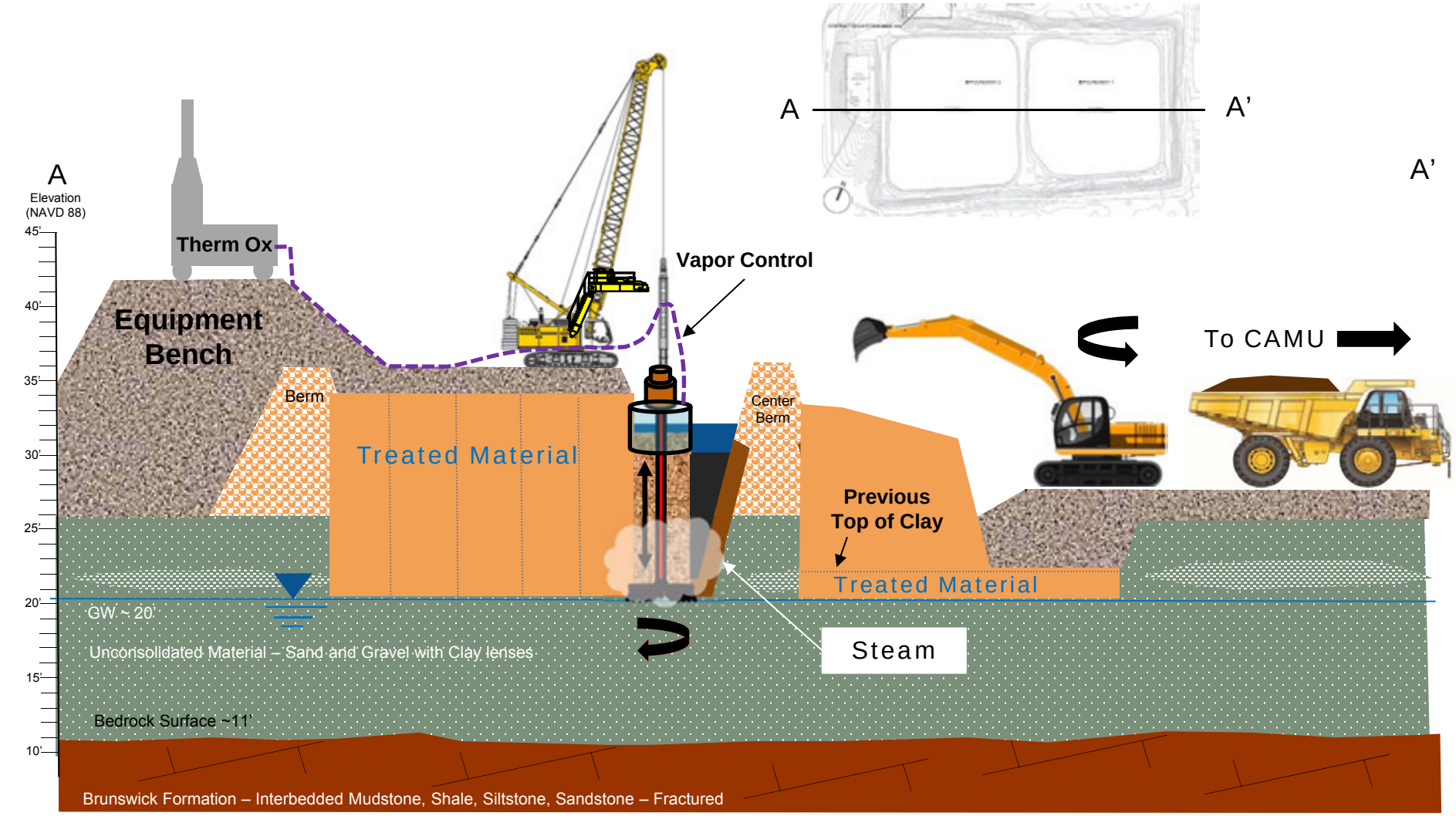
**Figure 5-2. Post-Treatment Conditions (Alternatives 3 and 4)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

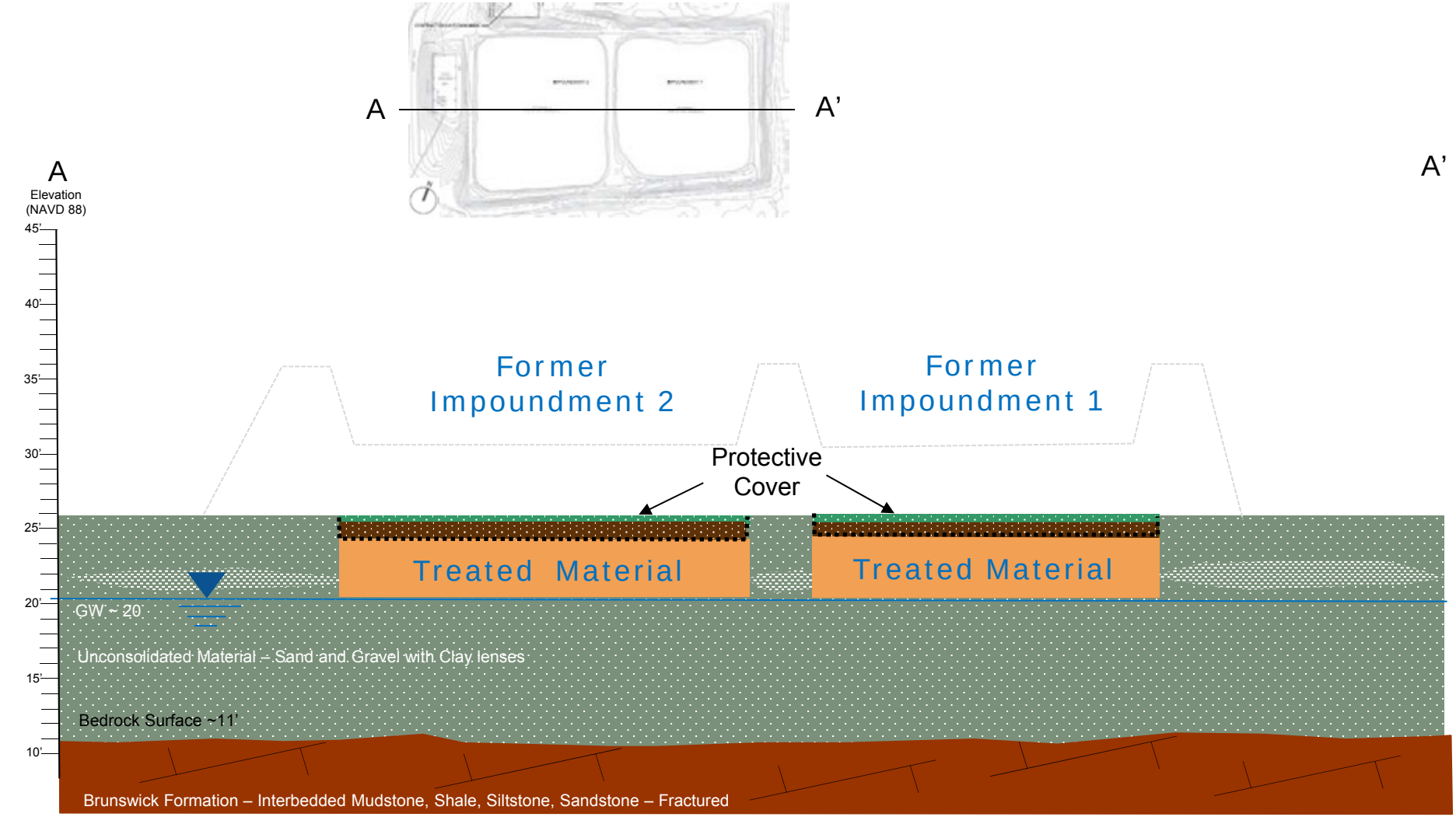
**Figure 5-3. During ISS Treatment (Alternative 4)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

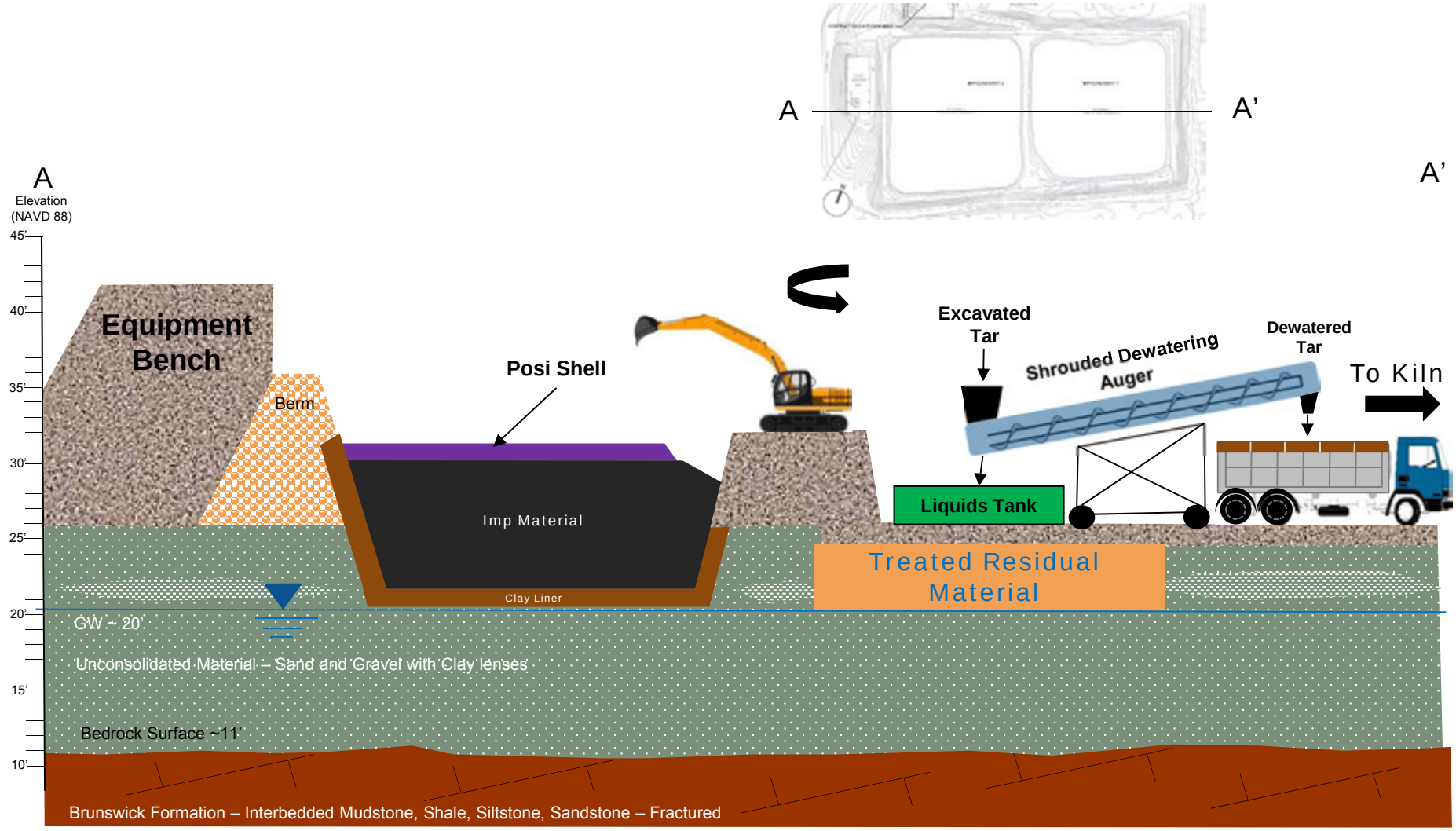
**Figure 5-4. During Treatment and Removal (Alternative 5)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

**Figure 5-5. Post-Removal Conditions (Alternatives 5 and 6)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*




Sources: Facility Elevations - *Flood Emergency Procedures Plan*, Woodard & Curran March 12, 2012
GW Elevation: *Impoundment 2 Baseline Groundwater Monitoring Program Final Report*, Golder, August 2014
Bedrock Elevation: *Bedrock Elevation Results Memorandum*, O'Brien & Gere, May 21, 2012

Vertical Exaggeration = 10x
Horizontal not to scale

**Figure 5-6. During Dewatering and Removal (Alternative 6)**
*Focused Feasibility Study Report, Operable Unit 8*
*American Cyanamid Superfund Site, Bridgewater, NJ*

# Appendix A
# Performance Criteria Memorandum

Quantum
Management Group, Inc.©

September 11, 2015

Mr. Mark Austin, Remedial Project Manager
American Cyanamid Superfund Site OU 8
New Jersey Remedial Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: American Cyanamid Superfund Site, Bridgewater, NJ OU8 Focused Feasibility Study
Response to USEPA's July 30, 2015 Comments on the Focused Feasibility Study Work Plan Addendum – Liner Compatibility Testing for Impoundment 8 Facility CAMU Memorandum and Proposed Performance Criteria for Remedial Alternatives Memorandum for the Operable Unit 8 Pilot Study, American Cyanamid Superfund Site, Bridgewater Township, New Jersey

Dear Mr. Austin,

Wyeth Holdings LLC (WH) is in receipt of the U.S. Environmental Protection Agency's (USEPA's) letter dated July 30, 2015 providing comments on the Focused Feasibility Study Work Plan Addendum – Liner Compatibility Testing for Impoundment 8 Facility CAMU Memorandum and Proposed Performance Criteria for Remedial Alternatives Memorandum for Operable Unit 8 (OU8) at the American Cyanamid Superfund Site, Bridgewater Township, New Jersey (Site). Per previous communications, comments on the Liner Compatibility Testing have been resolved and coordination for that testing is underway. CH2M HILL, on behalf of WH, has prepared the following responses for the Performance Criteria Memorandum comments. USEPA's comments are numbered in bold text followed by italicized responses.

1. **General Comment — Regarding Hydraulic Conductivity and Unconfined Compressive Strength (UCS): Both numbers proposed are based upon laboratory values, where samples are tightly compacted into a specimen holder and allowed to cure in optimal conditions (i.e., ideal temperature and relative humidity). In previous correspondence EPA has emphasized that the field value is more critical to the success of the project. There are ASTM methods for determining final in-place hydraulic conductivity values. As a rule of thumb, also mentioned in other discussions, UCS field values are expected to likely equal 50% of the lab value.**

   *Response (sent via e-mail 8/07/15): This comment refers to ASTM methods that employ field testing (as opposed to laboratory testing) for determining final in-place hydraulic conductivity and unconfined compressive strength values. Can you provide references or additional information about these ASTM field methods? We are not aware of any field methods that would be applicable.*

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**EPA Answer (sent via e-mail 8/13/15): The point to the comment was simply that we wish to note that field measurements are much more important than any laboratory measurements.**

*Response: Comment acknowledged. In the absence of specific test method references the proposed performance criteria remain $1\times10^{-6}$ cm/s for Hydraulic Conductivity and an average of 50 pounds per square inch (as measured in the laboratory) for UCS. There is no proposed change to the text, however it would be helpful to understand specific field test methods for measuring hydraulic conductivity and UCS that EPA has seen to be effective for evaluating in-situ solidification and stabilization (ISS) projects. Additional details regarding testing during implementation will be addressed during the design stage.*

2. **General Comment — Leaching: Regardless of the sites identified in Attachment 1; Region II has several DNAPL sites (Gowanus Canal as example) using modified laboratory procedures (modified LEAF methods) and modeling as the leaching method.**

   *Response: Comment acknowledged. The Performance Criteria memo references SPLP, ANSI 16.1 and other applicable methods, allowing for flexibility going forward as analytical methods are developed or modified. There is no proposed change to the text.*

3. **General Comment - pH: Please be aware that when a large range of acceptable values (4-12) are possible it leads to a susceptible risk to amphoteric metals which can drive further risk. For example, lead will most likely be leachable unless it is in a pH range of 9-11.5.**

   *Response: Comment acknowledged (pH changes can affect metals solubility and the resulting concentrations of metals in groundwater). It is important to note that metals concentrations in the untreated tar material are significantly lower than those of the organics. For example, benzene concentrations in untreated tar are on the order of 65,000 mg/kg; lead concentrations in the untreated tar material range from 10 mg/kg to 142 mg/kg (pilot test data). ISS is often used to treat metals because the selected reagents chemically stabilize the metals and prevent them from leaching. The results of the pilot test showed that lead TCLP concentrations were reduced from 0.26 mg/L (untreated tar) to <0.0065 to 0.035 mg/L following ISS; the pH of the treated material was 10-12 SU. An added benefit of ISS is that it reduces the hydraulic conductivity of the material (creates a monolith), which additionally reduces the surface area from which constituents of concern (COCs) can be leached. In summary, while the potential effect of pH on metals concentrations is acknowledged, there is no proposed change to the text.*

4. **General Comment - Air Emission Thresholds: Please ensure that the F&T model is one that EPA currently endorses. Also make sure the model projects upsets in the release term which may result from a hot spot being mixed and, that the RSL includes the possibility of dermal exposure.**

   *Response (sent via e-mail 8/07/15): Please clarify the term "F&T model" in this comment. We assume that F&T stands for fate and transport? Also, does "F&T model" refer to the model that*

*was used to estimate emissions from the material during handling or does it refer to the area wide model that was used to estimate fence line concentrations and risk?*

*We would like further clarification about the request to ensure that the model "RSL includes the possibility of dermal exposure." RSLs in air represent the screening levels that are used to assess impacts from emissions; the rationale for selecting RSLs in air is that the air exposure pathway is likely to be the only potentially complete pathway. Is EPA requesting that dermal exposure to VOCs in ambient air be quantified or that direct contact with waste is a potentially complete exposure pathway and that RSLs in soil also should also be used?*

**EPA Answer (sent via e-mail 8/13/15): F&T is the fate and transport models being used both for source emissions and subsequent transport (dispersion, dilution, etc.). It's important to ensure that the currently endorsed model for subsequent transport by EPA is used. The actual emission model can use field emissions data.**

**There is potentially two types of exposure to be assessed; the first being a dermal/incidental ingestion scenario if a worker comes into direct contact with the material and, two, the more significant, the inhalation exposure from vapor and dust being emitted during handling activities. Also note that certain compounds, such as PAHs, may have a dermal exposure criteria less than the inhalation criteria, so using the lower of the two may be more appropriate, not solely the inhalation criteria.**

*Response: Regarding the fate and transport models, fugitive emissions will be estimated using a modification of the Jury and Eklund models (as described below) and AERMOD will be used to evaluate subsequent transport (dispersion, dilution, etc.) following release.*

*Fugitive emissions from an active excavation area are generated based on two primary mechanisms: 1) static vaporization (mass transfer from an open excavation face or stockpile) and 2) dynamic pore space release (active soil movement). The equations from the USEPA-endorsed Jury Model (Appendix C, Limited Validation of the Jury Infinite Source Models for Emissions of Soil-Incorporated Volatile Organic Compounds, Environmental Quality Management, Contract No. 68-D30035, July 1995) are proposed to estimate the fugitive emissions associated with the static vaporization mechanism. The Eklund model for pore space emission rates (EPA-450/1-92-004, March 1992) will be used in conjunction with the number of anticipated disturbances to estimate the fugitive emissions from the dynamic pore space release. The following modifications to the Eklund model will be applied:*

- *Use Raoult's Law to take into account the multi-component system (Eklund assumed a pure component system)*
- *Assume a 100% release per disturbance (Eklund contained a "soil-gas to atmosphere exchange constant" of 0.33 or 33% release).*

*As requested by USEPA, the emission model will also consider the potential for upsets that may result from a hot spot being mixed. In addition, as suggested by USEPA, emissions data from future field studies may be used to further refine assumptions used in the modeling analysis.*

*Regarding worker exposure (dermal/ingestion/inhalation), workers will be protected from exposure by adhering to the site-specific Health & Safety Plan (HASP). A job hazard analysis will be conducted prior to implementation of any remedy to ensure protection of human health and the environment during implementation. This analysis will consider potential dermal/incidental ingestion exposures and inhalation exposure from vapor and dust that may be emitted during handling activities.*

*In addition, it is recognized that risk thresholds in the range of $1x10^{-4}$ to $1x10^{-6}$ are typically applied to environmental remediation projects. For the purposes of evaluating alternatives that consider removal, analyses will be based on an assumed upper risk threshold of $1x10^{-4}$. This assumption is premised upon minimizing the duration under which treated waste transfer occurs. No additional text changes are proposed.*

5. **General Comment - The performance criteria proposed in this memo represent typical performance criteria used to evaluate technologies for ISS remedies, and applies these criteria to the post-in situ pilot data results for the impoundment 2 material. This approach makes sense on one level — it is likely that the materials in impoundments 1 and 2 will undergo some in situ treatment as part of the overall remedy, since previous tests have concluded that the material cannot be handled safely ex situ in the absence of any treatment. However, using performance criteria typically used for other sites at which ISS technologies have been applied may not entirely make sense from the perspective that the unique characteristics of the materials in impoundments 1 and 2 are not likely to be similar to materials at other sites using ISS, certainly not in the concentration area. More examples of this are provided in the following comments.**

   *Response: Comment acknowledged. Also, see response to General Comment No. 7 below. No additional text changes are proposed.*

6. **General Comment - The memo applies the performance criteria that were identified for ISS remedies to the post-in situ pilot study material that was treated through ISS and the ISS/ISTT combination, under the assumption that this material will be left in place, and to the material that was treated only through ISS, if it is relocated to the impoundment 8 RCRA CAMU. Why wasn't the material treated only through ISTT also included in the evaluation if the material was left in place, and why wasn't the material treated through the ISS/ISTT combination as well as only ISTT included in the evaluation for relocation to the impoundment 8 RCRA CAMU. The characteristics of these other post-in situ materials should also be included in the evaluation of the performance criteria.**

   *Response: As determined during the pilot test, ISTT alone would not be implemented as a standalone treatment technology for multiple reasons. The primary factors are the constructability challenges due to a lack of UCS in untreated material to support ISTT equipment*

*and corrosion concerns during ISTT operations. Therefore, there were no feasible scenarios envisioned where only ISTT would be employed, i.e. ISTT only and closure in place or ISTT only and relocation to the CAMU. It is for these reasons that we have assumed some form of ISS would be needed prior to ISTT.*

*The proposed performance criteria for a relocation scenario include an appropriate strength (to be determined during design) and post treatment concentrations that are compatible with the liner system. These criteria would be applied regardless of treatment technology applied. The notes in Tables 1 and 2 have been modified in response to this comment and to comment #10.*

7. **General Comment - Applying a 90% reduction in leachability does not result in a benzene concentration that meets TCLP requirements. Although a 90% reduction in leachability may commonly be used at other ISS sites, this reduction may allow those sites to meet TCLP requirements. It is recommended that any required concentrations associated with leachate, such as TCLP, be used to determine the percent reduction that would be required from the original benzene concentrations. This site-specific, material-specific percent reduction would be a more appropriate performance criterion for leachability.**

*Response: It is recognized that the management and off-site disposal of solid waste that may be RCRA hazardous waste is centered on the use of TCLP testing methodologies. The application of TCLP however is premised upon the fundamental assumption that waste material generated (or excavated) is moved to an offsite permitted treatment storage and disposal (TSD) facility for final landfill disposal. Waste relocation affords for the collection of representative samples which can be evaluated in the laboratory using a prescribed methodology to emulate leaching characteristics after its final disposal. Although the application of TCLP values may be a convenient analog to assess remedy performance it must recognized that the testing methodologies and associated numeric standards were not developed for materials that are treated and closed in place. Materials that are closed in place retain specific structural property changes, such as greatly reduced interconnected porosity, which means that the amount of fluid (i.e. air or groundwater) that can move through the material is much lower. Consequently, TCLP based concentration standards are not applicable or representative of materials that are treated and closed-in-place.*

*If materials are excavated (treated or untreated) and sent for off-site treatment or disposal, then TCLP methodologies, promulgated standards and the receiving facility's requirements would dictate acceptable concentration for final disposal (e.g., TCLP, LDR)*

*The overall objective for closure in place is to address principle threat waste (PTW) through in-situ treatment. Specific requirements associated with treating PTW are not defined by the national contingency plan (NCP). As such, the range of preliminary alternatives assembled for OU8 afford varying degrees of treatment for PTW as measured by reduction in toxicity, mobility or volume. Treatment would be a component of every remedial alternative considered and concurrent application of engineering controls would further add to the overall protectiveness of any in place treatment closure option evaluated.*

*A 90 percent reduction in COC leaching from treated impoundment material would greatly improve groundwater quality downgradient of Impoundments 1 and 2. Also, as noted in the draft Technology Screening technical memorandum, application of ISS followed by in place*

*closure would be implemented in parallel with additional engineering controls, including a hydraulic barrier wall, which would further mitigate groundwater impacts downgradient of Impoundments 1 and 2. Additionally, the treatment standards for the material left in place must be determined in the context of the other remedial measures taken at the site. Groundwater downgradient of the impoundments is currently captured and treated by an existing extraction system, therefore there is no complete exposure pathway for groundwater. Therefore, for alternatives that include treatment and in place closure, a 90 percent reduction in leachability would be complemented by other engineering controls to ensure that the remedial alternative is protective of human health and the environment. Viewed in the context of the other remedial measures taken at the site, there is no justification for imposing a more stringent standard. No additional text changes are proposed.*

8. **General Comment - Please provide additional information on the hydraulic conductivity parameter so that EPA can evaluate its appropriateness as a performance criterion. For example, the parameter identified, 1 x $10^{-6}$ cm/s, is described as four orders of magnitude lower than the soils surrounding the impoundments. However, how does this conductivity relate to the treated material from the post-in situ study of impoundment 2? Based on the concentrations of contaminants in the treated material, what impacts would be predicted by applying this hydraulic conductivity.**

   *Response: The pilot study results indicate that ISS-treated materials exhibited a hydraulic conductivity (K) of < 1x$10^{-6}$ cm/s. The relative K is a comparison between the K of the treated material and that of the surrounding soils. A lower K of the treated impoundment material relative to the surrounding soil will force groundwater to flow around the treated impoundment material through the surrounding soils, minimizing contact with COCs in the impoundment material (therefore minimizing leaching of COCs). No additional text changes are proposed.*

9. **General Comment - Impoundment 8 Facility Liner Compatibility: This section states that further compatibility testing will be performed, but this section also suggests that the testing will be limited to only the ISTT-treated materials. Is this correct? Please explain why the ISS/ISTT-treated material will not also be included in the compatibility testing.**

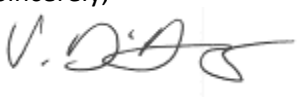
   *Response: This comment was previously addressed and USEPA subsequently approved the Bench-Scale Liner Compatibility Testing Work Plan via email on August 6, 2015.*

10. **Page 2, Table 1 & Page 7, Table 2 — In regards to the Imp 8 column, "ISS & Additional Treatment" — why isn't ISTT listed here or why would it not be appropriate?**

    *Response: ISTT may be considered as an additional treatment following implementation of ISS, the notes in Tables 1 and 2 have been modified to reflect this.*

We trust that you will find the foregoing satisfactory. If, however, you have any questions or require further information, please contact me at 973.650.3341.

Sincerely,



Vincent D'Aco
Project Coordinator – OU8/Focused Feasibility Study

| | | |
|---|---|---|
| cc | Pfizer Inc | Russell Downey |
| | USEPA | Joseph Battipaglia, Michael Sivak, Ed Barth |
| | NJDEP | Haiyesh Shah |
| | Bridgewater Township | Chris Poulsen |
| | Quantum Mgmt Group | Roman Pazdro |
| | CH2M-HILL | James Arthur |
| | | Carol Mowder |

MEMORANDUM

# Proposed Performance Criteria for Remedial Alternatives for Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey

| | |
|---|---|
| PREPARED FOR: | Mark Austin/U.S. Environmental Protection Agency |
| COPY TO: | Michael Sivak/U.S. Environmental Protection Agency<br>Joseph Battipaglia/U.S. Environmental Protection Agency<br>Ed Barth/U.S. Environmental Protection Agency<br>Russ Downey/Pfizer, Inc.<br>Vince D'Aco/Quantum Management Group |
| PREPARED BY: | CH2M HILL |
| DATE: | June 17, 2015 |
| REVISED: | September 11, 2015 |

This memorandum presents the proposed performance criteria that will be used to support development and analysis of remedial alternatives as part of the Focused Feasibility Study (FFS) for Impoundments 1 and 2 (designated as Operable Unit [OU] 8) at the American Cyanamid Superfund Site in Bridgewater, New Jersey (Site). Impoundments 1 and 2 contain acid tar, identified by the United States Environmental Protection Agency (USEPA) as principal threat waste (PTW). The conceptual remedial alternatives being considered for OU8 are based on the results of detailed laboratory- and pilot-scale treatability studies and include in-situ treatment of PTW followed by either onsite or offsite deposition. The onsite deposition endpoints include two potential response actions following in-situ treatment, specifically excavation and placement of treated material in the onsite corrective action management unit (CAMU, also known as the Impoundment 8 Facility) or closure of treated material in place.

## Background

The FFS process is being used to develop, screen, and evaluate candidate remedial alternatives for OU8. Overall, the FFS process is intended to identify alternatives that will meet the remedial action objectives (RAOs) and satisfy applicable or relevant and appropriate requirements (ARARs). The following RAOs are anticipated to be included in the FFS report. These RAOs were developed based on the preliminary RAOs presented in the Revised Impoundments 1 and 2 FFS Work Plan (CH2M HILL [CH2M] 2012), which USEPA approved on September 13, 2012:

- Remove, treat, or contain material that meets the definition of PTW
- Prevent current or potential future migration of Site-related material that meets the definition of PTW from the Site that would result in direct contact or inhalation exposure
- Prevent and minimize human and ecological exposure to constituents contained in impoundment materials and within adjacent earthen berms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- Prevent and minimize sources of groundwater impacts from the impoundments resulting in long-term improvement of groundwater quality and eventual achievement of applicable regulatory criteria to the extent practicable

The RAOs listed above are preliminary and will be finalized during development of the FFS.

# Performance Criteria Overview

The results of extensive bench- and pilot-scale studies have demonstrated that both in-situ solidification/stabilization (ISS) and in-situ thermal treatment (ISTT) are capable of treating impoundment materials to various treatment endpoints. This memorandum presents the key performance criteria categories that will be used to evaluate the overall ability of each remedial alterative to achieve the RAOs established within the FFS. The treatment requirements for offsite disposal are specific to individual disposal facilities and thus are well established; therefore, this memorandum focuses on performance criteria for onsite depositional endpoints following in-situ treatment, namely excavation and placement of treated material in the onsite CAMU or closure in place.

Performance criteria categories that will be used to measure an alternative's ability to achieve the RAOs for these depositional endpoints are presented in Table 1. The following sections describe the performance criteria in further detail. Additional parameters that will be evaluated, but are not considered key performance indicators (e.g., pH and air emissions), are discussed later in this document under "Other Considerations".

Table 1. Performance Criteria Overview

| | Closure In Place | | Impoundment 8 Facility CAMU |
|---|---|---|---|
| **Performance Criteria Parameter** | **ISS** | **ISS & ISTT** | **ISS & ISTT [a]** |
| Hydraulic Conductivity | X | - | - |
| Unconfined Compressive Strength | X | X | X |
| Leachability | X | X | - |
| Impoundment 8 Facility Liner Compatibility | - | - | X |

"a" – Note an alternate treatment technology may be implemented instead of ISTT
X - Applicable
"-" = Not Applicable

To support the evaluation of proposed performance criteria, application of ISS among both National Priority List (NPL) and State projects similar to OU8 was reviewed. Specifically, the review was performed to identify performance criteria contained within Records of Decision (RODs) and other project documentation (e.g., 5 Year Reviews, Explanation of Significant Differences, etc.) for projects where ISS was applied for remediation of volatile or semivolatile organic compounds and PTW. In total, more than 30 sites were reviewed and about half of these had at least one performance criteria reported in the documentation. Many of these sites contain materials with PTW and/or nonaqueous phase liquid layers at the site. Almost all of these sites were located along water bodies, and many were also located near residences. A summary table presenting the results of this review is included in Attachment 1 and specific references are provided, where applicable, in the following sections.

## Hydraulic Conductivity

Hydraulic conductivity of a porous medium is a function of both the physical properties of the solid matrix and the fluid passing through the medium. Hydraulic conductivity has emerged as a standard performance criteria parameter used to measure the effectiveness of ISS. The results of the literature review show that the majority of sites evaluated have established a hydraulic conductivity performance criteria for ISS (Attachment 1). The overall goal of ISS is to solidify and bind up constituents of concern


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(COCs) so leachability following treatment is minimized or eliminated. One reason ISS is effective in reducing leachability is because treated materials are significantly less permeable (i.e., have a lower hydraulic conductivity), precluding contact of COCs with infiltrating stormwater or groundwater. Treatment of a wide range of materials by ISS using a variety of reagents is well documented. Despite the diverse range of materials and amendments applied, a hydraulic conductivity of $1\times10^{-6}$ centimeters per second (cm/s) for treated material is readily achieved. A hydraulic conductivity value of $1\times10^{-6}$ cm/s is considered the benchmark standard for ISS-based technologies.

The proposed hydraulic conductivity performance criterion for an ISS-only remedy for OU8 where treated materials are closed in place is $1\times10^{-6}$ cm/s. This value was selected based on industry guidance documents and hydrogeologic properties of the surrounding soil. This value is consistent with performance criteria applied to other operable units at this site (i.e., OU4) and other ISS projects nationwide (Superfund and other regulatory programs), including in USEPA Region 2. As detailed in Attachment 1, 14 of the ISS projects reviewed adopted this value as the performance criteria; ISS performance criteria established at five additional sites reviewed accepted the use of a higher ($1 \times 10^{-5}$ cm/s) hydraulic conductivity criterion. The rationale for adopting a hydraulic conductivity performance criterion of $1 \times 10^{-6}$ cm/s for an ISS-only remedy where treated materials are closed in place is supported as follows:

- The ITRC guidance document, *Development of Performance Specifications for Solidification/ Stabilization* (ITRC 2011), indicates hydraulic conductivity values of many successfully implemented ISS projects did not exceed $1 \times 10^{-6}$ cm/s; therefore, this value has become an industry rule-of-thumb and best practice for implementing ISS projects.
- It is common among ISS projects to treat material such that the resulting hydraulic conductivity is one to two orders of magnitude lower than surrounding soil material (ITRC 2011). Based on the *Pre-Design Investigation for Site Wide Remedy* (Golder 2014), the hydraulic conductivity in the vicinity of Impoundments 1 and 2 is approximately $3.3 \times 10^{-2}$ cm/s. By comparison, the proposed performance criteria of $1 \times 10^{-6}$ cm/s is four orders of magnitude lower than that of the surrounding soil.
- The proposed hydraulic conductivity value is also consistent with the USEPA-approved ROD for OU4 at the American Cyanamid Superfund Site, which specifies a hydraulic conductivity performance criterion value of $1 \times 10^{-6}$ cm/s for the selected ISS remedy. In addition, this value has been used for other USEPA-approved RODs and/or ISS designs (Attachment 1).
- The OU8 pilot study results demonstrated that the proposed hydraulic conductivity value can be obtained for post-ISS treated material.

Hydraulic conductivity is not a proposed performance criterion for alternatives where ISTT is used, since low hydraulic conductivity can inhibit the effectiveness of ISTT (depending on the specific technology application), nor is it appropriate for alternatives where treated materials are excavated under a removal scenario. It is applicable only for ISS and closure in place alternatives.

## Unconfined Compressive Strength

Material strength is an important property used to assess the long-term durability of ISS-treated material. Unconfined compressive strength (UCS) is also directly related to the treated material's ability to support construction of an engineered cover, which would be required to meet the RAOs for alternatives involving a closure in place remedy. Alternatives that contemplate excavation following ISS must also consider UCS as treated materials placed in the onsite CAMU must also be capable of supporting a final cover. The parameter is also of importance for alternatives that include ISTT. Untreated material in Impoundments 1 and 2 possess limited to no UCS and, therefore, cannot support equipment or an engineered cover in their current physical state.


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Specific UCS values for treated material are dependent on the specific combination of technologies implemented and the final deposition endpoints considered. Therefore, UCS performance criteria are presented below for the following three scenarios:

- ISS and closure in place
- ISS and ISTT followed by closure in place
- Alternatives involving placement of material in the CAMU

### UCS Criteria for ISS and Closure in Place

The proposed UCS performance criteria for ISS only and closure in place is an average of 50 pounds per square inch (psi), with a minimum value of 40 psi, as measured at the 28-day cure. The 50 psi UCS value is an industry standard and is used as a measure of durability of the solidified matrix. This proposed UCS criteria for solidified material is also more than sufficient for supporting an engineered cover and thus meeting the RAOs for treating PTW and minimizing human and ecological exposure. The following rationale support this proposed criteria value.

- Remedy performance variability can be encountered when implemented at full-scale; therefore, it is recognized that variability in test results following a full-scale ISS approach are probable. With an ISS remedy, it is the overall aggregate performance of the treated material that is important, and some variability can be observed without compromising the success of a remedy. As such, a range of UCS measurements with an established minimum and average values is proposed.
- The proposed performance criteria for ISS only and closure in place is based in part on the ITRC (2011) guidance, which references using a 50 psi average UCS (or other site-specific value), with a minimum value of 40 psi. This approach allows for anticipated variability without compromising the success of the remedy.
- The OU8 pilot study results demonstrated that these UCS values can be obtained.
- The minimum 40 psi UCS is consistent with the value specified by the OU4 ROD for the American Cyanamid Superfund Site.
- The NPL ROD search revealed UCS performance criteria at 19 other sites that ranged from 25 to 100 psi, with the majority in the 40 to 50 psi range (Attachment 1). For the American Cyanamid Site, the 50 psi average with a minimum value of 40 psi will be sufficient to protect the remedy. For example, the minimum UCS required to support equipment during construction is approximately 20 psi, and the UCS required to support an engineered cover would be approximately 12 to 18 psi.

### UCS Criteria for ISS and ISTT Followed by Closure in Place

Although the 50 psi UCS value for durability of a solidified matrix is not applicable for this alternative because there will not be a monolith but rather “soil like” material, material treated by ISS and ISTT followed by closure in place would need a minimum strength to support equipment used during remedial construction and the engineered cover following treatment. As noted above, the minimum UCS required to support equipment during construction is approximately 20 psi, and the UCS required to support an engineered cover would be approximately 12 to 18 psi. However, it is proposed that the final UCS value for ISS and ISTT followed by closure in place would be determined in the design phase (when the cap is designed and the strength requirements can be determined). Since ISS would be implemented before ISTT in this scenario, treated material is expected to exhibit sufficient strength to support the engineered cover without the need for additional stabilization following treatment.

### UCS Criteria for Alternatives involving Placement of Material in the CAMU

For alternatives that involve placing treated material in the onsite CAMU, a minimum UCS value is required to ensure long-term stability and support the final engineered cover that would be placed upon

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closure of the CAMU. This UCS value will be based on the configuration of placed materials within the CAMU and will be determined in the design phase for the selected remedy.

According to the 1997 *Impound 8 Facility Basis of Design* (O'Brien & Gere 1997), a minimum 28-day UCS value of 42 psi (21 psi shear strength) was determined to meet the minimum factors of safety for the CAMU; however, this value was applied to material being solidified during placement and then allowed to cure in the CAMU. In addition, the 1997 value assumed a CAMU height greater than 100 feet and more than 1 million cubic yards (CY) of material placed in the CAMU. Approximately 400,000 CY of material have been placed in the CAMU to date and an additional 100,000 CY from OU8 would be placed if this alternative were selected. Because the total volume of material to be placed in the CAMU under this alternative would be less than what was assumed in 1997, the UCS requirement for placing treated materials in the CAMU is expected to be less than the 42 psi previously calculated. Therefore, it is proposed that the UCS requirement for alternatives that use the onsite CAMU be developed during design.

### Methods for Determining Compliance with the UCS Criteria

For the scenarios presented above, UCS measurements will be obtained using ASTM Method D1633, *Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders,* to evaluate if performance objectives have been met. Field measure of UCS using tools such as pocket penetrometers will be used only for collecting qualitative data as an indicator of expected curing times and not to establish quantitative performance.

## Leachability

Leachability is an indicator of the potential for COCs to dissolve into infiltrating water and potentially impact groundwater. ISTT reduces leachability through mass removal, while ISS reduces leachability through a combination of mass removal, reduction in hydraulic conductivity, and contaminant sequestration. Leachability reduction is a common performance metric for ISS projects, as described by ITRC (2011). As a rule of thumb, a 90 percent reduction in COC leachability for ISS-treated material is typically adopted in establishing performance metrics for environmental remediation projects in which treated materials are ultimately closed in place. Based on a review of performance criteria identified in ISS RODs or design documents, a leachability reduction performance criterion was specified in one other site reviewed (i.e., in addition to the American Cyanamid Superfund Site) (Attachment 1). This site is located in Region 2 and had a performance criterion that specified a 90 percent reduction in leachability. Although there is not sufficient information to compare the COC concentrations for this site with OU8, this site does involve PTW and nonaqueous phase liquids (Attachment 1).

The proposed performance criterion for OU8 alternatives that include closure in place, either ISS or ISS followed by ISTT, is a 90 percent leachability reduction of benzene (which makes up at least 80 percent of the total volatile organic compound (VOC) mass and is the most soluble/mobile of the COCs). A total VOC assessment is not recommended because high detection limits are anticipated for many VOCs, which can skew the leachability calculations because of nondetect COCs. The rationale for selecting a benzene leachability reduction value of 90 percent is based on industry guidance documents, the results of bench- and pilot-scale studies, and is consistent with performance criteria applied to OU4. Note that a leachability performance criterion is not proposed for alternatives that use the CAMU for final material disposition because the CAMU incorporates robust engineering and administrative controls to manage leachate (e.g., multiple liners, leachate collection, regular monitoring, etc.).

It is recognized that the concentration of benzene in the OU8 material differs from and in some cases is greater than OU4 materials for which the 90 percent reduction in leachability criterion following ISS was established. It is also understood that 10 percent of the original leachable benzene value may still be considered of concern. However, it must be emphasized that ISS followed by closure in place in OU8 is only one component of a multifaceted remediation approach for the Site; other aspects of the remedy

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for OU8 will further prevent threats to human health and the environment from the benzene that may remain after ISS or ISS and ISTT, as further described below. The following rationale support this proposed performance criteria value.

- The proposed value is consistent with the site-specific performance requirements documented in the OU4 ROD for the Site.
- The proposed value is consistent with at least one other site in USEPA Region 2 for which a leachability reduction performance criterion was used.
- Application of ISS followed by closure in place would be implemented in parallel with additional features and engineering controls (e.g., cap, hydraulic barrier wall, vapor controls, etc.) to protect human health and the environment.
- Operation of the OU4 groundwater containment, extraction, and treatment system provides an added level of control and treatment for residual constituents that may leach into groundwater.
- The pilot study results showed that ISS, ISTT, and a combination of these technologies were able to achieve greater than a 90 percent reduction in leachability.

### Methods for Determining Compliance with the Leachability Criteria

Leachability testing will require site-specific development during remedial design, using USEPA's synthetic precipitation leaching procedure, the ANSI/ANS 16.1 method, or other appropriate methods. The leachability reduction evaluation takes into account hydraulic conductivity to assess mass discharge from the materials pre- and post-treatment. Treatability testing will be conducted before full-scale implementation to optimize the ISS mix and demonstrate a correlation between leachability and UCS and hydraulic conductivity performance criteria.

## Impoundment 8 Facility Liner Compatibility

For alternatives where treated impoundment materials will be excavated and placed in the Impoundment 8 Facility CAMU, the material being placed must be physically and chemically compatible with the CAMU liner. The concentrations of constituents in the treated pilot test materials were compared to the concentrations of other materials previously approved to be placed at the CAMU. In addition, a literature review of chemical compatibility was conducted.

A chemical compatibility evaluation was conducted on the Cell 3 and 4 liner systems as part of the 1997 basis of design (O'Brien and Gere 1997). Based on vendor information, literature review, and data collected from Cells 1 and 2, the basis of design concluded that individual concentrations of contaminants encountered at the Site are not anticipated to be a concern regarding the compatibility with geosynthetic materials.

A review of chemical resistance charts from several high-density polyethylene (HDPE) manufacturers indicates that HDPE may experience some attack from benzene (GSE 2015; INEOS 2015). Based on the concentrations of materials previously approved for placement in the CAMU and the results of pilot testing, it is expected that ISTT-treated materials from Impoundments 1 and 2 will be compatible with the Impoundment 8 Facility CAMU liner. However, to evaluate a range of potential alternatives that may involve placement of treated materials in the CAMU, it is recommended that additional compatibility testing be performed.

To assess whether the treated Impoundment 1 and 2 materials are compatible with the existing CAMU liner, bench-scale testing will be performed using leachate generated from the treated impoundment materials. A work plan detailing the proposed testing procedures will be submitted to USEPA for review.


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# Summary

Table 2 presents a summary of the proposed performance criteria.

Table 2. Summary of Performance Criteria Values

| | Closure In Place | | Impoundment 8 Facility |
|---|---|---|---|
| **Performance Criteria Parameter** | **ISS** | **ISS & ISTT** | **ISS & ISTT[a]** |
| Hydraulic Conductivity (cm/s) | $1x10^{-6}$ | - | - |
| Unconfined Compressive Strength (psi) | 50 (average); 40 (minimum) | TBD | TBD |
| Leachability Reduction | 90% | 90% | - |
| Impoundment 8 Facility Liner Compatibility | - | - | Pass compatibility testing |

"a" – Note an alternate treatment technology may be implemented instead of ISTT
"-" = Not applicable
TBD – To be determined during detailed design to support an engineered cover

# Other Considerations

While the performance criteria presented above for hydraulic conductivity, strength, leachability reduction, and liner compatibility are considered the primary criteria used to evaluate an alternative's ability to meet the RAOs, other factors must also be considered when designing and implementing the remedy. Although not specifically associated with remedy performance, pH of treated materials and air emissions associated with treating impoundment materials must also be considered. These considerations are discussed in more detail below.

## pH

The pH of the tar material in Impoundments 1 and 2 is typically less than 2 standard units (SU), which is below the pH range used to determine if a liquid is noncorrosive (2 to 12.5 SU). Although USEPA does not regulate "corrosive solids", it is recognized that leachate generated by water contacting untreated acid tar may have a pH less than 2 SU. As defined by the Code of Federal Regulations (CFR) and detailed in 40 CFR §261.22, a solid waste is characteristically corrosive if a representative sample of the waste "…is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5." Therefore, it is proposed that the pH of the treated material range from 4 to 12 SU to meet the RAOs and allow for flexibility in the mix design and operations.

ISS remedies typically involve using alkaline reagents, such as cement or lime kiln dust, to achieve the primary remedial goals of reduced hydraulic conductivity, increased UCS, and reduced COC leachability. Adding alkaline reagents to achieve performance goals results in treated materials (solids) being in the alkaline range, often between 10 and 12 SU. If the circumstances and depositional endpoint of an alternative do not require the treated material to achieve all three primary goals (e.g., reduced hydraulic conductivity is unnecessary if ISS and ISTT are used or if the treated materials are excavated and placed in the CAMU), then less reagents can be used and the pH may be lower, though typically still above 8 SU. While pH is not a performance parameter for ISS remedies, it is noteworthy that an alkaline, noncorrosive, pH is expected for alternatives that involve ISS.

The following considerations are identified for pH values:

- A noncorrosive pH range (4 to 12 SU) is required for treated PTW.
- An alkaline pH range (8 to 12 SU) is anticipated for ISS-treated materials.


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## Air Emissions Thresholds

Emission of volatile constituents from the impoundment materials will be controlled to protect human health during implementation of the remedial action. For in-situ treatment, air emissions must be actively managed through source control (e.g., shrouded auger) and treatment (e.g., by thermal oxidation). This section presents a proposed methodology for evaluating potential air emissions during activities following treatment, specifically excavation and placement in the CAMU for those alternative that use the CAMU. These potential air emissions will be managed appropriately depending on the residual levels achieved through treatment. Achieving air emissions thresholds that are protective of human health are ARARs for implementing the remedy. The performance criteria for controlling volatile emissions is based on the $1 \times 10^{-6}$ to $1 \times 10^{-4}$ target cancer risk range or noncancer hazard index of 1, as described by USEPA (1991).

For alternatives that involve excavation of treated materials for subsequent ex-situ treatment or disposal, emissions associated with the ex-situ processes must also be evaluated. Air emissions, often estimated in pounds per day, are a function of the COC concentrations in the material being managed, physical/chemical characteristics of the COC (e.g., Henry's constant; air diffusion coefficient), environmental conditions (e.g., temperature), and the production rate (i.e., how many cubic yards of soil are moved each day).

Fugitive emissions will be estimated using a modification of the Jury and Eklund models (as described below) and AERMOD will be used to evaluate subsequent transport (dispersion, dilution, etc.) following release. Fugitive emissions from an active excavation area are generated based on two primary mechanisms: 1) static vaporization (mass transfer from an open excavation face or stockpile) and 2) dynamic pore space release (active soil movement). The equations from the USEPA- endorsed Jury Model (Appendix C, Limited Validation of the Jury Infinite Source Models for Emissions of Soil-Incorporated Volatile Organic Compounds, Environmental Quality Management, Contract No. 68-D30035, July 1995) are proposed to estimate the fugitive emissions associated with the static vaporization mechanism. The Eklund model for pore space emission rates (EPA-450/1-92-004, March 1992) will be used in conjunction with the number of anticipated disturbances to estimate the fugitive emissions from the dynamic pore space release. The following modifications to the Eklund model will be applied:

- Use Raoult's Law to take into account the multi-component system (Eklund assumed a pure component system)
- Assume a 100% release per disturbance (Eklund contained a "soil-gas to atmosphere exchange constant" of 0.33 or 33% release).

The emission model will also consider the potential for upsets that may result from a hot spot being mixed. In addition, as suggested by USEPA, emissions data from future field studies may be used to further refine assumptions used in the modeling analysis.

Although there is no defined concentration limit for the material being placed in the Impoundment 8 Facility CAMU (as long as it is compatible with the liner), the combination of COC concentrations and production rate must be managed so air emissions do not pose an unacceptable risk.

An air pathway assessment will be conducted to determine the combinations of production rate and COC concentrations in impoundment materials that can be handled while protecting potential receptors. Emissions to the air of volatile constituents potentially occurring during excavation and placement in the CAMU will be assessed using modeling methods presented in USEPA guidelines for conducting air pathway assessments (USEPA 1992a). The modeling methods involve emissions estimation (USEPA 1992b, 1995, 2002) and air dispersion modeling (USEPA 2004a, 2004b). These models

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will provide estimated concentrations in air from emissions of volatile constituents over the duration of the ex-situ process. Human health risks from these concentrations in air are estimated using risk assessment methods presented in USEPA's regional screening levels (RSL) calculator (USEPA 2015). If there is a need for modeling to support air permitting, guidelines published by the New Jersey Department of Environmental Protection (2009) will be consulted in addition to the USEPA air pathway assessment guidelines.

The output from the air pathway analysis will be used to estimate human health risks (cancer risk and hazard indices) associated with air emissions. Air dispersion modeling will identify short-term and long-term concentrations of COCs in air around the excavation and CAMU locations. The modeled concentrations in air will be estimated at receptor locations of offsite residents or workers; health risks will be estimated based on the receptor locations where the maximum concentrations in air are predicted to occur. Lifetime health risks will be estimated taking into consideration an anticipated reasonable project duration. Based on the constituents detected in Impoundments 1 and 2, the list of COCs to be included in the air pathway assessment will include 1,4 dichlorobenzene; benzene; cumene; naphthalene; and ethylbenzene. The assessment will evaluate the cumulative lifetime cancer risks and cumulative noncancer hazards for these potential constituents in air. Based on the results from the air pathway assessment, the maximum COC concentrations that will achieve the performance criteria (i.e., within the $10^{-6}$ to $10^{-4}$ target cancer risk levels or the noncancer hazard index of 1) will be identified for the material being placed in the Impoundment 8 Facility CAMU.

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# Attachment 1

**Attachment 1 - Record of Decision Document Review Summary for ISS Sites**
**Proposed Performance Criteria Memo**
**American Cyanamid Superfund Site, Bridgewater, NJ**

| Site Name | | Site Location | EPA Region | Non Aqueous Phase Liquid (NAPL) | Principal Threat Waste (PTW) | Performance Criteria | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hydraulic Conductivity (cm/s) | UCS (psi) | Leachability Reduction | pH |
| 1 | McColl Superfund Site (OU2) | CA, Fullerton | 9 | NAPL | PTW | NR | NR | NR | NR |
| 2 | Sand Springs Petrochemical Complex Superfund Site | OK, Tulsa County | 6 | NAPL | PTW | NR | > 25 psi | NR | 7 to 12.5 |
| 3 | American Cyanamid Superfund Site (OU4) | NJ, Boundbrook | 2 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s | > 40 psi | NR | NR |
| 4 | Koppers Co Ashley River Superfund Site | SC, Charleston | 4 | NAPL | No | ≤ 1 x $10^{-5}$ cm/s | > 50 psi | NR | NR |
| 5 | Gowanus Canal Superfund Site | NY, Brooklyn | 2 | NAPL | PTW | NR | > 20 psi | NR | NR |
| 6 | South 8th Street Landfill Superfund Site | AR, West Memphis | 6 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s (avg)<br>≤ 1 x $10^{-5}$ cm/s (max) | > 50 psi (avg)<br>> 40 psi (min) | NR | 7.0 - 11.5 |
| 7 | Madison Ave Former MGP Site | NY, Elmira | 2 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s | NR | NR | NR |
| 8 | North Cavalcade Street Superfund Site | TX, Houston | 6 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s | > 50 psi | NR | NR |
| 9 | NYSEG Norwich Former MGP Site | NY, Norwich | 2 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s | > 50 psi | NR | NR |
| 10 | Sheridan Disposal Services | TX, Waller County | 6 | NAPL | NR | NR | NR | NR | NR |
| 11 | Caldwell Trucking Site | NJ, Fairfield Township | 2 | NR | NR | ≤ 1 x $10^{-5}$ cm/s | > 50 psi | NR | NR |
| 12 | American Creosote Works | TN, Jackson | 4 | NAPL | NR | ≤ 1 x $10^{-6}$ cm/s | > 100 psi | NR | NR |
| 13 | OR - Suffern MGP Site | NY, Suffern | 2 | NAPL | NR | NR | NR | NR | NR |
| 14 | NYSEG Cortland Homer Former MGP Site | NY, Homer Village | 2 | NAPL | NR | NR | NR | NR | NR |
| 15 | Craig Farm Drum | PA, Parker | 3 | NR | NR | NR | NR | NR | NR |
| 16 | Industrial Waste Control | AR, Fort Smith | 6 | No | NR | NR | NR | NR | NR |
| 17 | Nease Chemical Site | OH, Columbiana and Mahoning Counties | 5 | NAPL | PTW | NR | NR | NR | NR |
| 18 | Niagara Mohawk (NM) – Hiawatha Boulevard - Syracuse Former MGP Site | NY, Syracuse | 2 | NAPL | PTW | NR | NR | NR | NR |
| 19 | PSC Resources | MA, Palmer | 1 | NR | No | NR | NR | NR | NR |
| 20 | Quanta Resources Corporation Site, | NJ, Edgewater | 2 | NAPL | PTW | ≤ 1 x $10^{-6}$ cm/s | > 40 psi | ≥ 90% | NR |
| 21 | St. Maries Creosote Site | ID, St. Maries | 10 | NAPL | NR | ≤ 1 x $10^{-7}$ cm/s | ≥ 30 psi | NR | NR |
| 22 | Sanford Gasification Plant | Sanford, FL | 4 | NAPL | NR | NR | NR | NR | NR |

**Attachment 1 - Record of Decision Document Review Summary for ISS Sites**
**Proposed Performance Criteria Memo**
**American Cyanamid Superfund Site, Bridgewater, NJ**

| Site Name | | Site Location | EPA Region | Non Aqueous Phase Liquid (NAPL) | Principal Threat Waste (PTW) | Performance Criteria | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hydraulic Conductivity (cm/s) | UCS (psi) | Leachability Reduction | pH |
| 23 | Unnamed Former MGP Site | GA, Columbus | 4 | NAPL | NR | $< 1 \times 10^{-5}$ cm/s (outer containment wall $< 1 \times 10^{-6}$ cm/s) | > 50 psi | NR | NR |
| 24 | MGP Site | PA, Tamaqua | 3 | NR | NR | $\leq 1 \times 10^{-5}$ cm/s | NR | NR | NR |
| 25 | MGP Site | WI, Burlington, | 5 | NR | NR | $\leq 1 \times 10^{-6}$ cm/s | > 50 psi | NR | NR |
| 26 | Unnamed Former MGP Site | GA, Macon | 4 | NR | NR | $\leq 1 \times 10^{-6}$ cm/s | > 50 psi | NR | NR |
| 27 | MGP Site | NH, Exeter | 1 | NR | NR | $\leq 1 \times 10^{-5}$ cm/s | NR | NR | NR |
| 28 | Nyack MGP Site | NY, Nyack | 2 | NAPL | NR | $\leq 1 \times 10^{-6}$ cm/s | > 50 psi | NR | NR |
| 29 | Waterville Gasworks Site | ME, Waterville | 1 | NR | NR | $\leq 1 \times 10^{-6}$ cm/s | > 30 psi | NR | NR |
| 30 | MGP Site | MA, Milford | 1 | NR | NR | $\leq 1 \times 10^{-6}$ cm/s | > 50 psi | NR | NR |
| 31 | MGP Site | MA, Anthol | 1 | NR | NR | $\leq 3 \times 10^{-5}$ cm/s | > 50 psi | NR | NR |
| 32 | Sydney Tar Ponds | Nova Scotia, Sydney | NA | NR | NR | $\leq 1 \times 10^{-6}$ cm/s | ≥ 25 psi | NR | NR |

**Notes:**
PTW - Principal Threat Waste
UCS - Unconfined Compressive Strength
NR - Not Reported
mg/kg - milligrams per kilogram
cm/s - centimeters per second
psi - pounds per square inch
ROD - Record of Decision

# Appendix B
# Technology Screening Memorandum

Quantum
Management Group, Inc.©

September 9, 2015

Mr. Mark Austin, Remedial Project Manager
American Cyanamid Superfund Site OU 8
New Jersey Remedial Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: American Cyanamid Superfund Site, Bridgewater, NJ OU8 Focused Feasibility Study
Response to USEPA's August 18, 2015 Comments on the Draft Technology Screening Memo to Support Alternatives Development, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey

Dear Mr. Austin,

Wyeth Holdings LLC (WH), is in receipt of the U.S. Environmental Protection Agency's (USEPA's) August 18, 2015 email providing comments on the Draft Technology Screening Memo to Support Alternative Development, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey (Site). CH2M, on behalf of WH, has prepared the following responses to USEPA's comment on the Draft Technology Screening Memo. USEPA's comments are numbered in bold text followed by italicized responses.

**Memorandum & Table 1B**

1. ***General Comment, Memorandum and Table 1B*** **- The memorandum and table utilize "Disposal" as a General Response Action (GRA). It is understood that the disposal option(s) will have a very important role in the selection of the remedial alternative for OU8, however, it should not be identified as part of the GRA as a standalone action(s). We recommend that disposal be discussed in more of a "common element" type of approach within the memorandum since almost all alternatives will have a disposal component.**

   *Response: WH agrees that disposal will be a common element for each alternative, just as treatment will be a common element for the alternatives. However, the disposal option/location will vary for the different alternatives (e.g., closure-in-place vs. the Impoundment 8 Facility Corrective Action Management Unit) to allow for a full spectrum of remedial alternatives. Therefore it is recommended that "Disposal" remain a General Response Action. No changes to the text are proposed to address this comment.*

2. ***Page 1, Background -*** **In the first paragraph, the text states there is a water cap on each impoundment. Please mention that the Impoundments are also covered with a synthetic cap.**

*Response: The text of this paragraph has been edited to indicate that a synthetic liner is also on top of each impoundment (below the water cap).*

**Table 1A**

1. ***Comment #1 General Note -*** **Some technologies, such as ISTT, are identified as being used in conjunction with other technologies while others, such as vapor extraction do not indicate if they can be used alone, or as part of a treatment train? The table should specifically state if the technology can be used by itself, if it must be used in conjunction with other technologies, or if there is flexibility in how it might be used.**

   *Response: The table has been revised to specify where containment and treatment technologies would be applied within a remedial alternative in conjunction with other technologies to meet Remedial Action Objectives (RAOs). Alternatives that involve ISTT, vapor extraction and steam-enhanced removal will all incorporate some form of ISS due to the limited strength and acidity of the untreated impoundment materials. The extent of ISS for a given alternative (e.g., ISS to neutralize acidity and create a monolith vs. ISS to neutralize acidity and add strength) will be described for each alternative.*

2. ***Comment #2 No Action, Effectiveness –*** **The statement needs some clarification. How is the groundwater pathway to the river eliminated under a no action response?**

   *Response: The No Action alternative assumes that existing control measures, such as the Removal Action groundwater extraction and treatment system, which become part of the OU4 site-wide groundwater remedy, will continue to operate. The continued operation of the groundwater extraction and treatment system, as well as other existing control measures, is included in the description of the alternative. No changes to the text are proposed to address this comment.*

3. ***Comment #3 Containment, Cap/Cover, Soil Cover –*** **This alternative should be screened out. The action simply does not warrant carrying through the process any further since it is really not viable.**

   *Response: No alternatives have been presented. The memo presents the screening of technologies and process options; it does not combine process options to form alternatives or screen alternatives. All of the alternatives that will be developed will incorporate some form of cover, whether materials are treated and closed in-place, or whether materials are excavated and the area backfilled. Per comments 1 and 4, the text has been modified to make it clear that Containment, Cap/Cover, Soil Cover is a process option that will be incorporated with other process options into alternatives.*

4. ***Comment #4 Containment, Cap/Cover, Low Perm. Eng. Cover (here and most, if not all, of the remaining alternatives) –*** **When wording the information within the "retain" column, it should be heavily emphasized that this alternative is NOT a standalone and MUST be implemented with other technologies to be successful. In fact, another option may be to**

**provide a paragraph that includes a discussion on the potential combination of technologies needed for the eventual remedy since all the alternatives being considered must include some other treatment technology to be completed as part of a successful remedy.**

*Response: No alternatives have been presented. This memo screens and presents process options that have been retained. The next step in developing alternatives is that the retained process options will be combined with other process options to form alternatives. To clarify this point, the introduction portion of the memo has been revised to include the following text:*

> *"This memo only covers screening of remedial technologies and more specifically the individual process options that fall under those technology categories. The overall objective of this memo is to determine the process options that are retained for subsequent assembly into remedial alternatives. The majority of the process options presented and screened in this memo are not standalone options; they will be combined with other process options and engineering controls into full spectrum remedial alternatives that can achieve remedial action objectives (RAOs). The remedial alternatives assembled using the retained process options will then be subject to detail evaluation and comparative analysis in the FFS report."*

*In addition, the last paragraph of the memo has been revised as follows (the underlined text has been added): "The process options passing the technology screening steps for effectiveness, implementability and cost will be retained and combined with other process options to form the initial list of remedial alternatives for OU8."*

5. ***Comment #5 Containment, Groundwater Gradient Control, Hydraulic Barriers –*** **See comment #4 above.**

   *Response: See response to Comment #4, above. No additional changes to the text are proposed to address this comment.*

6. ***Comment #6 Containment, Groundwater Gradient Control, Extraction Wells –*** **See comment #4 above.**

   *Response: See response to Comment #4, above. No additional changes to the text are proposed to address this comment.*

7. ***Comment #7 Treatment, In Situ, Vapor Extraction –*** **See comment #4.**

   *Response: See response to Comment #4, above. No additional changes to the text are proposed to address this comment.*

8. ***Comment #8 Treatment, In Situ, In-Situ Stabilization/Solidification, General Comment under the "Effectiveness" column –*** **It should be noted that the material left after a 25% reduction of VOC mass and a 90% reduction in leachability still remains a challenge to address until its final resting place is determined and all criteria that need to be met for relocation and disposal have been identified. While the results of the pilot study have been favorable and can be**

**considered successful based on the objectives of the study, the reduction of benzene concentrations to 23,500 ppm from 68,000 ppm may not fully address the hazard by itself.**

*Response: WH agrees that a combination of process options is required to achieve RAOs and protect human health and the environment. ISS is a single process option that will be combined with other process options to form alternatives that will achieve RAOs, as described in the response to Comment #4. No additional changes to the text are proposed to address this comment.*

9. ***Comment #9 Treatment, In Situ, In Situ Thermal Treatment –*** **See Comment [8], the same general thought applies to this technology even with a 90% reduction success rate.**

   *Response: WH agrees that a combination of process options is required to achieve RAOs and protect human health and the environment. ISTT is a single process option that will be combined with other process options to form alternatives that will achieve RAOS, as described in the response to Comment #4. The text in Table 1A has been updated to clarify this point.*

10. ***Comment #10 Treatment, Ex Situ, Bioremediation for both Effectiveness and Implementability -*** **the material itself will retain some measure of very low pH (acidic environment) after dewatering. There is no mention of this important factor here but is mentioned in the "Retain" column. If applicable, please insert wording on how high acidic environments are not suitable for bioremediation technologies.**

    *Response: The effectiveness and implementability cells for this process option have been edited to indicate that bioremediation technologies are most effective when the pH range is 5-8 SU.*

11. ***Comment #11 Treatment, Ex Situ, Thermal Desorption, General Comment, "Effectiveness" column*** **- Please note that the wording mentions that LDR concentrations could not be achieved (part of history as understood) however, it is a good idea to include this fact as part of all of the current Alternatives being screened, since this applies to the entire group and possibly others.**

    *Response: A footnote has been added to Table 1A to indicate that LDRs are not expected to be achieved for any of the process options evaluated.*

12. ***Comment #12 Treatment, Emissions Treatment –*** **See comment 4.**

    *Response: See response to Comment #4, above. No additional changes to the text are proposed to address this comment.*

13. ***Comment #13 Disposal, On-Site, Closure in Place, Retains Column –*** **This statement is not balanced as stated. Please edit to read something similar to "This disposal option will be retained for further consideration when utilized with In-Situ treatment."**

    *Response: The text has been revised to read "This disposal option is retained for further consideration when combined with in-situ treatment process options."*

Please contact me at 973.650.3341 should you have any comments or questions.

Sincerely,

Vincent D'Aco
Project Coordinator – OU8/Focused Feasibility Study

| | | |
|---|---|---|
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| | NJDEP | Haiyesh Shah |
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MEMORANDUM

# Technology Screening Memorandum to Support Alternatives Development, Impoundments 1 and 2, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater, New Jersey

| | |
|---|---|
| PREPARED FOR: | Mark Austin/U.S. Environmental Protection Agency |
| COPY TO: | Michael Sivak/U.S. Environmental Protection Agency<br>Joseph Battipaglia/U.S. Environmental Protection Agency<br>Ed Barth/U.S. Environmental Protection Agency<br>Russ Downey/Pfizer, Inc.<br>Vince D'Aco/Quantum Management Group |
| PREPARED BY: | CH2M HILL |
| DATE: | September 9, 2015 |

This memorandum describes the technology screening process and presents the technologies and process options retained for subsequent development of remedial alternatives as part of the Focused Feasibility Study (FFS) for Impoundments 1 and 2, Operable Unit (OU) 8, at the American Cyanamid Superfund Site in Bridgewater, New Jersey (Site). This memorandum only covers screening of remedial technologies and more specifically the individual process options that fall under those technology categories.

The overall objective of this memorandum is to determine the process options that are retained for subsequent assembly into remedial alternatives. The majority of the process options presented and screened in this memorandum are not standalone options; they will be combined with other process options and engineering controls into full spectrum remedial alternatives that can achieve remedial action objectives (RAOs). The remedial alternatives assembled using the retained process options will then be subject to detailed evaluation and comparative analysis in the FFS report. Technology and process option screening was conducted in accordance with United States Environmental Protection Agency (USEPA) guidance (USEPA 1988).

## Background

Impoundments 1 and 2 are approximately 4.5 acres in size (combined) and contain approximately 55,000 cubic yards of acid tar. The impoundment materials are characterized by low pH (typically less than 2 standard units [SU]), and USEPA has identified the volatile organic compound and semivolatile organic compound contents, primarily benzene and naphthalene, as principal threat waste (PTW). The impoundment materials consist of hard crumbly and viscous rubbery tar, as well as some coal aggregate (Impoundment 1 only) and clay/sand/silt material (Impoundment 1 only). Currently, a synthetic cover is on top of each impoundment and a water cap is above the synthetic cover for vapor control.

Impoundments 1 and 2 are located in the South Area of the Site, approximately 700 feet north of the Raritan River and within the floodplain. The impoundments are within the flood hazard area (defined using a 100-year flood equivalent plus a factor of safety) as indicated by the Federal Emergency Management Agency. Residential and commercial properties are located north, east, and northeast of the Site.

Bench-scale (laboratory) treatability studies and a field-scale pilot study have been conducted to help evaluate technologies that might be effective for remediation of Impoundments 1 and 2 (CH2M HILL [CH2M] 2014, 2015). In 2014, a pilot study evaluated the feasibility and efficacy of in-situ solidification/stabilization (ISS), in-situ thermal treatment (ISTT), and a combination of ISTT and ISS (CH2M 2015) to treat the impoundment materials in place.

Part of the FFS process is to develop, screen, and evaluate candidate remedial alternatives for OU8. Overall, the FFS process is intended to identify alternatives that will meet the RAOs and satisfy applicable or relevant and appropriate requirements. The following preliminary RAOs were presented in the Revised Impoundments 1 and 2 FFS Work Plan (CH2M 2012), which USEPA approved on September 13, 2012:

- Remove, treat, or contain material that meets the definition of PTW.
- Prevent current or potential future migration of material that meets the definition of PTW from the Site that would result in direct contact or inhalation exposure.
- Prevent and minimize human and ecological exposure to constituents contained in impoundment materials and within adjacent earthen berms.
- Prevent and minimize sources of groundwater impacts resulting in long-term improvement of groundwater quality and eventual achievement of applicable regulatory criteria.

The RAOs listed above are preliminary and will be finalized during development of the FFS.

It is important to recognize that OU8 represents one OU being remediated at the Site. In addition to other Site areas, sitewide groundwater is being remediated and is addressed as part of OU4. The sitewide groundwater remedy involves extraction and treatment of groundwater, including the capture, extraction, and treatment of groundwater downgradient of Impoundments 1 and 2.

## Identification and Screening of Remedial Technologies and Process Options

General response actions (GRAs) are general categories of actions that could be used to satisfy RAOs. The GRAs identified to achieve OU8 RAOs include:

- No Action
- Containment
- Treatment
- Removal
- Disposal

Following USEPA guidance (USEPA 1988), technology types and process options were identified for each GRA, as shown in Table 1A. Because USEPA has identified the materials in OU8 as PTW, treatment of the PTW will be an important aspect of the alternatives to be developed (USEPA 1991). For the “Treatment” GRA, the process options were organized by “in-situ” and “ex-situ” treatment technologies, along with technologies to treat process vapor emissions. The technologies and process options for each GRA were screened using the criteria of effectiveness, implementability, and cost (USEPA 1988), as defined below. In addition, the tenets of sustainability as outlined in the USEPA Clean and Green Policy (http://www.epa.gov/region2/superfund/green_remediation/policy.html) were incorporated into the screening process.

- Effectiveness – Considers the ability to handle the estimated areas or volumes of media and meeting the remediation goals identified in the RAOs; the potential impacts to human health and the environment during the construction and implementation phase; and how proven and reliable the process is with respect to the contaminants and conditions at the site. The scoring used for the

relative effectiveness assessment is: Low (1); Low-Moderate (2); Moderate (3); Moderate-High (4); High (5).

- Implementability – Encompasses the technical and administrative feasibility of implementing a technology or process option. This includes the ability to obtain necessary permits for offsite actions, availability of treatment, storage and disposal services (including capacity), and availability of necessary equipment and skilled workers to implement the technology or process option. The scoring used for the relative implementability assessment is: Low (1); Low-Moderate (2); Moderate (3); Moderate-High (4); High (5).
- Cost – Relative capital and operation and maintenance (O&M) cost assessments are made on the basis of engineering judgment; costs are identified as being high, low, or medium relative to other process options in the same technology type. The scoring used for the relative cost assessment is: Low (5); Low-Moderate (4); Moderate (3); Moderate-High (2); High (1).

The screening was conducted to assess the relative performance of a particular process option as compared to other process options within a given technology type. For example, if multiple process options are equally effective, a process option that is more challenging to implement may be screened out. Table 1A identifies the GRAs, technologies, and process options that were screened based on effectiveness, implementability, and cost. Technologies and process options that are not retained are shaded in grey in Table 1A. This table also provides rationale for the decisions regarding whether a process option is retained for development of remedial alternatives or whether it is screened out. Based on the technology screening results, the process options retained for development of remedial alternatives are shown in Table 1B.

The process options passing the technology screening steps for effectiveness, implementability, and cost will be retained and combined with other process options to form the initial list of remedial alternatives for OU8. The initial list of remedial alternatives is expected to be further screened to identify the final list of remedial alternatives that will be retained for detailed analysis in the FFS.

# References

CH2M HILL (CH2M). 2012. *Work Plan, Focused Feasibility Study Impoundments 1 and 2. American Cyanamid Superfund Site.* September.

CH2M HILL (CH2M). 2014. *Revised Impoundments 1 and 2 Treatability Study Results. American Cyanamid Superfund Site.* August.

CH2M HILL (CH2M). 2015. *Field-Scale Demonstration Study Results Report for Operable Unit 8 Pilot Study. American Cyanamid Superfund Site.* February 26.

New Jersey Department of Environmental Protection. 1998. Superfund Record of Decision for Group III Impoundments (1, 2, 3, 4, 5, 14, 20 &26). American Cyanamid Site. American Home Products Corporation, Bridgewater Township, Somerset County, New Jersey. October

U.S. Environmental Protection Agency (USEPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* OSWER Directive 9355.3-01. EPA/540/G-89/004.

U.S. Environmental Protection Agency (USEPA). 1991. *A Guide to Principal Threat and Low Level Threat Wastes.* Superfund Publication 9380.3-06FS.

# Tables

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| No Action | No Action | No Action | No additional activities beyond what is currently conducted will be implemented. The following activities will still be conducted: operation of the removal action groundwater collection trench and treatment system, periodic inspections and maintenance of the berms, maintenance of fencing and site security, maintenance of the water cap to suppress emissions, maintenance of berm armoring for flood resistance, maintenance of a geosynthetic cover over the materials for further flood resistance, and periodic ambient air monitoring. | **Low-Moderate (2).** While no activities are planned to treat the principal threat waste, the groundwater pathway to the river is eliminated, preventing exposure. | **Low (1).** While there are no challenging technologies to implement, it is unlikely to be accepted. | **Low (5).** | **Retain.** This option is retained per the FFS process. |
| Containment | Cap/Cover | Soil Cover | Use of clean soil/fill to create a physical barrier and prevent physical contact with subsurface materials. Surface would be graded and vegetated to promote runoff and help prevent erosion. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Low-Moderate (2).** Can be effective for limiting physical contact with waste materials and limited effectiveness minimizing physical mobility of impacted media; does not prevent infiltration/ leaching. Underlying materials must have adequate strength to support a soil cover. Effective technology when combined with other in-situ remediation technologies; however, it is not expected to reduce the toxicity, mobility, or volume of impacts as a stand-alone remedy. | **High (5).** While impoundment material must be strengthened before a soil cover can be adequately supported, soil cover materials are readily available and easily placed. | **Low (5).** Soil covers are generally inexpensive to design and construct. | **Retain.** This option is retained for assembly with other process options that treat PTW and increase impoundment material compressive strength through treatment operations. |
| | | Low-Permeability Engineered Cover | A multi-layered, low-permeability engineered cover used to prevent physical contact with subsurface materials and prevent infiltration of precipitation. This technology is frequently coupled with subsurface vapor collection systems. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3).** Can be effective for limiting contact with wastes and mobility of underlying media; prevents infiltration/leaching. Is not expected to reduce the toxicity or volume of impacts as a stand-alone remedy. | **Moderate-High (4)**. While impoundment material must be strengthened before a low-permeability engineered cover can be adequately supported, cover materials are readily available and easily placed. This receives a lower implementability rating than the soil cover because installation of an impermeable cover is more complicated than installing a simple soil cover. | **Moderate (3).** Low-permeability covers are more expensive to design and construct than soil covers.-Based on the impoundments' location within a floodplain, costs may be higher than a typical low-permeability engineered cover. | **Retain.** This option is retained for assembly with other process options that increase impoundment material compressive strength through treatment operations. |
| | Groundwater Gradient Control | Hydraulic Barriers | A physical barrier which reduces the lateral migration of groundwater, waste materials (treated or untreated) and if present, nonaqueous phase liquid (NAPL) within Impoundments 1 and 2. Barriers may be constructed using a wide variety of techniques (e.g., sheet piles, soil bentonite slurry walls). This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3)**. Barriers can be effective for limiting lateral migration of groundwater and site-related contaminants; effectiveness can be increased when site conditions allow barriers to be sealed vertically by anchoring in underlying low-permeability strata. Establishing a vertical seal at the bedrock contact could be difficult, but feasible. | **Moderate (3).** Construction materials and equipment are readily available. Subsurface conditions below the impoundments are composed of gravel overtop of shallow bedrock. These conditions may challenge sheet pile installation or slurry-based trenching. Barrier wall construction may disturb neighboring wetlands. | **Moderate (3)**. Barrier construction costs are influenced by subsurface conditions. The presence of gravel and shallow bedrock may increase total cost to install a barrier suitable for hydraulic containment of Impoundments 1 and 2. | **Retain.** This process option is retained for assembly with other process options that reduce toxicity, mobility, or volume through in-situ treatment. |
| | | Extraction Wells | An imposed barrier, developed by groundwater extraction which can reduce the lateral and vertical migration of groundwater, NAPL, or waste materials away from the boundary of Impoundments 1 and 2. This does not include groundwater extraction associated with OU4 (sitewide groundwater), which already occurs downgradient of OU8. This technology would likely be applied within a remedial alternative in conjunction with other in-situ treatment technologies. | **Moderate (3).** Can be effective for limiting lateral and vertical mobility of groundwater and NAPL from Impoundment 1 and 2. This technology can reduce the toxicity, mobility, and volume of site contaminants by reducing mobility, but it must be coupled with ex-situ treatment operations. | **Moderate (3)**. Groundwater extraction is currently employed downgradient of Impoundments 1 and 2 for recovery of dissolved phase contaminants. However, extraction efforts adjacent to impoundments must be capable of NAPL collection and extraction. Although extraction wells are readily installed and often used for hydraulic control, the collection, removal, conveyance, and treatment of multiple fluid types by this approach presents greater technical challenges over groundwater extraction alone. | **Moderate (3).** Capital installation costs for extraction well installation are low relative to hydraulic barriers like sheet piles or slurry walls. However, O&M costs are higher based on the volume of water or NAPL which must be extracted and the complexity of operations needed for water treatment prior to discharge. The incremental equipment and O&M costs for NAPL removal, treatment, and disposal (if needed) are significant. | **Retain.** This option is retained for assembly with other process options that reduce toxicity, mobility, or volume through in-situ treatment. May be used to address residual NAPL if determined present outside the Impoundment 1 and 2 footprint. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment | In-Situ | In-Situ Chemical Oxidation (ISCO) | Subsurface addition of an oxidizing agent to promote abiotic in-situ oxidation of organic compounds. Oxidant can be delivered using fixed injection points or mixed in-situ using augers or equipment designed for soil mixing. | **Low (1).** This technology can be effective for COC treatment in soil and groundwater when adequate oxidant can be supplied and good contact between contaminant and reagent is achieved. The oxidant demand posed by impoundment contents will be extremely high given the nature of impoundment contents and in particular the very high organic content of the acid tar; as such, the mass of reagents needed to impart significant reduction of contaminant toxicity and volume is likely prohibitive for this technology. | **Low-Moderate (2).** Oxidants and mixing equipment are readily available. Oxidant addition to impoundment materials through large-diameter mixers or augers can be readily implemented. Elevated temperatures of reaction are likely; therefore, active recovery and treatment of volatile emissions would be needed during implementation. Impoundment materials lack compressive strength capable of supporting mixing equipment; as such, provisions to increase impoundment material bearing strength or strategies for oxidant delivery over water must also be developed for effective implementation of this technology. | **High (1)**. Extremely large quantities of chemical oxidants will be needed to impart significant reduction of contaminant toxicity and volume given the presence of highly concentrated waste material within Impoundments 1 and 2. In addition, the presence of the water cap and absence of material, which can support mixing equipment, will significantly increase implementation costs for this technology. | **Discard.** Elevated high organic content requires an extremely high oxidant demand and consequently the effectiveness and implementability of this technology for treatment of acid tar in the impoundments is questionable. |
| | | Vapor Extraction | Vapor extraction is a physical removal technology that uses a vacuum system to remove vapors from the subsurface. This technology is frequently coupled with vapor treatment processes that are applicable for site-related COCs prior to atmospheric discharge. Can be used to control vapor emissions during implementation of other technologies; may also be used more passively after ISS or other technology. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. | **Moderate (3).** Physical and chemical characteristics of the constituents in the impoundment materials will influence the effectiveness of this technology. Permeability of the materials is required to facilitate vapor flow through the materials to be treated. The integration of supplemental processes to improve mass transfer of volatile components such as mixing, heating, or permeability enhancements can significantly enhance technology efficacy and ability to reduce toxicity and volume of materials contained within Impoundments 1 and 2. May be effectively combined with other process options as part of an alternative. | **Moderate (3).** Vapor extraction is a full-scale technology and is commercially available. This process may be implementable as a secondary treatment process, after initial treatment using other methods to improve material strength, neutralize pH, and increase permeability characteristics. Treatment processes for extracted vapors would be required to protect workers and the community in the near term. | **Low (5).** Overall costs for vapor extraction may be low when combined with other active in-situ technologies. Offgas treatment is expected to be the primary cost driver. | **Retain.** This option is capable of reducing toxicity and volume of COCs contained within the impoundments. Vapor extraction is retained for assembly with other technologies, which can enhance contaminant removal, reduce future mobility, and prevent direct contact with impoundment contents. |
| | | Air Sparging | Air is injected into the impoundment material to remove compounds of concern through volatilization and air stripping. May also be used at lower airflow rates to promote biodegradation. Often coupled with vapor extraction for collection and treatment of displaced VOCs at higher flow rates. Can be implemented via injection wells, during ISS, or after ISS or other pretreatment. | **Low (1).** This technology can be very effective when sufficient permeability is present for injected air to contact COCs that reside within a water saturated solid matrix. Overall, permeability of the tar contained within the impoundments is very low; although some of the impoundment material is porous, the majority lack the requisite physical characteristics needed to impart efficient removal of COCs. | **Moderate (3).** Numerous full-scale operations have been implemented to treat groundwater and soil contaminated by VOCs using vertically or horizontally drilled wells. May be implementable as a secondary treatment process, after initial treatment using other methods to improve material strength, neutralize pH, and increase permeability characteristics. Treatment processes for extracted vapors would be required to protect workers and the community in the near term. | **Low (5).** Overall costs for air sparging are low when compared to other active in-situ technologies. Offgas treatment is expected to be the primary cost driver. | **Discard**. As a stand-alone technology, air sparging is not expected to be as effective as other approaches for physical removal of COCs. Similarly, in a combined approach, other technologies will be more effective in reducing the toxicity and volume of COCs present in the impoundment materials. |
| | | In-Situ Bioremediation (ISB) | For non-chlorinated VOCs, electron acceptors (e.g., oxygen, nitrate, sulfate) are added via injection wells to support microbial activity that degrades the COCs. The COCs are used as an electron donor (a food source) to support metabolic activity. | **Low (1).** While benzene and other VOCs in groundwater have been successfully remediated via ISB, it is not expected that acid tars would be successfully remediated. Successful bioremediation requires a more moderate pH range (e.g., 5 to 8 SU). In addition, the COCs must be in an aqueous phase to be accessible to microbes. Effective transfer of electron acceptor is also required. Air sparing is typically the most cost-effective approach of electron acceptor delivery, and its effectiveness is limited, as discussed above. | **Low (1).** ISB typically is easily implemented; however, with the acidic conditions and tar material, implementation would be very challenging. | **High (1).** ISB is often a lower-cost in-situ process option. However, due to the challenges associated with the physical nature of the impoundment materials, it would be expensive to make ISB an effective option. | **Discard.** ISB is discarded because of its ineffectiveness and implementability challenges relative to other in-situ process options. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | In-Situ (continued) | In-Situ Stabilization/ Solidification (ISS) | Target contaminants are physically bound or encapsulated within a stabilized mass (solidification). A wide variety of technical strategies can be applied for ISS, which may incorporate large-diameter mixers and augers or specialty designed equipment for reagent blending with impoundment materials. The blending process can also be applied for homogenization and neutralization of impoundment materials through addition of alkaline reagents to buffer the material. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as implementation of an engineered cover and subsurface hydraulic barrier. | **Moderate-High (4).** The OU8 pilot test demonstrated that ISS can reduce the VOC mass by approximately 25 percent, reduce the physical mobility of tar materials, and reduce the leachability of COCs, specifically benzene and naphthalene, by more than 90 percent. The treated material possessed high compressive strength. ISS also was effective in neutralization of acidity. The total volume of material increased due to the addition of pozzolanic reagents. | **Moderate-High (4).** Overall implementability of ISS for treatment of impoundment material is moderate to high. There are numerous vendors and equipment capable of reagent addition. Amendments (e.g., neutralization agents and pozzolans) to achieve desired properties are readily available. As demonstrated during the pilot testing, ISS operations are expected to increase material temperature, which enhances VOC removal during mixing. Vapors must be captured and treated prior to discharge. Air monitoring is required to ensure protection of workers and the community during implementation. | **Moderate-High (2).** Stabilization costs are moderate when compared to other technologies. The costs are driven primarily by equipment and labor; bench-scale testing can be performed to optimize reagent addition and reduce amendment costs. Treatment of Impoundments 1 and 2 will require collection and treatment of vapors. | **Retain.** This option is capable of reducing toxicity and mobility of COCs contained within the impoundments. Optimization of the stabilization reagents is recommended during design to mitigate volume expansion if this process option is utilized. Optimization will also be required if ISS is used as a pretreatment process for ISTT. This option will be combined with other options to form remedial alternatives. |
| | | In-Situ Thermal Treatment (ISTT) | Uses heat to enhance volatilization of VOCs/SVOCs. Heat is applied via thermal conduction, resistive heating, or through other methods using electrodes or heaters placed in the treatment zone. The type of heating used (e.g., resistive, conductive,) depends on the physical characteristics of materials being treated. Fluids (vapor and liquids) are collected from the treatment zone using multiphase extraction wells (MPE) and treated prior to discharge. Pretreatment, e.g. ISS, is required to neutralize acidity and provide strength. Note for this evaluation, steam heating is discussed separately. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. | **High (5).** Heating was demonstrated to be effective for removal of VOCs (greater than 90 percent benzene removal) during the 2014 pilot study. In addition, leaching was demonstrated to be reduced by greater than 90 percent. Corrosion of heaters in the pilot study resulted in inconsistent heating and treatment. Additional treatment (e.g., neutralization) was required following heating in the pilot study to neutralize residual acidity in the acid tars to make them non-corrosive. | **Moderate (2).** Numerous full-scale operations have been implemented for VOC removal; however, none has treated acid tar. Several commercial providers of this technology are available. The low pH of impoundment material presents a significant challenge to heating operations as corrosion processes are strongly accelerated at increased temperature. Fluid extraction and treatment concurrent with heating system operation is a technology requisite; air monitoring is required to ensure protection of workers and the community during implementation. There are safety challenges and concerns associated with operating ISTT in a floodplain over an extended period because of the presence of hot tars and high VOC vapor concentrations. In addition, the equipment could not be demobilized safely/quickly in the event of a flood. | **High (1).** ISTT will require the greatest construction and operating costs relative to other in-situ process options. In addition to the high cost of constructing and operating the thermal treatment system, the need for pretreatment and high efficiency vapor treatment further increase the cost associated with this technology. | **Retain.** Field demonstrated technology in the reduction of COCs present within the impoundment material. Based on lessons learned during the 2014 pilot study, ISTT would be performed only after ISS/neutralization to help minimize heater corrosion and address technical feasibility concerns for impoundment vapor cover construction during heating. This process option will be combined with other treatment and engineering control options to form remedial alternatives. |
| | | Steam-Enhanced COC Removal | Steam and compressed air are introduced into the impoundment materials through injection points (wells or augers). Heating of the impoundment materials enhances volatilization and stripping of COCs. Fluids recovered are removed via MPE and collected for aboveground treatment and destruction. This technology would likely be applied within a remedial alternative in conjunction with other technologies, such as ISS. May be combined with an engineered cover and subsurface hydraulic barrier or possibly excavation and disposal. | **Moderate (3).** Can be an effective technology for treatment of VOCs in high concentration source areas where adequate contact between the VOCs and steam is achieved. Construction materials must be resistant to acidic conditions and high VOC concentrations. Would need to be combined with other technologies to neutralize acidity and achieve the required contact. | **Moderate (3)**. Shallow depth, specifically the absence of overburden pressure, make it challenging to effectively distribute steam; similarly, low permeability of the impoundment material will limit radial influence of injection points. Delivery using augers, as supplied for stabilization operations, would increase overall implementability for heating impoundment materials during mixing. A steam generation plant and vapor-liquid treatment and NAPL recovery systems would be necessary. Like other in-situ technologies, significant offgas treatment will be required. | **Moderate-High (2).** As a standalone technology, steam injection costs are projected to be similar to ISTT costs. However, when considered as a process to enhance stabilization, equipment to implement steam injection is projected to impart only minor cost escalation to stabilization efforts. Costs are largely dependent on system size, energy cost, mass of steam injected to impart desired treatment results, and production rates. | **Retain.** This option can potentially reduce concentrations of VOCs in the waste materials and render materials more amenable to supplemental treatment processes or removal. Limited SVOC treatment within the waste materials may occur. Bench-scale laboratory testing may be required. This option will be retained and combined with other process options to form remedial alternatives. |
| | | Freezing | Impoundment materials are cooled to the point they become solid (frozen); solidified materials are directly excavated and transported to a facility for ex-situ treatment and disposal. | **Low (1).** Freezing the impoundment materials would limit the production of VOC and odor emissions during excavation; however, the approach requires adding supplemental treatment to reduce COC mass. Overall, freezing would produce a material that is more solid than the raw impoundment materials; but even in a chilled state, the potential for high vapor phase emissions will exist. | **Low (1).** This technology likely would be difficult to implement because of the challenge of removing enough heat to solidify the impoundment materials. The potential for freezing of the acid tar is unknown, and with few commercial providers, overall implementability of this technology is considered low. | **High (1)**. Infrastructure and resources to implement this alternative would be high. Strategies to implement in the presence of the existing water cap would further add logistical complexity and overall cost. | **Discard.** This option is untested for the proposed application and is impractical to implement. In addition, it would require cold storage facilities to await ex-situ treatment or refrigerated transport to offsite facilities, which would add further to logistical complexity and overall cost. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | In-Situ (continued) | Surfactant/Co-solvent Flushing (Soil Flushing) | In-situ delivery of chemical reagents including water, surfactants, co-solvents, or other facilitators to enhance the physical displacement, solubilization, or desorption of target contaminants. Mobilized contaminants in the flushing solution are extracted and treated. | **Low (1).** Not demonstrated to be a viable technology for the impoundment materials because of the high VOC content and immiscible properties exhibited by the tar fraction contained in within Impoundment 1 and 2. | **Low (1)**. Soil flushing is a technology that has had limited use in site remediation. The availability of qualified contractors capable of implementing the technology is very limited, and extensive laboratory testing would be needed to confirm efficacy and selection of appropriate reagents to solubilize site COCs. | **High (1).** This option is projected to have high capital and operations costs. The site-specific aspects of application necessitates extensive pre-design data collection and treatability studies. Full-scale operation requires the management of multiple chemicals, treatment of multi-component fluid streams and disposal of complex aqueous phase waste mixtures. | **Discard.** This option is untested for the proposed application and is believed to be impractical to implement. Process option has not been demonstrated for impoundment materials. |
| | Ex-Situ | Bioremediation | Use of land farming, composting, or slurry bioreactors to treat material removed from the impoundments. Aerobic processes would be used for the COCs of interest (e.g., benzene and naphthalene). Neutralization would be required, as well as significant dilution or conditioning to make the material suitable for biodegradation to occur. | **Low (1).** While bioremediation of benzene is a demonstrated technology/process option, the effectiveness of bioremediation for the impoundment materials is projected to be low based on extremely high COC concentration and the characteristics of excavated materials (e.g., nonaqueous nature, tackiness, and the presence of salts). In addition, bioremediation technologies are most effective when the pH range is 5 to 8 SU. | **Low (1).** Not easily implemented at the site because of the high concentrations of VOCs, physical nature of the materials and low pH, as bioremediation technologies are most effective when the pH range is 5 to 8 SU. In addition, excavation and land farming of untreated impoundment materials is not recommended due to the high VOC concentrations and potential for unacceptable exposures to site workers or the surrounding community. | **Moderate-High (2).** This option is projected to have high capital and operations costs. The site-specific aspects of application necessitates extensive pre-design data collection and treatability studies. Full-scale operation requires the management of multiple chemicals, treatment of multi-component fluid streams to maintain biological activity. | **Discard.** This option is untested for the proposed application and is impractical to implement. Process option has not been demonstrated for the impoundment materials. Elevated concentration of VOCs, SVOCs, and very low pH in the waste materials will be toxic to microbes. |
| | | Co-Burning Cement Kiln | Impoundment materials are excavated, transported, blended and fed to a cement kiln as fuel. The cement kiln operates at 2,500 to 2,900 °F, and organic compounds are destroyed at these temperatures. | **Moderate-High (4).** The heat of a cement kiln would destroy the organic content of the impoundment materials, and the cement kiln dust would neutralize the acidic portion of the wastes. The residual waste materials become incorporated into the cement mixture. The acceptance of solids for use at the cement kiln may be limited by the presence of acid volatile sulfides in the impoundment materials, so not all treated tar materials are acceptable for cement kiln co-burning. | **Moderate (3).** The use of cement kilns to treat waste materials is well documented. Cement kilns maintain Resource Conservation and Recovery Act (RCRA) and Clean Air Act permits. Impoundment material would need to be treated in-situ before shipping to the cement kiln for treatment (so the materials can be removed without emissions issues). ISTT-treated material from the 2014 pilot study was subsequently treated at the Green America cement kiln in Hannibal, Missouri. ISS-only treated materials from the pilot study could not be accepted at this facility because of elevated acid volatile sulfide levels. The acceptance throughput rate of impoundment materials by kiln may control removal rate and project timeline. May be viable secondary treatment after initial in-situ treatment. | **Moderate-High (2).** Treatment costs for cement kiln co-burning are higher than some ex-situ process options and lower than other options. | **Retain.** This option may be applicable for treatment of material after removal from the impoundments or for residuals produced through other treatment processes performed onsite. It will be retained and combined with other process options to form remedial alternatives. |
| | | Hazardous Waste Incineration | Excavated impoundment materials or treatment residuals are excavated and treated in an onsite incinerator, or transported offsite and fed directly to a permitted hazardous waste incinerator. The high temperature combustion destroys the organic content of the wastes, and the sulfur compounds are liberated as sulfur gases, which are removed by scrubbing processes. If onsite incineration were used, subsequent disposal would be required. | **High (5).** The heat of the incinerator would destroy the organic content of the impoundment materials. Treatment would reduce the volume of impoundment material, but management and disposal of combustion ash is still required. | **Moderate (3).** The use of incinerators to treat waste materials is well documented; qualified facilities are regulated by RCRA and Clean Air Act permits. Implementation of onsite incineration would require a significant approval process. Impoundment material may need to be treated before excavation for incineration. Acceptance rate of impoundment materials and offsite facilities may control removal rate and project timeline. Throughput rates per facility for offsite incineration are approximately an order of magnitude higher than those for cement kilns. ISS-treated materials from the 2014 pilot study were sent to the Heritage hazardous waste incinerator for final treatment. | **High (1)**. Costs for treatment by incineration are high. This option also requires disposal of residuals after incineration, which would be handled by the hazardous waste incineration facility if treatment were performed offsite. | **Retain.** This option may be applicable for treatment of material after removal from the impoundments or for residuals produced through other treatment processes performed onsite. Because of the anticipated regulatory and public constraints, only offsite (not onsite), incineration is being retained for further consideration. This option will be retained and combined with other process options to form remedial alternatives. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Treatment (continued) | Ex-Situ (continued) | Thermal Desorption | Thermal desorbers treat waste by heating the materials in a rotating drum (or other types of reactors) in an oxygen-deficient atmosphere. Typically, treatment is performed onsite. Vapors produced are treated and in some applications can be processed into usable fuel. | **Moderate (3).** Heat from the thermal desorption units rapidly drive off VOCs and SVOCs present within the impoundment material. Treatment will reduce the overall volume of material and produce friable solid materials with limited compressive strength. Heating is projected to have limited effect on pH neutralization, and supplemental neutralization and stabilization may be needed to fulfill landfill requirements. Previous testing on raw impoundment materials at the site showed that land disposal restriction (LDR) concentrations could not be achieved (New Jersey Department of Environmental Protection 1998).[3] | **Moderate (3).** The use of thermal desorption to treat waste materials is well documented. Throughput (desorbed residence time) for desired impoundment material treatment may control removal rate and project timeline. Significant air treatment and permitting is required for these systems, which limits the effectiveness and implementability for full-scale use. | **Moderate-High (2).** Treatment costs for thermal desorption are higher than some ex-situ process options and lower than options. Disposal of the treatment residuals will still be required. | **Discard.** Once material is removed from the impoundments, the preference would be to place material in the CAMU or if additional treatment is required, to send material offsite to minimize potential exposure during treatment. Therefore, other ex-situ treatment options are retained rather than thermal desorption. |
| | | Asphalt Recycling | Excavated impoundment materials or treatment residuals are transported offsite and fed directly to the asphalt mix during the manufacturing process. The materials can be added to either a hot-mix or cold-mix asphalt process. | **Low-Moderate (2).** Some VOC reduction is likely and SVOCs would be integrated into the asphalt matrix. | **Low (1).** Implementability challenges are likely associated with approval to use characteristically hazardous waste in asphalt recycling. | **Moderate-High (2).** Costs are likely comparable to using a cement kiln. | **Discard.** This option is not a proven technology for impoundment materials; additionally, the high VOC content may limit reuse of material after treatment. |
| | Emissions Treatment | Granular Activated Carbon (GAC) | Vapor generated from material treatment or handling is captured and adsorbed on vapor phase GAC beds to remove VOCs. This method can also be used to treat liquid streams if condensate is generated by the selected treatment option(s). | **Moderate (3)**. The use of GAC to remove VOCs from air and water is well documented with numerous studies and full-scale treatment operations. Not an effective technology for initial treatment of air emissions during ISS or ISTT because of the high VOC and SVOC content expected during treatment. May be more effective technology as secondary treatment processes, after VOC content has been reduced or as part of a passive venting system. | **High (5).** This technology could be readily implemented at the site for low concentration vapor streams, as there are numerous suppliers of equipment and GAC services. This technology is not feasible for very high concentration vapor streams because of safety concerns, specifically the potential for vapor phase carbon bed fires. | **Moderate (3); High (1).** When applied for low concentration vapor streams, this technology is cost effective. However, application of GAC for highly concentrated, high volume treatment is inefficient and costly because of excessive GAC consumption and increased O&M requirements. The moderate cost rating is applicable for use on low concentration vapor streams. | **Retain.** Treatment of high concentration vapor streams with GAC is not feasible because of safety concerns. Use of the technology will be considered for treatment of low concentration, low volume vapor streams where alternative technologies are not considered feasible. This option will be combined with other process options to form remedial alternatives. |
| | | Thermal Oxidizer | Vapor generated from material treatment or handling is heated and destroyed by thermal oxidation in a controlled combustion chamber. The carbon from the VOCs is bound to oxygen and released as carbon dioxide; acid gasses and sulfur-bearing compounds generated during combustion processes are removed from oxidizer exhaust by caustic scrubbing. | **High (5).** Thermal oxidizer offgas treatment is a proven technology; the concepts, theory, and engineering aspects of the technology are well developed. Pilot testing completed onsite demonstrated the ability to effectively handle sulfur and acidic exhaust gasses using a caustic scrubber. | **High (5).** There are multiple suppliers of thermal oxidizers capable of treating vapor phase emissions generated during handling or treatment of impoundment materials. As with all air treatment technologies, emission control and air permitting will be required. A thermal oxidizer was used during the 2014 pilot study and effectively treated vapors generated via ISS and ISTT. | **Moderate-High (2).** Capital costs are higher when compared to other air treatment technologies. However, given the mas of VOCs present operations life-cycle cost of the oxidizer compared to alternate approaches like carbon adsorption is projected to be lower. | **Retain.** This option is projected to be the most effective approach for the treatment of high concentration, high volume vapor streams generated during treatment or handling of impoundment materials. This option will be combined with other process options to form remedial alternatives. |
| | | Catalytic Oxidizer | Vapor generated from material treatment or handling is heated and destroyed in the presence of a catalyst. The oxidation occurs through a chemical reaction between the VOC hydrocarbon molecules and a precious-metal catalyst bed that is internal to the oxidizer system. The catalyst accelerates the rate of a chemical reaction, allowing the oxidation and VOC destruction to occur at a lower temperature range (typically 550 to 650 °F). | **Low (2).** Catalytic thermal oxidation is a developed, refined, and proven technology for VOC destruction; the concepts, theory, and engineering aspects of the technology are well documented. However, the precious metal catalyst are easily poisoned by sulfur-bearing compounds. Once deactivated by sulfur, catalyst bed replacement is needed, which is very costly. | **High (5).** There are multiple suppliers of catalytic oxidizers capable of treating vapor phase emissions generated during handling or treatment of impoundment materials. However, the presence of sulfur compounds prohibits the use of this treatment technology. | **High (1)**. Sulfur is present in the impoundment materials at appreciable concentration. As a selective and irreversible poison for the platinum-based catalysts used in these systems, application of this option could result in extraordinary operations costs for vapor treatment by this option. | **Discard.** This option is incompatible with process vapor conditions anticipated during treatment or handling of impoundment materials. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Removal | Hydraulic Removal | Hydraulic Dredging | Removal of impoundment material as a liquid slurry suspended by mixing with water. The slurry suspension is subsequently conveyed to a dewatering system, where solids are separated from the liquid. The slurry is moved through piping from the excavation area to treatment area using potential created by turning an enclosed auger. | **Moderate (3).** Hydraulic dredging is effective at removing large volumes of sediment and can be implemented without removing the water cap from the impoundments. | **Moderate (3).** Dredging of material is considered implementable using a number of approaches. Dewatering of liquid slurry, however, is considerably more difficult given the VOC content of the material and the high liquid to solid ratio stream that must be managed. The approach will require extensive dewatering facilities with active vapor control. Dewatered material must be subsequently treated before offsite disposal or onsite consolidation in the CAMU. | **High (1).** Equipment and operating costs for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** This option may be moderately effective at removing impoundment materials prior to ex-situ treatment. However, the cost and complexity of treating the process streams generated by this option would be very high and require multiple material handling steps that increase the potential for unacceptable exposures for site workers and surrounding communities. |
| | | Heat and Pump | Removal of impoundment material as a liquid slurry produced following heating with a noncontact heat exchanger placed directly in the impoundments. Through circulation of hot heat transfer fluids to the exchanger, a portion of the impoundment materials will liquefy. The resulting liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for recovery and further processing. | **Low (2).** Effectiveness is predicated on viscosity reduction of the impoundment materials following heating. If the viscosity of the impoundment materials can be lowered, pumping could be effective at removing large volumes of materials without water cap removal. Material heating would increase vapor emissions even higher than those seen with just ambient removal methods. The approach has not been demonstrated onsite and would require extensive testing to fully evaluate potential efficacy onsite. | **Moderate (3).** Thermally enhanced removal of petroleum-derived sludges is a demonstrated technology and commercial suppliers are available to implement this option. However, it is unknown if physical and chemical properties of the impoundment materials can be pumped after heating. In addition, pumping materials through a pipeline may be difficult; heat loss from the pipeline may cause increase viscosity and pipes to clog. Relocation of the heat exchangers and pump head will be required as the materials are removed. | **High (1).** Equipment and operating cost for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** Other removal options provide a better combination of effectiveness and implementability. |
| | | Liquefaction | Use of a diluent (e.g., fuel oil) to help dissolve tar materials in place, followed by pumping of the liquid slurry. The liquid is pumped directly from the impoundments and conveyed to a secondary treatment area for diluent recovery and further processing/treatment. | **Low (2).** Effectiveness is predicated on viscosity reduction of the impoundment materials following diluent additional and mixing. If the viscosity of the impoundment materials can be lowered, pumping could be effective at removing the impoundment material as a liquid. Removal of the water cap is needed for this approach; provisions for the containment collection and destruction of organic vapors is necessary. The approach has not been demonstrated onsite and would require extensive testing to fully evaluate potential efficacy onsite. | **Low (2).** The use of diluents to liquefy and recover acid tar from an open surface impoundment has not been demonstrated; similarly, the availability of services and equipment to implement this approach is limited. | **High (1).** Equipment and operating costs for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. | **Discard.** Other removal options provide a better combination of effectiveness and implementability. |
| | Mechanical Removal | Excavation | Excavation of impoundment materials using a trackhoe, crane, bucket excavator, or similar equipment. Excavated materials are dewatered and placed in a container for storage, transport, treatment, or disposal. To protect workers and the community from exposure to high VOC vapor concentrations, in-situ treatment will be required prior to excavation. Alternatively, it may be possible to excavate untreated acid tar at low production rates using active vapor control measures (e.g. foam) to reduce emissions to acceptable levels. | **Moderate (3).** Mechanical excavation is effective for removing materials from the impoundments. Depending on the alternative/approach, the water cap may be maintained, and water management may be required. Because of the potential for elevated VOC concentrations, air monitoring will be required during excavation. In addition, some pretreatment will be required to address material handling challenges (viscous tars, low pH) and to remove VOCs. | **Moderate (3).** Equipment is readily available for mechanical excavation. However, conventional strategies to control vapor phase emissions during removal at typical production rates are impracticable. Effective control of vapor phase emissions during the excavation and protection of site workers and surrounding community residents remains the primary technical limitation to implementation of this option. | **Moderate (3).** Equipment and operating cost for this method of removal are projected to be high given vapor control requirements and multiple handling steps needed to produce material suitable for supplemental treatment or disposal. Controlling emissions by minimizing production rates will also result in higher costs. | **Retain**. This option is retained for potential application and will be combined with process options that involve treatment and disposal. |
| Disposal | Onsite | Closure in Place | Following completion of an in-situ treatment, alternative residuals would be capped, the treated area reinforced to withstand floods, and permanently closed in place. | **Moderate-High (4).** When coupled with an appropriate treatment alternative capable of reducing toxicity and mobility of impoundment materials in place closure is considered an effective remedial approach. An effective closure in place can be engineered in the floodplain. | **Moderate-High (4).** In-place closure is implementable. Design and construction provisions to permanently encapsulate treated materials are readily available. A closure in place strategy precludes the exposure potential associated with excavation, ex-situ treatment, and transportation/disposal. | **Moderate-High (2).** Cost of in-place closure is predicated on the individual costs of elements applied for in-situ treatment and capping. | **Retain**. This disposal option is retained for further consideration when combined with in-situ treatment process options. In-situ treatment and capping when properly selected and performed can achieve the remedial action objectives proposed for Impoundments 1 and 2. |

Table 1A. Technology and Process Option Screening

| General Response Action | Remedial Technology | Process Option | Description | Effectiveness[1] | Implementability[1] | Cost[2] | Retain for Alternative Development? |
|---|---|---|---|---|---|---|---|
| Disposal (continued) | Onsite (continued) | Impoundment 8 Facility Corrective Action Management Unit (CAMU) | Following completion of an in-situ treatment alternative, residuals would be excavated and transported to the onsite CAMU for final disposition. | **High (5).** When coupled with an appropriate treatment alternative capable of reducing toxicity of impoundment materials, onsite disposal in the CAMU is considered an effective remedial approach. This process option receives a slightly higher score than Closure in Place option because the materials are physically removed from the floodplain. | **Moderate (3).** Excavation following in-situ treatment is implementable. The Impoundment 8 Facility CAMU was designed and purposed for placement of treated residuals from the site. While LDR or TCLP concentrations do not apply to materials placed in the CAMU, concentrations must be such that excavation/ disposal in the CAMU does not create an exposure hazard. Production rate of excavation, supplemental treatment (if needed), and spreading at the CAMU may be limited, which would extend the project duration. | **High (1)**. Cost for CAMU disposal following in-situ treatment are projected to be high given the level of VOC removal needed for safe excavation of the treated residuals. | **Retain.** This disposal option will be retained for analysis with treatment alternatives that can appreciably reduce impoundment material toxicity (e.g., total VOC content). |
| | Offsite | Nonhazardous Waste Landfill | Following completion of an in-situ treatment alternative, residuals would be excavated and transported offsite to a nonhazardous landfill for final disposition. TCLP concentrations must be met. | **Low (1).** Based on bench and pilot tests conducted to date, remedial technologies have not consistently achieved TCLP concentrations that would allow for nonhazardous disposal. | **Low (1).** Achieving the required treatment standards for offsite disposal in Subtitle C landfill with a nonhazardous classification is unlikely. | **High (1)**. The cost and technical feasibility to achieve treatment levels suitable for nonhazardous disposal are unknown and projected to be prohibitively high. | **Discard**. This disposal option lacks technical feasibility; the type and cost of process options needed to achieve nonhazardous disposal requirements renders the option impractical to implement. |
| | | Hazardous Waste Landfill | Following completion of an in-situ treatment alternative, residuals would be excavated and transported offsite to a hazardous waste landfill for final disposition. LDR concentrations must be met. | **Low (1).** Based on bench and pilot tests conducted to date, remedial technologies have not achieved LDR concentrations. | **Low (1).** Achieving the required treatment standards for offsite disposal in a hazardous waste landfill would present significant technical challenges for all treatment strategies contemplated. | **High (1)**. The cost and technical feasibility to achieve treatment levels suitable for hazardous landfill disposal are unknown and projected to be high. | **Discard.** This disposal option lacks technical feasibility; the type and cost of process options needed to achieve LDRs (required for hazardous waste disposal) renders this option impractical to implement. |

Notes:

1. Screening scores for Effectiveness and Implementability are as follows:

    Low: 1 (worst)
    Low-Moderate: 2
    Moderate: 3
    Moderate-High: 4
    High: 5 (best)

2. Screening scores for Cost are as follows:

    Low Cost: 5 (best)
    Low-Moderate Cost: 4
    Moderate Cost: 3
    Moderate-High Cost: 2
    High Cost: 1 (worst)

3. LDRs are not expected to be achieved for any of the process options evaluated.

CAMU – Corrective Action Management Unit
COC – contaminant of concern
FFS – Focused Feasibility Study
GAC – granular activated carbon
ISB – in-situ bioremediation
ISCO – in-situ chemical oxidation
ISS – In-Situ Stabilization/Solidification
ISTT – In-Situ Thermal Treatment
LDR – land disposal restriction
MPE – multi-phase extraction
NAPL – nonaqueous phase liquid
O&M – operation and maintenance
OU – Operable Unit
RCRA – Resource Conservation and Recovery Act
SU – standard unit
SVOC – semivolatile organic compound
VOC – volatile organic compound

Table 1B. Summary of Retained Process Options

| General Response Action | Technology | Retained Process Option |
|---|---|---|
| No Action | No Action | No Action |
| Containment | Capping | Soil Cover |
| | | Engineered Cover |
| | Groundwater Gradient Control | Hydraulic Barriers |
| | | Extraction Wells |
| Treatment[1] | In-Situ Treatment | Vapor Extraction |
| | | ISS |
| | | ISTT |
| | | Steam-enhanced COC Removal |
| | Ex-Situ Treatment | Offsite Co-burning Cement Kiln |
| | | Offsite Hazardous Waste Incineration |
| | Process vapor treatment | Granular Activated Carbon |
| | | Thermal Oxidation |
| Removal | Mechanical Removal | Excavation |
| Disposal[1] | Onsite Disposal | Closure In Place |
| | | Corrective Action Management Unit (CAMU) |

Notes:

[1.] Ex-situ treatment options retained following screening will produce residuals which would be disposed offsite. However, since retained ex-situ treatment options incorporate residuals directly into a product for beneficial reuse (cement kiln) and incineration processes already include provisions for ash management, these technologies were evaluated as treatment technologies rather than disposal technologies.

# Appendix C
# USEPA Approval of Performance Criteria Memorandum and Technology Screening Memorandum

**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

October 15, 2015

Russell Downey
Pfizer Global Manufacturing
100 Route 206 North, m.s. 6/610
Peapack, New Jersey 07977

**RE: September 9, 2015 Technology Screening Memorandum to Support Alternatives Development and the September 11, 2015 Proposed Performance Criteria for Remedial Alternatives Memorandum for the Operable Unit 8 Pilot Study, American Cyanamid Superfund Site in Bridgewater Township, New Jersey**

Dear Mr. Downey,

The U.S. Environmental Protection Agency (EPA) has completed reviewing the above referenced plans and the subsequent follow-up responses to our comments. We have no further concerns.

Each are considered final and approved.

Should you have any questions, please contact me at (212) 637-3954.

Sincerely,

Mark Austin, Project Manager
New Jersey Remediation Branch

cc: V. D'Aco, QMG, Inc.
H. Shah, NJDEP

# Appendix D
# In-Situ Stabilization
# Pilot Study Summary

APPENDIX D

# In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey

*Prepared for*

Wyeth Holdings LLC

March 2017

CH2M HILL, Inc.
1717 Arch Street
Suite 4400
Philadelphia, PA 19103

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# Acronyms and Abbreviations

| | |
|---|---|
| 100 Percent Design | *100 Percent Design of Pilot Study for Operable Unit 8* |
| %Diff | standard percent difference |
| ANS | American Nuclear Society |
| ANSI | American National Standards Institute |
| CH2M | CH2M HILL, Inc. |
| cm/s | centimeters per second |
| COC | constituent of concern |
| FFS | focused feasibility study |
| HC | hard and crumbly |
| ISS | in-situ stabilization/solidification |
| ISTT | in-situ thermal treatment |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| $mg/m^2$ | milligrams per square meter |
| $mg/m^2$ s | milligrams per square meter-second |
| OU8 | Operable Unit 8 |
| PID | photoionization detector |
| psi | pounds per square inch |
| S/S | stabilization/solidification |
| Site | American Cyanamid Superfund Site in Bridgewater, Somerset County, New Jersey |
| SPLP | synthetic precipitation leaching procedure |
| SU | standard units |
| SVOC | semivolatile organic compound |
| TCLP | toxicity characteristic leaching procedure |
| TVOC | total volatile organic compound |
| UCS | unconfined compressive strength |
| USEPA | U.S. Environmental Protection Agency |
| VOC | volatile organic compound |
| VR | viscous rubbery |

SECTION 1

# Introduction

As part of the focused feasibility study (FFS) for Operable Unit 8 (OU8) at the American Cyanamid Superfund Site in Bridgewater, Somerset County, New Jersey (Site), a field-scale pilot study was performed in 2014, on behalf of Wyeth Holdings LLC, to evaluate two technologies (in-situ thermal treatment [ISTT] and in-situ stabilization [ISS]) for treating the acidic impoundment material within Impoundments 1 and 2. This report presents the results from the ISS portion of the pilot study, which was completed in May and June 2014. Details regarding field implementation of the ISS portion of the study are presented in the *In-Situ Solidification and Stabilization for Operable Unit 8 Pilot Study Construction Completion Report* (WRS 2014).

The pilot study focused on acid tar within the northwestern portion of Impoundment 2. These are the residual byproducts of benzene, toluene, xylene, and naphthalene extraction from coal light oil during historical facility operations. The acid tar material includes viscous rubbery (VR) material and hard and crumbly (HC) material. The contents of Impoundment 2 are similar to that of Impoundment 1, except Impoundment 2 has a higher proportion of VR material and Impoundment 1 has some inert materials from prior remediation attempts. The impoundment material has a low pH (average of 1.5 standard units [SU]) with a solid to semi-solid consistency. The VR and HC materials contain volatile organic compounds (VOCs) (primarily benzene), semivolatile organic compounds (SVOCs), and residual acidity. Malodorous sulfur compounds including hydrogen sulfide, sulfur dioxide, mercaptans, and carbon disulfide also are present in these materials.

SECTION 2

# ISS Pilot Study Background

The pilot study design was developed using results of extensive laboratory testing performed in 2012 and 2013, which evaluated the potential effectiveness of ISTT and ISS on acid tar collected from Impoundments 1 and 2 (*100 Percent Design of Pilot Study for Operable Unit 8* [100 Percent Design; CH2M HILL, Inc. {CH2M} 2013a]). The U.S. Environmental Protection Agency (USEPA) approved the design on December 12, 2013. The following paragraphs provide a brief background of pilot study components.

The pilot study was completed using three, 7-foot-diameter steel caissons, which were supported from a floating platform (Flexifloat) on the water surface in the northwestern portion of the Impoundment 2. The Flexifloat was anchored into the subgrade beyond the outer base of the impoundment berms. This approach allowed for isolation of discrete test cells from the surrounding impoundment materials. A 9-foot-diameter outer shroud was installed for each test cell to capture organic vapors and malodorous compounds generated during treatment operations. The inner caisson was keyed into the clay layer at the bottom of the impoundment to control the influx of water and untreated tar into the test cell during the pilot study. The three caissons were designated as follows:

- Caisson 1 – ISS only
- Caisson 2 – ISTT only
- Caisson 3 – ISTT followed by ISS

During ISS mixing, each caisson was fitted with a special cover that allowed for vapor capture during mixing operations (Figure 1). Vapors captured during ISS mixing and curing were conveyed to a thermal oxidizer to destroy the organic compounds and oxidize the reduced sulfur compounds, and then to a caustic scrubber to reduce the concentrations of acid gases.

SECTION 3

# In-Situ Stabilization Operations

## 3.1 Overview

Before implementing ISS activities in Caissons 1 and 3, ISTT operations were completed in Caissons 2 and 3. After an approximately 70-day heating period, the thermal treatment operations were concluded on May 9, 2014, and the in-situ thermal heaters were shut down and removed from Caissons 2 and 3. Primary ISS mixing operations for Caissons 1 and 3 were completed over a 2-day period between May 29 and May 30, 2014. Secondary mixing was performed approximately 1 week after primary mixing to evaluate supplemental increases in compressive strength.

Stabilization operations were completed in each caisson using auger based soil mixing equipment. Pilot study operations were completed using a Bauer rotary drilling rig (BG 28H and BS 80B base carrier), a hollow-stem Kelly bar, and a 6-foot-diameter mixing auger. Injection ports on the mixing auger were used to deliver reagents to the caissons in a slurry form. In Caisson 1, dry clay compounds were added through the opened caisson lids as outlined in the 100 Percent Design (CH2M 2013a).

Vapor controls were implemented during ISS mixing operations in accordance with the Environmental Improvement Pilot Test permit equivalent issued by the New Jersey Department of Environmental Protection on May 9, 2014 (EIP130002).

## 3.2 Caisson 1 ISS

The ISS implementation sequence for Caisson 1 is summarized below:

- May 30, 2014 – Impoundment material homogenization
- May 30, 2014 – pH buffering with a hydrated lime slurry
- May 30, 2014 – Primary ISS mixing with Partac clay, Lafarge NewCem, and OMNI fluidized bed ash
- June 4, 2014 – Material excavation to a rolloff container
- June 5, 2014 – Secondary mixing of excavated material with Portland cement in the rolloff container
- June 6, 2014 – Transfer of stabilized material from an unlined rolloff to a lined rolloff container with a tight fitting cover for shipping

## 3.3 Caisson 3 ISS

The ISS implementation sequence for Caisson 3 is summarized below:

- May 29, 2014 – Homogenization of thermally treated material
- May 29, 2014 – pH buffering with a lime kiln dust slurry
- May 29, 2014 – Primary ISS mixing using Lafarge NewCem grout
- June 4, 2014 – Material excavation to a rolloff container
- June 4, 2014 – Secondary mixing of excavated material with Portland cement in a rolloff container
- June 5, 2014 – Transfer of stabilized material from an unlined to lined rolloff container with a tight fitting cover for shipping

Demobilization of ISS equipment commenced on June 10, 2014. Site activities included removing and decontaminating unlined rolloffs used for secondary mixing, equipment, and other infrastructure located on or near the equipment bench. Final demobilization of ISS equipment and personnel was completed on June 19, 2014. Caisson removal and decontamination activities also commenced during the week of June 9, 2014, and were completed by June 27, 2014.

SECTION 4

# Discussion of Results

## 4.1 Impoundment Material Collection and Analysis

Material samples were collected at various stages throughout the pilot study, including before and after thermal treatment, after removing the ISS-treated material from the caisson, and after secondary ex-situ stabilization/solidification (S/S). Selected samples were analyzed for one or more of the following parameters:

- VOCs (standard, toxicity characteristic leaching procedure [TCLP], synthetic precipitation leaching procedure [SPLP], and monolithic leaching testing [ANSI])
- SVOCs (standard, TCLP, SPLP, and ANSI testing)
- Metals (standard, TCLP, SPLP, and ANSI testing)
- Physical characteristics (pH, moisture content, bulk density, dry density, unconfined compressive strength [UCS], hydraulic conductivity, and loss on ignition)

Sampling and analysis was conducted in accordance with the USEPA-approved *Sampling and Analysis Plan for Operable Unit 8 Pilot Study* (CH2M 2013b) and the *Sampling and Analysis Plan Addendum, Impoundment 1 and 2 Pilot Study, Operable Unit 8* (CH2M 2014). Table 1 summarizes the sample collection dates and locations.

## 4.2 Physical Analytical Results

Samples of treated materials from Caissons 1 and 3 were collected and analyzed for various physical parameters, including moisture content, bulk density, dry density, UCS, hydraulic conductivity, and loss on ignition. Table 2 presents the physical testing results, which are discussed below.

### 4.2.1 Bulk Density

Bulk density of stabilized materials was measured under field and laboratory conditions. Laboratory results are summarized on Figures 2 and 3 for Caissons 1 and 3, respectively, through the different stages of treatment. In Caisson 1, the bulk density gradually decreased between primary and secondary mixing. The decrease might be attributed to the addition of the reagent slurry during secondary S/S, which consisted of 400 gallons (3,336 pounds) of water and 3,940 pounds of Portland cement. Conversely, measurements in Caisson 3, illustrate a gradual bulk density increase between ISS treatment stages. Increasing bulk density is attributed to the loss of moisture as stabilized materials undergo the curing process. Water was not added to the mixture during secondary S/S of Caisson 3 because of the high water content already present in the caisson.

### 4.2.2 Unconfined Compressive Strength (28 and 56 days)

As shown in Table 3, physical testing performed on untreated impoundment materials yielded a UCS value of 0 pounds per square inch (psi). Following ISS, UCS measurements were repeated after 28 days and 56 days of curing. The initial addition of ISS reagents (post-first mix) to Caisson 1 resulted in a marked increase in strength, with the UCS measured at 121 psi after 28 days and 249 psi after 56 days. Following secondary S/S (post-second mix), the UCS of Caisson 1 materials was measured at 16 psi after 28 days and 34 psi after 56 days of curing.

Thermal treatment alone resulted in a modest UCS increase in treated materials collected from Caisson 3. Pilot study results suggest the post-ISTT compressive strength improvements can be attributed to the preferential removal of VOCs and water which likely prevent the agglomeration of heavier organics and sediment present in the untreated impoundment material. Upon completion of

ISTT operations, the UCS measurements in two samples from Caisson 3 were 9 psi and 56 psi. The addition of ISS reagents to Caisson 3 also resulted in increasing strength, with the UCS at 63 psi after 28 days and 168 psi after 56 days of curing. Following secondary S/S, the UCS of Caisson 3 materials was measured at 224 psi after 28 days and 198 psi after 56 days of curing.

USEPA moisture content measurements (i.e., weight of water divided by weight of sample) relative to UCS are depicted on Figure 4. Overall results show no significant change in moisture content throughout the curing process for both Caissons 1 and 3.

### 4.2.3 Hydraulic Conductivity Results

Table 2 and Figure 5 present the hydraulic conductivity data. Hydraulic conductivity results are summarized by sample location below.

- Caisson 1
  - Untreated Impoundment Material: Unknown (Emission of volatiles resulted in expansion of the material; thus, making the material untestable.)
  - Post-ISS: 1.4 x $10^{-8}$ centimeters per second (cm/s) after 28 days and 1.5 x $10^{-7}$ cm/s after 56 days
  - Post-S/S: 1.1 x $10^{-8}$ cm/s after 28 days and 8.5 x $10^{-8}$ cm/s after 56 days
- Caisson 3
  - Untreated Impoundment Material: Unknown (Volatiles expanded causing material to expand and making it untestable.)
  - Post-ISTT: 3.2 x $10^{-5}$ cm/s and 7.4 x $10^{-6}$ cm/s after approximately 70 days of heating
  - Post-ISS: 1.06 x $10^{-6}$ cm/s after 28 days and 3.5 x $10^{-7}$ cm/s after 56 days
  - Post-S/S: 2.9 x $10^{-7}$ cm/s after 28 days and 8.7 x $10^{-8}$ cm/s after 56 days

### 4.2.4 ISS Effectiveness at Attaining Strength Criteria for Disposal

The range of potential disposal options for treated impoundment material will be evaluated during the FFS, including potential placement of materials into the Impoundment 8 Facility, a Corrective Action Management Unit constructed to support the Site-wide remedial action. According to the 2009 Certification Report for the closure of Impoundments 14 and 20, the approved Basis of Design for Impoundment 8 requires that placed materials have a minimum shear strength of 21 psi (O'Brien & Gere 2009); this is approximately equivalent to a UCS of 42 psi. Based on the UCS results obtained in pilot study samples, ISS operations are capable of achieving these strength requirements.

## 4.3 Chemical Analytical Results

### 4.3.1 Organic Compounds

Tables 4 and 5 present the comprehensive chemical analytical results for samples obtained from Caissons 1 and 3, respectively. To aid in data interpretation, Table 6 presents a data summary illustrating average concentrations and standard deviation values for benzene, total volatile organic compounds (TVOCs), and naphthalene for Caissons 1 and 3. Mass changes for benzene, TVOCs, and naphthalene (not included in the TVOC value) data are discussed because these are the most significant constituents in the acid tar.

Table 7 presents the overall changes in concentration and mass for key constituents at various stages of the pilot study. In addition, Figures 6 and 7 show the average concentration changes for benzene, TVOCs, and naphthalene measured in Caissons 1 and 3, respectively. Average concentration values are presented by unit operation (such as untreated impoundment material, post-ISTT, post-ISS, post-

removal, and post-secondary S/S). The data presented on Figures 6 and 7 represent average concentrations from multiple samples; as such, standard deviation bars represent the range of detections for the respective datasets.

#### 4.3.1.1 Caisson 1

The average benzene concentration in the untreated impoundment material samples from Caisson 1 was approximately 66,000 milligrams per kilogram (mg/kg), with an average TVOC concentration of approximately 85,000 mg/kg. The naphthalene concentration in the untreated impoundment material sample from Caissons 1 was 24,600 mg/kg. Naphthalene concentration data are based on one value.

As illustrated on Figure 6, the addition of stabilization reagents into Caisson 1 reduced the concentrations of benzene, TVOCs, and naphthalene. However, because of the significant mass of amendments added, it is important to look at mass reductions in addition to concentration reductions. Table 7 presents the mass reduction estimates.

Overall, the implementation of ISS in Caisson 1 resulted in the estimated removal of 320 pounds of benzene, 430 pounds of TVOCs, and 330 pounds of naphthalene (Table 7). Compared to baseline conditions, post-treatment sample results suggest ISS alone reduced benzene mass by 26 percent, TVOC mass by 27 percent, and naphthalene mass by 72 percent. Supplemental reduction of benzene mass by 13 percent and TVOC mass by 13 percent was measured following secondary ex-situ S/S; however, because of variations in naphthalene concentration measurements, supplemental removal of this parameter by secondary S/S could not be confirmed. Mass reduction is likely attributable to volatilization and subsequent destruction of organics in the thermal oxidizer.

#### 4.3.1.2 Caisson 3

The average benzene concentration in the untreated impoundment material samples from Caisson 3 was approximately 67,000 mg/kg, with an average TVOC concentration of approximately 88,000 mg/kg. The naphthalene concentration in the untreated impoundment material sample from Caisson 3 was approximately 10,000 mg/kg. Naphthalene concentration data are based on one value for this compound.

The largest decrease in benzene and TVOC concentrations occurred as a result of ISTT implementation. Nine post-ISTT samples were collected from Caisson 3 at various depth intervals, and eight of the nine samples showed a significant concentration decrease. Following ISTT, the benzene concentration in the eight post-ISTT samples ranged from 19 to 308 mg/kg, representing a concentration reduction of more than 99 percent. Post-thermal treatment, TVOC concentrations in these same eight samples ranged from 34 to 1,096 mg/kg, representing a concentration reduction of more than 98 percent. For the ISTT concentration reduction calculations noted above, one of the nine samples was excluded. This sample, which reported concentration values of 61,900 mg/kg (benzene) and 76,502 mg/kg (TVOC), was representative of untreated impoundment material. This sample was collected from the deepest depth interval heated and in a location where desired treatment temperatures were not fully reached.

Following ISTT operations in Caisson 3, the contents of Caisson 3 were homogenized and then mixed with reagents during the ISS process. Mixing operations occurred over the full range of materials in Caisson 3, including the zones where incomplete heating was observed. Therefore, to establish the treatment concentration for chemical constituents in Caisson 3, the outlier results were included in the numeric average developed to represent pre-ISS conditions. The average post-ISTT concentration for benzene and TVOC in Caisson 3, including the outlier, was approximately 7,000 mg/kg and 8,800 mg/kg, respectively. The post-ISTT average naphthalene concentration for Caisson 3 was 1,388 mg/kg.

As summarized in Table 7, approximately 5,570 pounds of reagents were mixed into the contents of Caisson 3 during the pilot study. Because of the significant mass of amendments added, it important to

look at mass reductions in addition to concentration reductions. Table 7 presents the mass reduction estimates.

ISTT operations in Caisson 3 removed a significant mass of benzene, TVOCs, and naphthalene before implementation of ISS operations. Exclusion of the outlier sample point suggests that more than 99 percent of the benzene mass present before treatment was removed by ISTT; TVOC mass reduction by ISTT was calculated to be 98.8 percent. Following homogenization of thermal treatment residuals during ISS operations in Caisson 3, 138 pounds of benzene and 174 pounds of TVOCs were estimated to be present in Caisson 3. Upon completion of ISS operations in Caisson 3, an estimated 77 pounds of benzene and 100 pounds of TVOCs were removed. Sample results suggest that stabilization operations (i.e., primary ISS, excavation and placement in the rolloff, and secondary S/S) reduced benzene mass by 44 percent and TVOC mass by 74 percent compared to pre-ISS conditions.

Comparison of pre- and post-thermal treatment samples indicate approximately 175 pounds (nearly 96 percent) of naphthalene was removed from Caisson 3 by heating operations. Including the outlier sample point, the average concentration of naphthalene was 1,388 mg/kg, which is equivalent to a pre-ISS treatment mass of 27 pounds. However, the post-ISS naphthalene concentration was 2,485 mg/kg, which is equivalent to a mass of approximately 82 pounds. Post-ISS results, therefore, suggest the mass of naphthalene increased by 55 pounds after mixing operations. The increase in naphthalene mass was unexpected and is likely due to measurement or analytical error.

Concentrations for benzene and TVOC in samples from the caisson, rolloff box post-excavation, and after secondary S/S were largely unchanged. A notable decrease in naphthalene concentration was observed between samples collected after ISS operations and secondary S/S. Given the limited number of samples and the variability in naphthalene values, supplemental reduction of benzene, TVOC, and naphthalene mass following secondary S/S cannot be confirmed with certainty.

### 4.3.2 TCLP and SPLP

To evaluate the leaching characteristics of impoundment material treated by ISS (Caisson 1) and a combination of ISTT and ISS (Caisson 3), solid samples were collected and subjected to laboratory analysis using TCLP and SPLP methods. Sample conditions evaluated in Caisson 1 included untreated impoundment material, post-ISS, and post-secondary S/S. Conditions evaluated in Caisson 3 were identical with the addition of a sample following completion of ISTT operations. TCLP and SPLP results for benzene are summarized in Table 6 are shown graphically on Figures 8 and 9 for Caissons 1 and 3, respectively. Comprehensive TCLP and SPLP sample results are presented in Tables 8 and 9, respectively.

Benzene was the primary constituent detected in leachates from TCLP and SPLP testing. The benzene concentrations detected in TCLP leachate for untreated impoundment material samples from Caissons 1 and 3 were 326 and 526 milligrams per liter (mg/L), respectively. Benzene results for SPLP leachate in Caissons 1 and 3 were of similar concentration magnitude (383 and 531 mg/L, respectively). Following Caisson 1 ISS operations, benzene concentrations in TCLP and SPLP leachate were 439 and 471 mg/L, respectively. Following the addition of pozzolan regents during secondary S/S efforts in the rolloff container, both the TCLP and SPLP measurements for benzene decreased slightly, with final values falling below that of the untreated impoundment materials (TCLP benzene 313 mg/L and SPLP benzene 313 mg/L).

Six post-ISTT samples from Caisson 3 were submitted for TCLP and SPLP analyses. In four of the six samples, the TCLP benzene concentration was below the 0.5 mg/L hazardous characteristic criterion. In these samples, benzene concentrations in TCLP leachate ranged from less than 0.08 to 0.45 mg/L. Compared to pre-treatment measurements, sample results indicated a three order-of-magnitude reduction in concentration. The benzene TCLP concentrations in remaining post-ISTT samples measured approximately 3 and 12 mg/L.

To evaluate leachability data post-ISS, TCLP and SPLP results obtained post-ISTT were averaged to represent material leachability characteristics before stabilization. The average benzene TCLP and SPLP concentrations in Caisson 3 increased after in-situ blending of the pozzolans (post-first mix on Figure 9). It is suspected that the increased values observed following ISS are attributed to homogenization of areas that were not completely treated by ISTT. Final TCLP and SPLP samples were collected following excavation and secondary pozzolan addition to evaluate the effects of secondary S/S on constituent leachability. As illustrated on Figure 9, the addition of secondary S/S agents did little to further reduce benzene TCLP and SPLP concentrations.

# 4.4 ANSI Leaching Testing

The potential for each material to leach constituents of concern (COCs) was evaluated using several leaching procedures, including single batch equilibrium-based leaching tests promulgated by USEPA (i.e., USEPA Method 1311 [TCLP] and USEPA Method 1312 [SPLP]), and a mass transfer-based leaching test standardized by ANSI and published by the American Nuclear Society (ANS), ANSI/ANS 16.1. For brevity, the ANSI/ANS 16.1 test is referred herein as ANSI. Table 10 shows a matrix of pilot study samples and leaching test methods conducted for each sample. Although a broad range of analytes was processed, the primary COCs for the current discussion are benzene, naphthalene, and TVOCs.

This discussion addresses evaluation of leaching data specific to comparisons between pilot study treatments and does not address acceptability of materials for disposal. Therefore, TCLP data are neither presented nor discussed.

## 4.4.1 Leaching Test Procedures

### 4.4.1.1 ANSI/ANS 16.1 – Measurement of Leachability of Solidified Low-level Radioactive Wastes by a Short-term Test Procedure

The pilot study materials tested using ANSI included untreated tar from Caisson 1, thermally treated tar from Caisson 2 (before and after removal) and Caisson 3 (prior to ISS), and ISS-treated and secondary ex-situ S/S-treated samples from Caissons 1 and 3. Field samples were collected and shipped to KEMRON as intact cores. For the ANSI testing, test specimens were suspended from a stick spanning an open bowl of deionized water using fishing line. Approximately 2.5 centimeters of headspace was between the liquid in the bowl and the bowl's rim. A sheet of plastic wrap was used as a dust cover over the apparatus. KEMRON recorded test specimen dimensions and weight before testing and recorded leaching interval times, leachate volume, pH, conductivity, and temperature for each interval.

CH2M processed laboratory-level test information (e.g., sample geometries, leaching intervals) provided by KEMRON and leachate analytical test results from Accutest Laboratories (Dayton, New Jersey) into a spreadsheet format suitable for upload into LeachXS, a database-driven software package specifically designed for data management and report facilitation of leaching test results. The LeachXS comparison output for each caisson included:

- pH of the leaching solution in SU as a function of test time
- Leaching solution COC concentrations in mg/L for each test fraction of the ANSI test
- Cumulative COC release in milligrams per square meter ($mg/m^2$) as a function of test time
- Mean COC interval flux in milligrams per square meter-second ($mg/m^2 s$) plotted as a function of cumulative time at the end of each ANSI test interval

The mean interval flux was calculated using the leachate concentration for the interval, the volume of leachate, and the test specimen surface area exposed to leachate:

$$F_i = C_i * \frac{V_i}{SA * \Delta t_i}$$

where $F_i$ is the interval flux over the test interval *i* from $t_{1-1}$ to $t_1$ (mg/m$^2$ s)
$C_i$ is the leachate concentration for test interval *i* (mg/L)
$V_i$ is the leachate volume for test interval *i* (L)
*SA* is the surface area of the test specimen (m$^2$)
$\Delta t_i$ is the duration of test interval *i* from $t_{1-1}$ to $t_1$ *(s)*

The cumulative mass release is summation of the total leached mass from the start of the test:

$$\Sigma R_i = \sum_{k=0}^{i} C_k * \frac{V_k}{SA}$$

where $\Sigma R_i$ is the cumulative mass release at the end of test interval *i* (mg/m$^2$)

#### 4.4.1.2 EPA Method 1312 – Synthetic Precipitation Leaching Procedure

One of the most commonly used regulatory leaching tests is USEPA Method 1312 (SPLP), which is an equilibrium-based extraction test intended to provide a solution that is representative of field leachates when a granular material is exposed to acidic precipitation in a near-surface disposal scenario. Unlike TCLP for which federal COC limits have been promulgated, no specific acceptability criteria for COC concentrations from SPLP are established, and the results of SPLP testing need to be interpreted with respect to the anticipated leaching scenario and applicable regulatory guidance.

When more than one sample was collected for analysis, the SPLP concentration results for a caisson and treatment step were averaged to provide a mean concentration (mg/L). The SPLP concentrations were plotted relative to the ANSI concentrations to help determine whether the ANSI interval water bath concentrations potentially approached equilibrium.

### 4.4.2 Leaching Test Results

Figures 10 and 11 present the ANSI testing results for Caissons 1 and 3, respectively. In general, the interval flux (mg/m$^2$ s) for untreated and treated material follows a decreasing trend, indicating that with time, leaching from the material surface decreases due to diffusion limitations. For simple diffusion, flux decreases proportionally with leaching time to the -½ power (shown as the decreasing grey line in the mean interval flux graph); conversely, the cumulative mass released (mg/m$^2$) increases with time and reaches an asymptotic level. For the simple diffusion case, cumulative release should increase proportionally with leaching time to the ½ power (shown as the grey line in the cumulative release graph) until the solid material at its core is depleted with respect to the diffusing COC. At the point of depletion, the flux decreases more rapidly than diffusion would predict, and the cumulative release would level off asymptotically to the total or available COC content.

Ideally, the effect of a treatment would be demonstrated by a decrease in the release of a COC after treatment. For untreated tar and ISS-treated tar, the release mechanisms differ between materials such that SPLP best represents release from the untreated case, and ANSI results best represent release from treated materials. This document estimates the effect of treatment based on comparisons of cumulative mass released (mg/m$^2$) derived from ANSI for treated data (monolithic form) to release derived from SPLP for untreated tar normalized to the test shape used in the ANSI tests.

SPLP concentration for the untreated tar material from Caissons 1 and 3 was normalized to the ANSI test results by calculating the equivalent mass release across the surface area of the ANSI test specimen (mg/m$^2$):

$$R_{SPLP} = C_{SPLP} * \frac{V_{ANSI}}{SA_{ANSI}}$$

where $R_{SPLP}$ is the equivalent SPLP mass release of a COC relative to an ANSI test (mg/m$^2$)

$C_{SPLP}$ is the COC concentration from the SPLP test (mg/L)
$V_{ANSI}$ is the mean leachate volume used in the ANSI test (L)
$SA_{ANSI}$ is the surface area of the ANSI test specimen ($m^2$)

Normalization to the ANSI test specimen allows for direct comparison of release from SPLP analysis, conducted over the 18-hour testing period, relative to the ANSI cumulative release as a function of test time.

A notable decrease in flux and associated flattening in cumulative mass release for all materials occurred at the same point in each ANSI test (i.e., when the leaching intervals were larger than 24 hours [e.g., after 5 days of testing]). This is likely related to loss of COCs through volatilization that would result in lower measured COC concentrations in the leaching solution and, hence, lower calculated amount of release from the test specimen than had actually occurred. Because volatilization losses are a function of concentration, more significant losses would be expected for higher concentration samples (i.e., untreated tar samples).

The cumulative mass release data ($mg/m^2$) for each caisson were used to calculate the percentage reduction in leaching. Percentage reductions were calculated using a standard percent difference (%Diff) formula between the release from a base case ( $R_{SPLP}$ *– SPLP results*) and the release from a treatment (*$R_2$ – ANSI results at 1 day of leaching time*).

$$\%\,\text{Diff} = \frac{R_{SPLP} - R_2}{R_{SPLP}} * 100\%$$

For example, the effectiveness of ISS treatment in Caisson 1 can be calculated as a percentage difference between the cumulative mass release value of the untreated tar ($R_{SPLP}$) and the ISS-treated material ($R_2$). Tables 11 and 12 show the percentage reduction values for benzene and TVOCs, respectively, for each caisson. Because naphthalene was not detected in the SPLP analysis in the untreated tar, no percent reduction calculations are presented. Figure 12 is a schematic showing the location of data on the cumulative release curve for the various comparisons.

Specific to the materials from each caisson, the following observations on the leaching result and percentage reductions may be made:

- Caisson 1 – For Caisson 1 (ISS only), the 1-day percentage reduction values indicate a reduction in benzene and TVOC leachability of approximately 98 percent.
- Caisson 3 – For Caisson 3 (ISTT followed by ISS), the 1-day percentage reduction values indicate a reduction in benzene and TVOC leachability of greater than 99 percent.

### 4.4.3 Limitations of the Current Evaluation

The uncertainties of the ANSI procedure and with respect to the OU8 pilot study results include:

- Volatilization – No provisions are in the ANSI procedure to minimize volatilization. The effect of volatilization losses would be more prevalent for materials with high leaching solution concentrations (e.g., untreated material from Caisson 1) and for test intervals greater than 1 day.
- Aqueous Solubility Limitations – An overarching assumption made in the ANSI testing, or any mass transfer test, is that the concentrations in the leaching solution are low relative to the concentrations within the test specimens so that the concentration gradient, the driving force for mass transport, is maximized and the test results reflect mass transport. For some low-solubility COCs, leaching intervals greater than approximately 1 day can lead to COC concentrations sufficiently close to the equilibrium point that mass transport is reduced. Although this limitation should not be significant for benzene, naphthalene, or TVOCs as the aqueous solubility is relatively

high, the solubility limitation may affect the measured leaching rates over the wider range of COCs analyzed for the ANSI test beyond those highlighted in this discussion.

# 4.5 Air Sampling Results

This subsection summarizes key observations related to ambient air monitoring and caisson headspace vapor sampling.

## 4.5.1 Real-time Ambient Air Monitoring

Real-time air monitoring was conducted during the pilot study at ten locations within two zones, as described below:

- Zone 1: Five real-time monitoring locations in the work area (Flexifloat platform, elevated bench, and impoundment berms)
- Zone 2: Five real-time stations at the perimeter of the site or near adjacent receptors

Each location was equipped with real-time monitoring equipment for VOCs using a photoionization detector (PID) and sulfur-bearing compounds using a Jerome Meter. Each Zone 1 station also was equipped with a unit to perform benzene speciation if the TVOC concentration was detected greater than defined notification levels (1,000 parts per billion). The air monitoring program used Greenlight, a proprietary computer-based environmental monitoring system, which used wireless telemetry to relay field measurements, in real-time, to a database. Along with the real-time monitoring, sampling for laboratory analysis was performed once every 3 weeks at key stations and at certain locations where elevated readings were observed to be associated with pilot study operations.

In general, ISS operations had limited adverse effects on ambient air. Over the 7-day period in which ISS was performed, the perimeter air monitoring system recorded two events from a nearby Zone 1 station that classified as Alarm events.

- May 30, 2014 During removal of the mixing auger following ISS mixing
- June 4, 2014 During removal of impoundment tar and placement in rolloff containers

Zone 2 stations did not record exceedances during these events. Upon alarm notification, field activities were modified to correct the conditions that attributed to the exceedances. In both cases, the ISS activities were associated with Caisson 1, with alarm conditions triggered by VOC results at Station C5 (located approximately 30 feet away from Caisson 1) on the Flexifloat platform. The May 30, 2014, monitoring excursion occurred while the auger was being lifted out from Caisson 1 following ISS mixing. The vapor extraction system was operating at that time and pulling vapors from all three caissons during ISS mixing in Caisson 1. However, Caisson 1 was disconnected from the vapor extraction system before opening the cover doors to remove the auger. The exposed material was lifted clear of the caisson and exposed to the wind, blowing the vapors toward Station C5 as described below.

The wind direction was from the west, and the activities occurring at Caisson 1 were upwind of Station C5, located approximately 30 feet to the east. The Station C5 reading was confirmed with a handheld PID. A bottlevac sample was collected near Station C5 to identify and quantify the VOCs. To mitigate the conditions, the mixing auger was covered with poly sheeting, and Rusmar foam was applied to the surface of the impoundment material within Caisson 1. USEPA representatives were onsite during this activity, and were immediately notified of the occurrence and the steps implemented to mitigate it. Table 13 provides details of these events.

## 4.5.2 Caisson Vapor Extraction during ISS Operations

The caissons were under continuous vacuum 24 hours per day during ISS operations except for those times when the caisson doors were opened for adding reagents or the lid was removed for excavation.

On June 2, 2014, during the curing period following primary ISS mixing, vapor samples were collected from each of the three caisson vapor extraction header pipes. The samples were collected within minutes of one another to test the vapor composition from each treatment scenario for comparison purposes. The vapor samples were collected with bottlevacs and analyzed for TO15 VOCs plus isopropylbenzene and reduced sulfur compounds by ASTM D5504. Table 14 summarizes the sample observations.

As anticipated, Caisson 3 impoundment material, which was subjected to both ISTT and ISS, exhibited the lowest concentration of TVOCs. Caisson 1, subjected to ISS only, exhibited the highest concentration of TVOCs. Although not listed in Table 14, Caisson 2, subjected to ISTT treatment only, exhibited the only detectable concentration of hydrogen sulfide, 3,400 micrograms per cubic meter. The absence of hydrogen sulfide detection in the Caisson 3 vapor sample may be attributable to higher and more consistent temperatures that were achieved in this caisson, allowing greater removal of hydrogen sulfide during ISTT. Caisson 1 exhibited the highest overall concentration of reduced sulfur compounds excluding hydrogen sulfide. The ISS treatment was effective at immobilizing hydrogen sulfide in Caisson 1. During the alarm events triggered by VOC concentrations while performing ISS and excavation on Caisson 1, neither hydrogen sulfide nor sulfur dioxide was not detected at concentration levels sufficient to trigger compound-specific monitoring badges worn by field personnel.

SECTION 5

# Conclusions

The key findings developed as part of the data evaluation are summarized below.

- The approved performance criteria for alternatives involving closure-in-place can be achieved through ISS treatment.
- ISS treatment resulted in greater than 98 percent reduction in benzene and TVOC leachability.
- The hydraulic conductivity of treated material within Caisson 1 was reduced to levels equal to or less than $1.5 \times 10^{-7}$ cm/s following primary and secondary mixing.
- The average mass reductions associated with ISS treatment in Caisson 1 for benzene, naphthalene, and TVOCs were 26, 72, and 27 percent, respectively.
- The addition of buffering agent raised the pH of treated materials from less than 2 SU to greater than 10 SU.
- ISS treatment effectively immobilized hydrogen sulfide such that no detected hydrogen sulfide emissions were from Caisson 1.
- The addition of ISS amendments to both untreated material and thermally treated material increased the UCS from 0 psi to greater than 50 psi, and the UCS values approximately doubled between the 28- and 56-day curing times for the primary ISS treatment.
- Controls for fugitive VOCs would be necessary for direct handling of impoundment material, including mixing untreated and thermally treated materials during ISS operations.

SECTION 6

# References


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# Tables

**Table 1. Caisson Sampling Summary**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Sample Purpose | Date | Caisson 1 | | Caisson 3 | |
|---|---|---|---|---|---|
| | | Samples | Description | Samples | Description |
| Baseline | November 2013 | 2 | Untreated impoundment material | 2 | Untreated impoundment material |
| Supplemental Baseline[A] | May 2014 | 6 | Untreated impoundment material | 9 | Post ISTT Operations |
| Post Solidification | May 2014 | 2 | Post ISS Operations | 2 | Post ISS Operations |
| Post Removal | June 2014 | 2 | Post Removal | 2 | Post Removal |
| Post Secondary Stabilization | June 2014 | 2 | Post Secondary Stabilization | 2 | Post Secondary Stabilization |

Notes:

[A] Supplemental baseline sampling was performed to refine uncertainty in two previously collected baseline samples, which showed significant variability of VOC concentrations based on two sample points.

**Table 2. Physical Properties Testing**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Sample Number | Stage | Cure Interval | Unconfined Compressive Strength ASTM D2166 | | | | | Hydraulic Conductivity (k) (cm/sec) ASTM D5084 | | | | | Loss on Ignition (Organic Content) ASTM D2974 | | | | | | Average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ASTM Moisture Content (%) | EPA Moisture Content (%) | Bulk Density ($lb/ft^3$) | Dry Density ($lb/ft^3$) | UCS ($lb/in^2$) | ASTM Moisture Content (%) | EPA Moisture Content (%) | Bulk Density ($lb/ft^3$) | Dry Density ($lb/ft^3$) | Hydraulic Conductivity (cm/sec) | Average ASTM Moisture Content (%) | Average EPA Moisture Content (%) | Average ASTM Moisture Content (DUP) (%) | Average EPA Moisture Content(DUP) (%) | Average Loss on Ignition (Mass %) | Average Loss on Ignition (DUP) | EPA Moisture Content (%) | |
| Untreated Tar Sample | | | | | | | | | | | | | | | | | | | | |
| NA | Average Historical* | N/A | N/A | N/A | 74.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| IMP2 - HC - Homogenized | Bench-Scale Test | N/A | N/A | N/A | N/A | N/A | 0 | N/A | N/A | N/A | N/A | VE | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Caisson #1 (ISS Only) | | | | | | | | | | | | | | | | | | | | |
| 053014-TAR-TC01A-060080 | Post ISS | 28 Day | 43.3 | 30.2 | 90.0 | 62.8 | 120.9 | 39.8 | 28.5 | 91.7 | 65.5 | 1.40E-08 | 51.9 | 34.1 | 48.4 | 32.6 | 29.1 | 28.1 | 31.4 | |
| | | 56 Day | 44.3 | 30.7 | 93.3 | 64.7 | 249.0 | 43.4 | 30.3 | 91.4 | 63.8 | 1.50E-07 | | | | | | | 31.9 | |
| 060514-TAR-TC01B | Post S/S | 28 Day | 67.57 | 40.3 | 86.2 | 51.5 | 16.0 | 67.0 | 40.1 | 84.2 | 50.4 | 1.10E-05 | 64.36 | 39.2 | 65.91 | 39.7 | 20.09 | 20.28 | 39.8 | |
| | | 56 Day | 62.72 | 38.6 | 81.1 | 49.9 | 33.9 | 69.2 | 40.9 | 84.3 | 49.8 | 8.50E-06 | | | | | | | 39.6 | |
| Caisson #2 (ISTT Only) | | | | | | | | | | | | | | | | | | | | |
| 052714-TAR-TC02B-0080090 | Post ISTT | N/A | 37.2 | 27.1 | 83.3 | 60.7 | 148.1 | 16.0 | 13.8 | 83.7 | 72.7 | 7.40E-06 | 26.5 | 21.0 | | | 59.0 | | 20.6 | |
| 052714-TAR-TC02C-090100 | Post ISTT | N/A | 28.9 | 22.4 | 72.8 | 56.5 | 23.1 | 27.5 | 21.6 | 76.4 | 59.9 | 3.20E-05 | 24.5 | 19.7 | 27.9 | 21.8 | 80.5 | 80.1 | 21.4 | |
| Caisson #3 (ISTT/ISS) | | | | | | | | | | | | | | | | | | | | |
| 052814-TAR-TC03C-030040 | Post ISTT | N/A | 50.4 | 33.5 | 82.2 | 54.7 | 9.1 | 50.2 | 33.4 | 80.4 | 53.5 | 3.40E-04 | 50.3 | 33.5 | | | 29.3 | | 33.5 | |
| 052814-TAR-TC03C-040050 | Post ISTT | N/A | 46.6 | 31.8 | 85.7 | 58.5 | 56.2 | 45.7 | 31.4 | 84.6 | 58.1 | 3.20E-05 | 51.6 | 34.0 | 50.2 | 33.4 | 31.9 | 31.5 | 32.7 | |
| 052914-TAR-TC03-000080 | Post ISS | 28 Day | 81.7 | 45.0 | 80.7 | 44.4 | 62.8 | 73.0 | 42.2 | 85.1 | 49.2 | 1.60E-06 | 97.9 | 49.4 | 93.3 | 48.2 | 31.5 | 32.8 | 46.2 | |
| | | 56 Day | 90.0 | 47.4 | 83.2 | 43.8 | 167.7 | 93.2 | 48.2 | 78.7 | 40.7 | 3.50E-07 | | | | | | | 48.3 | |
| 060414-TAR-TC03C | Post S/S | 28 Day | 60.8 | 37.8 | 85.7 | 53.3 | 224.5 | 54.6 | 35.3 | 83.7 | 54.1 | 2.90E-07 | 62.66 | 38.6 | 59.44 | 37.3 | 18.54 | 19.66 | 37.3 | |
| | | 56 Day | 62.3 | 38.4 | 86.2 | 53.1 | 197.5 | 60.4 | 37.6 | 86.0 | 53.6 | 8.70E-08 | | | | | | | 38.0 | |

Notes:
% = percent
$lb/ft^3$ = pounds per square feet
$lb/in^2$ = pounds per square inch
cm/sec = centimeter per seconds
ASTM Moisture Content=Weight of Water/Dry Weight of Sample
EPA Moistture Content=Weight of Water/Wet Weight of Sample
N/A= Not applicable, Sample would not compact for UCS Testing
ISS = In-Situ Stabilization/Solidification
ISTT = In-Situ Thermal Treatment
S/S = Stabilization/Solidification (ex-situ)
VE = volatiles expanded causing material to expand becoming untestable.
*Bulk Density Value is average value reported in September 26, 2011 Treatment Alternatives Evaluation report by Focus Environmenta

**Table 3. UCS Measurements for Impoundment 2 Materials following ISS**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| | | |
|---|---|---|
| **Caisson 1:** | | |
| Untreated Sample: | 0.0 psi | |
| Post-ISS Sample: | 120.9 psi (28 days) | 249.0 psi (56 days) |
| Post-Secondary Mix Sample: | 16.0 psi (28 days) | 33.9 psi (56 days) |
| **Caisson 3:** | | |
| Untreated Sample: | 0.0 psi | |
| Post-ISTT Sample (3 to 4 feet depth): | 9.1 psi | |
| Post-ISTT Sample (4 to 5 feet depth): | 56.2 psi | |
| Post-ISS Sample: | 62.8 psi (28 days) | 167.7 psi (56 days) |
| Post-Secondary Mix Sample: | 224.5 psi (28 days) | 197.5 psi (56 days) |

**Table 4. Caisson 1 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #1 | | | | | | | | | | | ROLL OFF | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | 5/20/2014 | | | | | | 5/30/2014 | 5/30/2014 | | 6/4/2014 | | | 6/5/2014 | 6/5/2014 | |
| Treatment Stage | | Pre-ISS (Untreated Tar) | | | | | | | | | POST 1st MIX | | Post Removal (Post 1st, Pre 2nd) | | | | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | A - 0-0.8' | A - 0.8-2.6' | A - 2.6-5.3' | B - 0-0.1' | B - 1.9-2.7' | B - 4.2-5.6' | | A - 6-8' | B - 6-8' | NA | NA | N/A | | NA | NA |
| Parameter | Unit | 112113-TAR-TC01-0012 (Encore) | 112113-TAR-TC01-0012 (Terracore) | 052014-VR-TC01A-000008 | 052014-INT-TC01A-008026 | 052014-HC-TC01A-026053 | 052014-VR-TC01B-000001 | 052014-INT-TC01B-019027 | 052014-HC-TC01B-042056 | | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060414-TAR-TC01A | 060414-TAR-TC01A-D | 060414-TAR-TC01B | | 060514-TAR-TC01B | 060514-TAR-TC01B-D |
| **VOCs** | | | | | | | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | ug/kg | < 9760 | **54200 J** | < 40000 | < 43000 | < 4600 | **4670 J** | < 110000 | < 110000 | | < 7000 | < 8100 | **460 J** | **424 J** | -- | | < 3700 | < 840 |
| 1,1,2,2-TETRACHLOROETHANE | ug/kg | -- | < 9700 | < 47000 | < 51000 | < 5500 | < 3900 | < 130000 | < 130000 | | < 8300 | < 9600 | < 410 | < 390 | -- | | < 4400 | < 1000 |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | ug/kg | < 22400 | < 20700 | < 60000 | < 65000 | < 7000 | < 4900 | < 170000 | < 160000 | | < 11000 | < 12000 | < 520 | < 500 | -- | | < 5600 | < 1300 |
| 1,1,2-TRICHLOROETHANE | ug/kg | < 3860 | < 3560 | < 110000 | < 120000 | < 13000 | < 9200 | < 310000 | < 300000 | | < 20000 | < 23000 | < 970 | < 950 | -- | | < 11000 | < 2400 |
| 1,1-DICHLOROETHANE | ug/kg | < 5810 | < 5350 | < 43000 | < 47000 | < 5000 | < 3500 | < 120000 | < 110000 | | < 7700 | < 8800 | < 370 | < 360 | -- | | < 4100 | < 920 |
| 1,1-DICHLOROETHENE | ug/kg | < 13700 | < 12600 | < 40000 | < 43000 | < 4600 | < 3200 | < 110000 | < 110000 | | < 7000 | < 8100 | < 340 | < 330 | -- | | < 3700 | < 840 |
| 1,2,3-TRICHLOROBENZENE | ug/kg | < 21700 | < 20000 | < 29000 | < 31000 | < 3300 | < 2300 | < 79000 | < 76000 | | < 5000 | < 5800 | < 250 | < 240 | -- | | < 2700 | < 600 |
| 1,2,4-TRICHLOROBENZENE | ug/kg | < 18400 | **316,000** | < 25000 | < 27000 | < 2900 | < 2000 | < 69000 | < 66000 | | < 4400 | < 5100 | < 210 | **1440 J** | -- | | < 2300 | < 530 |
| 1,2-DIBROMO-3-CHLOROPROPANE | ug/kg | < 17200 | < 15800 | < 180000 | < 200000 | < 21000 | < 15000 | < 510000 | < 490000 | | < 32000 | < 37000 | < 1600 | < 1500 | -- | | < 17000 | < 3900 |
| 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) | ug/kg | < 12400 | < 11400 | < 76000 | < 82000 | < 8800 | < 6200 | < 210000 | < 200000 | | < 13000 | < 15000 | < 650 | < 630 | -- | | < 7100 | < 1600 |
| 1,2-DICHLOROBENZENE | ug/kg | **2,050,000** | **18500000 J** | **2,430,000** | **5,700,000** | **486,000** | **2,250,000** | **1110000 J** | **449000 J** | | **686,000** | **831,000** | **814,000** | **722,000** | -- | | **517,000** | **498,000** |
| 1,2-DICHLOROETHANE | ug/kg | < 11900 | < 11000 | < 44000 | < 48000 | < 5100 | < 3600 | < 120000 | < 120000 | | < 7800 | < 9000 | < 380 | < 370 | -- | | < 4100 | < 940 |
| 1,2-DICHLOROPROPANE | ug/kg | < 4590 | < 4230 | < 60000 | < 65000 | < 7000 | < 4900 | < 170000 | < 160000 | | < 11000 | < 12000 | < 520 | < 500 | -- | | < 5600 | < 1300 |
| 1,3-DICHLOROBENZENE | ug/kg | **33700 J** | **296,000** | **36000 J** | **76600 J** | **7530 J** | **38300 J** | < 83000 | < 80000 | | **9910 J** | **12600 J** | **12,200** | **11,400** | -- | | **7520 J** | **7640 J** |
| 1,4-DICHLOROBENZENE | ug/kg | **154000 J** | **1,630,000** | **203000 J** | **456000 J** | **40100 J** | **220,000** | < 95000 | < 92000 | | **55700 J** | **66700 J** | **67,800** | **63,200** | -- | | **44200 J** | **43,400** |
| 1,4-DIOXANE (P-DIOXANE) | ug/kg | -- | -- | < 11000000 | < 11000000 | < 1200000 | < 860000 | < 29000000 | < 28000000 | | < 1900000 | < 2100000 | < 91000 | < 88000 | -- | | < 990000 | < 220000 |
| 2-HEXANONE | ug/kg | < 17800 | < 16400 | < 250000 | < 270000 | < 28000 | < 20000 | < 680000 | < 650000 | | < 43000 | < 50000 | < 2100 | < 2100 | -- | | < 23000 | < 5200 |
| ACETONE | ug/kg | **72600 J** | **305000 J** | < 630000 | < 680000 | **309,000** | < 51000 | < 1700000 | < 1700000 | | < 110000 | < 130000 | **61,300** | **55,800** | -- | | < 59000 | **55,700** |
| BENZENE | ug/kg | **50,500,000** | **335,000,000** | **43,800,000** | **140,000,000** | **62,400,000** | **36,000,000** | **70,100,000** | **55,800,000** | | **18,600,000** | **28,300,000** | **27,600,000** | **20,700,000** | -- | | **16,800,000** | **13,200,000** |
| BROMOCHLOROMETHANE | ug/kg | < 20000 | < 18400 | < 72000 | < 78000 | < 8300 | < 5800 | < 200000 | < 190000 | | < 13000 | < 15000 | < 620 | < 600 | -- | | < 6700 | < 1500 |
| BROMODICHLOROMETHANE | ug/kg | < 6240 | < 5750 | < 39000 | < 42000 | < 4500 | < 3200 | < 110000 | < 100000 | | < 6800 | < 7900 | < 330 | < 320 | -- | | < 3600 | < 820 |
| BROMOFORM | ug/kg | < 26300 | < 24300 | < 36000 | < 39000 | < 4200 | < 3000 | < 100000 | < 96000 | | < 6400 | < 7400 | < 310 | < 300 | -- | | < 3400 | < 760 |
| BROMOMETHANE | ug/kg | < 29300 | < 27000 | < 66000 | < 72000 | < 7700 | < 5400 | < 180000 | < 180000 | | < 12000 | < 14000 | < 570 | < 560 | -- | | < 6200 | < 1400 |
| CARBON DISULFIDE | ug/kg | < 11300 | **435,000** | **53700 J** | **154000 J** | < 2300 | **55200 J** | < 54000 | < 52000 | | < 3400 | < 4000 | **1030 J** | **1250 J** | -- | | < 1800 | < 410 |
| CARBON TETRACHLORIDE | ug/kg | < 11400 | < 10500 | < 35000 | < 38000 | < 4000 | < 2800 | < 95000 | < 92000 | | < 6100 | < 7100 | < 300 | < 290 | -- | | < 3200 | < 730 |
| CHLOROBENZENE | ug/kg | **20500 J** | **152000 J** | < 27000 | < 30000 | < 3100 | **16600 J** | < 75000 | < 72000 | | < 4800 | < 5500 | **3900 J** | **3620 J** | -- | | < 2500 | **2530 J** |
| CHLOROETHANE | ug/kg | < 12100 | < 11200 | < 140000 | < 150000 | < 16000 | < 11000 | < 380000 | < 360000 | | < 24000 | < 28000 | < 1200 | < 1100 | -- | | < 13000 | < 2900 |
| CHLOROFORM | ug/kg | < 10400 | < 9580 | < 35000 | < 38000 | < 4100 | < 2900 | < 96000 | < 93000 | | < 6200 | < 7100 | < 300 | < 290 | -- | | < 3300 | < 740 |
| CHLOROMETHANE | ug/kg | < 11600 | < 10700 | < 47000 | < 51000 | **66300 J** | < 3900 | < 130000 | < 130000 | | < 8400 | < 9600 | < 410 | < 400 | -- | | < 4400 | < 1000 |
| CIS-1,2-DICHLOROETHYLENE | ug/kg | < 6870 | < 6340 | < 29000 | < 31000 | < 3300 | < 2300 | < 79000 | < 76000 | | < 5000 | < 5800 | < 250 | < 240 | -- | | < 2700 | < 600 |
| CIS-1,3-DICHLOROPROPENE | ug/kg | < 7780 | < 7180 | < 31000 | < 34000 | < 3600 | < 2600 | < 86000 | < 83000 | | < 5500 | < 6400 | < 270 | < 260 | -- | | < 2900 | < 660 |
| CYCLOHEXANE | ug/kg | **20700 J** | **165000 J** | < 35000 | < 39000 | **10700 J** | **16100 J** | < 98000 | < 94000 | | < 6300 | < 7200 | **7,150** | **6,660** | -- | | **4650 J** | **4810 J** |
| DIBROMOCHLOROMETHANE | ug/kg | < 15100 | < 13900 | < 33000 | < 36000 | < 3900 | < 2700 | < 92000 | < 89000 | | < 5900 | < 6800 | < 290 | < 280 | -- | | < 3100 | < 710 |
| DICHLORODIFLUOROMETHANE | ug/kg | < 13500 | < 12400 | < 49000 | < 53000 | < 5600 | < 4000 | < 130000 | < 130000 | | < 8600 | < 9900 | < 420 | < 410 | -- | | < 4600 | < 1000 |
| ETHYLBENZENE | ug/kg | **166000 J** | **1,680,000** | **187,000** | **471,000** | **105,000** | **183,000** | **167000 J** | **93600 J** | | **62,500** | **85,400** | **81,600** | **76,400** | -- | | **53,700** | **52,900** |
| ISOPROPYLBENZENE (CUMENE) | ug/kg | **326,000** | **3,980,000** | **374000 J** | **1,030,000** | **257,000** | **387,000** | **350000 J** | **250000 J** | | **145,000** | **184,000** | **201,000** | **188,000** | -- | | **123,000** | **124,000** |
| M,P-XYLENE (SUM OF ISOMERS) | ug/kg | **1,710,000** | **17,700,000** | **1,820,000** | **4,820,000** | **1,030,000** | **1,890,000** | **1,540,000** | **936,000** | | **638,000** | **837,000** | **803,000** | **719,000** | -- | | **515,000** | **502,000** |
| METHYL ACETATE | ug/kg | **259000 J** | **1,240,000** | < 230000 | **782,000** | **2,220,000** | **64,800** | **2,780,000** | **2,900,000** | | < 41000 | < 47000 | < 2000 | < 1900 | -- | | < 22000 | < 4900 |
| METHYL ETHYL KETONE (2-BUTANONE) | ug/kg | < 19400 | **74000 J** | < 610000 | < 660000 | < 70000 | < 50000 | < 1700000 | < 1600000 | | < 110000 | < 120000 | < 5200 | < 5100 | -- | | < 57000 | < 13000 |
| METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE) | ug/kg | < 9290 | < 8570 | < 180000 | < 200000 | < 21000 | < 15000 | < 500000 | < 480000 | | < 32000 | < 37000 | < 1600 | < 1500 | -- | | < 17000 | < 3800 |
| METHYLCYCLOHEXANE | ug/kg | **35700 J** | **321,000** | **39600 J** | **96900 J** | **15300 J** | **39900 J** | < 62000 | < 60000 | | **8110 J** | **12400 J** | **15,700** | **14,900** | -- | | **8650 J** | **9610 J** |
| METHYLENE CHLORIDE | ug/kg | < 30800 | < 28400 | < 230000 | < 250000 | < 27000 | < 19000 | < 650000 | < 620000 | | < 41000 | < 48000 | < 2000 | < 2000 | -- | | < 22000 | < 5000 |
| O-XYLENE (1,2-DIMETHYLBENZENE) | ug/kg | **462,000** | **5,170,000** | **500,000** | **1,300,000** | **257,000** | **508,000** | **388,000** | **234000 J** | | **170,000** | **224,000** | **203,000** | **190,000** | -- | | **136,000** | **132,000** |
| STYRENE | ug/kg | < 5020 | < 4630 | < 32000 | < 35000 | < 3700 | < 2600 | < 88000 | < 85000 | | < 5700 | < 6500 | < 280 | < 270 | -- | | < 3000 | < 680 |
| TERT-BUTYL METHYL ETHER | ug/kg | < 3670 | < 3380 | < 47000 | < 51000 | < 5500 | < 3900 | < 130000 | < 130000 | | < 8400 | < 9600 | < 410 | < 400 | -- | | < 4400 | < 1000 |
| TETRACHLOROETHYLENE (PCE) | ug/kg | < 17800 | < 16400 | < 57000 | < 61000 | < 6600 | < 4600 | < 160000 | < 150000 | | < 10000 | < 12000 | < 490 | < 470 | -- | | < 5300 | < 1200 |
| TOLUENE | ug/kg | **11,100,000** | **70,800,000** | **9,720,000** | **27,300,000** | **10,200,000** | **8,410,000** | **11,600,000** | **8,380,000** | | **3,660,000** | **5,160,000** | **4,440,000** | **3,990,000** | -- | | **3,150,000** | **2,500,000** |
| TRANS-1,2-DICHLOROETHENE | ug/kg | < 7170 | < 6620 | < 58000 | < 63000 | < 6800 | < 4800 | < 160000 | < 150000 | | < 10000 | < 12000 | < 500 | < 490 | -- | | < 5500 | < 1200 |
| TRANS-1,3-DICHLOROPROPENE | ug/kg | < 4950 | < 4560 | < 37000 | < 40000 | < 4300 | < 3000 | < 100000 | < 99000 | | < 6600 | < 7600 | < 320 | < 310 | -- | | < 3500 | < 790 |
| TRICHLOROETHYLENE (TCE) | ug/kg | < 7660 | < 7060 | < 48000 | < 52000 | < 5600 | < 3900 | < 130000 | < 130000 | | < 8500 | < 9800 | < 420 | < 400 | -- | | < 4500 | < 1000 |
| TRICHLOROFLUOROMETHANE | ug/kg | < 7780 | < 7180 | < 31000 | < 34000 | < 3600 | < 2500 | < 85000 | < 82000 | | < 5500 | < 6300 | < 270 | < 260 | -- | | < 2900 | < 660 |
| VINYL CHLORIDE | ug/kg | < 11700 | < 10800 | < 47000 | < 51000 | < 5500 | < 3900 | < 130000 | < 130000 | | < 8300 | < 9600 | < 410 | < 390 | -- | | < 4400 | < 1000 |
| Total VOC (SUM of VOCs) | ug/kg | **66,910,200** | **457,818,200** | **59,163,300** | **182,186,500** | **77,403,930** | **50,083,570** | **88,035,000** | **69,042,600** | | **24,035,220** | **35,713,100** | **34,312,140** | **26,744,094** | -- | | **21,359,720** | **17,132,590** |

**Table 4. Caisson 1 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #1 | | | | | | | | | | | ROLL OFF | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | 5/20/2014 | | | | | | 5/30/2014 | 5/30/2014 | | 6/4/2014 | | | 6/5/2014 | 6/5/2014 | |
| Treatment Stage | | Pre-ISS (Untreated Tar) | | | | | | | | | POST 1st MIX | | Post Removal (Post 1st, Pre 2nd) | | | | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | A - 0-0.8' | A - 0.8-2.6' | A - 2.6-5.3' | B - 0-0.1' | B - 1.9-2.7' | B - 4.2-5.6' | | A - 6-8' | B - 6-8' | NA | NA | N/A | | NA | NA |
| Parameter | Unit | 112113-TAR-TC01-0012 (Encore) | 112113-TAR-TC01-0012 (Terracore) | 052014-VR-TC01A-000008 | 052014-INT-TC01A-008026 | 052014-HC-TC01A-026053 | 052014-VR-TC01B-000001 | 052014-INT-TC01B-019027 | 052014-HC-TC01B-042056 | | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060414-TAR-TC01A | 060414-TAR-TC01A-D | 060414-TAR-TC01B | | 060514-TAR-TC01B | 060514-TAR-TC01B-D |
| **SVOCs** | | | | | | | | | | | | | | | | | | |
| 1,2,4,5-TETRACHLOROBENZENE | ug/kg | -- | < 43600 | -- | -- | -- | -- | -- | -- | | < 78 | < 84 | < 160 | < 160 | -- | | < 170 | < 170 |
| 2,2-OXYBIS(2-CHLOROPROPANE) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | < 76 | < 81 | < 150 | < 160 | -- | | < 170 | < 160 |
| 2,3,4,6-TETRACHLOROPHENOL | ug/kg | -- | < 55100 | -- | -- | -- | -- | -- | -- | | < 260 | < 280 | < 530 | < 550 | -- | | < 590 | < 560 |
| 2,4,5-TRICHLOROPHENOL | ug/kg | -- | < 55600 | -- | -- | -- | -- | -- | -- | | < 300 | < 320 | < 600 | < 620 | -- | | < 660 | < 630 |
| 2,4,6-TRICHLOROPHENOL | ug/kg | -- | < 62000 | -- | -- | -- | -- | -- | -- | | < 240 | < 260 | < 480 | < 500 | -- | | < 540 | < 510 |
| 2,4-DICHLOROPHENOL | ug/kg | -- | < 50700 | -- | -- | -- | -- | -- | -- | | < 410 J | < 440 J | < 830 | < 860 | -- | | < 920 | < 870 |
| 2,4-DIMETHYLPHENOL | ug/kg | -- | < 34900 | -- | -- | -- | -- | -- | -- | | < 430 J | < 460 J | < 860 | < 890 | -- | | < 960 | < 910 |
| 2,4-DINITROPHENOL | ug/kg | -- | < 120000 | -- | -- | -- | -- | -- | -- | | < 310 | < 330 | < 630 | < 650 | -- | | < 690 | < 660 |
| 2,4-DINITROTOLUENE | ug/kg | -- | < 35900 | -- | -- | -- | -- | -- | -- | | < 110 | < 120 | < 220 | < 230 | -- | | < 250 | < 240 |
| 2,6-DINITROTOLUENE | ug/kg | -- | < 65800 | -- | -- | -- | -- | -- | -- | | < 97 | < 100 | < 200 | < 200 | -- | | < 220 | < 210 |
| 2-CHLORONAPHTHALENE | ug/kg | -- | < 56200 | -- | -- | -- | -- | -- | -- | | < 79 | < 84 | < 160 | < 160 | -- | | < 180 | < 170 |
| 2-CHLOROPHENOL | ug/kg | -- | < 38700 | -- | -- | -- | -- | -- | -- | | < 260 | < 270 | < 510 | < 530 | -- | | < 570 | < 540 |
| 2-METHYLNAPHTHALENE | ug/kg | -- | **1390000 J** | -- | -- | -- | -- | -- | -- | | -- | **246,000** | **222,000** | **209,000** | -- | | **194,000** | **166,000** |
| 2-METHYLPHENOL (O-CRESOL) | ug/kg | -- | < 54600 | -- | -- | -- | -- | -- | -- | | < 290 | < 310 | < 590 | < 610 | -- | | < 650 | < 610 |
| 2-NITROANILINE | ug/kg | -- | < 22400 | -- | -- | -- | -- | -- | -- | | < 110 | < 120 | < 230 | < 230 | -- | | < 250 | < 240 |
| 2-NITROPHENOL | ug/kg | -- | < 63100 | -- | -- | -- | -- | -- | -- | | < 270 J | < 290 J | < 550 | < 560 | -- | | < 600 | < 570 |
| 3- AND 4- METHYLPHENOL (TOTAL) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | < 320 | < 350 | < 650 | < 670 | -- | | < 720 | < 680 |
| 3,3'-DICHLOROBENZIDINE | ug/kg | -- | < 169000 | -- | -- | -- | -- | -- | -- | | < 65 | < 69 | < 130 | < 130 | -- | | < 140 | < 140 |
| 3-NITROANILINE | ug/kg | -- | < 24000 | -- | -- | -- | -- | -- | -- | | < 100 | < 110 | < 210 | < 210 | -- | | < 230 | < 220 |
| 4,6-DINITRO-2-METHYLPHENOL | ug/kg | -- | < 95200 | -- | -- | -- | -- | -- | -- | | < 310 | < 330 | < 630 | < 650 | -- | | < 690 | < 660 |
| 4-BROMOPHENYL PHENYL ETHER | ug/kg | -- | < 56200 | -- | -- | -- | -- | -- | -- | | < 93 | < 99 | < 190 | < 190 | -- | | < 210 | < 200 |
| 4-CHLORO-3-METHYLPHENOL | ug/kg | -- | < 39700 | -- | -- | -- | -- | -- | -- | | < 260 J | < 270 J | < 510 | < 530 | -- | | < 570 | < 540 |
| 4-CHLOROANILINE | ug/kg | -- | < 33900 | -- | -- | -- | -- | -- | -- | | < 82 J | < 87 J | < 160 | < 170 | -- | | < 180 | < 170 |
| 4-CHLOROPHENYL PHENYL ETHER | ug/kg | -- | < 39300 | -- | -- | -- | -- | -- | -- | | < 77 | < 82 | < 150 | < 160 | -- | | < 170 | < 160 |
| 4-NITROANILINE | ug/kg | -- | < 22700 | -- | -- | -- | -- | -- | -- | | < 100 | < 110 | < 200 | < 210 | -- | | < 220 | < 210 |
| 4-NITROPHENOL | ug/kg | -- | < 112000 | -- | -- | -- | -- | -- | -- | | < 430 | < 460 | < 870 | < 900 | -- | | < 960 | < 910 |
| ACENAPHTHENE | ug/kg | -- | **267000 J** | -- | -- | -- | -- | -- | -- | | **18,400** | **50,800** | **8,600** | **7,190** | -- | | **6,890** | **6,550** |
| ACENAPHTHYLENE | ug/kg | -- | < 36100 | -- | -- | -- | -- | -- | -- | | < 82 | < 87 | < 160 | < 170 | -- | | < 180 | < 170 |
| ACETOPHENONE | ug/kg | -- | < 52700 | -- | -- | -- | -- | -- | -- | | **242,000** | **407,000** | **443,000** | **418,000** | -- | | **313,000** | **332,000** |
| ANILINE | ug/kg | -- | < 120000 | -- | -- | -- | -- | -- | -- | | **47,300** | **215,000** | **138000 J** | **170000 J** | -- | | **96000 J** | **83300 J** |
| ANTHRACENE | ug/kg | -- | < 36300 | -- | -- | -- | -- | -- | -- | | < 89 | < 95 | < 180 | < 190 | -- | | < 200 | < 190 |
| ATRAZINE | ug/kg | -- | < 37100 | -- | -- | -- | -- | -- | -- | | < 50 | < 54 | < 100 | < 100 | -- | | < 110 | < 110 |
| BENZALDEHYDE | ug/kg | -- | < 171000 | -- | -- | -- | -- | -- | -- | | < 59 | < 63 | < 120 | < 120 | -- | | < 130 | < 120 |
| BENZO(A)ANTHRACENE | ug/kg | -- | < 32900 | -- | -- | -- | -- | -- | -- | | < 83 | < 89 | **1,290** | < 170 | -- | | < 190 | **2,430** |
| BENZO(A)PYRENE | ug/kg | -- | < 22100 | -- | -- | -- | -- | -- | -- | | < 78 | < 83 | < 160 | < 160 | -- | | < 170 | **815** |
| BENZO(B)FLUORANTHENE | ug/kg | -- | < 34900 | -- | -- | -- | -- | -- | -- | | < 85 | < 91 | < 170 | < 180 | -- | | < 190 | < 180 |
| BENZO(G,H,I)PERYLENE | ug/kg | -- | < 26700 | -- | -- | -- | -- | -- | -- | | < 95 | < 100 | < 190 | < 200 | -- | | < 210 | < 200 |
| BENZO(K)FLUORANTHENE | ug/kg | -- | < 27300 | -- | -- | -- | -- | -- | -- | | < 96 | < 100 | < 190 | < 200 | -- | | < 210 | < 200 |
| BENZYL BUTYL PHTHALATE | ug/kg | -- | < 35200 | -- | -- | -- | -- | -- | -- | | < 150 | < 160 | < 300 | < 310 | -- | | < 330 | < 310 |
| BIPHENYL (DIPHENYL) | ug/kg | -- | < 26100 | -- | -- | -- | -- | -- | -- | | **13,000** | **21,300** | **15,800** | **15,200** | -- | | **14,400** | **13,100** |
| BIS(2-CHLOROETHOXY) METHANE | ug/kg | -- | < 30800 | -- | -- | -- | -- | -- | -- | | < 100 J | < 110 J | < 210 | < 210 | -- | | < 230 | < 220 |
| BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER) | ug/kg | -- | < 68500 | -- | -- | -- | -- | -- | -- | | < 77 | < 82 | < 150 | < 160 | -- | | < 170 | < 160 |
| BIS (2-CHLOROISOPROPYL)ETHER | ug/kg | -- | <38700 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | -- | -- |
| BIS(2-ETHYLHEXYL) PHTHALATE | ug/kg | -- | < 25000 | -- | -- | -- | -- | -- | -- | | < 230 | < 240 | < 450 | < 470 | -- | | < 500 | < 480 |
| CAPROLACTAM | ug/kg | -- | < 78100 | -- | -- | -- | -- | -- | -- | | < 80 J | < 86 J | < 160 | < 170 | -- | | < 180 | < 170 |
| CARBAZOLE | ug/kg | -- | < 34100 | -- | -- | -- | -- | -- | -- | | < 120 | < 130 | < 240 | < 250 | -- | | < 260 | < 250 |
| CHRYSENE | ug/kg | -- | < 38200 | -- | -- | -- | -- | -- | -- | | < 86 | < 92 | **1,370** | < 180 | -- | | < 190 | **2,260** |
| DIBENZ(A,H)ANTHRACENE | ug/kg | -- | < 25400 | -- | -- | -- | -- | -- | -- | | < 87 | < 93 | < 180 | < 180 | -- | | < 190 | < 180 |
| DIBENZOFURAN | ug/kg | -- | < 33600 | -- | -- | -- | -- | -- | -- | | **17,000** | **19,500** | < 150 | **7,250** | -- | | **7,100** | **6,690** |
| DIETHYL PHTHALATE | ug/kg | -- | < 65300 | -- | -- | -- | -- | -- | -- | | < 87 | < 93 | < 180 | < 180 | -- | | < 190 | < 180 |
| DIMETHYL PHTHALATE | ug/kg | -- | < 27500 | -- | -- | -- | -- | -- | -- | | < 90 | < 96 | < 180 | < 190 | -- | | < 200 | < 190 |
| DI-N-BUTYL PHTHALATE | ug/kg | -- | < 34100 | -- | -- | -- | -- | -- | -- | | < 57 | < 60 | < 110 | < 120 | -- | | < 130 | < 120 |
| DI-N-OCTYLPHTHALATE | ug/kg | -- | < 23400 | -- | -- | -- | -- | -- | -- | | < 120 | < 130 | < 250 | < 260 | -- | | < 280 | < 260 |
| FLUORANTHENE | ug/kg | -- | < 28700 | -- | -- | -- | -- | -- | -- | | **4,050** | **5,880** | **4,300** | **4,060** | -- | | **3,830** | **8,420** |
| FLUORENE | ug/kg | -- | **6,280,000** | -- | -- | -- | -- | -- | -- | | < 84 | < 89 | < 170 | < 170 | -- | | < 190 | < 180 |
| HEXACHLOROBENZENE | ug/kg | -- | < 68500 | -- | -- | -- | -- | -- | -- | | < 83 | < 89 | < 170 | < 170 | -- | | < 190 | < 180 |
| HEXACHLOROBUTADIENE | ug/kg | -- | < 46700 | -- | -- | -- | -- | -- | -- | | < 71 J | < 76 J | < 140 | < 150 | -- | | < 160 | < 150 |
| HEXACHLOROCYCLOPENTADIENE | ug/kg | -- | < 374000 | -- | -- | -- | -- | -- | -- | | < 260 | < 280 | < 520 | < 540 | -- | | < 580 | < 550 |
| HEXACHLOROETHANE | ug/kg | -- | < 84000 | -- | -- | -- | -- | -- | -- | | < 71 | < 76 | < 140 | < 150 | -- | | < 160 | < 150 |
| INDENO(1,2,3-C,D)PYRENE | ug/kg | -- | < 42500 | -- | -- | -- | -- | -- | -- | | < 89 | < 94 | < 180 | < 180 | -- | | < 200 | < 190 |
| ISOPHORONE | ug/kg | -- | < 31400 | -- | -- | -- | -- | -- | -- | | < 69 J | < 73 J | < 140 | < 140 | -- | | < 150 | < 140 |
| M,P-CRESOL | ug/Kg | -- | < 66300 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | -- | -- |
| NAPHTHALENE | ug/kg | -- | **24,600,000** | -- | -- | -- | -- | -- | -- | | **2,740,000** | **4,010,000** | **4,340,000** | **4,000,000** | -- | | **3,550,000** | **3,340,000** |

PRIMARY ISS MIXING

REMOVAL

SECONDARY ISS MIXING

**Table 4. Caisson 1 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #1 | | | | | | | | | | | ROLL OFF | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | 5/20/2014 | | | | | | 5/30/2014 | 5/30/2014 | 6/4/2014 | 6/4/2014 | | | 6/5/2014 | 6/5/2014 | |
| Treatment Stage | | Pre-ISS (Untreated Tar) | | | | | | | | | POST 1st MIX | | Post Removal (Post 1st, Pre 2nd) | | | | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | A - 0-0.8' | A - 0.8-2.6' | A - 2.6-5.3' | B - 0-0.1' | B - 1.9-2.7' | B - 4.2-5.6' | | A - 6-8' | B - 6-8' | NA | NA | N/A | | NA | NA |
| Parameter | Unit | 112113-TAR-TC01-0012 (Encore) | 112113-TAR-TC01-0012 (Terracore) | 052014-VR-TC01A-000008 | 052014-INT-TC01A-008026 | 052014-HC-TC01A-026053 | 052014-VR-TC01B-000001 | 052014-INT-TC01B-019027 | 052014-HC-TC01B-042056 | | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060414-TAR-TC01A | 060414-TAR-TC01A-D | 060414-TAR-TC01B | | 060514-TAR-TC01B | 060514-TAR-TC01B-D |
| NITROBENZENE | ug/kg | -- | < 92000 | -- | -- | -- | -- | -- | -- | | < 74 J | < 79 J | < 150 | < 150 | -- | | < 160 | < 160 |
| N-NITROSODI-N-PROPYLAMINE | ug/kg | -- | < 77000 | -- | -- | -- | -- | -- | -- | | < 62 | < 66 | < 130 | < 130 | -- | | < 140 | < 130 |
| N-NITROSODIPHENYLAMINE | ug/kg | -- | < 37300 | -- | -- | -- | -- | -- | -- | | < 150 | < 160 | < 310 | < 320 | -- | | < 340 | < 320 |
| PENTACHLOROPHENOL | ug/kg | -- | < 39500 | -- | -- | -- | -- | -- | -- | | < 440 | < 470 | < 880 | < 910 | -- | | < 970 | < 920 |
| PHENANTHRENE | ug/kg | -- | < 40500 | -- | -- | -- | -- | -- | -- | | **19,600** | **22,700** | **38,200** | **39,400** | -- | | **33,400** | **36,300** |
| PHENOL | ug/kg | -- | < 48700 | -- | -- | -- | -- | -- | -- | | < 270 | < 290 | < 540 | < 560 | -- | | < 600 | < 570 |
| PYRENE | ug/kg | -- | < 24800 | -- | -- | -- | -- | -- | -- | | < 98 | < 100 | **1,000** | **797** | -- | | **647** | **4,130** |
| **PCBs** | | | | | | | | | | | | | | | | | | |
| PCB, TOTAL | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 14 | | -- | -- |
| PCB-1016 (AROCLOR 1016) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 23 J | | -- | -- |
| PCB-1221 (AROCLOR 1221) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 30 | | -- | -- |
| PCB-1232 (AROCLOR 1232) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 34 J | | -- | -- |
| PCB-1242 (AROCLOR 1242) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 24 J | | -- | -- |
| PCB-1248 (AROCLOR 1248) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 22 | | -- | -- |
| PCB-1254 (AROCLOR 1254) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 22 J | | -- | -- |
| PCB-1260 (AROCLOR 1260) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 18 J | | -- | -- |
| PCB-1268 (AROCLOR 1268) | ug/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 14 J | | -- | -- |
| **Metals** | | | | | | | | | | | | | | | | | | |
| ALUMINUM | mg/kg | -- | **316** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **15,600** | -- |
| ANTIMONY | mg/kg | -- | < 1.07 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **1.2 J** | -- |
| ARSENIC | mg/kg | -- | < 1.4 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **14** | -- |
| BARIUM | mg/kg | -- | **10** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **134** | -- |
| BERYLLIUM | mg/kg | -- | < 0.071 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **1** | -- |
| CADMIUM | mg/kg | -- | < 0.089 | < 0.011 | < 0.011 | < 0.014 | < 0.011 | < 0.014 | < 0.015 | | < 0.048 | < 0.052 | < 0.049 | < 0.051 | -- | | < 0.055 | -- |
| CALCIUM | mg/kg | -- | **745** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **144,000** | -- |
| CHROMIUM, TOTAL | mg/kg | -- | **11** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **23** | -- |
| COBALT | mg/kg | -- | **1** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **5.5 J** | -- |
| COPPER | mg/kg | -- | **60** | **1** | **49** | **5** | **1** | **8** | **5** | | **10** | **14** | **3** | **5** | -- | | **5** | -- |
| IRON | mg/kg | -- | **6,270** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **12,800** | -- |
| LEAD | mg/kg | -- | **142** | **10** | **72** | **41** | **10** | **39** | **28** | | **51** | **47** | **40** | **61** | -- | | **42** | -- |
| MAGNESIUM | mg/kg | -- | **94** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **10,700** | -- |
| MANGANESE | mg/kg | -- | **35** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **495** | -- |
| MERCURY | mg/kg | -- | **1** | **0** | **0** | **0** | < 0.0034 | **0** | **0** | | **0** | **0** | **0** | **0.0079 J** | -- | | **0** | -- |
| NICKEL | mg/kg | -- | **16** | **2** | **27** | **6** | **2** | **11** | **10** | | **9** | **8** | **8** | **10** | -- | | **9** | -- |
| POTASSIUM | mg/kg | -- | **41** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **2,940** | -- |
| SELENIUM | mg/kg | -- | **8** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **5** | -- |
| SILVER | mg/kg | -- | **0.19 J** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **3** | -- |
| SODIUM | mg/kg | -- | **3,210** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **4,630** | -- |
| THALLIUM | mg/kg | -- | < 0.36 | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | < 4 | -- |
| VANADIUM | mg/kg | -- | **2** | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | -- | | **17** | -- |
| ZINC | mg/kg | -- | **36** | **3** | **12** | **4** | **2** | **7** | **10** | | **17** | **11** | **14** | **17** | -- | | **77** | -- |
| **AVS/SEM** | | | | | | | | | | | | | | | | | | |
| ACID VOLATILE SULFIDE | umol/g | -- | -- | **0** | < 0.09 | **1** | < 0.09 | < 0.11 | < 0.12 | | **16** | **0** | **15** | **17** | -- | | **18** | -- |
| CADMIUM | umol/g | -- | -- | < 0.0016 | < 0.0016 | < 0.002 | < 0.0015 | < 0.002 | < 0.0021 | | < 0.0068 | < 0.0075 | < 0.007 | < 0.0072 | -- | | < 0.0078 | -- |
| COPPER | umol/g | -- | -- | **0** | **1** | **0** | **0** | **0** | **0** | | **0** | **0** | **0** | **0** | -- | | **0** | -- |
| LEAD | umol/g | -- | -- | **0** | **0** | **0** | **0** | **0** | **0** | | **0** | **0** | **0** | **0** | -- | | **0** | -- |
| MERCURY | umol/g | -- | -- | **0** | **0** | **0** | < 0.000043 | **0** | **0** | | **0** | **0** | **0** | **0.0000394 J** | -- | | **0** | -- |
| NICKEL | umol/g | -- | -- | **0** | **0** | **0** | **0** | **0** | **0** | | **0** | **0** | **0** | **0** | -- | | **0** | -- |
| RATIO OF SEM/AVS | mole ratio | -- | -- | **1** | < 0 | **0** | < 0 | < 0 | < 0 | | **0** | **4** | **0** | **0** | -- | | **0** | -- |
| ZINC | umol/g | -- | -- | **0** | **0** | **0** | **0** | **0** | **0** | | **0** | **0** | **0** | **0** | -- | | **1** | -- |

**Table 4. Caisson 1 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #1 | | | | | | | | | | | ROLL OFF | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | 5/20/2014 | | | | | | 5/30/2014 | 5/30/2014 | | 6/4/2014 | | | 6/5/2014 | 6/5/2014 | |
| Treatment Stage | | Pre-ISS (Untreated Tar) | | | | | | | | | POST 1st MIX | | Post Removal (Post 1st, Pre 2nd) | | | | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | A - 0-0.8' | A - 0.8-2.6' | A - 2.6-5.3' | B - 0-0.1' | B - 1.9-2.7' | B - 4.2-5.6' | | A - 6-8' | B - 6-8' | NA | NA | N/A | | NA | NA |
| Parameter | Unit | 112113-TAR-TC01-0012 (Encore) | 112113-TAR-TC01-0012 (Terracore) | 052014-VR-TC01A-000008 | 052014-INT-TC01A-008026 | 052014-HC-TC01A-026053 | 052014-VR-TC01B-000001 | 052014-INT-TC01B-019027 | 052014-HC-TC01B-042056 | | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060414-TAR-TC01A | 060414-TAR-TC01A-D | 060414-TAR-TC01B | | 060514-TAR-TC01B | 060514-TAR-TC01B-D |
| **General Chemistry** | | | | | | | | | | | | | | | | | | |
| ACIDITY, TOTAL | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | < 50 | < 50 | -- | -- | -- | | < 50 | -- |
| ALKALINITY, TOTAL (AS CACO3) | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | **2,730** | **1,360** | -- | -- | -- | | **39,500** | -- |
| ASHCONTENT | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **449,000** | | -- | -- |
| BROMIDE | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | < 20 | | -- | -- |
| CHLORINE | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **1,260** | | -- | -- |
| CORROSIVITY | SU | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **12.3 J** | | -- | -- |
| CYANIDE | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **1.8 J** | | -- | -- |
| DENSITY | g/cm3 | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **1** | | -- | -- |
| FLUORINE | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **112 J** | | -- | -- |
| GROSS CALORIFIC VALUE | BTU/lb | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **2,270** | | -- | -- |
| IGNITABILITY | Degrees F | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **104** | | -- | -- |
| MOISTURE, PERCENT (D4017) | percent | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **37** | | -- | -- |
| MOISTURE, PERCENT (D4643) | percent | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **43** | | -- | -- |
| NITROGEN, AMMONIA (AS N) | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **27** | | -- | -- |
| OXIDATION-REDUCTION POTENTIAL | mV | -- | -- | -- | -- | -- | -- | -- | -- | | **186** | **58** | -- | -- | -- | | **40** | -- |
| PH | ph units | -- | -- | -- | -- | -- | -- | -- | -- | | **12** | **10** | -- | -- | -- | | **12** | -- |
| SOLIDS, PERCENT | percent | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **57** | | -- | -- |
| SULFIDE | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **44 J** | | -- | -- |
| SULFUR, PERCENT | percent | -- | -- | -- | -- | -- | -- | -- | -- | | **4** | **8** | -- | -- | -- | | -- | -- |
| SULFUR, MOL (S8) | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **40,900** | | -- | -- |
| TOTAL ORGANIC CARBON | mg/kg | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | -- | -- | **210000 J** | | -- | -- |

**Notes:**

-- = no sample taken

BTU/lb = British Thermal Units per pound

g/cm3=grams per cubic centimeter

ug/Kg = micrograms per kilogram

mg/Kg = miligrams per kilogram

umol/g = micromoles per gram

Degree F = Degrees Fahrenheit

mV = milivolt

SU = Standard Units

J = estimated detected result

NA = Not applicable

< = non-detected result

**Detects are in BOLD font**

**Table 5. Caisson 3 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #3 | | | CAISSON #3 | | | | | | | | | | | | | ROLL OFF | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | | 5/28/2014 | | | | | | | | | | 5/29/2014 | | | 6/4/2014 | | | 6/4/2014 | |
| Treatment Stage | | PRE THERMAL (Untreated Tar) | | 2/28/14-5/9/14 | POST THERMAL (PRE ISS MIXING) | | | | | | | | | | 5/29/2014 | POST 1st MIX | | 6/4/2014 | POST REMOVAL (Pre 2nd MIX) | | 6/4/2014 | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | | A - 0.8-2.2' | A - 5-5.8' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | B - 5-7.6' Dup | B - 7.6-8' | C - 4-5' | C - 5-7' | C - 7-8' | | Sample A | Sample B | | Sample A | Sample B | | Sample C | Sample C DUP |
| Parameter | Unit | 112113-TAR-TC03-0012 (Encore) | 112113-TAR-TC03-0012 | | 052814-TAR-TC03A-008022 | 052814-SWSM-TC03A-050058 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-TAR-TC03B-050076-D | 052814-TAR-TC03B-076080 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 052814-HC-TC03C-070080 | | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | | 060414-TAR-TC03A | 060414-TAR-TC03B | | 060414-TAR-TC03C | 060414-TAR-TC03C-D |
| **VOCs** | | | | | | | | | | | | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | ug/kg | < 6790 | **11600 J** | | < 150 | < 150 | < 260 | < 200 | < 45 | < 170 | < 2700 | < 300 | < 47 | < 220 | | < 2000 | < 2000 | | < 3300 | < 1900 | | < 470 | < 390 |
| 1,1,2,2-TETRACHLOROETHANE | ug/kg | < 7320 | < 7230 | | < 180 | < 180 | < 310 | < 240 | < 54 | < 200 | < 3200 | < 360 | < 56 | < 260 | | < 2300 | < 2400 | | < 3900 | < 2300 | | < 560 | < 460 |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | ug/kg | < 15600 | < 15400 | | < 230 | < 230 | < 390 | < 300 | < 69 | < 250 | < 4100 | < 450 | < 71 | < 340 | | < 3000 | < 3100 | | < 4900 | < 2900 | | < 720 | < 580 |
| 1,1,2-TRICHLOROETHANE | ug/kg | < 2690 | < 2650 | | < 440 | < 440 | < 730 | < 570 | < 130 | < 480 | < 7700 | < 850 | < 130 | < 640 | | < 5600 | < 5800 | | < 9300 | < 5500 | | < 1400 | < 1100 |
| 1,1-DICHLOROETHANE | ug/kg | < 4040 | < 3990 | | < 170 | < 170 | < 280 | < 220 | < 50 | < 180 | < 2900 | < 330 | < 51 | < 240 | | < 2200 | < 2200 | | < 3600 | < 2100 | | < 520 | < 420 |
| 1,1-DICHLOROETHENE | ug/kg | < 9510 | < 9390 | | < 150 | < 150 | < 260 | < 200 | < 45 | < 170 | < 2700 | < 300 | < 47 | < 220 | | < 2000 | < 2000 | | < 3300 | < 1900 | | < 470 | < 390 |
| 1,2,3-TRICHLOROBENZENE | ug/kg | < 15100 | < 14900 | | < 110 | < 110 | < 190 | < 140 | < 33 | < 120 | < 1900 | < 220 | < 34 | < 160 | | < 1400 | < 1500 | | < 2300 | < 1400 | | < 340 | < 280 |
| 1,2,4-TRICHLOROBENZENE | ug/kg | < 12800 | < 12600 | | **997 J** | **430 J** | **512 J** | < 130 | < 29 | < 110 | < 1700 | < 190 | < 30 | < 140 | | < 1200 | < 1300 | | < 2100 | < 1200 | | < 300 | < 240 |
| 1,2-DIBROMO-3-CHLOROPROPANE | ug/kg | < 11900 | < 11800 | | < 720 | < 700 | < 1200 | < 920 | < 210 | < 770 | < 12000 | < 1400 | < 220 | < 1000 | | < 9100 | < 9400 | | < 15000 | < 8800 | | < 2200 | < 1800 |
| 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) | ug/kg | < 8630 | < 8520 | | < 300 | < 290 | < 490 | < 380 | < 87 | < 320 | < 5100 | < 570 | < 89 | < 420 | | < 3800 | < 3900 | | < 6200 | < 3600 | | < 900 | < 740 |
| 1,2-DICHLOROBENZENE | ug/kg | **1,650,000** | **2,980,000** | | **280,000** | **105,000** | **171,000** | **10,100** | **2,220** | **24,400** | **1,530,000** | **46,400** | **2,010** | **104,000** | | **115,000** | **112,000** | | **131,000** | **113,000** | | **194,000** | **190,000** |
| 1,2-DICHLOROETHANE | ug/kg | < 8300 | < 8190 | | < 170 | < 170 | < 290 | < 220 | < 51 | < 190 | < 3000 | < 330 | < 52 | < 250 | | < 2200 | < 2300 | | < 3600 | < 2100 | | < 530 | < 430 |
| 1,2-DICHLOROPROPANE | ug/kg | < 3190 | < 3150 | | < 230 | < 230 | < 390 | < 300 | < 69 | < 250 | < 4100 | < 450 | < 71 | < 340 | | < 3000 | < 3100 | | < 4900 | < 2900 | | < 720 | < 590 |
| 1,3-DICHLOROBENZENE | ug/kg | **27400 J** | **46000 J** | | **3,720** | **1390 J** | **2430 J** | < 150 | < 35 | **354 J** | **28200 J** | **521 J** | < 36 | **1220 J** | | **1880 J** | **1800 J** | | < 2500 | **1560 J** | | **2740 J** | **2820 J** |
| 1,4-DICHLOROBENZENE | ug/kg | **139000 J** | **236,000** | | **22,000** | **8,280** | **14,400** | **719 J** | **154 J** | **2100 J** | **153,000** | **3410 J** | **135 J** | **7,640** | | **8750 J** | **8370 J** | | **9990 J** | < 1700 | | **15,600** | **15,800** |
| 1,4-DIOXANE (P-DIOXANE) | ug/kg | -- | -- | | < 41000 | < 40000 | < 68000 | < 53000 | < 12000 | < 44000 | < 720000 | < 79000 | < 12000 | < 59000 | | < 520000 | < 540000 | | < 870000 | < 510000 | | < 130000 | < 100000 |
| 2-HEXANONE | ug/kg | < 12400 | < 12200 | | < 960 | < 940 | < 1600 | < 1200 | < 280 | < 1000 | < 17000 | < 1900 | < 290 | < 1400 | | < 12000 | < 13000 | | < 20000 | < 12000 | | < 2900 | < 2400 |
| ACETONE | ug/kg | < 12400 | **67700 J** | | **3890 J** | < 2400 J | **12000 J** | < 3100 | **1,680** | **3580 J** | **74400 J** | < 4700 J | **3,890** | **5890 J** | | < 31000 | < 32000 | | < 52000 | < 30000 | | **9840 J** | < 6100 |
| BENZENE | ug/kg | **65,700,000** | **68,200,000** | | **123,000** | **118,000** | **308,000** | **18,600** | **20,200** | **243,000** | **61,900,000** | **39,600** | **20,100** | **226,000** | | **2,310,000** | **2,310,000** | | **1,830,000** | **1,320,000** | | **2,490,000** | **1,970,000** |
| BROMOCHLOROMETHANE | ug/kg | < 13900 | < 13700 | | < 280 | < 270 | < 460 | < 360 | < 82 | < 300 | < 4900 | < 540 | < 85 | < 400 | | < 3600 | < 3700 | | < 5900 | < 3500 | | < 860 | < 700 |
| BROMODICHLOROMETHANE | ug/kg | < 4340 | < 4290 | | < 150 | < 150 | < 250 | < 190 | < 45 | < 160 | < 2600 | < 290 | < 46 | < 220 | | < 1900 | < 2000 | | < 3200 | < 1900 | | < 460 | < 380 |
| BROMOFORM | ug/kg | < 18300 | < 18100 | | < 140 | < 140 | < 230 | < 180 | < 42 | < 150 | < 2500 | < 270 | < 43 | < 200 | | < 1800 | < 1800 | | < 3000 | < 1700 | | < 430 | < 350 |
| BROMOMETHANE | ug/kg | < 20400 | < 20100 | | < 260 | < 250 | < 430 | < 330 | < 76 | < 280 | < 4500 | < 500 | < 78 | < 370 | | < 3300 | < 3400 | | < 5500 | < 3200 | | < 790 | < 650 |
| CARBON DISULFIDE | ug/kg | **84100 J** | **95100 J** | | **393 J** | **1050 J** | **1140 J** | **407 J** | **605 J** | **4,160** | **73,200** | **347 J** | **381 J** | **1580 J** | | < 970 | < 990 | | < 1600 | < 940 | | **1270 J** | < 190 |
| CARBON TETRACHLORIDE | ug/kg | < 7900 | < 7800 | | < 140 | < 130 | < 220 | < 170 | < 40 | < 150 | < 2400 | < 260 | < 41 | < 190 | | < 1700 | < 1800 | | < 2800 | < 1700 | | < 410 | < 340 |
| CHLOROBENZENE | ug/kg | **15000 J** | **29100 J** | | **513 J** | **195 J** | **267 J** | < 140 | < 31 | < 110 | **6920 J** | < 200 | < 32 | < 150 | | < 1400 | < 1400 | | < 2200 | < 1300 | | **801 J** | < 260 |
| CHLOROETHANE | ug/kg | < 8450 | < 8340 | | < 540 | < 530 | < 890 | < 690 | < 160 | < 580 | **62,700** | < 1000 | < 160 | < 770 | | < 6800 | < 7000 | | < 11000 | < 6600 | | < 1600 | < 1300 |
| CHLOROFORM | ug/kg | < 7230 | < 7130 | | < 140 | < 130 | < 230 | < 180 | < 40 | < 150 | < 2400 | < 260 | < 41 | < 200 | | < 1700 | < 1800 | | < 2900 | < 1700 | | < 420 | < 340 |
| CHLOROMETHANE | ug/kg | < 8070 | < 7970 | | < 180 | < 180 | **381 J** | < 240 | < 54 | **474 J** | **24900 J** | < 360 | < 56 | **303 J** | | < 2400 | < 2400 | | < 3900 | < 2300 | | < 570 | < 460 |
| CIS-1,2-DICHLOROETHYLENE | ug/kg | < 4780 | < 4720 | | < 110 | < 110 | < 190 | < 140 | < 33 | < 120 | < 1900 | < 220 | < 34 | < 160 | | < 1400 | < 1500 | | < 2300 | < 1400 | | < 340 | < 280 |
| CIS-1,3-DICHLOROPROPENE | ug/kg | < 5420 | < 5350 | | < 120 | < 120 | < 200 | < 160 | < 36 | < 130 | < 2100 | < 240 | < 37 | < 180 | | < 1600 | < 1600 | | < 2600 | < 1500 | | < 370 | < 300 |
| CYCLOHEXANE | ug/kg | **16300 J** | **27800 J** | | < 140 | < 140 | < 230 | < 180 | < 41 | < 150 | **9960 J** | < 270 | < 42 | < 200 | | < 1800 | < 1800 | | < 2900 | < 1700 | | **608 J** | **649 J** |
| DIBROMOCHLOROMETHANE | ug/kg | < 10500 | < 10300 | | < 130 | < 130 | < 220 | < 170 | < 38 | < 140 | < 2300 | < 250 | < 39 | < 190 | | < 1700 | < 1700 | | < 2700 | < 1600 | | < 400 | < 320 |
| DICHLORODIFLUOROMETHANE | ug/kg | < 9390 | < 9270 | | < 190 | < 190 | < 320 | < 240 | < 56 | < 210 | < 3300 | < 370 | < 58 | < 270 | | < 2400 | < 2500 | | < 4000 | < 2300 | | < 580 J | < 470 J |
| ETHYLBENZENE | ug/kg | **192000 J** | **291,000** | | **8,880** | **6,060** | **6,000** | **534 J** | **312** | **2,530** | **198,000** | **1,440** | **1,200** | **3,910** | | **10,600** | **11,200** | | **13,300** | **10,900** | | **21,100** | **18,600** |
| ISOPROPYLBENZENE (CUMENE) | ug/kg | **405,000** | **645,000** | | **23,000** | **9,780** | **11,700** | **578 J** | **186 J** | **2690 J** | **316,000** | **2580 J** | **702 J** | **6,860** | | **17600 J** | **17400 J** | | **24200 J** | **20300 J** | | **38,000** | **36,900** |
| M,P-XYLENE (SUM OF ISOMERS) | ug/kg | **1,780,000** | **2,720,000** | | **86,300** | **55,200** | **181,000** | **5,830** | **2,350** | **23,500** | **1,450,000** | **10,700** | **2,710** | **84,100** | | **98,400** | **103,000** | | **115,000** | **95,400** | | **170,000** | **156,000** |
| METHYL ACETATE | ug/kg | **279,000** | **216,000** | | **3,110** | **1810 J** | **247,000** | < 1200 | **2,040** | **14,600** | **403,000** | < 1700 | < 270 | **38,300** | | < 11000 | < 12000 | | < 19000 | < 11000 | | < 2800 | < 2200 |
| METHYL ETHYL KETONE (2-BUTANONE) | ug/kg | < 13500 | < 13400 | | < 2400 J | < 2300 J | < 3900 J | < 3000 | < 700 | < 2600 J | < 41000 J | < 4600 J | < 720 | < 3400 J | | < 30000 | < 31000 | | < 50000 | < 29000 | | < 7300 | < 5900 |
| METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE) | ug/kg | < 6470 | < 6390 | | < 710 | < 700 | < 1200 | < 910 | < 210 | < 770 | < 12000 | < 1400 | < 220 | < 1000 | | < 9000 | < 9300 | | < 15000 | < 8800 | | < 2200 | < 1800 |
| METHYLCYCLOHEXANE | ug/kg | **31900 J** | **51000 J** | | < 88 | < 87 | **158 J** | < 110 | < 26 | < 95 | **27000 J** | < 170 | **99.1 J** | < 130 | | < 1100 | < 1200 | | < 1900 | < 1100 | | **1640 J** | **1810 J** |
| METHYLENE CHLORIDE | ug/kg | < 21500 | < 21200 | | < 920 | < 900 | < 1500 | < 1200 | < 270 | < 990 | < 16000 | < 1800 | < 280 | < 1300 | | < 12000 | < 12000 | | < 19000 | < 11000 | | < 2800 | < 2300 |
| O-XYLENE (1,2-DIMETHYLBENZENE) | ug/kg | **514,000** | **805,000** | | **24,400** | **10,900** | **17,600** | **846** | **298** | **3,550** | **405,000** | **2,480** | **736** | **9,620** | | **25,200** | **26,000** | | **27,400** | **22,900** | | **41,900** | **38,800** |
| STYRENE | ug/kg | < 3500 | < 3450 | | < 120 | < 120 | < 210 | < 160 | < 37 | < 130 | < 2200 | < 240 | < 38 | < 180 | | < 1600 | < 1600 | | < 2600 | < 1500 | | < 380 | < 310 |
| TERT-BUTYL METHYL ETHER | ug/kg | < 2550 | < 2520 | | < 180 | < 180 | < 310 | < 240 | < 54 | < 200 | < 3200 | < 360 | < 56 | < 270 | | < 2400 | < 2400 | | < 3900 | < 2300 | | < 570 | < 460 |
| TETRACHLOROETHYLENE (PCE) | ug/kg | < 12400 | < 12200 | | < 220 | < 220 | < 370 | < 280 | < 65 | < 240 | < 3800 | < 430 | < 67 | < 320 | | < 2800 | < 2900 | | < 4600 | < 2700 | | < 680 | < 550 |
| TOLUENE | ug/kg | **13,200,000** | **15,700,000** | | **116,000** | **71,200** | **122,000** | **7,980** | **3,970** | **57,200** | **9,840,000** | **15,400** | **6,670** | **86,200** | | **415,000** | **442,000** | | **410,000** | **306,000** | | **556,000** | **464,000** |
| TRANS-1,2-DICHLOROETHENE | ug/kg | < 4990 | < 4930 | | < 230 | < 220 | < 380 | < 290 | < 67 | < 250 | < 4000 | < 440 | < 69 | < 330 | | < 2900 | < 3000 | | < 4800 | < 2800 | | < 700 | < 570 |
| TRANS-1,3-DICHLOROPROPENE | ug/kg | < 3440 | < 3400 | | < 150 | < 140 | < 240 | < 190 | < 43 | < 160 | < 2500 | < 280 | < 44 | < 210 | | < 1900 | < 1900 | | < 3100 | < 1800 | | < 450 | < 360 |
| TRICHLOROETHYLENE (TCE) | ug/kg | < 5330 | < 5260 | | < 190 | < 190 | < 310 | < 240 | < 55 | < 200 | < 3300 | < 360 | < 57 | < 270 | | < 2400 | < 2500 | | < 4000 | < 2300 | | < 580 | < 470 |
| TRICHLOROFLUOROMETHANE | ug/kg | < 5420 | < 5350 | | < 120 | < 120 | < 200 | < 160 | < 36 | < 130 | < 2100 | < 230 | < 37 | < 170 | | < 1500 | < 1600 | | < 2600 | < 1500 | | < 370 | < 300 |
| VINYL CHLORIDE | ug/kg | < 8120 | < 8020 | | < 180 | < 180 | < 310 | < 240 | < 54 | < 200 | < 3200 | < 360 | < 56 | < 260 | | < 2300 | < 2400 | | < 3900 | < 2300 | | < 560 | < 460 |
| Total VOC (Sum of all VOCs) | ug/kg | **84,033,700** | **92,121,300** | | **696,203** | **389,295** | **1,095,588** | **45,594** | **34,015** | **382,138** | **76,502,280** | **122,878** | **38,633** | **575,623** | | **3,002,430** | **3,031,770** | | **2,560,890** | **1,890,060** | | **3,543,499** | **2,895,379** |

**Table 5. Caisson 3 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | | CAISSON #3 | | CAISSON #3 | | | | | | | | | | | | ROLL OFF | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | | 11/21/2013 | | 5/28/2014 | | | | | | | | | | 5/29/2014 | | 6/4/2014 | | | 6/4/2014 |
| Treatment Stage | | | PRE THERMAL (Untreated Tar) | | 2/28/14-5/9/14 | POST THERMAL (PRE ISS MIXING) | | | | | | | | | 5/29/2014 | POST 1st MIX | 6/4/2014 | POST REMOVAL (Pre 2nd MIX) | | 6/4/2014 | POST 2nd MIX | |
| Core/Depth | | | 0-1.2' | 0-1.2' | | A - 0.8-2.2' | A - 5-5.8' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | B - 5-7.6' Dup | B - 7.6-8' | C - 4-5' | C - 5-7' | C - 7-8' | | Sample A | Sample B | | | Sample A | Sample B | | Sample C | Sample C DUP |
| Parameter | | Unit | 112113-TAR-TC03-0012 (Encore) | 112113-TAR-TC03-0012 | | 052814-TAR-TC03A-008022 | 052814-SWSM-TC03A-050058 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-TAR-TC03B-050076-D | 052814-TAR-TC03B-076080 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 052814-HC-TC03C-070080 | | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | | | 060414-TAR-TC03A | 060414-TAR-TC03B | | 060414-TAR-TC03C | 060414-TAR-TC03C-D |
| **SVOCs** | | | | | | | | | | | | | | | | | | | | | | | | |
| 1,2,4,5-TETRACHLOROBENZENE | | ug/kg | -- | < 32100 | | < 83 | < 80 | < 72 | < 66 | < 11 | < 60 | < 73 | < 73 | < 14 J | < 63 | | < 100 | < 210 | | | < 170 | < 38 | | < 40 | < 33 |
| 2,2-OXYBIS(2-CHLOROPROPANE) | | ug/kg | -- | -- | | < 80 | < 78 | < 70 | < 64 | < 11 | < 58 | < 70 | < 71 | < 13 J | < 61 | | < 100 | < 200 | | | < 170 | < 37 | | < 39 | < 32 |
| 2,3,4,6-TETRACHLOROPHENOL | | ug/kg | -- | < 40500 | | < 280 | < 270 | < 240 | < 220 | < 38 | < 200 | < 240 | < 240 | < 47 J | < 210 | | < 350 | < 700 | | | < 580 | < 130 | | < 140 | < 110 |
| 2,4,5-TRICHLOROPHENOL | | ug/kg | -- | < 40900 | | < 310 | < 300 | < 270 | < 250 | < 43 | < 220 | < 270 | < 280 | < 53 J | < 240 | | < 390 | < 790 | | | < 660 | < 140 | | < 150 | < 120 |
| 2,4,6-TRICHLOROPHENOL | | ug/kg | -- | < 45700 | | < 250 | < 250 | < 220 | < 200 | < 35 | < 180 | < 220 | < 220 | < 43 J | < 190 | | < 320 | < 640 | | | < 530 | < 120 | | < 120 | < 100 |
| 2,4-DICHLOROPHENOL | | ug/kg | -- | < 37300 | | < 430 | < 420 | < 380 J | < 340 | < 59 J | < 310 | < 380 J | < 380 | < 73 J | < 330 | | < 540 | < 1100 | | | < 910 | < 200 | | < 210 | < 170 |
| 2,4-DIMETHYLPHENOL | | ug/kg | -- | < 25700 | | **4,010** | **5,590** | **4,110** | **463 J** | **567** | < 330 | < 400 | **1,540** | **522** | < 350 | | **3,130** | **3,670** | | | **3,030** | **2,120** | | < 220 | **1,520** |
| 2,4-DINITROPHENOL | | ug/kg | -- | < 88600 | | < 330 | < 320 | < 290 | < 260 | < 45 | < 240 | < 290 | < 290 | < 55 J | < 250 | | < 410 | < 830 | | | < 690 | < 150 | | < 160 | < 130 |
| 2,4-DINITROTOLUENE | | ug/kg | -- | < 26400 | | < 120 | < 110 | < 100 | < 94 | < 16 | < 85 | < 100 | < 100 | < 20 J | < 90 | | < 150 | < 300 | | | < 250 | < 55 | | < 57 | < 47 |
| 2,6-DINITROTOLUENE | | ug/kg | -- | < 48400 | | < 100 | < 100 | < 89 | < 82 | < 14 | < 74 | < 90 | < 90 | < 17 J | < 79 | | < 130 | < 260 | | | < 220 | < 48 | | < 50 | < 41 |
| 2-CHLORONAPHTHALENE | | ug/kg | -- | < 41300 | | < 84 | < 81 | < 73 | < 66 | < 11 | < 60 | < 73 | < 74 | < 14 J | < 64 | | < 100 | < 210 | | | < 180 | < 39 | | < 41 | < 33 |
| 2-CHLOROPHENOL | | ug/kg | -- | < 28500 | | < 270 | < 260 | < 230 | < 210 | < 37 | < 190 | < 240 | < 240 | < 45 J | < 210 | | < 340 | < 680 | | | < 570 | < 120 | | < 130 | < 110 |
| 2-METHYLNAPHTHALENE | | ug/kg | -- | **463000 J** | | **92,300** | **156,000** | **118,000** | **20,300** | **14200** | **10,100** | **143,000** | **72,300** | **26,700** | **62,700** | | **146,000** | **171,000** | | | **103,000** | **56,300** | | **83,000** | **52,700** |
| 2-METHYLPHENOL (O-CRESOL) | | ug/kg | -- | < 40100 | | **1,260** | **1,810** | **449 J** | **269 J** | **227** | < 220 | < 270 | **612** | **465** | < 230 | | < 390 | **1300 J** | | | < 650 | < 140 | | < 150 | < 120 |
| 2-NITROANILINE | | ug/kg | -- | < 16500 | | < 120 | < 120 | < 100 | < 94 | < 16 | < 85 | < 100 | < 100 | < 20 J | < 91 | | < 150 | < 300 | | | < 250 | < 55 | | < 58 | < 47 |
| 2-NITROPHENOL | | ug/kg | -- | < 46400 | | < 290 | < 280 | < 250 J | < 230 | < 39 J | < 210 | < 250 J | < 250 | < 48 J | < 220 | | < 360 | < 720 | | | < 600 | < 130 | | < 140 | < 110 |
| 3- AND 4- METHYLPHENOL (TOTAL) | | ug/kg | -- | -- | | **4,260** | **6,060** | **3,920** | **875** | **703** | **502** | < 300 | **2,080** | **872** | **1,630** | | **2,740** | < 860 | | | < 720 | < 160 | | < 170 | < 140 |
| 3,3'-DICHLOROBENZIDINE | | ug/kg | -- | < 124000 | | < 68 | < 66 | < 60 | < 54 | < 9.4 | < 49 | < 60 | < 60 | < 11 J | < 52 | | < 86 | < 170 | | | < 140 | < 32 | | < 33 | < 27 J |
| 3-NITROANILINE | | ug/kg | -- | < 17700 | | < 110 | < 100 | < 94 | < 86 | < 15 | < 78 | < 95 | < 95 | < 18 J | < 82 | | < 140 | < 270 | | | < 230 | < 50 | | < 53 | < 43 |
| 4,6-DINITRO-2-METHYLPHENOL | | ug/kg | -- | < 70100 | | < 330 | < 320 | < 290 | < 260 | < 45 | < 240 | < 290 | < 290 | < 55 J | < 250 | | < 410 | < 830 | | | < 690 | < 150 | | < 160 | < 130 |
| 4-BROMOPHENYL PHENYL ETHER | | ug/kg | -- | < 41300 | | < 98 | < 95 | < 85 | < 78 | < 13 | < 70 | < 86 | < 86 | < 16 J | < 75 | | < 120 | < 250 | | | < 210 | < 45 | | < 48 | < 39 |
| 4-CHLORO-3-METHYLPHENOL | | ug/kg | -- | < 29200 | | < 270 | < 260 | < 230 J | < 210 | < 37 J | < 190 | < 240 J | < 240 | < 45 J | < 210 | | < 340 | < 680 | | | < 570 | < 120 | | < 130 | < 110 |
| 4-CHLOROANILINE | | ug/kg | -- | < 25000 | | < 86 | < 84 | < 75 J | < 69 | < 12 J | < 62 | < 76 J | < 76 | < 14 J | < 66 | | < 110 | < 220 | | | < 180 | < 40 | | < 42 | < 34 |
| 4-CHLOROPHENYL PHENYL ETHER | | ug/kg | -- | < 28900 | | < 81 | < 79 | < 71 | < 64 | < 11 | < 58 | < 71 | < 71 | < 14 J | < 62 | | < 100 | < 200 | | | < 170 | < 38 | | < 40 | < 32 |
| 4-NITROANILINE | | ug/kg | -- | < 16700 | | < 110 | < 100 | < 92 | < 84 | < 14 | < 76 | < 92 | < 93 | < 18 J | < 80 | | < 130 | < 260 | | | < 220 | < 49 | | < 51 | < 42 |
| 4-NITROPHENOL | | ug/kg | -- | < 82600 | | < 460 | < 440 | < 400 | < 360 | < 62 | < 330 | < 400 | < 400 | < 77 J | < 350 | | < 570 | < 1100 | | | < 960 | < 210 | | < 220 | < 180 |
| ACENAPHTHENE | | ug/kg | -- | < 39700 | | **20,300** | **8,170** | **4,030** | **918** | **630** | < 56 | **2,820** | **4,270** | **950** | **3,170** | | **9,620** | **10,400** | | | **10,000** | **5,130** | | **5,950** | **3,510** |
| ACENAPHTHYLENE | | ug/kg | -- | < 26600 | | < 86 | < 84 | < 75 | < 69 | < 12 | < 62 | < 76 | < 76 | < 14 J | < 66 | | < 110 | < 220 | | | < 180 | < 40 | | < 42 | < 34 |
| ACETOPHENONE | | ug/kg | -- | **725000 J** | | **59,500** | **83,500** | **61,500** | **11,500** | **9340** | **6,630** | **239,000** | **29,300** | **14,400** | **31,000** | | **97,500** | **118,000** | | | **54,100** | **38,900** | | **67,600** | **39,000** |
| ANILINE | | ug/kg | -- | < 88600 | | **13800 J** | **12,800** | < 470 J | **1070 J** | < 74 J | < 390 J | < 470 J | < 470 J | < 91 J | < 410 J | | **7,860** | **16,100** | | | **32,600** | **13,700** | | **19,000** | **11,300** |
| ANTHRACENE | | ug/kg | -- | < 26700 | | < 94 | < 91 | < 82 | < 75 | < 13 | < 68 | < 83 | < 83 | < 16 J | < 72 | | < 120 | < 240 | | | < 200 | < 44 | | < 46 | < 38 |
| ATRAZINE | | ug/kg | -- | < 27300 | | < 53 | < 52 | < 46 | < 42 | < 7.3 | < 38 | < 47 | < 47 | < 8.9 J | < 41 | | < 67 | < 130 | | | < 110 | < 25 | | < 26 | < 21 |
| BENZALDEHYDE | | ug/kg | -- | < 126000 | | < 62 | < 60 | < 54 | < 49 | < 8.5 | < 45 | < 55 | < 55 | < 10 J | < 47 | | < 78 | < 160 | | | < 130 | < 29 | | < 30 | < 25 |
| BENZO(A)ANTHRACENE | | ug/kg | -- | < 24200 | | **984** | **3,400** | **476** | **372** | **176** | **218** | **751** | **736** | **698** | **403** | | **1,400** | **2,070** | | | **1,770** | **699** | | **669** | **464 J** |
| BENZO(A)PYRENE | | ug/kg | -- | < 16300 | | < 82 | < 80 | < 72 J | < 65 | < 11 | < 59 | < 72 J | < 72 | < 14 J | < 63 | | < 100 | < 210 | | | < 170 | < 38 | | < 40 J | < 33 J |
| BENZO(B)FLUORANTHENE | | ug/kg | -- | < 25700 | | < 90 | < 87 | < 78 J | < 72 | < 12 | < 65 | < 79 J | < 79 | < 15 J | < 69 | | < 110 | < 230 | | | < 190 | < 42 | | < 44 J | < 36 J |
| BENZO(G,H,I)PERYLENE | | ug/kg | -- | < 19600 | | < 100 | < 97 | < 87 J | < 80 | < 14 | < 72 | < 88 J | < 88 | < 17 J | < 77 | | < 130 | < 250 | | | < 210 | < 46 | | < 49 J | < 40 J |
| BENZO(K)FLUORANTHENE | | ug/kg | -- | < 20100 | | < 100 | < 98 | < 88 J | < 81 | < 14 | < 73 | < 89 J | < 89 | < 17 J | < 77 | | < 130 | < 250 | | | < 210 | < 47 | | < 49 J | < 41 J |
| BENZYL BUTYL PHTHALATE | | ug/kg | -- | < 25900 | | < 160 | < 150 | < 140 | < 120 | < 21 | < 110 | < 140 | < 140 | < 26 J | < 120 | | < 200 | < 390 | | | < 330 | < 72 | | < 76 | < 62 |
| BIPHENYL (DIPHENYL) | | ug/kg | -- | < 19200 | | **13,600** | **62,900** | **10,600** | **6,070** | **14200** | **11,700** | **13,400** | **18,100** | **32,600** | **11,300** | | **33,200** | **44,600** | | | **42,200** | **22,300** | | **13,100** | **10,400** |
| BIS(2-CHLOROETHOXY) METHANE | | ug/kg | -- | < 22700 | | < 110 | < 110 | < 95 J | < 87 | < 15 J | < 78 | < 96 J | < 96 | < 18 J | < 83 | | < 140 | < 270 | | | < 230 | < 50 | | < 53 | < 44 |
| BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER) | | ug/kg | -- | < 50400 | | < 81 | < 79 | < 71 | < 64 | < 11 | < 58 | < 71 | < 71 | < 14 J | < 62 | | < 100 | < 200 | | | < 170 | < 38 | | < 40 | < 32 |
| BIS (2-CHLOROISOPROPYL)ETHER | | ug/kg | -- | < 28500 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | | -- | -- | | -- | -- |
| BIS(2-ETHYLHEXYL) PHTHALATE | | ug/kg | -- | < 18400 | | < 240 | < 230 | < 210 | < 190 | < 33 | < 170 | < 210 | < 210 | < 40 J | < 180 | | < 300 | < 600 | | | < 500 | < 110 | | < 120 | < 95 J |
| CAPROLACTAM | | ug/kg | -- | < 57500 | | < 85 | < 82 | < 74 J | < 67 | < 12 J | < 61 | < 75 J | < 75 | < 14 J | < 65 | | < 110 | < 210 | | | < 180 | < 39 | | < 41 | < 34 |
| CARBAZOLE | | ug/kg | -- | < 25100 | | < 120 | < 120 | < 110 | < 99 | < 17 | < 90 | < 110 | < 110 | < 21 J | < 95 | | < 160 | < 310 | | | < 260 | < 58 | | < 61 | < 50 |
| CHRYSENE | | ug/kg | -- | < 28100 | | **622** | **2,960** | **446** | **239** | **137** | **131 J** | **728** | **665** | **491 J** | **336** | | **1,280** | **1,640** | | | **1,230** | **560** | | **509** | **370 J** |
| DIBENZ(A,H)ANTHRACENE | | ug/kg | -- | < 18700 | | < 92 | < 89 | < 80 J | < 73 | < 13 | < 66 | < 81 J | < 81 | < 15 J | < 70 | | < 120 | < 230 | | | < 190 | < 43 | | < 45 J | < 37 J |
| DIBENZOFURAN | | ug/kg | -- | < 24700 | | **13,600** | **15,000** | **9,710** | **3,580** | **2220** | **2,150** | **13,200** | **12,400** | **2460 J** | **7,820** | | **19,200** | **17,100** | | | **16,700** | **7,880** | | < 39 | < 32 |
| DIETHYL PHTHALATE | | ug/kg | -- | < 48000 | | < 92 | < 89 | < 80 | < 73 | < 13 | < 66 | < 81 | < 81 | < 15 J | < 70 | | < 120 | < 230 | | | < 190 | < 43 | | < 45 | < 37 |
| DIMETHYL PHTHALATE | | ug/kg | -- | < 20200 | | < 95 | < 92 | < 83 | < 75 | < 13 | < 68 | < 83 | < 84 | < 16 J | < 73 | | < 120 | < 240 | | | < 200 | < 44 | | < 46 | < 38 |
| DI-N-BUTYL PHTHALATE | | ug/kg | -- | < 25100 | | < 60 | < 58 | < 52 | < 48 | < 8.2 | < 43 | < 53 | < 53 | < 10 J | < 46 | | < 75 | < 150 | | | < 130 | < 28 | | < 29 | < 24 |
| DI-N-OCTYLPHTHALATE | | ug/kg | -- | < 17200 | | < 130 | < 130 | < 110 J | < 100 | < 18 J | < 94 | < 120 J | < 120 | < 22 J | < 100 | | < 160 | < 330 | | | < 280 | < 61 | | < 64 | < 52 |
| FLUORANTHENE | | ug/kg | -- | < 21100 | | **2,600** | **5,620** | **1,660** | **783** | **548** | **483** | **4,390** | **3,170** | **1690 J** | **1,370** | | **3,720** | **3,710** | | | **3,360** | **1,080** | | **1,300** | **760** |
| FLUORENE | | ug/kg | -- | < 23400 | | < 88 | < 86 | < 77 | < 70 | < 12 | < 64 | < 78 | < 78 | < 15 J | < 68 | | < 1100 | < 220 | | | < 190 | < 41 | | < 43 | < 35 |
| HEXACHLOROBENZENE | | ug/kg | -- | < 50400 | | < 88 | < 85 | < 77 | < 70 | < 12 | < 63 | < 77 | < 77 | < 15 J | < 67 | | < 110 | < 220 | | | < 180 | < 41 | | < 43 | < 35 |
| HEXACHLOROBUTADIENE | | ug/kg | -- | < 34400 | | < 75 | < 73 | < 65 J | < 60 | < 10 J | < 54 | < 66 J | < 66 | < 13 J | < 57 | | < 94 | < 190 | | | < 160 | < 35 | | < 37 | < 30 |
| HEXACHLOROCYCLOPENTADIENE | | ug/kg | -- | < 275000 | | < 280 | < 270 | < 240 | < 220 | < 38 | < 200 | < 240 | < 240 | < 46 J | < 210 | | < 340 | < 690 | | | < 580 | < 130 | | < 130 | < 110 |
| HEXACHLOROETHANE | | ug/kg | -- | < 61800 | | < 75 | < 73 | < 65 | < 60 | < 10 | < 54 | < 66 | < 66 | < 13 J | < 57 | | < 94 | < 190 | | | < 160 | < 35 | | < 37 | < 30 |
| INDENO(1,2,3-C,D)PYRENE | | ug/kg | -- | < 31300 | | < 94 | < 91 | < 81 J | < 74 | < 13 | < 67 | < 82 J | < 82 | < 16 J | < 72 | | < 120 | < 240 | | | < 200 | < 43 | | < 46 J | < 37 J |
| ISOPHORONE | | ug/kg | -- | < 23100 | | < 73 | < 70 | < 63 J | < 58 | < 9.9 J | < 52 | < 64 J | < 64 | < 12 J | < 55 | | < 91 | < 180 | | | < 150 | < 34 | | < 35 | < 29 |
| M,P-Cresol | | ug/kg | -- | <48800 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | | -- | -- | | -- | -- |
| NAPHTHALENE | | ug/kg | -- | **9,690,000** | | **1,330,000** | **2,280,000** | **2,530,000** | **286,000** | **273000** | **203,000** | **3,690,000** | **833,000** | **386,000** | **884,000** | | **2,290,000** | **2,680,000** | | | **1,710,000** | **1,070,000** | | **1,740,000** | **1,120,000** |
| NITROBENZENE | | ug/kg | -- | < 67700 | | < 78 | < 76 | < 68 J | < 62 | < 11 J | < 56 | < 69 J | < 69 | < 13 J | < 60 | | < 98 | < 200 | | | < 160 | < 36 | | < 38 | < 31 |

THERMAL TREATMENT

PRIMARY ISS MIXING

REMOVAL

SECONDARY ISS MIXING

**Table 5. Caisson 3 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #3 | | | CAISSON #3 | | | | | | | | | | | | | ROLL OFF | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | | 5/28/2014 | | | | | | | | | | 5/29/2014 | | | 6/4/2014 | | | | 6/4/2014 |
| Treatment Stage | | PRE THERMAL (Untreated Tar) | | 2/28/14-5/9/14 | POST THERMAL (PRE ISS MIXING) | | | | | | | | | | 5/29/2014 | POST 1st MIX | | 6/4/2014 | POST REMOVAL (Pre 2nd MIX) | | 6/4/2014 | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | | A - 0.8-2.2' | A - 5-5.8' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | B - 5-7.6' Dup | B - 7.6-8' | C - 4-5' | C - 5-7' | C - 7-8' | | Sample A | Sample B | | Sample A | Sample B | | Sample C | Sample C DUP |
| Parameter | Unit | 112113-TAR-TC03-0012 (Encore) | 112113-TAR-TC03-0012 | | 052814-TAR-TC03A-008022 | 052814-SWSM-TC03A-050058 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-TAR-TC03B-050076-D | 052814-TAR-TC03B-076080 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 052814-HC-TC03C-070080 | | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | | 060414-TAR-TC03A | 060414-TAR-TC03B | | 060414-TAR-TC03C | 060414-TAR-TC03C-D |
| N-NITROSODI-N-PROPYLAMINE | ug/kg | -- | < 56700 | | < 66 | < 64 | < 57 | < 52 | < 9 | < 47 | < 58 | < 58 | < 11 J | < 50 | | < 82 | **255 J** | | < 140 | < 30 | | < 32 | < 26 |
| N-NITROSODIPHENYLAMINE | ug/kg | -- | < 27500 | | < 160 | < 160 | < 140 | < 130 | < 22 | < 120 | < 140 | < 140 | < 27 J | < 120 | | < 200 | < 400 | | < 340 | < 74 | | < 79 | < 64 |
| PENTACHLOROPHENOL | ug/kg | -- | < 29100 | | < 460 | < 450 | < 400 | < 370 | < 63 | < 330 | < 410 | < 410 | < 77 J | < 350 | | < 580 | < 1200 | | < 970 | < 210 | | < 220 | < 180 |
| PHENANTHRENE | ug/kg | -- | < 29800 | | **18,800** | **38,500** | **9,980** | **5,220** | **3080** | **3,050** | **13,300** | **14,900** | **10,600** | **8,910** | | **17,500** | **24,500** | | **22,800** | **10,800** | | **11,500** | **7,180** |
| PHENOL | ug/kg | -- | < 35800 | | < 280 | < 270 | < 250 | **993** | **801** | < 200 | < 250 | **2,100** | < 48 J | **661** | | < 350 | < 710 | | < 590 | **1,910** | | < 140 | < 110 |
| PYRENE | ug/kg | -- | < 18200 | | **704** | < 100 | **309** | **190 J** | < 14 | **371** | < 91 | **1,700** | **1730 J** | **547** | | < 130 | < 260 | | **1,560** | **697** | | **819** | **503** |
| **PCBs** | | | | | | | | | | | | | | | | | | | | | | | |
| PCB, TOTAL | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 14 | -- |
| PCB-1016 (AROCLOR 1016) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 23 J | -- |
| PCB-1221 (AROCLOR 1221) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 30 | -- |
| PCB-1232 (AROCLOR 1232) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 34 J | -- |
| PCB-1242 (AROCLOR 1242) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 24 J | -- |
| PCB-1248 (AROCLOR 1248) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 22 | -- |
| PCB-1254 (AROCLOR 1254) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 22 J | -- |
| PCB-1260 (AROCLOR 1260) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 18 J | -- |
| PCB-1268 (AROCLOR 1268) | ug/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 14 J | -- |
| **Metals** | | | | | | | | | | | | | | | | | | | | | | | |
| ALUMINUM | mg/kg | -- | **106** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **13,100** | -- |
| ANTIMONY | mg/kg | -- | < 0.78 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **0.9 J** | -- |
| ARSENIC | mg/kg | -- | **2** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **18** | -- |
| BARIUM | mg/kg | -- | **8** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **127** | -- |
| BERYLLIUM | mg/kg | -- | < 0.052 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **2** | -- |
| CADMIUM | mg/kg | -- | < 0.065 | | < 0.01 | < 0.01 | < 0.0089 | **0.086 J** | < 0.0072 | < 0.0073 | < 0.0092 | < 0.0095 | < 0.0088 | < 0.0082 | | < 0.063 | < 0.067 | | < 0.11 | < 0.12 | | < 0.13 | -- |
| CALCIUM | mg/kg | -- | **150** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **121,000** | -- |
| CHROMIUM, TOTAL | mg/kg | -- | **5** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **21** | -- |
| COBALT | mg/kg | -- | **0.29 J** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **3.1 J** | -- |
| COPPER | mg/kg | -- | **25** | | **0.23 J** | **0.47 J** | **0.67 J** | **0.41 J** | **0.21 J** | **0.14 J** | **3** | **0.1 J** | **0.56 J** | **0.17 J** | | **3** | **3** | | **2** | **0.14 J** | | **5** | -- |
| IRON | mg/kg | -- | **2,630** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **9,280** | -- |
| LEAD | mg/kg | -- | **59** | | **11** | **16** | **17** | **5** | **10.1** | **8** | **14** | **18** | **36** | **23** | | **24** | **30** | | **30** | **25** | | **41** | -- |
| MAGNESIUM | mg/kg | -- | **30** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **6,750** | -- |
| MANGANESE | mg/kg | -- | **15** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **295** | -- |
| MERCURY | mg/kg | -- | **2** | | < 0.0032 | < 0.0032 | < 0.0028 | **0** | **0.0025 J** | **0** | **0** | **0** | **0.0055 J** | **0** | | < 0.0041 | < 0.0043 | | **0** | **0.0052 J** | | **0** | -- |
| NICKEL | mg/kg | -- | **6** | | **2** | **3** | **3** | **7** | **1.1 J** | **0.85 J** | **2** | **2** | **2** | **6** | | **7** | **8** | | **8** | **6** | | **13** | -- |
| POTASSIUM | mg/kg | -- | **22.1 J** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **2,240** | -- |
| SELENIUM | mg/kg | -- | **4** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **9** | -- |
| SILVER | mg/kg | -- | < 0.13 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **2** | -- |
| SODIUM | mg/kg | -- | **1,510** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **5,620** | -- |
| THALLIUM | mg/kg | -- | < 0.26 | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 0.42 | -- |
| VANADIUM | mg/kg | -- | **0.87 J** | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **17** | -- |
| ZINC | mg/kg | -- | **24** | | **3** | **5** | **9** | **2** | **1.6** | **2** | **4** | **3** | **3** | **7** | | **13** | **14** | | **13** | **15** | | **92** | -- |
| **AVS/SEM** | | | | | | | | | | | | | | | | | | | | | | | |
| ACID VOLATILE SULFIDE | umol/g | -- | -- | | < 0.08 | < 0.08 | < 0.07 | < 0.06 | < 0.06 | < 0.06 | < 0.07 | < 0.08 | < 0.07 | < 0.07 | | **1** | **18** | | **0** | **15** | | < 0.1 | -- |
| CADMIUM | umol/g | -- | -- | | < 0.0014 | < 0.0014 | < 0.0012 | **0.000765 J** | < 0.0011 | < 0.0011 | < 0.0013 | < 0.0013 | < 0.0012 | < 0.0012 | | < 0.0089 | < 0.0098 | | < 0.016 | < 0.017 | | < 0.018 | -- |
| COPPER | umol/g | -- | -- | | **0.00362 J** | **0.0074 J** | **0.0105 J** | **0.00645 J** | **0.00331 J** | **0.0022 J** | **0** | **0.00157 J** | **0.00881 J** | **0.00268 J** | | **0** | **0** | | **0** | **0.0022 J** | | **0** | -- |
| LEAD | umol/g | -- | -- | | **0** | **0** | **0** | **0** | **0.0487** | **0** | **0** | **0** | **0** | **0** | | **0** | **0** | | **0** | **0** | | **0** | -- |
| MERCURY | umol/g | -- | -- | | < 0.00004 | < 0.00004 | < 0.000035 | **0** | **0.0000125 J** | **0** | **0** | **0** | **0.0000274 J** | **0** | | < 0.00005 | < 0.000055 | | **0** | **0.0000259 J** | | **0** | -- |
| NICKEL | umol/g | -- | -- | | **0** | **0** | **0** | **0** | **0.0187 J** | **0.0145 J** | **0** | **0** | **0** | **0** | | **0** | **0** | | **0** | **0** | | **0** | -- |
| RATIO OF SEM/AVS | mole ratio | -- | -- | | < 0 | < 0 | < 0 | < 0 | < 0 | < 0 | < 0 | < 0 | < 0 | < 0 | | **1** | **0** | | **1** | **0** | | < 0 | -- |
| ZINC | umol/g | -- | -- | | **0** | **0** | **0** | **0** | **0.0245** | **0** | **0** | **0** | **0** | **0** | | **0** | **0** | | **0** | **0** | | **1** | -- |
| **General Chemistry** | | | | | | | | | | | | | | | | | | | | | | | |
| ACIDITY, TOTAL | mg/kg | -- | -- | | **5,700** | -- | **35,500** | **4,140** | **6360** | -- | -- | **4,180** | **8,130** | -- | | < 50 | < 50 | | -- | -- | | < 50 | -- |
| ALKALINITY, TOTAL (AS CACO3) | mg/kg | -- | -- | | < 50 | -- | < 50 | < 50 | < 50 | -- | -- | < 50 | < 50 | -- | | **14,300** | **11,900** | | -- | -- | | **1,570** | -- |
| ASHCONTENT | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **465,000** | -- |
| BROMIDE | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 20 | -- |
| CHLORINE | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **1,620** | -- |
| CORROSIVITY | SU | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **12.6 J** | -- |
| CYANIDE | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 0.21 | -- |
| DENSITY | g/cm3 | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **1** | -- |
| FLUORINE | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **118 J** | -- |
| GROSS CALORIFIC VALUE | BTU/lb | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **3120 J** | -- |
| IGNITABILITY | Degrees F | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **200** | -- |
| MOISTURE, PERCENT (D4017) | percent | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **34** | -- |
| MOISTURE, PERCENT (D4643) | percent | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **41** | -- |
| NITROGEN, AMMONIA (AS N) | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | **13** | -- |

**Table 5. Caisson 3 Analytical Testing Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON #3 | | | CAISSON #3 | | | | | | | | | | | | | ROLL OFF | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/21/2013 | | 2/28/14-5/9/14 | 5/28/2014 | | | | | | | | | | 5/29/2014 | 5/29/2014 | | 6/4/2014 | | | 6/4/2014 | 6/4/2014 | |
| Treatment Stage | | PRE THERMAL (Untreated Tar) | | | POST THERMAL (PRE ISS MIXING) | | | | | | | | | | | POST 1st MIX | | POST REMOVAL (Pre 2nd MIX) | | | POST 2nd MIX | |
| Core/Depth | | 0-1.2' | 0-1.2' | | A - 0.8-2.2' | A - 5-5.8' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | B - 5-7.6' Dup | B - 7.6-8' | C - 4-5' | C - 5-7' | C - 7-8' | | Sample A | Sample B | | Sample A | Sample B | | Sample C | Sample C DUP |
| Parameter | Unit | 112113-TAR-TC03-0012 (Encore) | 112113-TAR-TC03-0012 | | 052814-TAR-TC03A-008022 | 052814-SWSM-TC03A-050058 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-TAR-TC03B-050076-D | 052814-TAR-TC03B-076080 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 052814-HC-TC03C-070080 | | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | | 060414-TAR-TC03A | 060414-TAR-TC03B | | 060414-TAR-TC03C | 060414-TAR-TC03C-D |
| OXIDATION-REDUCTION POTENTIAL | mV | -- | -- | | 577 | -- | 584 | 581 | 605 | -- | -- | 563 | 593 | -- | | (168) | 414 | | -- | -- | | 67 | -- |
| PH | ph units | -- | -- | | 2 | -- | 1 | 2 | 1.48 | -- | -- | 2 | 2 | -- | | 12 | 13 | | -- | -- | | 12 | -- |
| SOLIDS, PERCENT | percent | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | 59 | -- |
| SULFIDE | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | < 4.8 J | -- |
| SULFUR, PERCENT | percent | -- | -- | | 4 | 11 | 13 | 11 | 14.1 | 14 | 22 | 11 | 8 | 13 | | 9 | 5 | | -- | -- | | -- | -- |
| SULFUR, MOL (S8) | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | 34200 J | -- |
| TOTAL ORGANIC CARBON | mg/kg | -- | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | | -- | -- | | -- | -- | | 170000 J | -- |

**Notes:**

-- = no sample taken

BTU/lb = British Thermal Units per pound

g/cm3=grams per cubic centimeter

ug/Kg = micrograms per kilogram

mg/Kg = miligrams per kilogram

umol/g = micromoles per gram

Degree F = Degrees Fahrenheit

mV = milivolt

SU = Standard Units

J = estimated detected result

NA = Not applicable

< = non-detected result

**Detects are in BOLD font**

**Table 6. Caissons 1 and 3 Analytical Testing Summary**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| | | Pre-Treatment (Untreated Tar) | | | | | | Post ISTT | | | | | | Post 1st Mix | | | | | | Post Removal | | | | | | Post 2nd Mix | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Range | | Median | Average | Std. Dev. | Notes | Range | | Median | Average | Std. Dev. | Notes | Range | | Median | Average | Std. Dev. | Notes | Range | | Median | Average | Std. Dev. | Notes | Range | | Median | Average | Std. Dev. | Notes |
| | | Low | High | | | | | Low | High | | | | | Low | High | | | | | Low | High | | | | | Low | High | | | | |
| **Caisson #1** | **Units** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Chemical Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Benzene** | **mg/kg** | 36,000 | 140,000 | 55,800 | **65,514** | 34,740 | Outlier Removed | -- | -- | -- | -- | -- | No ISTT on Caisson 1 | 18,600 | 28,300 | 23,450 | **23,450** | 6,859 | | 27,600 | 27,600 | 27,600 | **27,600** | N/A | One Value | 16,800 | 16,800 | 16,800 | **16,800** | N/A | One Value |
| **Total VOCs** | **mg/kg** | 50,084 | 182,187 | 69,043 | **84,689** | 44,684 | Outlier Removed | -- | -- | -- | -- | -- | | 24,035 | 35,713 | 29,874 | **29,874** | 8,258 | | 34,312 | 34,312 | 34,312 | **34,312** | N/A | One Value | 21,360 | 21,360 | 21,360 | **21,360** | N/A | One Value |
| **Naphthalene** | **mg/kg** | 24,600 | 24,600 | 24,600 | **24,600** | N/A | One Value | -- | -- | -- | -- | -- | | 2,740 | 4,010 | 3,375 | **3,375** | 898 | | 4,340 | 4,340 | 4,340 | **4,340** | N/A | One Value | 3,550 | 3,550 | 3,550 | **3,550** | N/A | One Value |
| **TCLP Benzene** | **mg/L** | 326 | 326 | 326 | **326** | N/A | One Value | -- | -- | -- | -- | -- | | 345 | 533 | 439 | **439** | 133 | | -- | -- | -- | **--** | -- | No Data | 313 | 313 | 313 | **313** | N/A | One Value |
| **SPLP Benzene** | **mg/L** | 383 | 383 | 383 | **383** | N/A | One Value | -- | -- | -- | -- | -- | | 463 | 479 | 471 | **471** | 11 | | -- | -- | -- | **--** | -- | No Data | 313 | 313 | 313 | **313** | N/A | One Value |
| **Caisson #3** | **Units** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Chemical Parameters** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Benzene** | **mg/kg** | **65,700** | 68,200 | 66,950 | **66,950** | 1,768 | | 19 | 61,900 | 118 | **124** | 20,597 | | 2,310 | 2,310 | 2,310 | **2,310** | - | 2 identical values | 1,320 | 1,830 | 1,575 | **1,575** | 361 | | 2,490 | 2,490 | 2,490 | **2,490** | N/A | One Value |
| **Total VOCs** | **mg/kg** | **84,034** | 92,121 | 88,078 | **88,078** | 5,719 | | 34 | 76,502 | 389 | **376** | 25,378 | | 3,002 | 3,032 | 3,017 | **3,017** | 21 | | 1,890 | 2,561 | 2,225 | **2,225** | 474 | | 3,543 | 3,543 | 3,543 | **3,543** | N/A | One Value |
| **Naphthalene** | **mg/kg** | **9,690** | 9,690 | 9,690 | **9,690** | N/A | One Value | 273 | 3,690 | 884 | **1,001** | 1,195 | | 2,290 | 2,680 | 2,485 | **2,485** | 276 | | 1,070 | 1,710 | 1,390 | **1,390** | 453 | | 1,740 | 1,740 | 1,740 | **1,740** | N/A | One Value |
| **TCLP Benzene** | **mg/L** | **526** | 526 | 526 | **526** | N/A | One Value | 0.281 | 12 | 0.45 | **3** | 5 | | 85 | 85 | 85 | **85** | 18 | | -- | -- | -- | **--** | -- | No Data | 59 | 59 | 59 | **59** | N/A | One Value |
| **SPLP Benzene** | **mg/L** | **531** | 531 | 531 | **531** | N/A | One Value | 0.085 | 10 | 0.28 | **2** | 4 | | 87 | 132 | 110 | **110** | 32 | | -- | -- | -- | **--** | -- | No Data | 59 | 59 | 59 | **59** | N/A | One Value |

**(a) One of six samples omitted from average/standard deviation assessment due to an anomalously high value (outlier).**

**Table 7. Caisson Concentration and Mass Removal Data**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| | | Baseline | Post-Treatment 1 | | | | | Post-Treatment 2 | | | | | | Post-Removal | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Material | Units | Pretreatment (Untreated) | Mass Added Reagents + Pumice | Initial Conditions | Post Treatment (mg/kg) Caisson 3 Post ISTT Outlier Removed | Mass Removed (lb) | Mass Reduction (%) | Post Thermal Treatment (mg/kg) Caisson 3 Post ISTT Outlier Included | Post Treatment Reagent Addition | Initial Conditions | Post Treatment | Mass Removed (lb) | Mass Reduction (%) | Estimated Mass Removed from Caisson | Post Treatment Reagent Addition | Initial Conditions | Post Treatment | Mass Removed (lb) | Mass Reduction (%) |
| **Caisson 1 Material** | | | | | sample | | | | | | | | | | | | | | |
| Total Material Mass in Caisson 1 | lbs | 18,741 | 20,409 | 39,150 | 38,720 | | | | | | | | | 32,244 | | 39,524 | 39,180 | | |
| Estimated Water Mass | lbs | 3,040 | 2,919 | 5,959 | 5,959 | | | | | | | | | | 3,940 | 3,940 | 3,940 | | |
| Estimated Solids Mass | lbs | 14,114 | 17,490 | 31,604 | 31,604 | | | | | | | | | | 3,340 | 34,403 | 34,403 | | |
| | | | | | | | | | | | | | | | | | | | |
| **Concentration Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene[1] | mg/kg | 65,514 | 0 | 31,362 | 23,450 | | 64% | | | | | | | 23,450 | 0 | 19,131 | 16,800 | | 28% |
| Average Naphthalene | mg/kg | 24,600 | 0 | 11,776 | 3,375 | | 86% | | | | | | | 3,375 | 0 | 2,753 | 3,550 | | -5% |
| Average Total VOCs[1] | mg/kg | 84,689 | 0 | 40,541 | 29,874 | | 65% | | | | | | | 29,874 | 0 | 24,371 | 21,360 | | 28% |
| | | | | | | | | | | | | | | | | | | | |
| **Mass Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene[1] | lbs | 1,228 | 0 | 1,228 | 908 | 320 | 26% | | | | | | | 756 | | 756 | 658 | 98 | 13% |
| Average Naphthalene | lbs | 461 | 0 | 461 | 131 | 330 | 72% | | | | | | | 109 | | 109 | 139 | -30 | -28% |
| Average Total VOCs[1] | lbs | 1,587 | 0 | 1,587 | 1,157 | 430 | 27% | | | | | | | 963 | | 963 | 837 | 126 | 13% |
| **Caisson 2 Material** | | | | | | | | | | | | | | | | | | | |
| Total Material Mass in Caisson 2 | lbs | 26,937 | | 28,112 | 23,972 | | | | | | | | | 11,900 | | | 11,900 | | |
| Estimated Water Mass | lbs | 4,369 | 0 | 4,369 | 0 | | | | | | | | | | 0 | | | | |
| Estimated Solids Mass | lbs | 19,081 | 4,661 | 23,743 | 23,743 | | | | | | | | | | 0 | | | | |
| | | | | | | | | | | | | | | | | | | | |
| **Concentration Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene | mg/kg | 96,100 | 0 | 92,084 | 5,775 | | 94% | | - | | | | | 5,775 | | | 6,120 | | |
| Average Naphthalene | mg/kg | 22,000 | 0 | 21,081 | 3,817 | | 83% | | - | | | | | 3,817 | | | 4,085 | | |
| Average Total VOCs | mg/kg | 129,432 | 0 | 124,022 | 9,552 | | 93% | | - | | | | | 9,552 | | | 9,474 | | |
| **Mass Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene | lbs | 2,589 | 0 | 2,589 | 138 | 2,450 | 95% | | | | | | | 69 | | | 73 | -4 | -6% |
| Average Naphthalene | lbs | 593 | 0 | 593 | 92 | 501 | 85% | | | | | | | 45 | | | 49 | -3 | -7% |
| Average Total VOCs | lbs | 3,487 | 0 | 3,487 | 229 | 3,258 | 93% | | | | | | | 114 | | | 113 | 1 | 1% |
| **Caisson 3 Material** | | | | | | | | | | | | | | | | | | | |
| Total Material Mass in Caisson 3 | lbs | 18,856 | | 22,767 | 19,730 | | | 19,730 | | 33,040 | 33,140 | | | 23,638 | | 26,306 | 26,320 | | |
| Estimated Water Mass | lbs | 3,058 | 0 | 3,058 | 0 | | | 0 | 3,169 | 3,169 | 3,169 | | | | 0 | 0 | 0 | | |
| Estimated Solids Mass | lbs | 14,137 | 5,572 | 19,708 | 19,708 | | | 19,708 | 10,163 | 29,871 | 29,871 | | | | 2,668 | 26,227 | 26,227 | | |
| **Concentration Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene | mg/kg | 66,950 | 0 | 55,449 | 109 | | | 6,975 | 0 | 4,165 | 2,310 | | | 2,310 | 0 | 2,076 | 2,490 | | |
| Average Naphthalene | mg/kg | 9,690 | 0 | 8,025 | 375 | | | 1,388 | 0 | 829 | 2,485 | | | 2,485 | 0 | 2,233 | 1,740 | | |
| Average Total VOCs | mg/kg | 88,078 | 0 | 72,948 | 1,100 | | | 8,833 | 0 | 5,275 | 3,017 | | | 3,017 | 0 | 2,711 | 3,543 | | |
| **Mass Summary** | | | | | | | | | | | | | | | | | | | |
| Average Benzene | lbs | 1,262 | 0 | 1,262 | 2 | 1,260 | 99.8% | 138 | | 138 | 77 | 61 | 44.4% | 55 | | 55 | 66 | -11 | -20% |
| Average Naphthalene | lbs | 183 | 0 | 183 | 7 | 175 | 96.0% | 27 | | 27 | 82 | -55 | -200.7% | 59 | | 59 | 46 | 13 | 22% |
| Average Total VOCs | lbs | 1,661 | 0 | 1,661 | 22 | 1,639 | 98.7% | 174 | | 174 | 100 | 74 | 42.6% | 71 | | 71 | 93 | -22 | -31% |

Notes:

1 - Baseline data are presented with one outlier (Sample ID:112113-TAR-TC01-0012 (Terracore)) removed

* - Estimated/calculated based on materials removed (=initial-removed)

Averages presented do not include results for duplicate samples

**Table 8. Caissons 1 and 3 TCLP Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON 1 | | | | CAISSON 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/12/2013 | 5/30/2014 | | 6/5/2014 | 11/12/2013 | 5/28/2014 | | | | | | 5/30/2014 | | 6/4/2014 |
| Treatment Stage | | PRE ISS (UNTREATED TAR) | POST 1st MIX | | POST 2nd MIX | PRE THERMAL (UNTREATED TAR) | POST THERMAL (PRE ISS MIXING) | | | | | | POST 1st MIX | | POST 2nd MIX |
| Core/Depth | | 0-1.2' | A -6-8' | B - 6-8' | Sample B | 0-1.2' | A - 0.8-2.2' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | C -4-5' | C - 5-7' | A - 6-8' | B - 6-8' | Sample C |
| Parameter | Unit | 112113-TAR-TC01-0012 | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060514-TAR-TC01B | 112113-TAR-TC03-0012 | 052814-TAR-TC03A-008022 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | 060414-TAR-TC03C |
| **TCLP VOCs** | | | | | | | | | | | | | | | |
| 1,1-DICHLOROETHENE | mg/L | < 1 | < 0.17 | < 0.034 | < 0.17 | < 1 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.17 |
| 1,2-DICHLOROETHANE | mg/L | < 0.581 | < 0.11 | < 0.022 | < 0.11 | < 0.581 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.11 |
| 1,4-DICHLOROBENZENE | mg/L | -- | < 0.15 | **0.108** | < 0.15 | -- | **0.0723** | **0.0477** | **0.0053** | < 0.0015 | **0.0043 J** | < 0.0015 | **0.072** | **0.0707** | < 0.15 |
| BENZENE | mg/L | **326** | **345** | **533** | **313** | **526** | **3** | **11.6** | **0.448** | **0.401** | **0.281** | < 0.0823 | **84.7** | **84.9** | **59.2** |
| CARBON TETRACHLORIDE | mg/L | < 1.24 | < 0.11 | < 0.023 | < 0.11 | < 1.24 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.11 |
| CHLOROBENZENE | mg/L | < 0.414 | < 0.17 | < 0.035 | < 0.17 | < 0.414 | **0.0066** | **0.0038 J** | < 0.0017 | < 0.0017 | < 0.0017 | < 0.0017 | **0.0133** | **0.0131** | < 0.17 |
| CHLOROFORM | mg/L | < 0.775 | < 0.12 | **0.0275 J** | < 0.12 | < 0.775 | < 0.0012 | < 0.0012 | < 0.0012 | < 0.0012 | < 0.0012 | < 0.0012 | **0.0035 J** | **0.0035 J** | < 0.12 |
| NAPHTHALENE | mg/L | <0.881 | -- | -- | -- | <0.881 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| METHYL ETHYL KETONE (2-BUTANONE) | mg/L | < 0.711 | < 1.6 | < 0.32 | < 1.6 | < 0.711 | < 0.016 | **0.0633 J** | < 0.016 | < 0.016 | < 0.016 | < 0.016 | **0.0224 J** | **0.0284 J** | < 1.6 |
| TETRACHLOROETHYLENE (PCE) | mg/L | < 0.963 | < 0.13 | < 0.025 | < 0.13 | < 0.963 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.13 |
| TRICHLOROETHYLENE (TCE) | mg/L | < 0.807 | < 0.25 | < 0.051 | < 0.25 | < 0.807 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.25 |
| VINYL CHLORIDE | mg/L | < 0.636 | < 0.26 | < 0.051 | < 0.26 | < 0.636 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.26 |
| **TCLP SVOCs** | | | | | | | | | | | | | | | |
| 1,4-DICHLOROBENZENE | mg/L | < 0.0245 | **0.059** | **0.0353** | **0.0568** | < 0.0245 | **0.0246** | **0.0171 J** | < 0.0036 | < 0.0036 | < 0.0036 | < 0.0036 | **0.0246** | **0.0261** | **0.0202** |
| 2,4,5-TRICHLOROPHENOL | mg/L | < 0.0134 | < 0.016 | < 0.016 | < 0.016 | < 0.0134 | < 0.016 | < 0.016 | < 0.016 | < 0.016 | < 0.016 | < 0.016 | < 0.016 | < 0.016 | < 0.016 |
| 2,4,6-TRICHLOROPHENOL | mg/L | < 0.0162 | < 0.013 | < 0.013 | < 0.013 | < 0.0162 | < 0.013 | < 0.013 | < 0.013 | < 0.013 | < 0.013 | < 0.013 | < 0.013 | < 0.013 | < 0.013 |
| 2,4-DINITROTOLUENE | mg/L | < 0.0141 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0141 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 | < 0.0043 |
| 2-METHYLPHENOL (O-CRESOL) | mg/L | < 0.0126 | **0.0193 J** | **0.027** | **0.0196 J** | < 0.0126 | **0.0414** | **0.0123 J** | < 0.01 | < 0.01 | < 0.01 | < 0.01 | **0.0208** | **0.0222** | **0.0125 J** |
| 3- AND 4- METHYLPHENOL (TOTAL) | mg/L | -- | **0.12** | **0.115** | < 0.0093 | -- | **0.1** | **0.124** | **0.0176 J** | < 0.0093 | **0.0261** | < 0.0093 | **0.0453** | **0.046** | **0.0334** |
| CRESOL | mg/L | <0.0215 | -- | -- | -- | <0.0215 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| HEXACHLOROBENZENE | mg/L | < 0.025 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.025 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0034 |
| HEXACHLOROBUTADIENE | mg/L | < 0.0245 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0245 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 | < 0.0051 |
| HEXACHLOROETHANE | mg/L | < 0.0238 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0238 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 | < 0.0055 |
| M,P-CRESOL | | <0.0088 | -- | -- | -- | <0.0088 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| NITROBENZENE | mg/L | **0.631** | < 0.0042 | < 0.0042 | < 0.0042 | < 0.019 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 | < 0.0042 |
| PENTACHLOROPHENOL | mg/L | < 0.0144 | < 0.014 | < 0.014 | < 0.014 | < 0.0144 | < 0.014 | < 0.014 | < 0.014 | < 0.014 | < 0.014 | < 0.014 | < 0.014 | < 0.014 | < 0.014 |
| PYRIDINE | mg/L | **0.238 J** | **0.555** | **0.301** | **1.77** | **0.646** | **0.223** | **4.33** | **0.464** | **1.26** | **0.204** | < 0.0032 | **0.329** | **0.0462** | **0.237** |
| **TCLP Metals** | | | | | | | | | | | | | | | |
| ARSENIC | mg/L | < 0.025 | **0.0029 J** | **0.057 J** | **0.022 J** | < 0.025 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | **0.014 J** |
| BARIUM | mg/L | < 0.013 | **0.69 J** | **0.48 J** | **0.33 J** | < 0.013 | **0.054 J** | **0.023 J** | **0.04 J** | **0.026 J** | **0.051 J** | **0.037 J** | **0.27 J** | **0.28 J** | **0.75 J** |
| CADMIUM | mg/L | < 0.0063 | **0.0011 J** | **0.0025 J** | < 0.0007 | < 0.0063 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | **0.0009 J** | **0.0011 J** | < 0.0007 |
| CHROMIUM, TOTAL | mg/L | **0.067 J** | < 0.00089 | **0.052** | **0.011** | **0.13 J** | **0.14** | **0.25** | **0.11** | **0.28** | **0.092** | **0.12** | < 0.00089 | **0.0016 J** | < 0.00089 |
| LEAD | mg/L | **0.26 J** | **0.013 J** | **0.035 J** | < 0.0065 | **0.29 J** | **0.32 J** | **0.8** | **0.38 J** | **0.42 J** | **0.37 J** | **0.55** | **0.0068 J** | **0.0064 J** | < 0.0065 |
| MERCURY | mg/L | **0.00021 J** | **0.00012 J** | **0.00014 J** | **0.0005** | **0.00023 J** | < 0.000064 | < 0.000064 | < 0.000064 | < 0.000064 | < 0.000064 | < 0.000064 | **0.000074 J** | **0.00008 J** | **0.00022** |
| SELENIUM | mg/L | < 0.05 | **0.044 J** | **0.062 J** | **0.0038 J** | < 0.05 | **0.0038 J** | **0.0092 J** | **0.0042 J** | **0.0041 J** | **0.0043 J** | **0.0056 J** | **0.036 J** | **0.035 J** | < 0.0036 |
| SILVER | mg/L | < 0.013 | **0.03** | **0.021 J** | < 0.0062 | < 0.013 | **0.0042 J** | **0.0046 J** | **0.0037 J** | **0.0044 J** | **0.0028 J** | **0.003 J** | **0.033** | **0.032** | **0.013** |

**Notes:**

-- = no sample taken

mg/L = miligram per liter

J = estimated detected result

< = non-detected result

**Detects are in BOLD font**

**Table 9. Caissons 1 and 3 SPLP Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON 1 | | | | CAISSON 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/12/2013 | 5/30/2014 | | 6/5/2014 | 11/12/2013 | 5/28/2014 | | | | | | 5/30/2014 | | 6/4/2014 |
| Treatment Stage | | PRE ISS (UNTREATED TAR) | POST 1st MIX | | POST 2nd MIX | PRE THERMAL (UNTREATED TAR) | POST THERMAL (PRE ISS MIXING) | | | | | | POST 1st MIX | | POST 2nd MIX |
| Core/Depth | | 0-1.2' | A -6-8' | B - 6-8' | Sample B | 0-0.1' | A - 0.8-2.2' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | C -4-5' | C - 5-7' | A - 6-8' | B - 6-8' | Sample C |
| Parameter | Unit | 112113-TAR-TC01-0012 | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060514-TAR-TC01B | 112113-TAR-TC03-0012 | 052814-TAR-TC03A-008022 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | 060414-TAR-TC03C |
| **SPLP VOCs** | | | | | | | | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | mg/L | **ND** | **0.0068 J** | **0.0075 J** | < 0.5 | **ND** | < 0.0025 | < 0.012 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.00025 | < 0.025 | < 0.0025 | < 0.062 |
| 1,1,1,2-TETRACHLOROETHANE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,1,2,2-TETRACHLOROETHANE | mg/L | **ND** | < 0.002 | < 0.002 | < 0.39 | **ND** | < 0.002 | < 0.0098 | < 0.00039 | < 0.00039 | < 0.00039 | < 0.0002 | < 0.02 | < 0.002 | < 0.049 |
| 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE | mg/L | **ND** | < 0.0077 | < 0.0077 | < 1.5 | **ND** | < 0.0077 | < 0.038 | < 0.0015 | < 0.0015 | < 0.0015 | < 0.00077 | < 0.077 | < 0.0077 | < 0.19 |
| 1,1,2-TRICHLOROETHANE | mg/L | **ND** | < 0.0021 | < 0.0021 | < 0.42 | **ND** | < 0.0021 | < 0.011 | < 0.00042 | < 0.00042 | < 0.00042 | < 0.00021 | < 0.021 | < 0.0021 | < 0.053 |
| 1,1-DICHLOROETHANE | mg/L | **ND** | < 0.0026 | < 0.0026 | < 0.52 | **ND** | < 0.0026 | < 0.013 | < 0.00052 | < 0.00052 | < 0.00052 | < 0.00026 | < 0.026 | < 0.0026 | < 0.065 |
| 1,1-DICHLOROETHENE | mg/L | **ND** | < 0.0034 | < 0.0034 | < 0.69 | **ND** | < 0.0034 | < 0.017 | < 0.00069 | < 0.00069 | < 0.00069 | < 0.00034 | < 0.034 | < 0.0034 | < 0.086 |
| 1,1-DICHLOROPROPENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,3-DICHLOROPROPANE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2,2-DICHLOROPROPANE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3-TRICHLOROBENZENE | mg/L | -- | < 0.0024 | < 0.0024 | < 0.49 | -- | < 0.0024 | < 0.012 | < 0.00049 | < 0.00049 | < 0.00049 | < 0.00024 | < 0.024 | < 0.0024 | < 0.061 |
| 1,2,4-TRICHLOROBENZENE | mg/L | **ND** | < 0.0022 | < 0.0022 | < 0.43 | **ND** | < 0.0022 | < 0.011 | < 0.00043 | < 0.00043 | < 0.00043 | < 0.00022 | < 0.022 | < 0.0022 | < 0.054 |
| 1,2,3-TRICHLOROPROPANE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,4-TRIMETHYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,3,5-TRIMETHYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-DIBROMO-3-CHLOROPROPANE | mg/L | **ND** | < 0.013 | < 0.013 | < 2.5 | **ND** | < 0.013 | < 0.063 | < 0.0025 | < 0.0025 | < 0.0025 | < 0.0013 | < 0.13 | < 0.013 | < 0.32 |
| 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) | mg/L | **ND** | < 0.0016 | < 0.0016 | < 0.32 | **ND** | < 0.0016 | < 0.008 | < 0.00032 | < 0.00032 | < 0.00032 | < 0.00016 | < 0.016 | < 0.0016 | < 0.04 |
| 1,2-DICHLOROBENZENE | mg/L | **1.69 J** | **1.47** | **1.37** | **1.37 J** | **1.37 J** | **0.52** | **0.397** | **0.0978** | **0.0089** | **0.0971** | **0.00044 J** | **0.965** | **0.843** | **0.743** |
| 1,2-DICHLOROETHANE | mg/L | **ND** | < 0.0022 | < 0.0022 | < 0.44 | **ND** | < 0.0022 | < 0.011 | < 0.00044 | < 0.00044 | < 0.00044 | < 0.00022 | < 0.022 | < 0.0022 | < 0.055 |
| 1.2-DICHLOROETHENE (TOTAL) | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2-DICHLOROPROPANE | mg/L | **ND** | < 0.0028 | < 0.0028 | < 0.56 | **ND** | < 0.0028 | < 0.014 | < 0.00056 | < 0.00056 | < 0.00056 | < 0.00028 | < 0.028 | < 0.0028 | < 0.07 |
| 1,3-DICHLOROBENZENE | mg/L | **ND** | **0.0219** | **0.02** | < 0.63 | **ND** | **0.0068 J** | < 0.016 | **0.00088 J** | < 0.00063 | **0.00073 J** | < 0.00031 | < 0.031 | **0.0118** | < 0.079 |
| 1,4-DICHLOROBENZENE | mg/L | **ND** | **0.122** | **0.112** | < 0.6 | **ND** | **0.0401** | **0.0317 J** | **0.0051** | < 0.0006 | **0.0045** | < 0.0003 | **0.0847 J** | **0.0647** | < 0.075 |
| 1,4-DIOXANE (P-DIOXANE) | mg/L | -- | < 0.73 | < 0.73 | < 150 | -- | < 0.73 | < 3.6 | < 0.15 | < 0.15 | < 0.15 | < 0.073 | < 7.3 | < 0.73 | < 18 |
| 2-CHLOROTOLUENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 4-CHLOROTOLUENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2-HEXANONE | mg/L | **ND** | **0.0388 J** | **0.0825** | < 3.4 | **ND** | < 0.017 | < 0.085 | < 0.0034 | < 0.0034 | < 0.0034 | < 0.0017 | < 0.17 | < 0.017 | < 0.43 |
| 4-ISOPROPYLTOLUENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 4-METHYL-2-PENTANONE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| ACETONE | mg/L | **ND** | **1.4** | **2.99** | < 6.7 | **ND** | **0.127** | < 0.17 | **0.0454** | **0.0341** | **0.0448** | **0.174** | < 0.33 | **0.417** | < 0.84 |
| BENZENE | mg/L | **383** | **463** | **479** | **313** | **531** | **1.82** | **9.65** | **0.473** | **0.227** | **0.28** | **0.0849** | **132** | **87** | **59.4** |
| BROMOBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| BROMOCHLOROMETHANE | mg/L | **ND** | < 0.0042 | < 0.0042 | < 0.83 | **ND** | < 0.0042 | < 0.021 | < 0.00083 | < 0.00083 | < 0.00083 | < 0.00042 | < 0.042 | < 0.0042 | < 0.1 |
| BROMODICHLOROMETHANE | mg/L | **ND** | < 0.0021 | < 0.0021 | < 0.42 | **ND** | < 0.0021 | < 0.011 | < 0.00042 | < 0.00042 | < 0.00042 | < 0.00021 | < 0.021 | < 0.0021 | < 0.053 |
| BROMOFORM | mg/L | **ND** | < 0.003 | < 0.003 | < 0.6 | **ND** | < 0.003 | < 0.015 | < 0.0006 | < 0.0006 | < 0.0006 | < 0.0003 | < 0.03 | < 0.003 | < 0.075 |
| BROMOMETHANE | mg/L | **ND** | < 0.0056 | < 0.0056 | < 1.1 | **ND** | < 0.0056 | < 0.028 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.00056 | < 0.056 | < 0.0056 | < 0.14 |
| CARBON DISULFIDE | mg/L | **ND** | **0.0479** | **0.369** | < 0.36 | **1.04 J** | **0.004 J** | **0.0316 J** | **0.0038 J** | **0.0019 J** | **0.0019 J** | **0.0021** | < 0.018 | < 0.0018 | < 0.046 |
| CARBON TETRACHLORIDE | mg/L | **ND** | < 0.0023 | < 0.0023 | < 0.45 | **ND** | < 0.0023 | < 0.011 | < 0.00045 | < 0.00045 | < 0.00045 | < 0.00023 | < 0.023 | < 0.0023 | < 0.057 |
| CHLOROBENZENE | mg/L | **ND** | **0.0261** | **0.0273** | < 0.69 | **ND** | < 0.0035 | < 0.017 | < 0.00069 | < 0.00069 | < 0.00069 | < 0.00035 | < 0.035 | **0.0128** | < 0.087 |
| CHLOROETHANE | mg/L | **ND** | < 0.0039 | **0.0663** | < 0.78 | **ND** | < 0.0039 | **0.027 J** | < 0.0019 | < 0.00078 | < 0.00078 | < 0.00039 | < 0.039 | < 0.0039 | < 0.097 |
| CHLOROFORM | mg/L | **ND** | **0.0038 J** | **0.007 J** | < 0.49 | **ND** | < 0.0025 | < 0.012 | < 0.00049 | < 0.00049 | < 0.00049 | < 0.00025 | < 0.025 | < 0.0025 | < 0.061 |
| CHLOROMETHANE | mg/L | **ND** | < 0.0036 | **0.0104** | < 0.73 | **ND** | < 0.0036 | < 0.018 | **0.0017 J** | < 0.00073 | < 0.00073 | < 0.00036 | < 0.036 | < 0.0036 | < 0.091 |
| CIS-1,2-DICHLOROETHYLENE | mg/L | **ND** | < 0.0024 | < 0.0024 | < 0.48 | **ND** | < 0.0024 | < 0.012 | < 0.00048 | < 0.00048 | < 0.00048 | < 0.00024 | < 0.024 | < 0.0024 | < 0.06 |
| CIS-1,3-DICHLOROPROPENE | mg/L | **ND** | < 0.0015 | < 0.0015 | < 0.3 | **ND** | < 0.0015 | < 0.0076 | < 0.0003 | < 0.0003 | < 0.0003 | < 0.00015 | < 0.015 | < 0.0015 | < 0.038 |
| CYCLOHEXANE | mg/L | -- | **0.0135 J** | **0.0183 J** | < 0.36 | -- | < 0.0018 | < 0.009 | < 0.00036 | < 0.00036 | < 0.00036 | < 0.00018 | < 0.018 | **0.0042 J** | < 0.045 |
| DIBROMOCHLOROMETHANE | mg/L | **ND** | < 0.0019 | < 0.0019 | < 0.38 | **ND** | < 0.0019 | < 0.0096 | < 0.00038 | < 0.00038 | < 0.00038 | < 0.00019 | < 0.019 | < 0.0019 | < 0.048 |
| DIBROMOMETHANE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| DICHLORODIFLUOROMETHANE | mg/L | **ND** | < 0.0063 | < 0.0063 | < 1.3 | **ND** | < 0.0063 | < 0.032 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.00063 | < 0.063 | < 0.0063 | < 0.16 |
| ETHYLBENZENE | mg/L | **ND** | **0.28** | **0.295** | < 0.42 | **ND** | **0.0391** | **0.0316 J** | **0.0061** | **0.0013 J** | **0.0047** | **0.00052 J** | **0.215** | **0.174** | **0.157 J** |
| ISOPROPYLBENZENE (CUMENE) | mg/L | **ND** | **0.358** | **0.354** | < 0.45 | **ND** | **0.0458** | **0.0242 J** | **0.0054** | **0.00083 J** | **0.005** | < 0.00022 | **0.186 J** | **0.173** | **0.14 J** |
| M,P-XYLENE (SUM OF ISOMERS) | mg/L | **ND** | **2.81** | **2.92** | **2.83** | **ND** | **0.395** | **0.981** | **0.0827** | **0.0142** | **0.0409** | **0.0014** | **1.91** | **1.61** | **1.26** |
| METHYL ACETATE | mg/L | -- | < 0.015 | < 0.015 | < 3 | -- | < 0.015 | < 0.075 | < 0.003 | < 0.003 | < 0.003 | < 0.0015 | < 0.15 | < 0.015 | < 0.38 |
| METHYL ETHYL KETONE (2-BUTANONE) | mg/L | **ND** | **0.119 J** | **0.294** | < 6.4 | **ND** | < 0.032 | < 0.16 | < 0.0064 | < 0.0064 | < 0.0064 | **0.0104 J** | < 0.32 | < 0.032 | < 0.8 |
| METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE) | mg/L | **ND** | **0.0324 J** | **0.0637** | < 3 | **ND** | < 0.015 | < 0.074 | < 0.003 | < 0.003 | < 0.003 | < 0.0015 | < 0.15 | < 0.015 | < 0.37 |
| METHYL IODIDE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |

**Table 9. Caissons 1 and 3 SPLP Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON 1 | | | | CAISSON 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/12/2013 | 5/30/2014 | | 6/5/2014 | 11/12/2013 | 5/28/2014 | | | | | | 5/30/2014 | | 6/4/2014 |
| Treatment Stage | | PRE ISS (UNTREATED TAR) | POST 1st MIX | | POST 2nd MIX | PRE THERMAL (UNTREATED TAR) | POST THERMAL (PRE ISS MIXING) | | | | | | POST 1st MIX | | POST 2nd MIX |
| Core/Depth | | 0-1.2' | A -6-8' | B - 6-8' | Sample B | 0-0.1' | A - 0.8-2.2' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | C -4-5' | C - 5-7' | A - 6-8' | B - 6-8' | Sample C |
| Parameter | Unit | 112113-TAR-TC01-0012 | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060514-TAR-TC01B | 112113-TAR-TC03-0012 | 052814-TAR-TC03A-008022 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | 060414-TAR-TC03C |
| METHYLCYCLOHEXANE | mg/L | -- | **0.0086 J** | **0.0104 J** | < 0.31 | -- | < 0.0015 | < 0.0077 | < 0.00031 | < 0.00031 | < 0.00031 | < 0.00015 | < 0.015 | **0.0032 J** | < 0.039 |
| METHYLENE CHLORIDE | mg/L | **ND** | < 0.0086 | < 0.0086 | < 1.7 | **ND** | < 0.0086 | < 0.043 | < 0.0017 | < 0.0017 | < 0.0017 | < 0.00086 | < 0.086 | < 0.0086 | < 0.22 |
| N-BUTYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| N-PROPYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| O-XYLENE (1,2-DIMETHYLBENZENE) | mg/L | **ND** | **0.886** | **0.893** | **0.753 J** | **ND** | **0.13** | **0.111** | **0.015** | **0.0023** | **0.0111** | **0.00043 J** | **0.552** | **0.46** | **0.346** |
| SEC-BUTYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| STYRENE | mg/L | **ND** | < 0.003 | < 0.003 | < 0.6 | **ND** | < 0.003 | < 0.015 | < 0.0006 | < 0.0006 | < 0.0006 | < 0.0003 | < 0.03 | < 0.003 | < 0.076 |
| TERT-BUTYLBENZENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TERT-BUTYL METHYL ETHER | mg/L | **ND** | < 0.0029 | < 0.0029 | < 0.57 | **ND** | < 0.0029 | < 0.014 | < 0.00057 | < 0.00057 | < 0.00057 | < 0.00029 | < 0.029 | < 0.0029 | < 0.071 |
| TETRACHLOROETHYLENE (PCE) | mg/L | **ND** | < 0.0025 | < 0.0025 | < 0.5 | **ND** | < 0.0025 | < 0.013 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.00025 | < 0.025 | < 0.0025 | < 0.063 |
| TOLUENE | mg/L | **39** | **55.8** | **45** | **37** | **47.9** | **1.09** | **1.66** | **0.14** | **0.0323** | **0.0755** | **0.0075** | **16.7** | **12.8** | **8.95** |
| TRANS-1,2-DICHLOROETHENE | mg/L | **ND** | < 0.0038 | < 0.0038 | < 0.76 | **ND** | < 0.0038 | < 0.019 | < 0.00076 | < 0.00076 | < 0.00076 | < 0.00038 | < 0.038 | < 0.0038 | < 0.095 |
| TRANS-1,3-DICHLOROPROPENE | mg/L | **ND** | < 0.0021 | < 0.0021 | < 0.41 | **ND** | < 0.0021 | < 0.01 | < 0.00041 | < 0.00041 | < 0.00041 | < 0.00021 | < 0.021 | < 0.0021 | < 0.052 |
| TRANS-1,4-DICHLORO-2-BUTENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| TRICHLOROETHYLENE (TCE) | mg/L | **ND** | < 0.0051 | < 0.0051 | < 1 | **ND** | < 0.0051 | < 0.025 | < 0.001 | < 0.001 | < 0.001 | < 0.00051 | < 0.051 | < 0.0051 | < 0.13 |
| TRICHLOROFLUOROMETHANE | mg/L | **ND** | < 0.0033 | < 0.0033 | < 0.67 | **ND** | < 0.0033 | < 0.017 | < 0.00067 | < 0.00067 | < 0.00067 | < 0.00033 | < 0.033 | < 0.0033 | < 0.084 |
| VINYL ACETATE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| VINYL CHLORIDE | mg/L | **ND** | < 0.0051 | < 0.0051 | < 1 | **ND** | < 0.0051 | < 0.026 | < 0.001 | < 0.001 | < 0.001 | < 0.00051 | < 0.051 | < 0.0051 | < 0.13 |
| Xylenes | mg/L | **ND** | **3.7** | **3.81** | **3.58** | **ND** | **0.525** | **1.09** | **0.0977** | **0.0165** | **0.052** | **0.0018** | **2.47** | **2.07** | **1.6** |
| **SPLP SVOCs** | | | | | | | | | | | | | | | |
| 1,2,4,5-TETRACHLOROBENZENE | mg/L | **ND** | < 0.00031 | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00036 | < 0.00035 | < 0.00036 | < 0.00035 | < 0.00034 | < 0.00031 | < 0.00032 | < 0.00031 |
| 1,2-DIPHENYLHYDRAZINE/AZOBENZEN | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2,2-OXYBIS(2-CHLOROPROPANE) | mg/L | -- | < 0.00047 J | < 0.00049 | < 0.00045 | -- | < 0.00076 | < 0.00054 | < 0.00053 | < 0.00053 | < 0.00052 | < 0.00051 | < 0.00045 | < 0.00048 | < 0.00045 |
| 2,3,4,6-TETRACHLOROPHENOL | mg/L | -- | < 0.00097 | < 0.001 | < 0.00094 | -- | < 0.0016 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.00094 | < 0.00099 | < 0.00094 |
| 2,4,5-TRICHLOROPHENOL | mg/L | **ND** | < 0.0016 | < 0.0017 | < 0.0016 | **ND** | < 0.0026 | < 0.0019 | < 0.0018 | < 0.0018 | < 0.0018 | < 0.0018 | < 0.0016 | < 0.0016 | < 0.0016 |
| 2,4,6-TRICHLOROPHENOL | mg/L | **ND** | < 0.0013 | < 0.0014 | < 0.0013 | **ND** | < 0.0022 | < 0.0015 | < 0.0015 | < 0.0015 | < 0.0015 | < 0.0014 | < 0.0013 | < 0.0014 | < 0.0013 |
| 2,4-DICHLOROPHENOL | mg/L | **ND** | < 0.0012 | < 0.0012 | < 0.0012 | **ND** | < 0.0019 | < 0.0014 | < 0.0013 | < 0.0014 | < 0.0013 | < 0.0013 | < 0.0012 | < 0.0012 | < 0.0012 |
| 2,4-DIMETHYLPHENOL | mg/L | **ND** | **0.0371** | **0.0598** | < 0.0015 | **ND** | **0.0939** | **0.063** | **0.0159** | **0.0031 J** | **0.0118** | < 0.0017 | **0.15** | **0.0856** | **0.0297** |
| 2,4-DINITROPHENOL | mg/L | **ND** | < 0.017 | < 0.018 | < 0.017 | **ND** | < 0.028 | < 0.02 | < 0.019 | < 0.019 | < 0.019 | < 0.019 | < 0.017 | < 0.017 | < 0.017 |
| 2,4-DINITROTOLUENE | mg/L | **ND** | < 0.00044 | < 0.00046 | < 0.00043 | **ND** | < 0.00071 | < 0.00051 | < 0.0005 | < 0.0005 | < 0.00048 | < 0.00048 | < 0.00043 | < 0.00045 | < 0.00043 |
| 2,6-DINITROTOLUENE | mg/L | **ND** | < 0.00048 | < 0.0005 | < 0.00046 | **ND** | < 0.00077 | < 0.00055 | < 0.00054 | < 0.00054 | < 0.00052 | < 0.00052 | < 0.00046 | < 0.00049 | < 0.00046 |
| 2-CHLORONAPHTHALENE | mg/L | **ND** | < 0.00031 | < 0.00032 | < 0.0003 | **ND** | < 0.0005 | < 0.00035 | < 0.00035 | < 0.00035 | < 0.00034 | < 0.00033 | < 0.0003 | < 0.00031 | < 0.0003 |
| 2-CHLOROPHENOL | mg/L | **ND** | < 0.001 J | < 0.001 | < 0.00097 | **ND** | < 0.0016 | < 0.0012 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.0011 | < 0.00097 | < 0.001 | < 0.00097 |
| 2-METHYLNAPHTHALENE | mg/L | **0.0656 J** | **0.0385** | **0.0406** | **0.0245** | **0.124 J** | **0.0446** | **0.0393** | **0.0239** | **0.0018 J** | **0.0163** | < 0.00043 | **0.0271** | **0.0434** | **0.0324** |
| 2-METHYLPHENOL (O-CRESOL) | mg/L | **ND** | **0.0293** | **0.0303** | **0.0013 J** | **ND** | **0.064** | **0.0185** | **0.0088** | < 0.0012 | **0.0061** | < 0.0012 | **0.0044** | **0.0052** | **0.0122** |
| 2-NITROANILINE | mg/L | **ND** | < 0.0011 | < 0.0012 | < 0.0011 | **ND** | < 0.0019 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0013 | < 0.0012 | < 0.0011 | < 0.0012 | < 0.0011 |
| 2-NITROPHENOL | mg/L | **ND** | < 0.0015 | < 0.0016 | < 0.0015 | **ND** | < 0.0025 | < 0.0018 | < 0.0017 | < 0.0018 | < 0.0017 | < 0.0017 | < 0.0015 | < 0.0016 | < 0.0015 |
| 3- AND 4- METHYLPHENOL (TOTAL) | mg/L | -- | < 0.00095 J | < 0.00099 | < 0.00093 | -- | **0.116** | **0.107** | **0.0277** | < 0.0011 | **0.02** | **0.0021 J** | < 0.00093 | < 0.00097 | **0.0278** |
| 3,3'-DICHLOROBENZIDINE | mg/L | **ND** | < 0.00037 | < 0.00039 | < 0.00036 | **ND** | < 0.0006 | < 0.00043 | < 0.00042 | < 0.00042 | < 0.00041 | < 0.0004 | < 0.00036 | < 0.00038 | < 0.00036 |
| 3-NITROANILINE | mg/L | **ND** | < 0.0013 | < 0.0014 | < 0.0013 J | **ND** | < 0.0021 | < 0.0015 | < 0.0015 | < 0.0015 | < 0.0014 | < 0.0014 | < 0.0013 | < 0.0013 | < 0.0013 J |
| 4,6-DINITRO-2-METHYLPHENOL | mg/L | **ND** | < 0.001 | < 0.0011 | < 0.00099 | **ND** | < 0.0016 | < 0.0012 | < 0.0011 | < 0.0012 | < 0.0011 | < 0.0011 | < 0.00099 | < 0.001 | < 0.00099 |
| 4-BROMOPHENYL PHENYL ETHER | mg/L | **ND** | < 0.00037 | < 0.00038 | < 0.00036 | **ND** | < 0.0006 | < 0.00043 | < 0.00042 | < 0.00042 | < 0.00041 | < 0.0004 | < 0.00036 | < 0.00038 | < 0.00036 |
| 4-CHLORO-3-METHYLPHENOL | mg/L | **ND** | < 0.0019 | < 0.002 | < 0.0018 | **ND** | < 0.003 | < 0.0022 | < 0.0021 | < 0.0021 | < 0.0021 | < 0.002 | < 0.0018 | < 0.0019 | < 0.0018 |
| 4-CHLOROANILINE | mg/L | **ND** | < 0.00054 | < 0.00057 | < 0.00053 | **ND** | < 0.00088 | < 0.00063 | < 0.00061 | < 0.00062 | < 0.0006 | < 0.00059 | < 0.00053 | < 0.00056 | < 0.00053 |
| 4-CHLOROPHENYL PHENYL ETHER | mg/L | **ND** | < 0.00032 | < 0.00034 | < 0.00031 | **ND** | < 0.00052 | < 0.00037 | < 0.00036 | < 0.00037 | < 0.00035 | < 0.00035 | < 0.00031 | < 0.00033 | < 0.00031 |
| 4-NITROANILINE | mg/L | **ND** | < 0.0017 | < 0.0018 | < 0.0017 | **ND** | < 0.0028 | < 0.002 | < 0.0019 | < 0.0019 | < 0.0019 | < 0.0019 | < 0.0017 | < 0.0017 | < 0.0017 |
| 4-NITROPHENOL | mg/L | **ND** | < 0.0054 | < 0.0056 | < 0.0052 | **ND** | < 0.0087 | < 0.0062 | < 0.006 | < 0.0061 | < 0.0059 | < 0.0058 | < 0.0052 | < 0.0055 | < 0.0052 |
| ACENAPHTHENE | mg/L | **ND** | < 0.00031 | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00036 | < 0.00035 | < 0.00036 | < 0.00035 | < 0.00034 | < 0.00031 | < 0.00032 | < 0.00031 |
| ACETOPHENONE | mg/L | -- | **1.77** | **2.45** | **4.6** | -- | **4.26** | **3.72** | **0.455** | **0.0372** | **0.324** | **0.0054 J** | **8.15** | **7.73** | **0.824** |
| ANILINE | ug/l | **315** | **--** | **--** | **2460** | **243 J** | **500** | **31.1** | **147** | **159 J** | **79.1** | **--** | **--** | **--** | **139** |
| ATRAZINE | mg/L | -- | < 0.0005 | < 0.00052 | < 0.00049 | -- | < 0.00081 | < 0.00058 | < 0.00057 | < 0.00057 | < 0.00055 | < 0.00055 | < 0.00049 | < 0.00051 | < 0.00049 |
| BENZALDEHYDE | mg/L | -- | < 0.0034 | < 0.0035 | < 0.0033 | -- | < 0.0054 | < 0.0039 | < 0.0038 | < 0.0038 | < 0.0037 | < 0.0037 | < 0.0033 | < 0.0034 | < 0.0033 |
| BENZYL ALCOHOL | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| BENZYL BUTYL PHTHALATE | mg/L | < 5.33 | < 0.0003 | < 0.00031 | < 0.00029 | < 5.33 | < 0.00048 | < 0.00034 | < 0.00034 | < 0.00034 | < 0.00033 | < 0.00032 | < 0.00029 | < 0.0003 | < 0.00029 |
| BIPHENYL (DIPHENYL) | mg/L | -- | **0.0073** | **0.0066** | **0.0021** | -- | **0.0055** | **0.0033** | **0.0042** | **0.00043 J** | **0.0027** | < 0.00034 | **0.0024** | **0.0035** | **0.0059** |
| BIS(2-CHLOROETHOXY) METHANE | mg/L | **ND** | < 0.00032 | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00037 | < 0.00036 | < 0.00036 | < 0.00035 | < 0.00034 | < 0.00031 | < 0.00032 | < 0.00031 |

**Table 9. Caissons 1 and 3 SPLP Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON 1 | | | | CAISSON 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/12/2013 | 5/30/2014 | | 6/5/2014 | 11/12/2013 | 5/28/2014 | | | | | | 5/30/2014 | | 6/4/2014 |
| Treatment Stage | | PRE ISS (UNTREATED TAR) | POST 1st MIX | | POST 2nd MIX | PRE THERMAL (UNTREATED TAR) | POST THERMAL (PRE ISS MIXING) | | | | | | POST 1st MIX | | POST 2nd MIX |
| Core/Depth | | 0-1.2' | A -6-8' | B - 6-8' | Sample B | 0-0.1' | A - 0.8-2.2' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | C -4-5' | C - 5-7' | A - 6-8' | B - 6-8' | Sample C |
| **Parameter** | **Unit** | **112113-TAR-TC01-0012** | **053014-PTM-TC01A-060080** | **053014-PTM-TC01B-060080** | **060514-TAR-TC01B** | **112113-TAR-TC03-0012** | **052814-TAR-TC03A-008022** | **052814-HC-TC03A-070082** | **052814-HC-TC03B-009016** | **052814-TAR-TC03B-050076** | **052814-HC-TC03C-040050** | **052814-SW-TC03C-050070** | **053014-PTM-TC03A-060080** | **053014-PTM-TC03B-060080** | **060414-TAR-TC03C** |
| BIS(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER) | mg/L | **ND** | < 0.00032 J | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00037 | < 0.00036 | < 0.00036 | < 0.00035 | < 0.00035 | < 0.00031 | < 0.00032 | < 0.00031 |
| BIS(2-CHLOROISOPROPYL)ETHER | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| BIS(2-ETHYLHEXYL) PHTHALATE | mg/L | **ND** | < 0.0006 | < 0.00063 | **0.001 J** | **ND** | < 0.00098 | < 0.0007 | < 0.00068 | < 0.00069 | < 0.00067 | < 0.00066 | < 0.00059 | < 0.00062 | < 0.00059 |
| CAPROLACTAM | mg/L | -- | < 0.00071 | < 0.00074 | < 0.00069 | -- | < 0.0011 J | < 0.00082 J | < 0.0008 J | < 0.00081 J | < 0.00078 J | < 0.00077 J | < 0.00069 | < 0.00073 | < 0.00069 |
| CARBAZOLE | mg/L | **ND** | < 0.00037 | < 0.00039 | < 0.00036 | **ND** | < 0.0006 | < 0.00043 | < 0.00042 | < 0.00042 | < 0.00041 | < 0.0004 | < 0.00036 | < 0.00038 | < 0.00036 |
| DIBENZOFURAN | mg/L | **ND** | **0.0022 J** | **0.0018 J** | < 0.00027 | **ND** | **0.0033 J** | **0.0018 J** | **0.0018 J** | < 0.00031 | **0.0013 J** | < 0.0003 | < 0.00027 | **0.0024 J** | **0.0015 J** |
| DIETHYL PHTHALATE | mg/L | **ND** | < 0.00034 | < 0.00035 | < 0.00033 | **ND** | < 0.00055 | < 0.00039 | < 0.00038 | < 0.00038 | < 0.00037 | < 0.00037 | < 0.00033 | < 0.00034 | < 0.00033 |
| DIMETHYL PHTHALATE | mg/L | **ND** | < 0.00029 | < 0.0003 | < 0.00028 | **ND** | < 0.00047 | < 0.00034 | < 0.00033 | < 0.00033 | < 0.00032 | < 0.00032 | < 0.00028 | < 0.0003 | < 0.00028 |
| DI-N-BUTYL PHTHALATE | mg/L | **ND** | < 0.00057 | < 0.0006 | < 0.00056 | **ND** | < 0.00093 | **0.0042** | < 0.00065 | < 0.00065 | < 0.00063 | < 0.00062 | < 0.00056 | < 0.00058 | < 0.00056 |
| DI-N-OCTYLPHTHALATE | mg/L | **ND** | < 0.00032 | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00037 | < 0.00036 | < 0.00036 | < 0.00035 | < 0.00035 | < 0.00031 | < 0.00032 | < 0.00031 |
| HEXACHLOROBUTADIENE | mg/L | **ND** | < 0.00053 | < 0.00055 | < 0.00051 | **ND** | < 0.00085 | < 0.00061 | < 0.0006 | < 0.0006 | < 0.00058 | < 0.00058 | < 0.00051 | < 0.00054 | < 0.00051 |
| HEXACHLOROCYCLOPENTADIENE | mg/L | **ND** | < 0.0073 | < 0.0076 | < 0.0071 | **ND** | < 0.012 | < 0.0085 | < 0.0083 | < 0.0084 | < 0.0081 | < 0.008 | < 0.0071 | < 0.0075 | < 0.0071 |
| HEXACHLOROETHANE | mg/L | **ND** | < 0.00057 J | < 0.00059 | < 0.00055 | **ND** | < 0.00092 | < 0.00065 | < 0.00064 | < 0.00065 | < 0.00062 | < 0.00062 | < 0.00055 | < 0.00058 | < 0.00055 |
| ISOPHORONE | mg/L | **ND** | **0.0085** | **0.012** | **0.0273** | **0.0662** | **0.0243** | **0.0114** | < 0.00032 | < 0.00032 | < 0.00031 | < 0.00031 | **0.0519 J** | **0.0451** | **0.0045** |
| M,P-CRESOL | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| NAPHTHALENE | mg/L | **ND** | **2.17** | **2.68** | **1.81** | **ND** | **2.72** | **2.77** | **1.01** | **0.107** | **0.757** | -- | **1.96** | **2.84** | **1.82** |
| NITROBENZENE | mg/L | **0.682** | < 0.00043 | < 0.00045 | < 0.00042 | **ND** | < 0.0007 | < 0.0005 | < 0.00049 | < 0.00049 | < 0.00048 | < 0.00047 | < 0.00042 | < 0.00044 | < 0.00042 |
| N-NITROSODI-N-PROPYLAMINE | mg/L | **ND** | < 0.00031 | < 0.00032 | < 0.0003 | **ND** | < 0.0005 | < 0.00036 | < 0.00035 | < 0.00036 | < 0.00034 | < 0.00034 | < 0.0003 | < 0.00032 | < 0.0003 |
| N-NITROSODIPHENYLAMINE | mg/L | **ND** | < 0.00031 | < 0.00033 | < 0.00031 | **ND** | < 0.00051 | < 0.00036 | < 0.00035 | < 0.00036 | < 0.00035 | < 0.00034 | < 0.00031 | < 0.00032 | < 0.00031 |
| N-NITROSODIMETHYLAMINE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PYRIDINE | mg/L | **0.586** | -- | -- | -- | **1.04** | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PHENOL | mg/L | **0.147 J** | < 0.0013 J | < 0.0014 | **0.0327** | **0.213 J** | **0.147** | **0.084** | **0.0284** | < 0.0015 | **0.0199** | **0.0037** | **0.0529 J** | **0.111** | < 0.0013 |
| **SPLP PAHs** | | | | | | | | | | | | | | | |
| ACENAPHTHENE | mg/L | -- | **0.00327** | **0.00358** | **0.00223 J** | -- | **0.00484** | **0.00149** | **0.00249** | < 0.000024 | **0.00192** | < 0.000023 | **0.00257** | **0.00578** | **0.0019** |
| ACENAPHTHYLENE | mg/L | **ND** | **0.000348** | < 0.00013 | < 0.000024 | **ND** | < 0.000039 | < 0.000028 | < 0.000027 | < 0.000028 | < 0.000027 | < 0.000027 | < 0.000024 | < 0.00012 | < 0.000024 |
| ANTHRACENE | mg/L | **ND** | **0.000424** | < 0.00011 | < 0.00002 | **ND** | **0.000263** | **0.000218** | **0.000222** | < 0.000024 | **0.000143** | < 0.000023 | < 0.00002 | < 0.00011 | < 0.00002 |
| BENZO(A)ANTHRACENE | mg/L | **ND** | < 0.000012 | < 0.000062 | **0.000179** | **ND** | < 0.000019 | < 0.000014 | < 0.000013 | < 0.000014 | < 0.000013 | < 0.000013 | < 0.000012 | < 0.000061 | < 0.000012 |
| BENZO(A)PYRENE | mg/L | **ND** | < 0.000013 | < 0.000066 | < 0.000012 | **ND** | < 0.000021 | < 0.000015 | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000012 | < 0.000065 | < 0.000012 |
| BENZO(B)FLUORANTHENE | mg/L | **ND** | < 0.00001 | < 0.000054 | < 0.00001 | **ND** | < 0.000017 | < 0.000012 | < 0.000012 | < 0.000012 | < 0.000011 | < 0.000011 | < 0.00001 | < 0.000053 | < 0.00001 |
| BENZO(G,H,I)PERYLENE | mg/L | **ND** | < 0.000016 | < 0.000084 | < 0.000016 | **ND** | < 0.000026 | < 0.000019 | < 0.000018 | < 0.000018 | < 0.000018 | < 0.000018 | < 0.000016 | < 0.000082 | < 0.000016 |
| BENZO(K)FLUORANTHENE | mg/L | **ND** | < 0.000015 | < 0.00008 | < 0.000015 | **ND** | < 0.000025 | < 0.000018 | < 0.000017 | < 0.000017 | < 0.000017 | < 0.000017 | < 0.000015 | < 0.000078 | < 0.000015 |
| CHRYSENE | mg/L | **ND** | < 0.000012 | < 0.000063 | **0.000109** | **ND** | < 0.00002 | < 0.000014 | < 0.000014 | < 0.000014 | < 0.000013 | < 0.000013 | < 0.000012 | < 0.000062 | < 0.000012 |
| DIBENZ(A,H)ANTHRACENE | mg/L | **ND** | < 0.000017 | < 0.000089 | < 0.000017 | **ND** | < 0.000028 | < 0.00002 | < 0.000019 | < 0.00002 | < 0.000019 | < 0.000019 | < 0.000017 | < 0.000087 | < 0.000017 |
| FLUORANTHENE | mg/L | **ND** | < 0.000014 | < 0.000072 | **0.000321** | **ND** | < 0.000022 | < 0.000016 | < 0.000015 | < 0.000016 | < 0.000015 | < 0.000015 | < 0.000013 | < 0.00007 | < 0.000013 |
| FLUORENE | mg/L | **0.02 J** | < 0.000018 | < 0.000091 | < 0.000017 | **0.308** | < 0.000028 | < 0.00002 | < 0.00002 | < 0.00002 | < 0.000019 | < 0.000019 | < 0.000017 | < 0.000089 | < 0.000017 |
| HEXACHLOROBENZENE | mg/L | **ND** | < 0.000017 | < 0.000089 | < 0.000017 | **ND** | < 0.000028 | < 0.00002 | < 0.000019 | < 0.00002 | < 0.000019 | < 0.000019 | < 0.000017 | < 0.000087 | < 0.000017 |
| INDENO(1,2,3-C,D)PYRENE | mg/L | **ND** | < 0.000015 | < 0.000077 | < 0.000014 | **ND** | < 0.000024 | < 0.000017 | < 0.000017 | < 0.000017 | < 0.000016 | < 0.000016 | < 0.000014 | < 0.000076 | < 0.000014 |
| NAPHTHALENE | mg/L | **ND** | -- | -- | -- | **ND** | -- | -- | -- | -- | -- | **0.00302** | -- | -- | -- |
| PENTACHLOROPHENOL | mg/L | **ND** | < 0.0001 | < 0.00054 | < 0.0001 | **ND** | < 0.00017 | < 0.00012 | < 0.00012 | < 0.00012 | < 0.00011 | < 0.00011 | < 0.0001 | < 0.00053 | < 0.0001 |
| PHENANTHRENE | mg/L | **ND** | **0.00076** | **0.00065** | **0.000646** | **ND** | **0.000822** | **0.000417** | **0.000521** | **0.000124** | **0.000444** | < 0.000023 | **0.000511** | **0.000877** | **0.000509** |
| PYRENE | mg/L | **ND** | < 0.000015 | < 0.000081 | **0.000204** | **ND** | < 0.000025 | < 0.000018 | < 0.000017 | < 0.000018 | < 0.000017 | < 0.000017 | < 0.000015 | < 0.000079 | < 0.000015 |
| **SPLP Metals** | | | | | | | | | | | | | | | |
| ALUMINUM | mg/L | -- | -- | -- | **0.24** | -- | **5.86** | **13.8** | **4.48** | **9.97** | **5.73** | **9.41** | -- | -- | **0.397** |
| ANTIMONY | mg/L | -- | -- | -- | < 0.0026 | -- | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | < 0.0026 | -- | -- | < 0.0026 |
| ARSENIC | mg/L | **ND** | < 0.026 | < 0.026 | < 0.026 | **ND** | < 0.0051 | < 0.064 | < 0.0051 | < 0.013 | < 0.0051 | < 0.013 | < 0.013 | < 0.013 | **0.0082 J** |
| BARIUM | mg/L | **0.0089 J** | **0.19 J** | **0.079 J** | **0.273 J** | **0.012** | **0.034 J** | **0.0234 J** | **0.0293 J** | **0.0265 J** | **0.0369 J** | **0.0335 J** | **0.42 J** | **0.44 J** | **0.891 J** |
| BERYLLIUM | mg/L | -- | -- | -- | < 0.0004 | -- | **0.0007 J** | **0.001 J** | **0.0004 J** | **0.0006 J** | < 0.0004 | **0.0005 J** | -- | -- | < 0.0004 |
| CADMIUM | mg/L | **ND** | < 0.0007 | < 0.0007 | < 0.0007 | **ND** | **0.0007 J** | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 |
| CALCIUM | mg/L | -- | -- | -- | **1050** | -- | **2.16 J** | **4.45 J** | **1.93 J** | **6.07 J** | **3.85 J** | **4.21 J** | -- | -- | **449** |
| CHROMIUM, TOTAL | mg/L | **0.055** | **0.0069 J** | **0.0039 J** | < 0.00089 | **0.14** | **0.113** | **0.241** | **0.0814** | **0.194** | **0.103** | **0.213** | < 0.00089 | < 0.00089 | < 0.00089 |
| COBALT | mg/L | -- | -- | -- | **0.0019 J** | -- | **0.0059 J** | **0.0107 J** | **0.0017 J** | **0.0074 J** | **0.003 J** | **0.0054 J** | -- | -- | **0.0009 J** |
| COPPER | mg/L | -- | -- | -- | **0.005 J** | -- | **0.0087 J** | **0.0137** | **0.0237** | **0.0066 J** | **0.0051 J** | **0.0169** | -- | -- | **0.0037 J** |
| IRON | mg/L | -- | -- | -- | **0.0435 J** | -- | **108** | **149** | **71** | **151** | **90.5** | **146** | -- | -- | **0.0361 J** |
| LEAD | mg/L | **0.065** | < 0.0013 | < 0.0013 | **0.0081 J** | **0.36** | **0.257** | **0.739** | **0.32** | **0.671** | **0.353** | **0.685** | < 0.0013 | < 0.0013 | **0.0042 J** |
| MAGNESIUM | mg/L | -- | -- | -- | **0.0467 J** | -- | **1.56 J** | **1.87 J** | **0.895 J** | **1.22 J** | **1.35 J** | **1.52 J** | -- | -- | < 0.041 |
| MANGANESE | mg/L | -- | -- | -- | **0.0008 J** | -- | **1.32** | **1.42** | **1.05** | **1.94** | **1.09** | **1.51** | -- | -- | **0.0005 J** |

**Table 9. Caissons 1 and 3 SPLP Results**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Location | | CAISSON 1 | | | | CAISSON 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | | 11/12/2013 | 5/30/2014 | | 6/5/2014 | 11/12/2013 | 5/28/2014 | | | | | | 5/30/2014 | | 6/4/2014 |
| Treatment Stage | | PRE ISS (UNTREATED TAR) | POST 1st MIX | | POST 2nd MIX | PRE THERMAL (UNTREATED TAR) | POST THERMAL (PRE ISS MIXING) | | | | | | POST 1st MIX | | POST 2nd MIX |
| Core/Depth | | 0-1.2' | A -6-8' | B - 6-8' | Sample B | 0-0.1' | A - 0.8-2.2' | A - 7-8.2' | B - 0.9-1.6' | B - 5-7.6' | C -4-5' | C - 5-7' | A - 6-8' | B - 6-8' | Sample C |
| Parameter | Unit | 112113-TAR-TC01-0012 | 053014-PTM-TC01A-060080 | 053014-PTM-TC01B-060080 | 060514-TAR-TC01B | 112113-TAR-TC03-0012 | 052814-TAR-TC03A-008022 | 052814-HC-TC03A-070082 | 052814-HC-TC03B-009016 | 052814-TAR-TC03B-050076 | 052814-HC-TC03C-040050 | 052814-SW-TC03C-050070 | 053014-PTM-TC03A-060080 | 053014-PTM-TC03B-060080 | 060414-TAR-TC03C |
| MERCURY | mg/L | **0.00014 J** | **0.0017** | **0.00024** | **0.00045** | **0.00063** | < 0.000064 | < 0.000064 | < 0.000064 | < 0.000064 | < 0.000064 | **0.000079 J** | **0.00032** | **0.00033** | **0.00011 J** |
| NICKEL | mg/L | -- | **--** | **--** | **0.0017 J** | -- | **0.24** | **0.173** | **0.0476** | **0.0971** | **0.0784** | **0.12** | **--** | **--** | < 0.00075 |
| POTASSIUM | mg/L | -- | **--** | **--** | **47.5** | -- | **8.6 J** | **12.9** | **6.03 J** | **7.06 J** | **8.58 J** | **10.2** | **--** | **--** | **64.7** |
| SELENIUM | mg/L | < 0.013 | **0.0061 J** | **0.0046 J** | < 0.0036 | **0.02 J** | < 0.0036 | < 0.0036 | < 0.0036 | < 0.0036 | < 0.0036 | < 0.0036 | **0.009 J** | **0.0081 J** | < 0.0036 |
| SILVER | mg/L | < 0.0025 | **0.0017 J** | **0.0027 J** | **0.0142** | < 0.0025 | **0.0072 J** | **0.008 J** | **0.0055 J** | **0.0069 J** | **0.0059 J** | **0.0081 J** | **0.0021 J** | **0.002 J** | **0.0078 J** |
| SODIUM | mg/L | -- | **--** | **--** | **116** | **--** | **88.4** | **268** | **86.9** | **215** | **121** | **189** | **--** | **--** | **132** |
| THALLIUM | mg/L | | **--** | **--** | < 0.018 | **--** | < 0.0037 | < 0.046 | < 0.0037 | < 0.0092 | < 0.0037 | < 0.0092 | **--** | **--** | < 0.0055 |
| VANADIUM | mg/L | -- | **--** | **--** | **0.0015 J** | **--** | **0.0137 J** | **0.041 J** | **0.0131 J** | **0.0337 J** | **0.0157 J** | **0.0327 J** | **--** | **--** | **0.0013 J** |
| ZINC | mg/L | -- | **--** | **--** | < 0.0076 | **--** | **0.138** | **0.289** | **0.072** | **0.112** | **0.1** | **0.15** | **--** | **--** | < 0.0076 |

**Notes:**

-- = no sample taken

mg/L = miligram per liter

J = estimated detected result

ND or < = non-detected result

**Detects are in BOLD font**

**Table 10. Sample and Leachate Testing Matrix for OU8 Materials**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Caisson # | Treatment | Material Code | ANSI | TCLP | SPLP |
|---|---|---|---|---|---|
| 1 | Untreated Tar | Caisson 1 Untreated | X | X | X |
| | In-situ solidification/stabilization | Caisson 1 ISS | X | X(2) | X(2) |
| | ISS followed by ex-situ S/S | Caisson 1 ISS-S/S | X | X | X |
| 2 | Untreated Tar | Caisson 2 Untreated | NA | X | X |
| | In-situ Thermal Treatment | Caisson 2 ISTT | X | X(7) | X(7) |
| | ISTT followed by excavation | Caisson 2 ISTT-Excav'd | X | X(2) | X(2) |
| 3 | Untreated Tar | Caisson 3 Untreated | NA | X | X |
| | In-situ Thermal Treatment | Caisson 3 ISTT | X | X(6) | X(6) |
| | ISTT followed by ISS | Caisson 3 ISTT-ISS | X | X(2) | X(2) |
| | ISTT-ISS followed by S/S | Caisson 3 ISTT-ISS-S/S | X | X | X |

Note: NA indicates that data was "not available" for these materials.

(#) indicates the number of analyses, collected at various depths within the caisson that were used in an average SPLP calculation.

**Table 11. Percent Reduction in Cumulative Release of Benzene by Caisson**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Base Case (R1) | Treatment (R2) | ANSI/SPLP ~1 day |
|---|---|---|
| Caisson 1 Untreated | Caisson 1 ISS | 98.70% |
| | Caisson 1 ISS-S/S | 96.70% |
| Caisson 3 Untreated | Caisson 3 ISTT | 99.99% |
| | Caisson 3 ISTT-ISS | 99.60% |
| | Caisson 3 ISTT-ISS-S/S | 99.80% |

Notes: ANSI/SPLP indicates that SPLP value at 18-hrs was used for untreated tar leaching release.

**Table 12. Percent Reduction in Cumulative Release of TVOCs by Caisson**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| Base Case (R1) | Treatment (R2) | ANSI/SPLP ~1 day |
|---|---|---|
| Caisson 1 Untreated | Caisson 1 ISS | 98.30% |
| | Caisson 1 ISS-S/S | 94.90% |
| Caisson 3 Untreated | Caisson 3 ISTT | 99.90% |
| | Caisson 3 ISTT-ISS | 99.50% |
| | Caisson 3 ISTT-ISS-S/S | 99.70% |

Notes: ANSI/SPLP indicates that SPLP value at 18-hrs was used for untreated tar leaching release.

**Table 13. Events Recorded by the Perimeter Air Monitoring System**

*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| | **Event 1** | **Event 2** |
|---|---|---|
| **Date** | May 30, 2014 | June 4, 2014 |
| **C5 VOC 15 Min Average** | 2.93 ppm | 0.87 ppm |
| **Total Duration of Event** | 72 minutes | 71 minutes |
| **Confirmation with Handheld PID** | 0-2 ppm | 0-72 ppm (intermittent spikes in vicinity of C5) |
| | | 1-4 ppm (sustained when bucket auger removed from caisson) |
| **Summary of Bottlevac results (µm/m$^3$) (select compounds of concern)** | | |
| Benzene | 5-50 (estimated) | 16,000 |
| 1,2-Dichlorobenzene | 11 | 71 |
| Isopropylbenzene | 2.8 | 38 |
| Toluene | 120 | 1,800 |
| Xylenes (m, o, p isomers) | 20.1 | 246 |
| Naphthalene | 17 | 72 |
| Sulfides | Non-detect | 29 (methyl sulfide) |

**Table 14. Summary of TVOCs and Total Reduced Sulfide Concentrations in Three Caissons**
*In-Situ Stabilization/Solidification Pilot Study, Operable Unit 8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

| | Total VOCS (µg/$m^3$) | Total Reduced Sulfide Compound (µg/$m^3$) |
|---|---|---|
| Caisson 1 | 813,000 | 1,660 |
| Caisson 3 | 25,700 | 95 |

# Figures

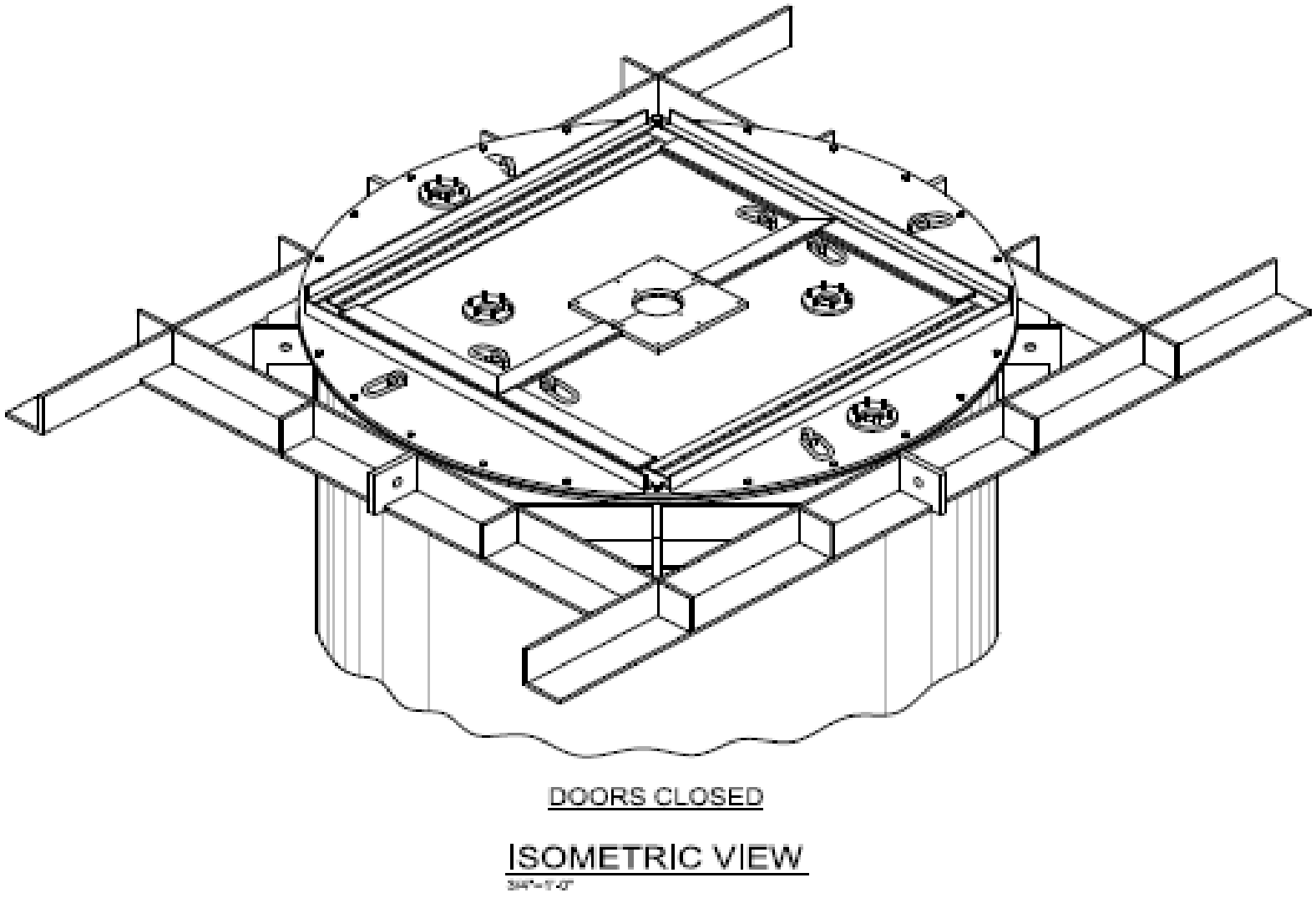



**Figure 1. ISS Caisson Configuration**

*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

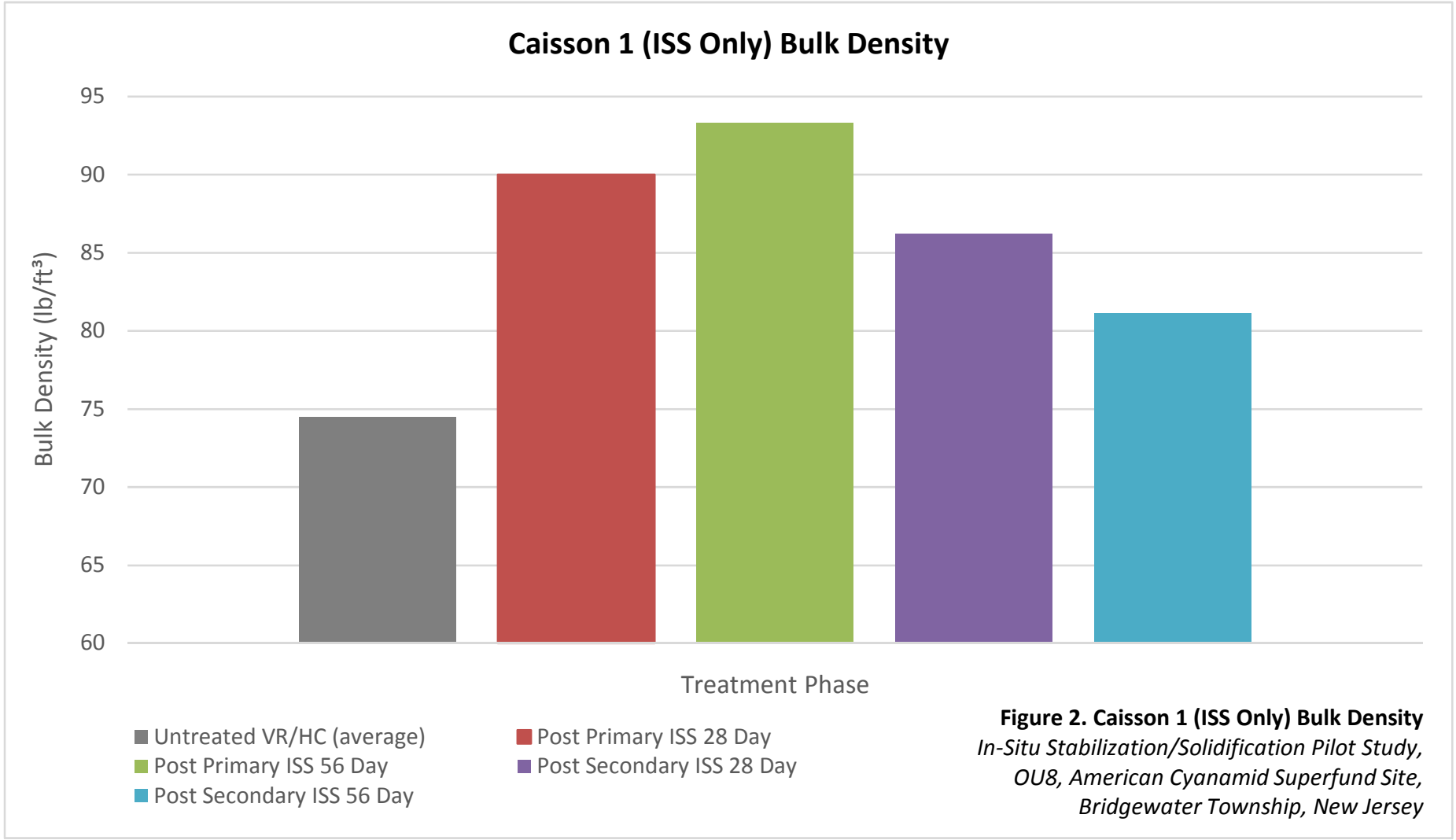



**Figure 2. Caisson 1 (ISS Only) Bulk Density**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

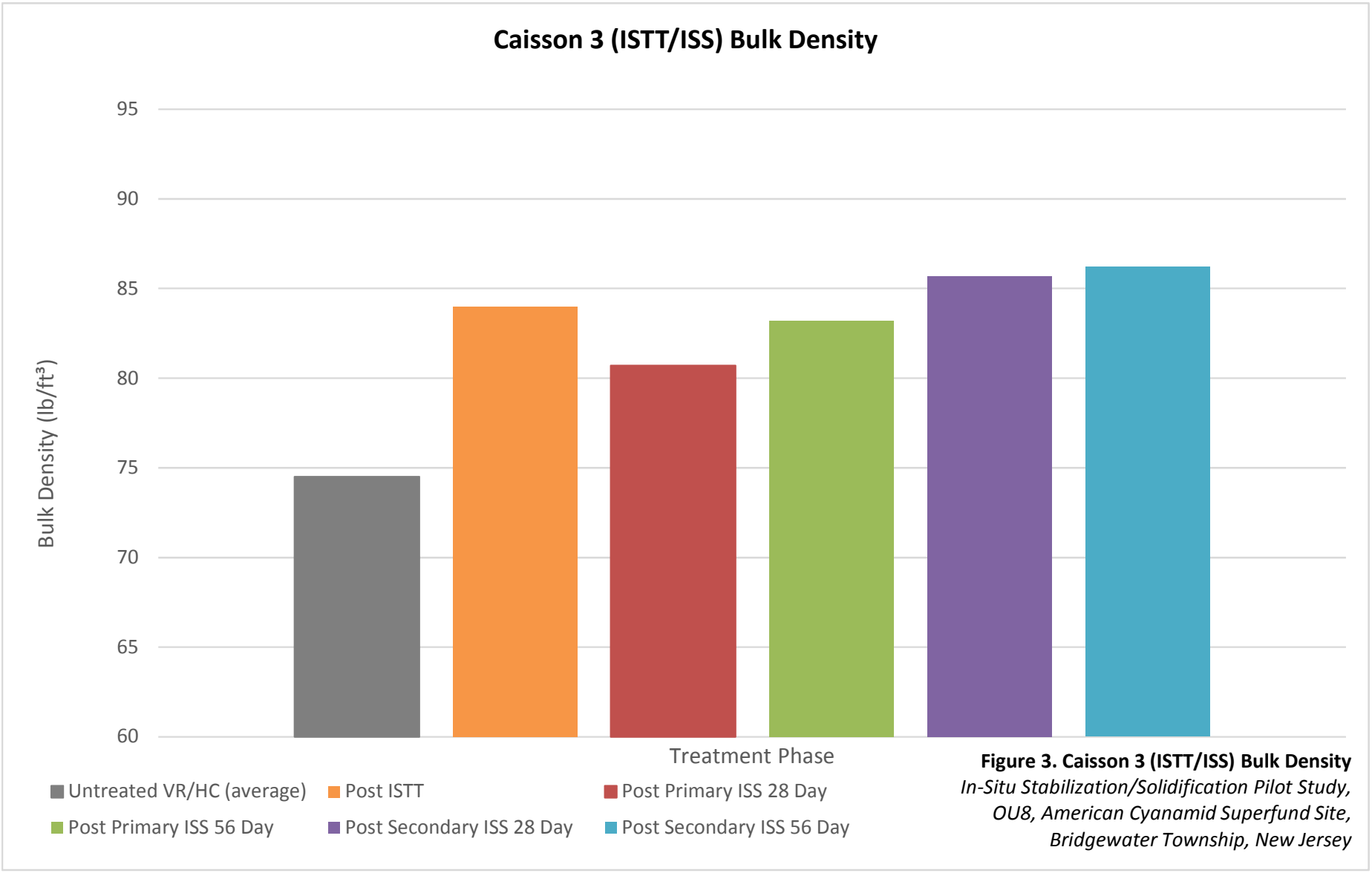



**Figure 3. Caisson 3 (ISTT/ISS) Bulk Density**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

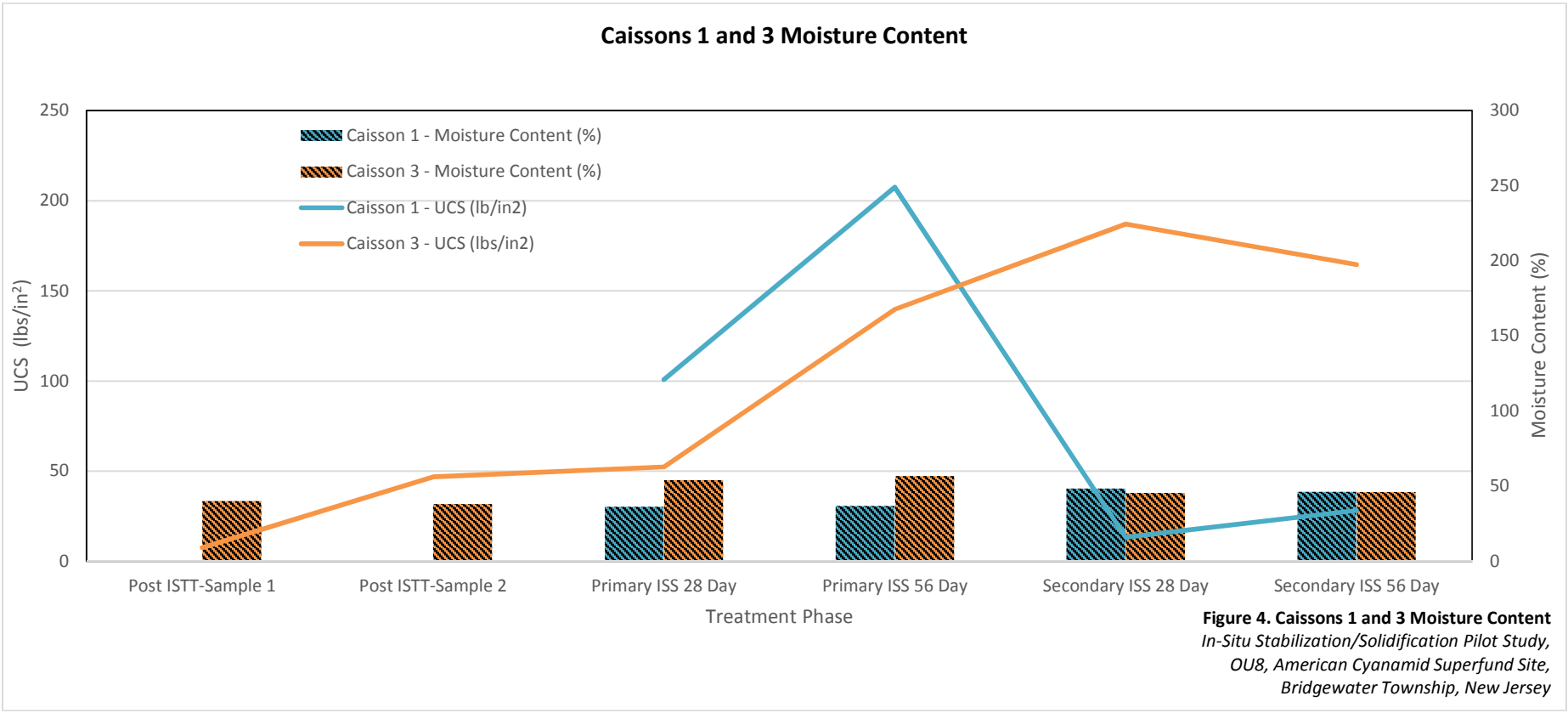



**Figure 4. Caissons 1 and 3 Moisture Content**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

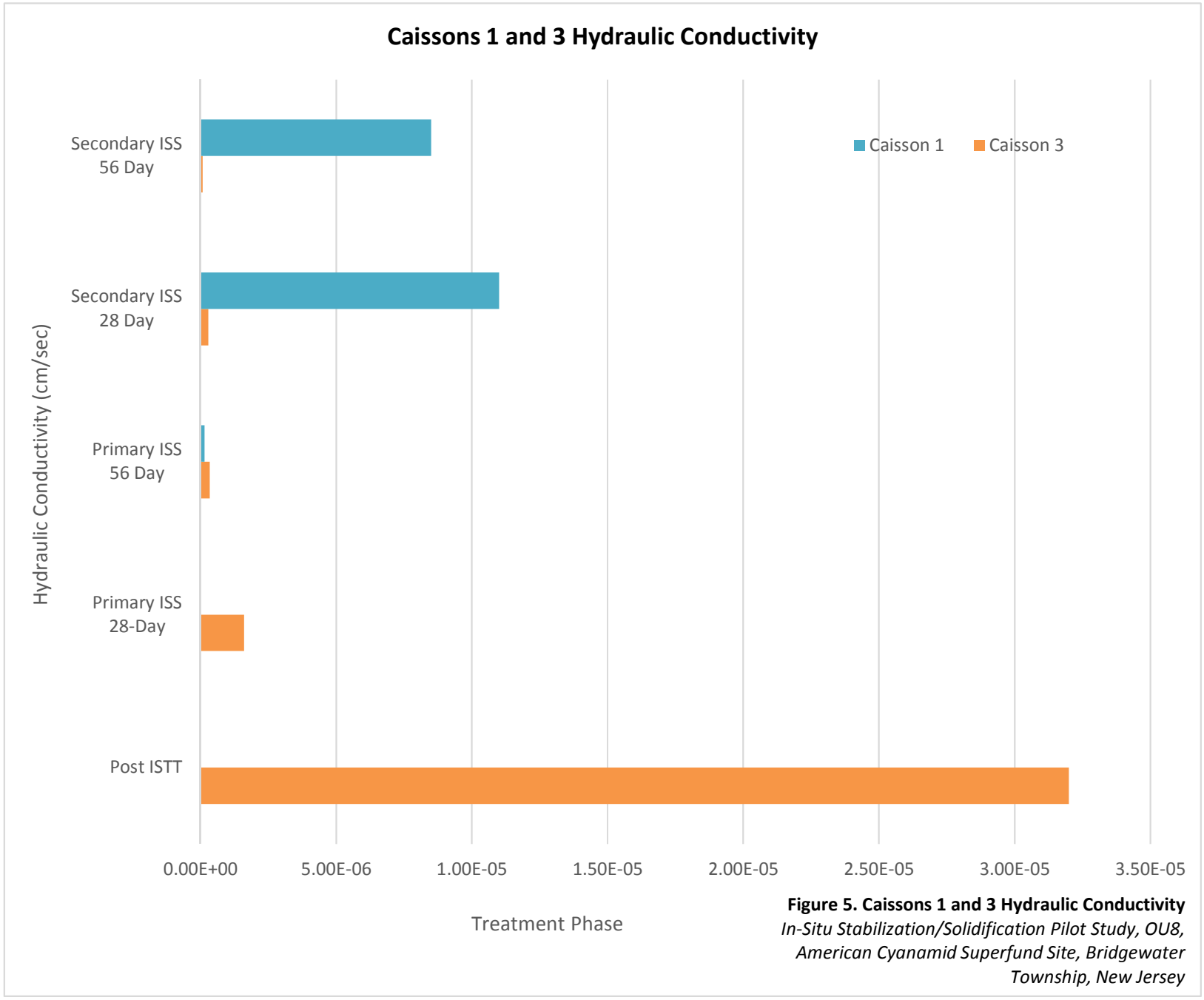



**Figure 5. Caissons 1 and 3 Hydraulic Conductivity**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

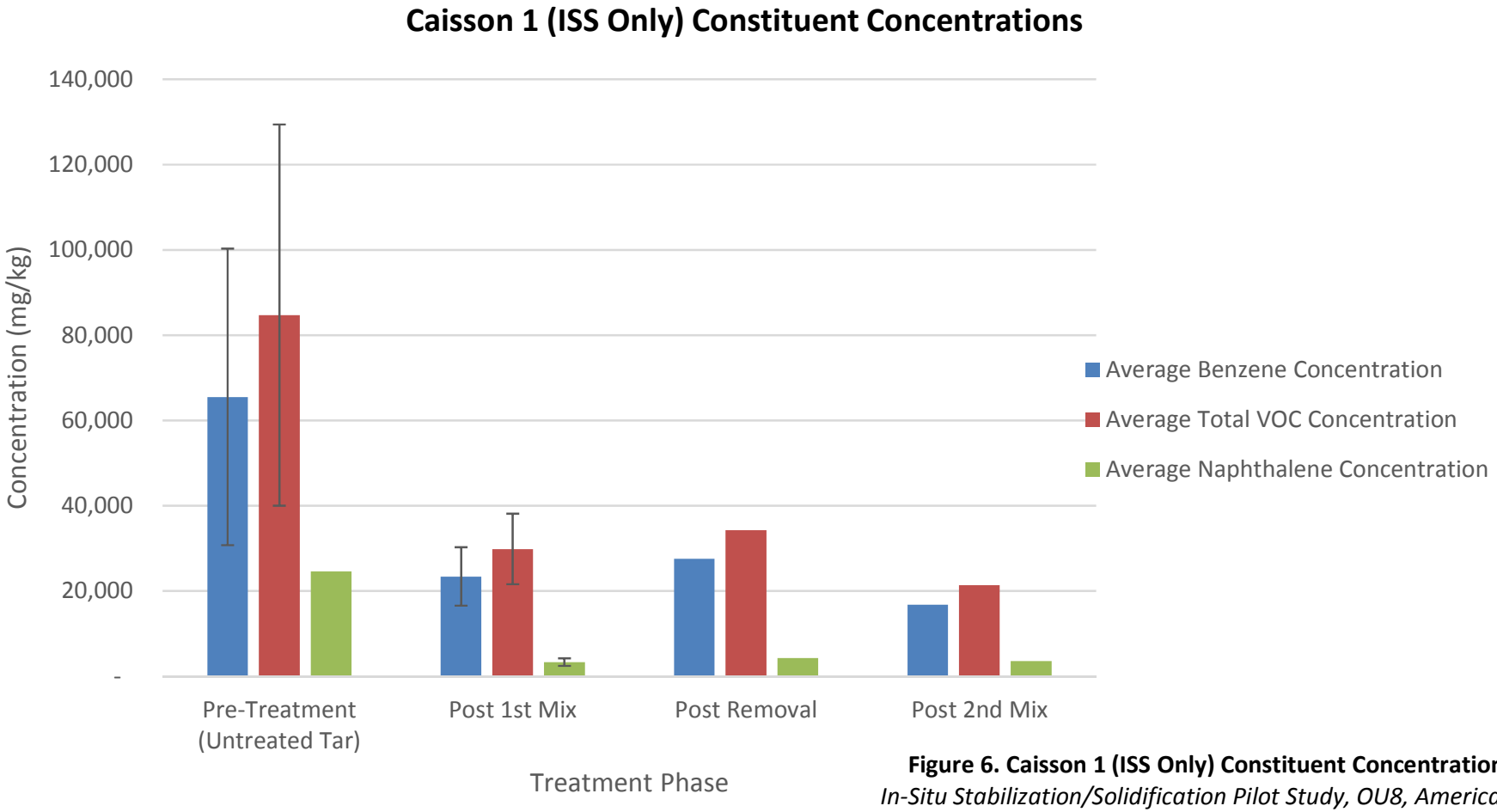



**Figure 6. Caisson 1 (ISS Only) Constituent Concentrations**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

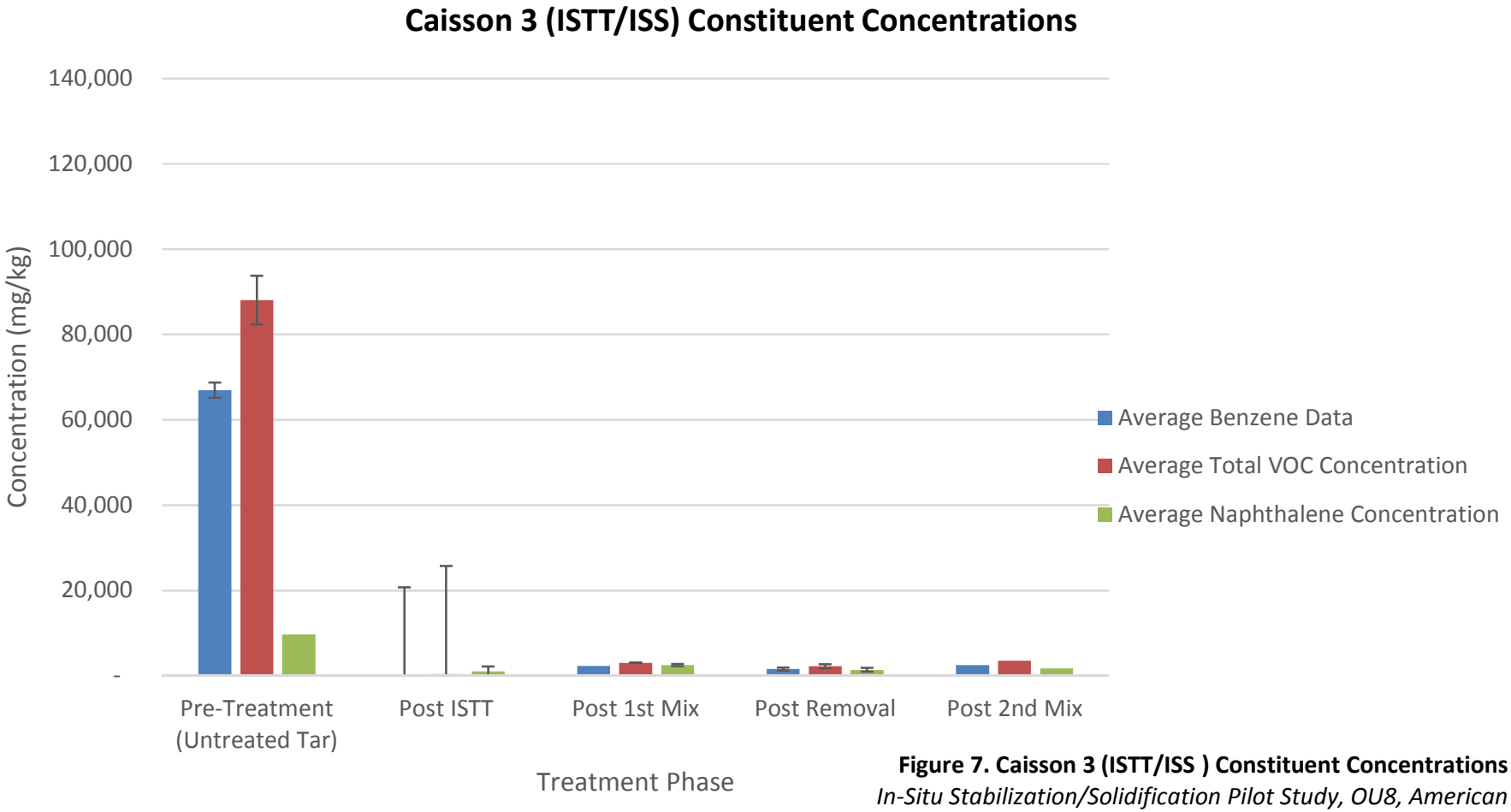



**Figure 7. Caisson 3 (ISTT/ISS ) Constituent Concentrations**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

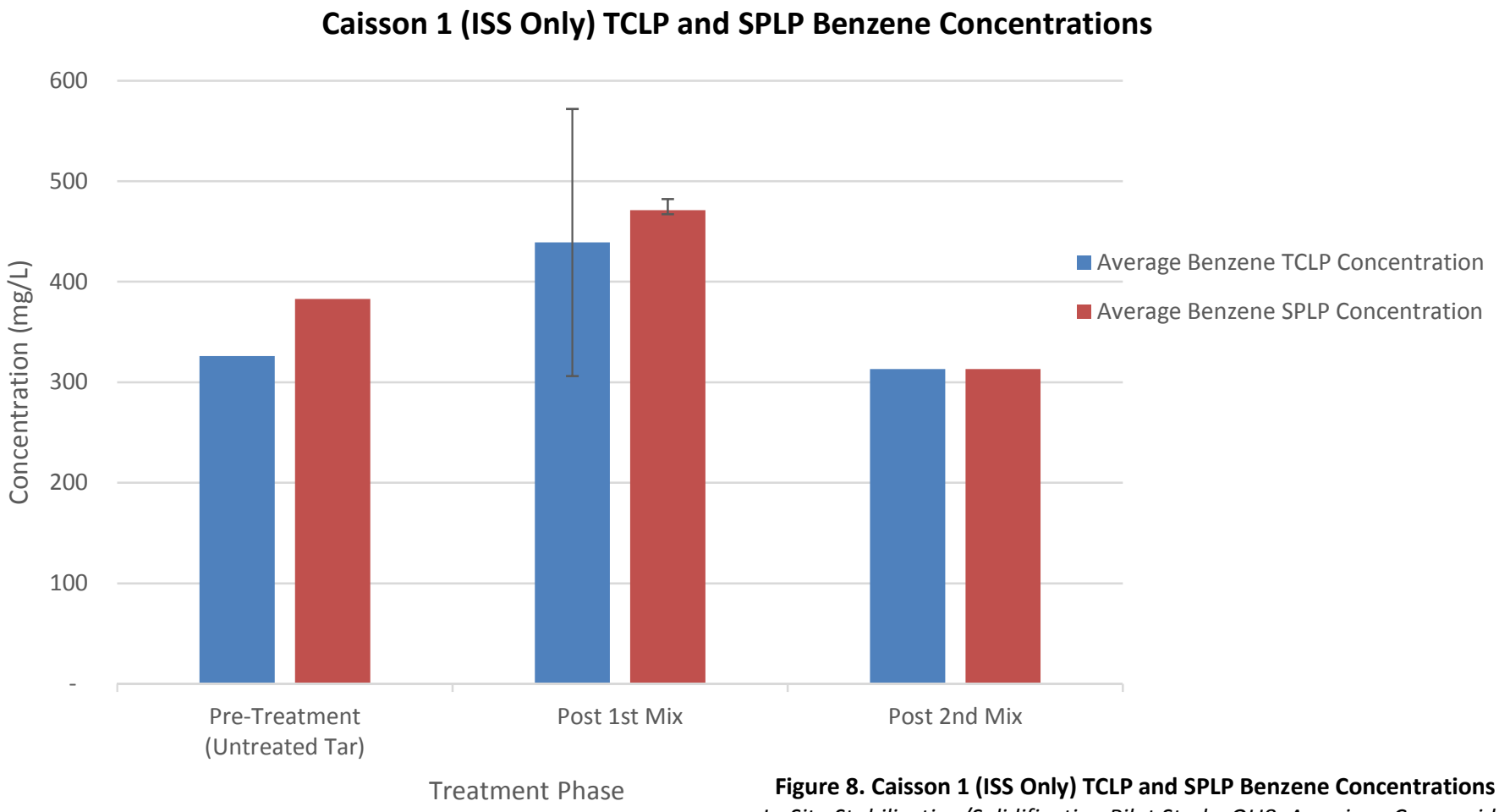



**Figure 8. Caisson 1 (ISS Only) TCLP and SPLP Benzene Concentrations**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

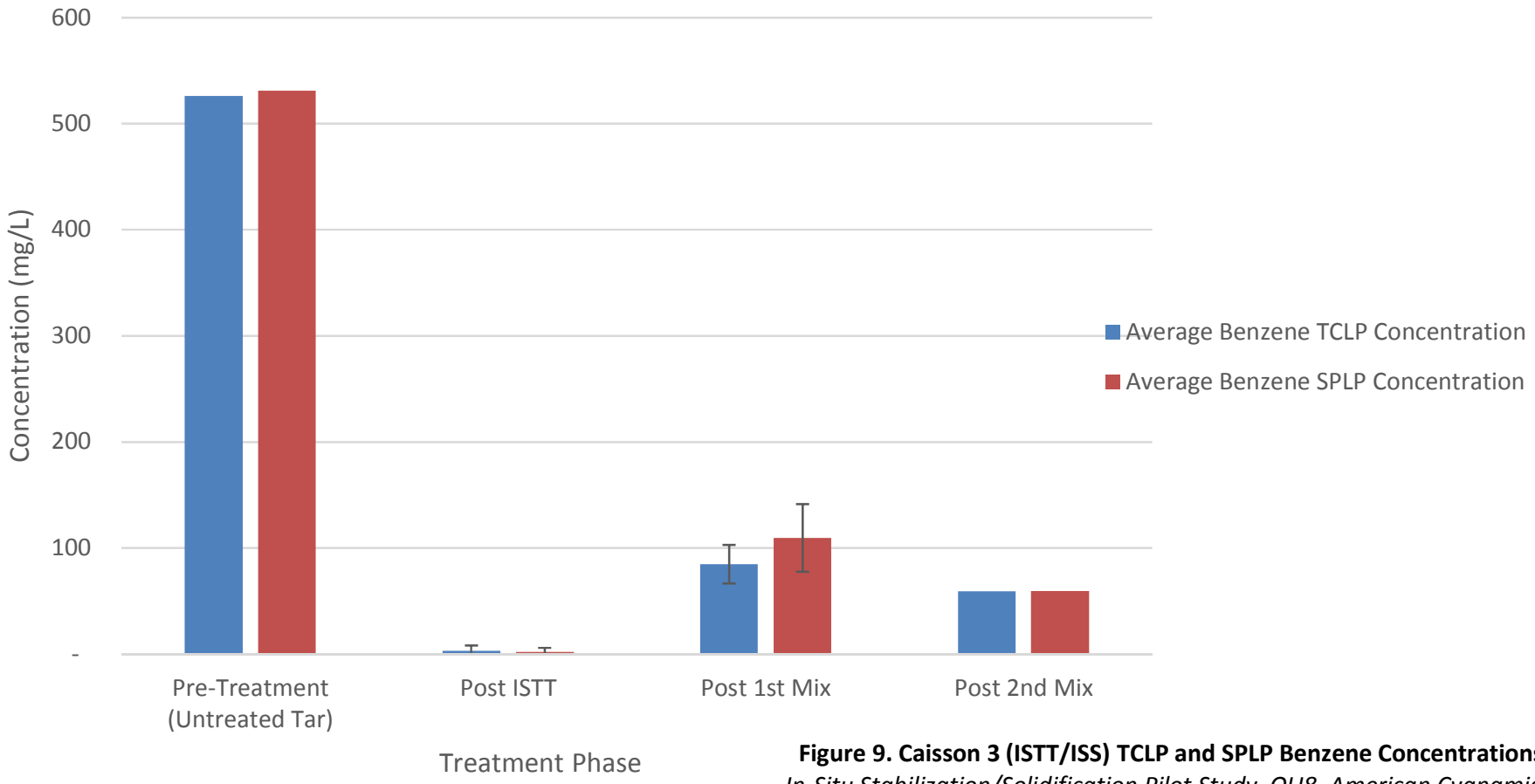
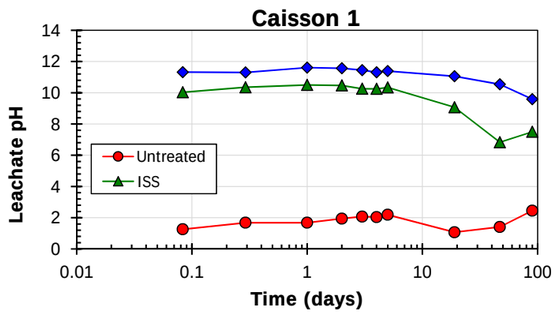
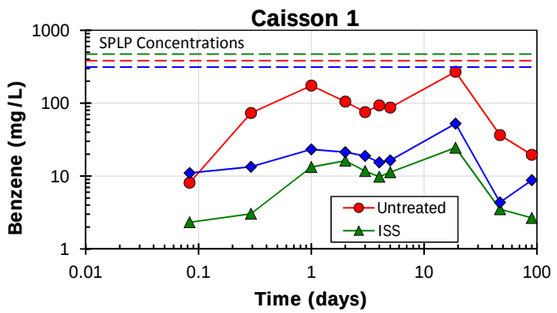


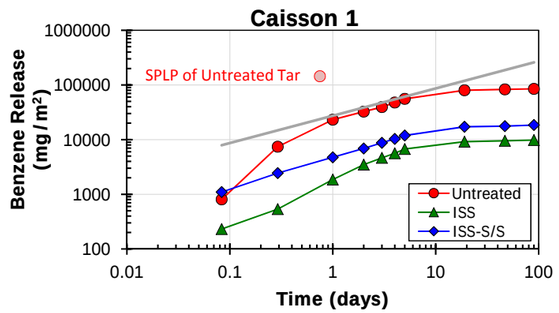

**Figure 9. Caisson 3 (ISTT/ISS) TCLP and SPLP Benzene Concentrations**
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

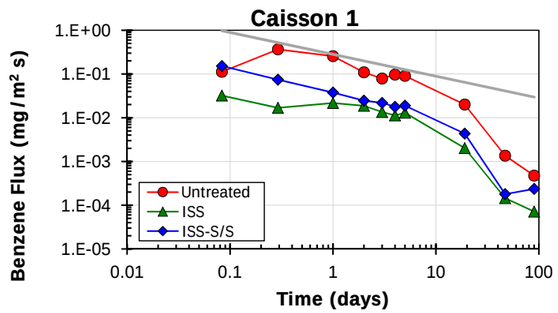
**Figure 10. Caisson 1 ANSI Results**

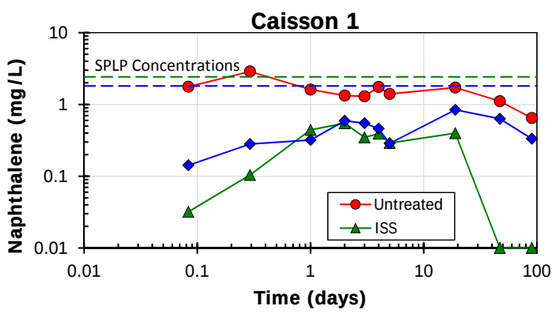
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

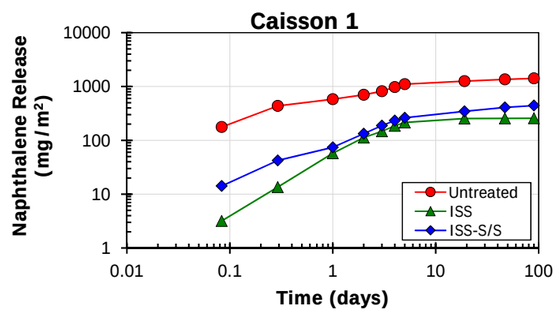


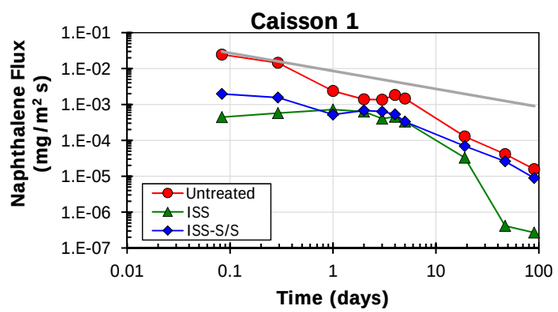



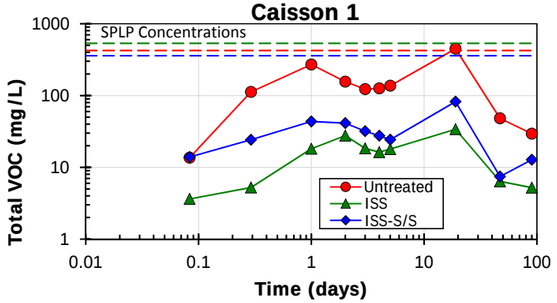



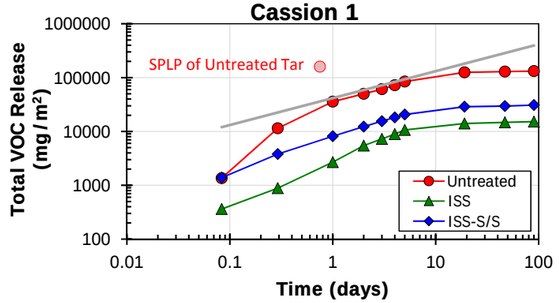



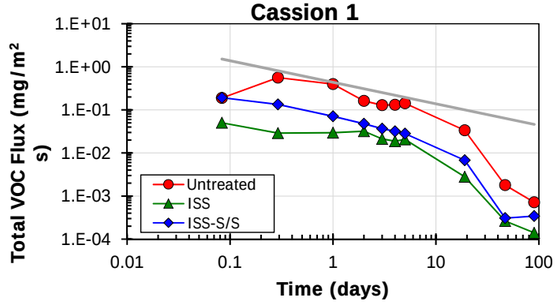
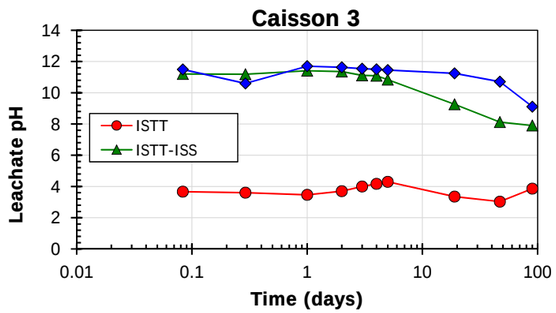
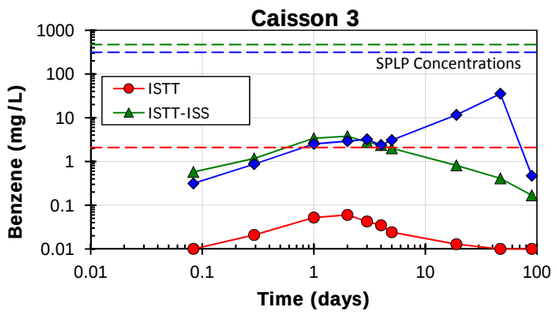
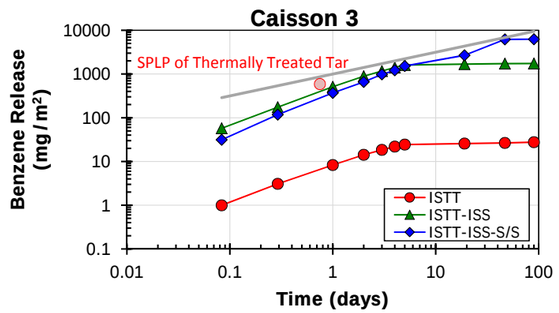



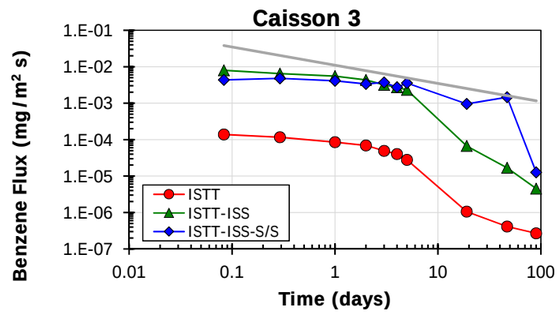
**Figure 11. Caisson 3 ANSI Results**

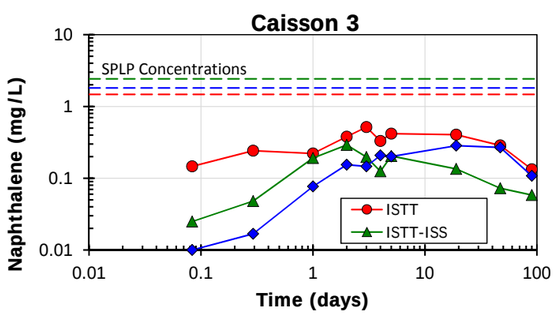
*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*

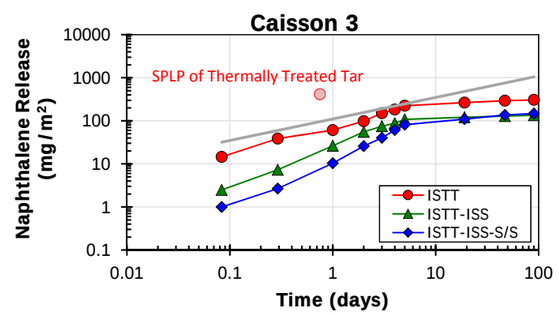


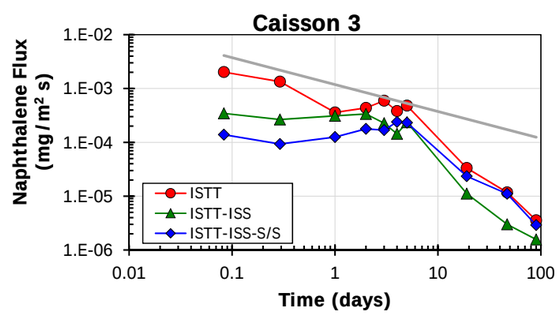



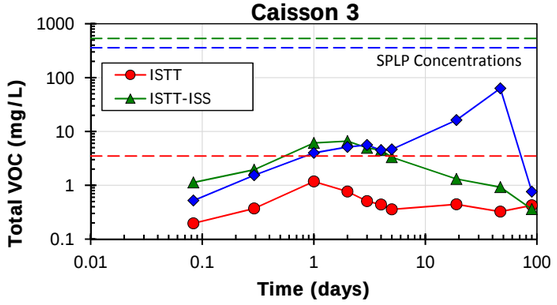



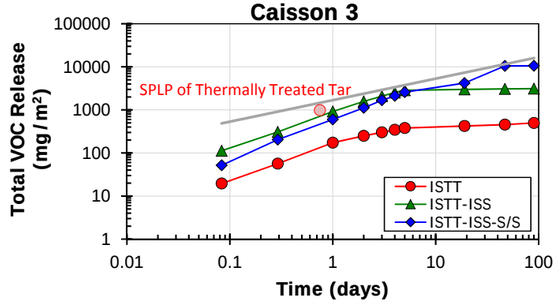



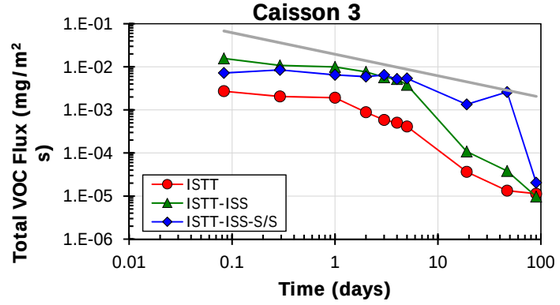
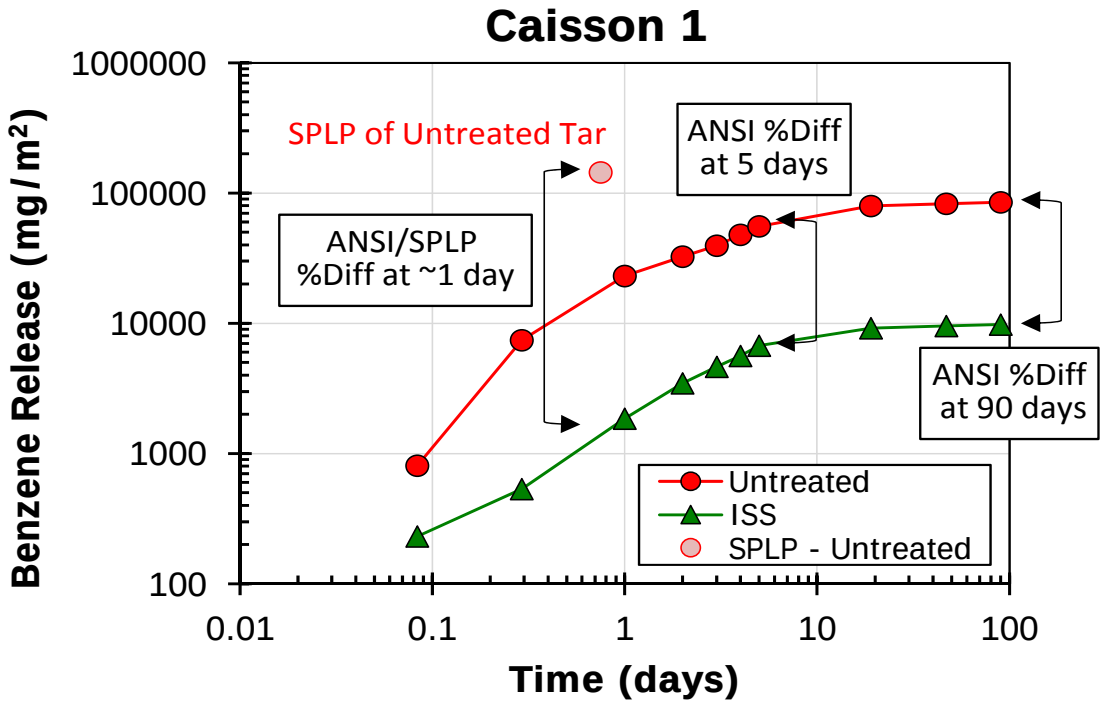



**Figure 12. Example of Percent Difference (% Diff) Comparisons between ANSI and SPLP Data**

*In-Situ Stabilization/Solidification Pilot Study, OU8, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*



# Appendix E
# Bench-Scale Treatability Test Summary

# Appendix E1
# 2016 CAMU Liner Bench Study

TECHNICAL MEMORANDUM

# Bench-Scale Liner Compatibility Study for the Impoundment 8 Facility, American Cyanamid Superfund Site, Bridgewater, New Jersey

| | |
|---|---|
| PREPARED FOR: | Mark Austin/U.S. Environmental Protection Agency |
| COPY TO: | Russell Downey/Pfizer Inc.<br>Vince D'Aco/Quantum Management Group |
| PREPARED BY: | CH2M HILL Operable Unit 8 Project Team |
| DATE: | May 20, 2016 |

This bench-scale liner compatibility study was conducted on behalf of Wyeth Holdings LLC in support of the Focused Feasibility Study (FFS) for Operable Unit 8 (OU8) (Impoundments 1 and 2) at the American Cyanamid Superfund Site in Bridgewater, New Jersey (Site). Several remedial alternatives are under evaluation as part of the FFS process and include the potential use of the Impoundment 8 Facility corrective action management unit (CAMU) for final deposition of treated materials from Impoundments 1 and 2.

Specifically, this study was conducted to test the compatibility of the high-density polyethylene (HDPE) geomembrane, which lines the CAMU, with simulated leachate generated from treated impoundment material from the 2014 OU8 pilot study. The bench-scale study approach and methods are detailed in the *FFS Work Plan Addendum* (CH2M HILL [CH2M] 2015a) and the *Amendment to the Bench-Scale Testing Plan* (CH2M 2015b).

## Executive Summary

Liner compatibility testing was conducted on HDPE geomembrane matching the material used in lining the CAMU. The tests were conducted in accordance with American Society for Testing and Materials (ASTM) procedures using two simulated leachates – Leachate A ("high batch") and Leachate B ("low batch"). Concentrations of constituents of concern (COCs) were maintained close to target levels in the test tanks to simulate reoccurring leachate exposure to the geomembrane liner. Statistical evaluations were conducted on the mechanical testing results, and no patterns of increase or decrease in material properties with exposure time were found for liner material exposed to Leachate A or Leachate B.

The results of the bench-scale study indicate that HDPE liner material similar to that used in the Impoundment 8 Facility CAMU is compatible with leachates potentially generated from treated OU8 material, even under high leachate concentration scenarios.

## Background

The Impoundment 8 Facility CAMU was constructed in stages beginning in 1991 and was designated as a CAMU by the United States Environmental Protection Agency (USEPA) and the New Jersey Department of Environmental Protection (NJDEP) in 1996. It is composed of four operating cells – Cells 1 through 4. Cells 1 and 2 were constructed in 1991 and 1995, respectively. Cells 3 and 4 were constructed in 1998.

The cell designs incorporate a composite HDPE geomembrane liner system (primary and secondary liners). Each cell is equipped with individual leachate collection and leak detection systems. Cells 3 and 4 may potentially be used for placement of the treated material from OU8. The specific treatment program and deposition endpoint for OU8 treated materials have not yet been selected. Therefore, this liner compatibility study was conducted using a range of simulated leachate concentrations to evaluate the potential effects of placing treated OU8 materials in the Impoundment 8 Facility CAMU.

# Testing Program Setup

Compatibility testing consisted of immersing liner coupons in leachate generated from solid-phase treated materials. The coupons were tested over 120 days to assess changes in physical and mechanical properties of the geomembrane. The influence of leachate on the liner material was tested using ASTM standardized methods. Details are provided here on the following elements of the testing program:

- Liner material acquisition and coupon generation
- Leachate generation from treated impoundment materials
- Compatibility testing of the liner material
- Chemical control study to evaluate leachate concentration changes during the bench-scale study

## Liner Material Acquisition and Coupon Generation

The liner material that was tested for this study matches the liner product used in the construction of the Cells 3 and 4 bottom liners of the CAMU. Virgin HDPE geomembrane (AGRU 60-mil HDPE Micro Spike liner) was shipped from Northwest Linings Inc., a liner supplier and installer, to TRI Environmental Inc. (TRI), a geosynthetics testing firm located in Austin, Texas. Upon receipt, the material was logged, conditioned in the laboratory (bringing to laboratory temperature and humidity), and prepared by cutting it into 8-inch by 10-inch coupons for use in the compatibility test. Sets of four coupons were then drilled and clipped together for each of the benchmark time pulls.

## Leachate Generation from Treated Impoundment Materials

The *FFS Work Plan Addendum* (CH2M 2015a) originally specified that the compatibility tests would be conducted using leachates from treated materials generated during the 2014 pilot study in order to simulate the range of leachate concentrations potentially generated from treated material placed in the Impoundment 8 Facility CAMU. These consisted of treated materials from Caisson 1, where in-situ solidification/stabilization (ISS) was applied, and Caisson 2, where in-situ thermal treatment (ISTT) was applied. However, when the material from Caissons 1 and 2 was collected in September 2015 to generate leachate for this study, chemical screening results showed that COC concentrations were much lower than the 2014 pilot study results. To better simulate a range of possible liner-exposure scenarios, the leachate generated from Caisson 2 (which exhibited the highest COC concentrations during the September 2015 chemical screening tests) was spiked with pure, laboratory-grade chemical stocks to bring the COC concentrations up to comparable levels observed in synthetic precipitation leaching procedure (SPLP) samples collected during the 2014 pilot study.

Two 30-gallon batches of leachate were generated from the Caisson 2 material. The leachate was first generated using USEPA Method 1312, SPLP (USEPA 1994), analyzed for COC concentrations, and then shipped in laboratory-certified clean carboys to TRI where the compatibility testing was performed.

### Leachate Spiking and Confirmatory Testing

Before initiating compatibility testing, TRI spiked the leachate in the test tanks to achieve target concentrations that were observed in the 2014 OU8 pilot study for material treated by ISS and ISTT.

These target concentrations were established for seven COCs as shown in Table 1 (also shown are Henry's Law constants for each COC). Two sets of target concentrations were created. Concentrations for Leachate A were selected to simulate leachate from material treated by ISS only (Caisson 1), and concentrations for Leachate B were chosen to simulate leachate from material treated by ISTT only (Caisson 2). In general, with the exception of acetophenone, target COC concentrations for Leachate A ("high batch") were higher than Leachate B ("low batch"), and naphthalene had the same target concentrations in both leachates.

Table 1. COC Target Concentrations for Leachate A and Leachate B and Henry's Law Constants

| | **Target Concentration (µg/L)** | | |
|---|---|---|---|
| | ***Leachate A "High Batch"*** | ***Leachate B "Low Batch"*** | **Henry's Law Constant [a] (kPa $m^3$/mol)** |
| Acetone* | 3,000 | 500 | 0.004 |
| Benzene* | 500,000 | 100,000 | 0.588 |
| 1,2-Dichlorobenzene * | 2,000 | 1,000 | 0.147 |
| Naphthalene | 2,000 | 2,000 | 0.048 |
| Toluene* | 50,000 | 15,000 | 0.667 |
| Xylene* | 3,000 | 2,000 | 0.417 - 0.714 |
| Acetophenone | 2,000 | 8,000 | 0.001 |
| ***Total Volatile Organic Compounds*** | ***558,000*** | ***118,500*** | - |

[a] Source: Sander (2015)
* Included in total volatile organic compounds calculation.
µg/L – micrograms per liter
kPa $m^3$/mol – kilopascal cubic meter per mole

Following the spiking step, leachate samples were collected and shipped to Accutest Laboratories in Dayton, New Jersey (Accutest) to confirm that the target concentrations were reached. The leachate tanks were also sampled periodically during bench-scale testing to monitor COC concentration changes over time. Re-spiking was performed as needed following sampling to maintain target concentrations over the 120-day compatibility testing period.

## Compatibility Testing

Liner compatibility testing was performed following ASTM D5322 – *Standard Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetic to Liquids* (ASTM 2009), ASTM D5747 – *Standard Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids* (ASTM 2008), and in accordance with the *Amendment to the Bench-Scale Testing Plan* (CH2M 2015b).

Each test was set up in 11.75-inch-wide by 11.75-inch-long by 11.75-inch-deep glass tanks containing approximately 26.6 liters of leachate (Figure 1). Tests included immersing the HDPE geomembrane coupons (twenty 8-inch by 10-inch coupons in each tank, each coupon weighing on average approximately 80 grams before immersion) containing either Leachate A or Leachate B. The tanks were capped with a glass top and sealed with vacuum grease. Tests were run at room temperature, and Leachate A had a pH = 1.8 and Leachate B had a pH = 3.3. A set of four coupons was removed from each tank at intervals of 30, 60, 90, and 120 days and tested for physical and mechanical properties. One set of extra coupons was provided in each of the two tanks for a total of five sets.

Figure 1. Compatibility Testing Tank
*Cube-shaped glass tank containing leachate and liner coupons.*

ASTM D5747 specifies the number of required and optional (but recommended) tests based on the type of liner material to be tested. Table 2 presents the tests performed along with the test methods.

Table 2. Physical and Mechanical Compatibility Tests

| Property | Test Method | Units |
|---|---|---|
| ***Required (All Geomembranes):*** | | |
| Weight Change | USEPA/600/2-88/052 | g, %change |
| Dimensional Changes | | |
| *Thickness* | D638 or D5199 | mm, %change |
| *Length and Width* | USEPA/600/2-88/053 | mm, %change |
| Volatile Loss | USEPA/600/2-88/054 Appendix G | g, %change |
| Visual Observation | | |
| ***Required (Group I - HDPE Geomembrane)*** | | |
| Tensile Properties | ASTM D6693 Type IV | kN/m |
| *Yield Strength* | | |
| *Break Strength* | | |
| *Yield Elongation* | | |
| *Break Elongation* | | |
| Tear Resistance | ATSM D1004 | N/mm |
| Puncture | ASTM D4833 /4833M | N/mm |
| 2% Secant Modulus | ASTM D5323 | |
| Hardness | ASTM D2240 Type D | |

Table 2. Physical and Mechanical Compatibility Tests

| Property | Test Method | Units |
|---|---|---|
| Extractable Content | Appendix E of USEPA/600/2-88/052 | |
| Density [a] | ASTM D792 | g/cc |
| ***Recommended:*** | | |
| Hydrostatic Resistance (Mullen Burst) | ASTM D751 Method A, Procedure 1 | N/mm |

[a] Based on best industry practices and as specified in the *FSS Work Plan Addendum* (CH2M 2015a), an older and previously approved standard test method for density (ASTM D792) was substituted for the ASTM D5747 recommended procedure. This method has been demonstrated to be a more accurate method for determining density.
% - percent
ASTM – American Society for Testing and Materials
g – grams
g/cc – grams per cubic centimeter
HDPE – high-density polyethylene
kN/m – kilonewtons per meter
mm - millimeter
N/mm – newtons per millimeter
USEPA – United States Environmental Protection Agency

At each test interval, the glass tank lid was removed, a set of four coupons were pulled, aqueous samples were collected and sent to Accutest for COC concentration testing, and the lid was reset. Once the aqueous analytical results were received, each tank was re-spiked as needed to the target concentrations (and periodically resampled to confirm target concentrations were achieved). After the coupons were removed from the tanks, they were cut down to specimen sizes for individual physical and mechanical testing.

## Chemical Control Study

During the compatibility testing, monitoring of COC concentrations in the leachate indicated there were some losses of COCs in the leachate over time. To determine whether these changes were due to sorption by the HDPE liner coupons, volatilization, or both, a control study was conducted. The control study consisted of setting up two tanks, one with coupons and one without coupons and monitoring volatile organic compound (VOC) concentrations over time. Target concentrations for the control study were the same as Leachate A (“high batch”, Table 1), with the exception of acetophenone, which was not included because the control study focused on VOCs only. In addition, the volume needed for chemical analysis of acetophenone is relatively large and would result in significant liquid volume losses in the control tanks, and acetophenone losses were relatively insignificant during the compatibility study. VOC concentrations were higher in Leachate A than Leachate B, so the concentrations in the control best represented the higher exposure scenario of Leachate A.

Figure 2 shows the control tank setup. Two control experiments were run – Control 1 (C-1) contained liner coupons, while Control 2 (C-2) did not. The experimental setup was smaller than the tanks used in compatibility testing but maintained a proportional coupon mass to leachate volume ratio (approximately 60 grams of geomembrane per liter of liquid). The controls were evaluated over 59 days with one spike event at Day 9 to reach target VOC concentrations. The coupons were placed in the leachate on Day 0 (before the spiking event).

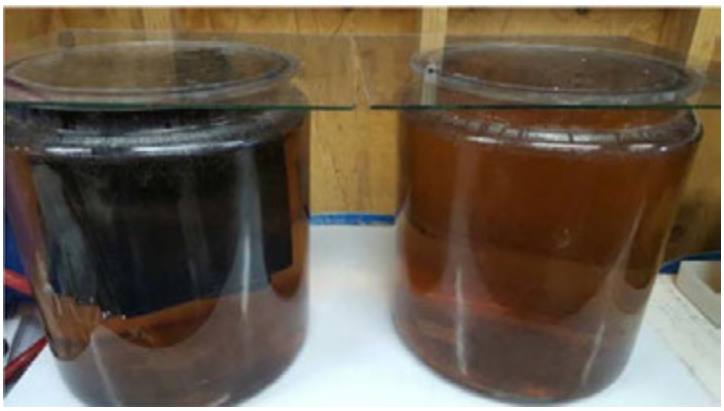


Figure 2. Control Study Setup

*Left: Control 1 "C-1" (with liner coupons); Right: Control 2 "C-2" (without liner coupons).*

# Test Results and Evaluation

A summary of the test results is provided for the following test components:

- Assessment of aqueous chemical concentrations in leachate over time in compatibility tests and control tests
- Physical property assessment of the HDPE liner coupons before and after exposure
- Mechanical property assessment of the HDPE liner coupons before and after exposure

Also provided are a statistical evaluation of the compatibility data (physical and mechanical property data) and a comparison of the compatibility results to acceptance criteria.

## Chemical Concentrations in the Tanks/Control Study

During the 120-day compatibility testing, COC concentrations in the leachate were monitored following each test interval and adjusted as needed to maintain concentrations near the target levels (analytical laboratory reports are provided in Attachment 1). The purpose was to simulate field conditions where leachate is continually being refreshed with precipitation and coming into contact with the liner system. When COC concentrations decreased below the target values in the test tanks, re-spiking of the deficient COCs was performed following the liner testing intervals after analytical test results were provided (spiking on Days 10, 43, 70, and 100 for test Day 0, Day 30, Day 60, and Day 90, respectively). It was observed that some COCs exhibited high losses in concentration over time, while others did not (Figures A2-1 through A2-8 of Attachment 2). In general, COCs with higher Henry's Law constants (Table 1) showed greater losses than those with lower Henry's Law constants, suggesting that losses due to volatilization was likely a contributing factor. To assess the extent of the loss due to volatilization and/or sorption, the control study was conducted.

Figure 3 shows the control results for two representative VOCs, benzene and 1,2-dichlorobenzene (1,2-DCB). Measured concentrations of VOCs were lower in C-1 (with coupons), than C-2 (without coupons), even though each control tank was spiked with sufficient chemical mass to reach the target concentrations. The lower concentrations in C-1 are indicative of VOC losses associated with sorption of COCs onto and into the coupons, which appears to be more pronounced early in the control study shortly after spiking. Based on the favorable material properties testing results, the observed VOC sorption does not appear to have affected the overall test. Additional VOC loss observed later in the control study appears to be associate with volatilization, which is not surprising given that the test is

being run at ambient temperature conditions. A comprehensive summary of control study results is provided in Attachment 3.

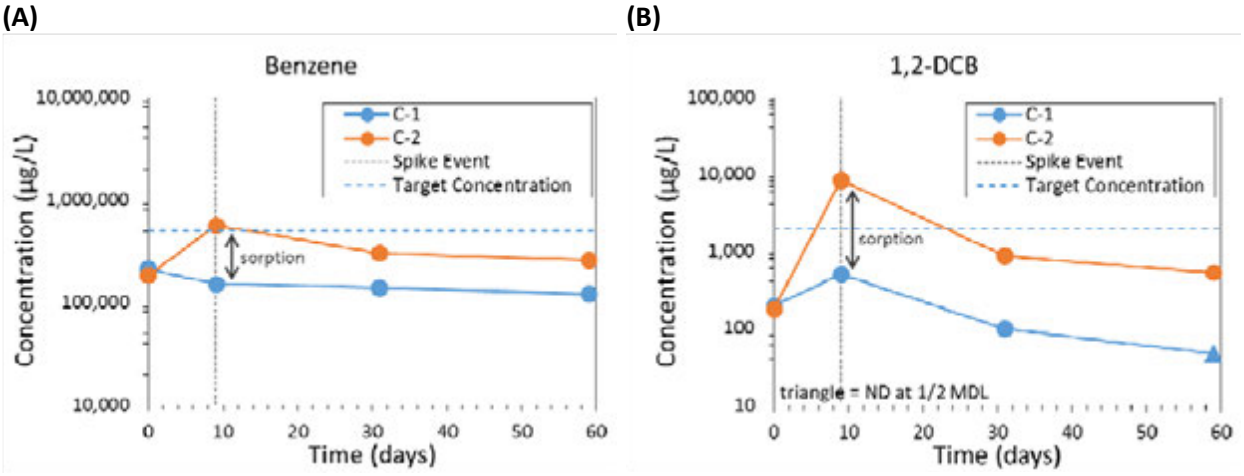



Figure 3. Representative Control Study Concentration Time-series Plots
*(A) Benzene and (B) 1,2-DCB Concentrations in Controls.*

## Statistical Evaluation of Data

Changes in coupon physical and mechanical properties were measured after exposure to Leachate A and Leachate B at Days 30, 60, 90, and 120 as compared to the baseline. A statistical analysis was performed to determine if the results from different exposure intervals were statistically different from one another. These temporal differences were evaluated using analysis of variance (ANOVA) applied with a nonparametric approach (based on ranks of the data). When significant differences were determined to exist in the initial testing phase a *post hoc* test using Tukey multiple comparisons followed to determine which results were or were not statistically different from one another. A review of this statistical analysis did not identify consistent patterns of increases or decreases in material properties with exposure time for coupons exposed to either Leachate A or Leachate B. Attachment 4 describes the details of the statistical methods.

## Physical Properties

The primary physical properties tested were thickness, length, width, and mass. Attachment 5 presents the complete laboratory test reports. Physical properties of each coupon were measured at each time interval using coupons exposed to simulated leachate for the specified time interval. The difference in these results and those of the unexposed (baseline) coupons was used to determine the percent change from baseline. Figure 4 provides a summary of the percent change in physical properties over time for Leachate A and Leachate B. In general, less change is noted in coupons exposed to Leachate B than Leachate A. In both cases, however, the percent change was less than ±2 percent for thickness and less than approximately ±0.5 percent for all other properties. As discussed in the "Acceptance Criteria Evaluation" section below, the mass change results (the only physical property for which acceptance criteria are suggested) are within the range of acceptability (less than 2 percent change) and indicate that the leachate is compatible with the liner tested.

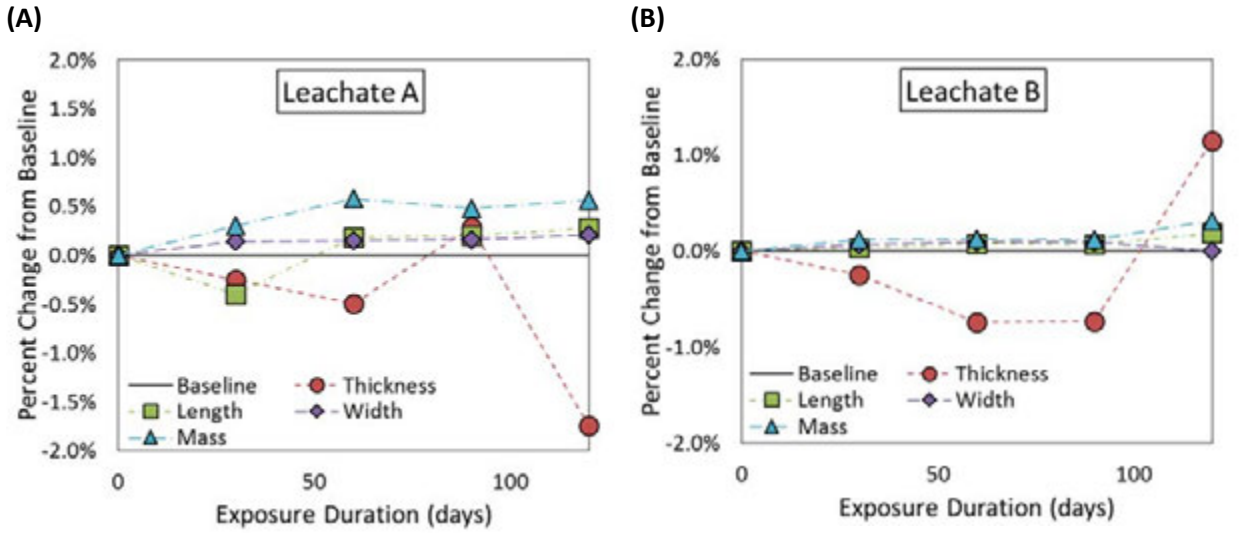



Figure 4. Changes in Physical Properties with Exposure Time

*Changes in coupon thickness, length, width, and mass following exposure to (A) Leachate A and (B) Leachate B.*

In addition to the physical properties discussed above, the change in VOC content was also measured. Attachment 5 and Figure 5 provide the laboratory test results. For this analysis, four replicate analyses were run on unexposed (baseline) liner coupons, and two replicates were run on coupons exposed to each leachate at each testing interval. Even for Leachate A ("high batch"), the percent change from baseline did not exceed 0.5 percent. The volatiles content in Leachate A was greater than Leachate B, which is expected given the larger mass of chemicals that were lost by sorption into and/or onto the geomembrane. This is also reflected in the larger amount of chemical quantities that were spiked and re-spiked in Leachate A compared to Leachate B to reach target concentrations. Although the data indicate additional sorption of VOC mass associated with Leachate A, this sorption does not appear to significantly affect the physical properties of the liner (as discussed below).

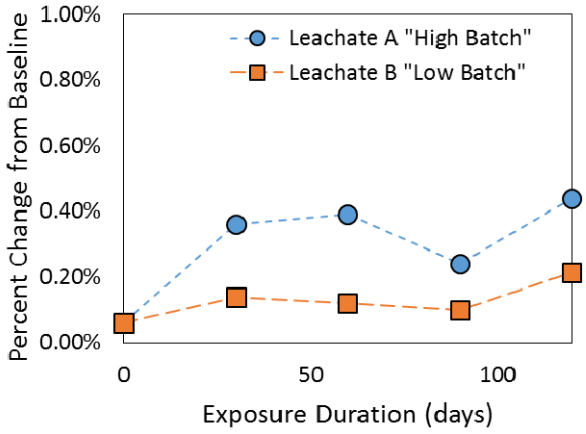



Figure 5. Changes in Volatiles Content with Exposure Time

*For Leachate A ("high batch") and Leachate B ("low batch").*

## Mechanical Properties

A summary of the mechanical property testing results are presented below. Attachment 5 provides the complete laboratory test reports. Mechanical properties were measured on unexposed liner material (baseline) and coupons exposed to leachate at each of the time intervals (Days 30, 60, 90, and 120).

- ***Tensile properties***. Tensile properties evaluated were yield strength, break strength, yield elongation, and break elongation in both the machine direction (MD) and transverse direction (TD). Attachment 5 graphically summarizes MD tensile stress at yield, MD elongation at yield, MD tensile stress at break, and MD elongation at break. These figures show that for all exposure intervals, average measurements for coupons exposed to Leachate A and Leachate B were above the manufacturer's (AGRU's) minimum average. As shown in Table 3, the average percent change from baseline results measured in either the MD or TD at all time intervals are within the range of acceptability and indicate that the leachate is compatible with the liner tested. Additionally, each individual percent change value used to calculate the average met the acceptability criterion.
- ***Tear resistance.*** Attachment 5 graphically summarizes the results for MD tear resistance. For all exposure intervals, the average MD tear resistance was greater than the geomembrane manufacturer's minimum average value with no recognizable pattern of increasing or decreasing tear resistance over time.. No consistent pattern of increasing or decreasing tear resistance over time was observed in either leachate. As shown in Table 3 and discussed in the "Acceptance Criteria Evaluation" section below, the measured percent change from baseline results are within the range of acceptability and indicate that the leachate is compatible with the liner tested. Additionally, each individual percent change value used to calculate the average met the acceptability criterion.
- ***Puncture resistance***. Attachment 5 graphically summarizes the puncture resistance results. For most exposure intervals, the average puncture resistance was greater than the manufacture's minimum average value. The average puncture resistance for coupons exposed to Leachate A for 120 days was at the manufacture's minimum average value. No consistent pattern of increasing or decreasing puncture resistance over time was observed for either leachate. As shown in Table 3 and discussed in the "Acceptance Criteria Evaluation" section below, the measured percent change from baseline results are within the range of acceptability and indicate that the leachate is compatible with the liner tested. Additionally, each individual percent change value used to calculate the average met the acceptability criterion.
- ***Modulus of elasticity***. Attachment 5 graphically summarizes the 2 percent secant modulus of elasticity results. No consistent pattern of increase or decrease over time was observed. As shown in Table 3 and discussed in the "Acceptance Criteria Evaluation" section below, the percent change from baseline results are within the range of acceptability and indicate that the leachate is compatible with the liner tested. Additionally, each individual percent change value used to calculate the average met the acceptability criterion.
- ***Indentation hardness***. The range of percent change in indentation hardness from baseline evaluated at each time interval was -7 to -1 percent for Leachate A and -5 to -2 percent for Leachate B. No consistent pattern of increasing or decreasing indentation hardness with time was observed. As discussed in the "Acceptance Criteria Evaluation" section below, these results are within the range of acceptability and indicate that the leachate is compatible with the liner tested.
- ***Extractable content***. The percent extractables varied from an average of 0.11 percent in baseline samples to a range of 0.10 to 0.34 percent in exposed coupons. Percent change was not reported. No consistent increase or decrease in percent extractables with exposure time was observed. As

discussed in the "Acceptance Criteria Evaluation" section below, these results are within the range of acceptability and indicate that the leachate is compatible with the liner tested.

- ***Density***. The range of percent change in density from baseline evaluated at each time interval was -0.064 to 0.042 percent for Leachate A and -0.085 to 0 percent for Leachate B. No consistent pattern of increasing or decreasing density over time was observed. As discussed in the "Acceptance Criteria Evaluation" section below, these results are within the range of acceptability and indicate that the leachate is compatible with the liner tested.
- ***Hydrostatic resistance***. Attachment 5 graphically summarizes the results for hydrostatic resistance. The measured percent change from baseline varied from 0 to 8 percent for Leachate A and 6 to 10 percent for Leachate B. No consistent pattern of increase or decrease with time was observed. As discussed in the "Acceptance Criteria Evaluation" section below, these results are within the range of acceptability and indicate that the leachate is compatible with the liner tested.

## Acceptance Criteria Evaluation

Table 3 provides a summary of industry best practices for compatibility testing acceptance criteria for HDPE geomembrane, which presents selected test properties and criteria for resistance based on industry publications (Koerner 2005; National Sanitation Foundation [NSF] 1987). Comparing the changes observed during this bench-scale study to the suggested criteria, the percent change from baseline results for all test properties pass the criteria (that is, considered "acceptable").

Table 3. Acceptance Criteria and Comparison to Results

*Comparison of suggested resistance criteria to the range of results reported to various test properties*

| **Test Property** | **Suggested Criteria for Acceptance (% Change)** [a] | | **Criteria Met? (Yes/No) *(Average Observed % Change)*** [b] | | |
|---|---|---|---|---|---|
| | ***Koerner (2005)*** [c] | ***NSF (1987)*** [d] | ***Direction*** | ***Leachate A*** | ***Leachate B*** |
| Weight change | < 2 increase | < 3 increase | --- | Yes *(0.48)* | Yes *(0.17)* |
| Tensile strength at break | --- | < 20 decrease | MD | Yes *(7)* | Yes *(23)* [d] |
| | | | TD | Yes *(4)* | Yes *(6)* |
| Elongation at break | --- | < 20 decrease | MD | Yes *(-2)* | Yes *(-3)* |
| | | | TD | Yes *(5)* | Yes *(5)* |
| Tensile strength at yield | < 20 decrease | < 20 decrease | MD | Yes *(-3)* | Yes *(-1)* |
| | | | TD | Yes *(-1)* | Yes *(3)* |
| Elongation at yield | < 30 decrease | < 20 decrease | MD | Yes *(14)* | Yes *(21)* [d] |
| | | | TD | Yes *(-1)* | Yes *(-9)* |
| Tear resistance | < 20 decrease | < 20 decrease | MD | Yes *(3)* | Yes *(13)* |
| | | | TD | Yes *(6)* | Yes *(8)* |
| Puncture | < 30 decrease | --- | --- | Yes *(-2)* | Yes *(1)* |
| Modulus | < 30 decrease | < 30 decrease | MD | Yes *(-4)* | Yes *(2)* |
| | | | TD | Yes *(2)* | Yes *(8)* |

[a] Acceptance criteria (% increase and % decrease) are relative to respective baseline

[b] Whether or not the criteria was met was determined by considering the average percent change for all exposure intervals in either the MD or TD (if applicable). The averaged value is shown in parentheses and is reported in both the positive (increasing) and negative (decreasing) directions. Complete results are presented in Attachment 5.
[c] For semi-crystalline polymers (such as high-density polyethylene [HDPE]).
[d] For HDPE geomembrane.
% - percent
NSF - National Sanitation Foundation

# Conclusions

The results of this bench-scale study indicate the Impoundment 8 Facility CAMU liner material is compatible with leachates expected to be generated from treated OU8 material, even under high leachate concentrations, which simulate leachate generated from post ISS only treated material. Physical and mechanical testing results show no discernable patterns of property degradation over time. In addition, the percent change in physical properties was minimal, and the percent change in mechanical properties was within suggested acceptance criteria.

# References

American Society for Testing and Materials (ASTM). 2008. D5747-08—Standard Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids, ASTM International.

American Society for Testing and Materials (ASTM). 2009. D5322 – *Standard Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetic Liquids*, ASTM International.

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Koerner, R.M. 2005. Designing with Geosynthetics. 5th Edition. Prentice Hall. Englewood Cliffs, New Jersey.

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Sander, R. 2015. Compilation of Henry's law constants (version 4.0) for water as solvent. *Atmos. Chem. Phys.*, 15, 4399-4981.

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# Attachment 1
# Accutest Laboratory Reports

SGS ACCUTEST IS PART OF SGS, THE WORLD'S LEADING INSPECTION, VERIFICATION, TESTING AND CERTIFICATION COMPANY.

*e-Hardcopy 2.0*
*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC8154

Sampling Date: 11/09/15

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **13**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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Test results relate only to samples analyzed.



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**3.2:** JC8154-2: LEACHATE B-PRESPIKE ..... 8
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# Sample Summary

CH2M Hill

**Job No:** JC8154

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC8154-1 | 11/09/15 | 16:00 | JN | 11/10/15 | AQ | Water | LEACHATE A-PRESPIKE |
| JC8154-2 | 11/09/15 | 16:15 | JN | 11/10/15 | AQ | Water | LEACHATE B-PRESPIKE |

# Summary of Hits

**Job Number:** JC8154
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 11/09/15

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC8154-1** | **LEACHATE A-PRESPIKE** | | | | | |
| Acetone | | 926 | 500 | 170 | ug/l | SW846 8260C |
| Benzene | | 28900 | 130 | 59 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 76.0 | 50 | 9.3 | ug/l | SW846 8260C |
| Naphthalene | | 198 J | 250 | 10 | ug/l | SW846 8260C |
| Toluene | | 2680 | 50 | 8.1 | ug/l | SW846 8260C |
| Xylene (total) | | 199 | 50 | 8.3 | ug/l | SW846 8260C |
| Acetophenone | | 5250 | 200 | 36 | ug/l | SW846 8270D |
| **JC8154-2** | **LEACHATE B-PRESPIKE** | | | | | |
| Acetone | | 142 J | 200 | 66 | ug/l | SW846 8260C |
| Benzene | | 8700 | 50 | 24 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 75.7 | 20 | 3.7 | ug/l | SW846 8260C |
| Naphthalene | | 193 | 100 | 4.0 | ug/l | SW846 8260C |
| Toluene | | 1170 | 20 | 3.2 | ug/l | SW846 8260C |
| Xylene (total) | | 117 | 20 | 3.3 | ug/l | SW846 8260C |
| Acetophenone | | 6600 | 200 | 36 | ug/l | SW846 8270D |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A-PRESPIKE
**Lab Sample ID:** JC8154-1 **Date Sampled:** 11/09/15
**Matrix:** AQ - Water **Date Received:** 11/10/15
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | U200684.D | 50 | 11/12/15 | NH | n/a | n/a | VU9240 |
| Run #2 | U200658.D | 250 | 11/11/15 | NH | n/a | n/a | VU9239 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 926 | 500 | 170 | ug/l | |
| 71-43-2 | Benzene | 28900 [a] | 130 | 59 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 76.0 | 50 | 9.3 | ug/l | |
| 91-20-3 | Naphthalene | 198 | 250 | 10 | ug/l | J |
| 108-88-3 | Toluene | 2680 | 50 | 8.1 | ug/l | |
| 1330-20-7 | Xylene (total) | 199 | 50 | 8.3 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 98% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 105% | 73-122% |
| 2037-26-5 | Toluene-D8 | 98% | 98% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 96% | 97% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE A-PRESPIKE
**Lab Sample ID:** JC8154-1 **Date Sampled:** 11/09/15
**Matrix:** AQ - Water **Date Received:** 11/10/15
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 5P23087.D | 1 | 11/11/15 | AP | 11/11/15 | OP88863 | E5P1177 |
| Run #2 | 5P23119.D | 100 | 11/12/15 | SD | 11/11/15 | OP88863 | E5P1178 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 5250 [a] | 200 | 36 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 34% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 24% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 56% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 68% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 52% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 30% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B-PRESPIKE
**Lab Sample ID:** JC8154-2 **Date Sampled:** 11/09/15
**Matrix:** AQ - Water **Date Received:** 11/10/15
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | U200683.D | 20 | 11/12/15 | NH | n/a | n/a | VU9240 |
| Run #2 | U200657.D | 100 | 11/11/15 | NH | n/a | n/a | VU9239 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 142 | 200 | 66 | ug/l | J |
| 71-43-2 | Benzene | 8700 [a] | 50 | 24 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 75.7 | 20 | 3.7 | ug/l | |
| 91-20-3 | Naphthalene | 193 | 100 | 4.0 | ug/l | |
| 108-88-3 | Toluene | 1170 | 20 | 3.2 | ug/l | |
| 1330-20-7 | Xylene (total) | 117 | 20 | 3.3 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 99% | 98% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 107% | 106% | 73-122% |
| 2037-26-5 | Toluene-D8 | 97% | 96% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 94% | 98% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B-PRESPIKE
**Lab Sample ID:** JC8154-2 **Date Sampled:** 11/09/15
**Matrix:** AQ - Water **Date Received:** 11/10/15
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 5P23088.D | 1 | 11/11/15 | AP | 11/11/15 | OP88863 | E5P1177 |
| Run #2 | 5P23120.D | 100 | 11/12/15 | SD | 11/11/15 | OP88863 | E5P1178 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 6600 [a] | 200 | 36 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 43% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 31% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 67% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 91% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 63% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 46% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

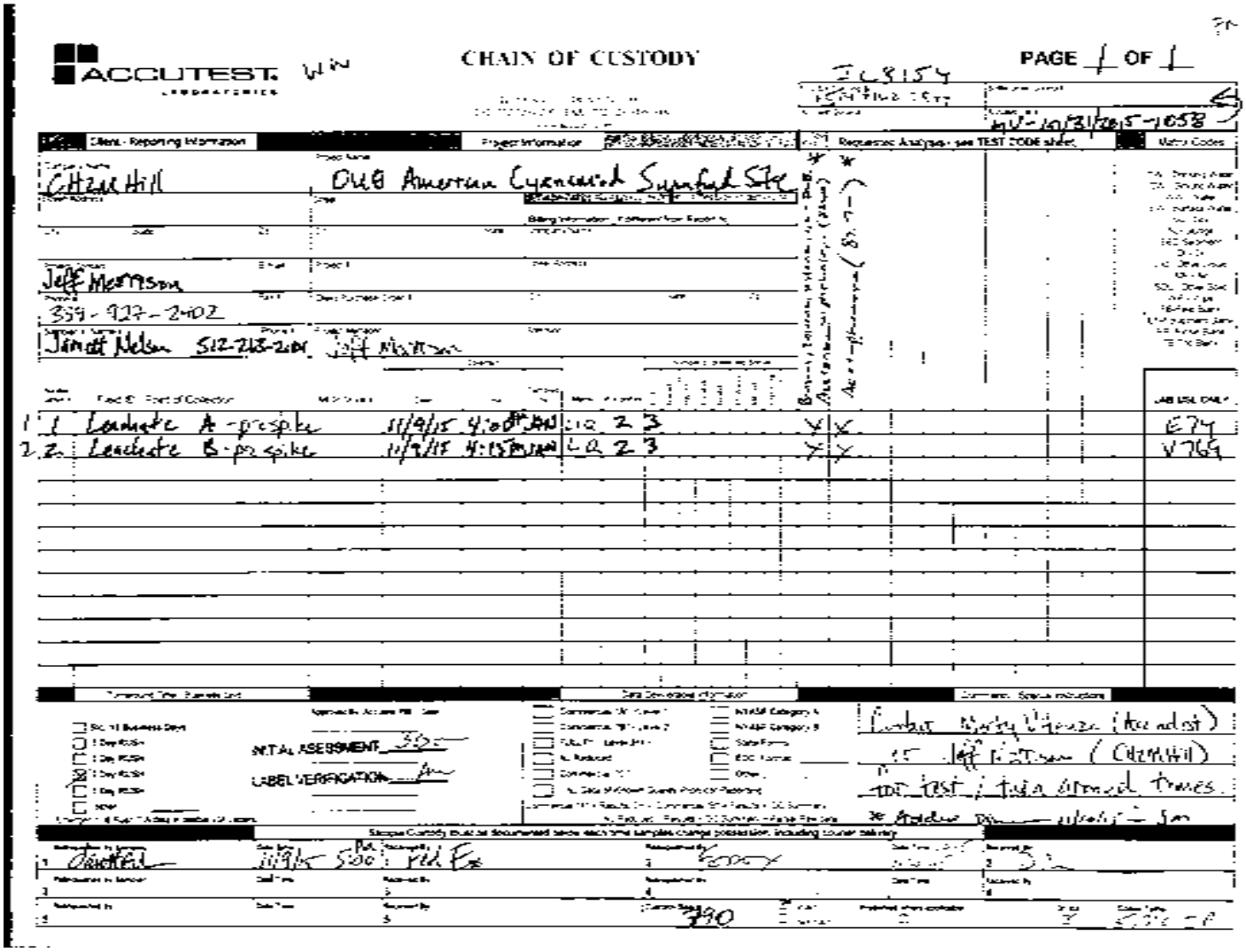
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody





ACCUTEST LABORATORIES

WIN

# CHAIN OF CUSTODY

PAGE 1 OF 1

JC8154

NV-10/31/2015-1058

Client - Reporting Information | Project Information | Requested Analysis - see TEST CODE sheet | Matrix Codes

CH2M Hill

OU8 American Cyanamid Superfund Site

Jeff Morrison

359-927-2402

Janett Nelson 512-213-2101 Jeff Morrison

| Item | Sample ID - Point of Collection | Matrix | Date | Time | Container | Preservative | Bromide, Nitrate, Nitrite, Phosphate (EPA 300.0) | Acetate, Phosphate (EPA 300.0) | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 Leachate A-prespike | | 11/9/15 | 4:00 PM JAN | LQ | 2 3 | X | X | E74 |
| 2 | 2 Leachate B-prespike | | 11/9/15 | 4:15 PM JAN | LQ | 2 3 | X | X | V769 |

Turnaround Time - Business Days: 1 Day RUSH, 1 Day RUSH, 1 Day RUSH, 1 Day RUSH, NORM

INITIAL ASSESSMENT SDS

LABEL VERIFICATION JAN

Data Deliverable Information: NYASP Category A, NYASP Category B, State Forms, EDD Format, Other

Comments - Special Instructions: Contact Marty Vitunac (Accutest) 15 Jeff Morrison (CH2MHill) for test / twin around times.

Sample Custody must be documented below each time samples change possession, including courier delivery

| Relinquished by | Date/Time | Received by | Relinquished by | Date/Time | Received by |
|---|---|---|---|---|---|
| 1 [signature] | 11/9/15 5:00 PM | 1 Fed Ex | 2 [signature] | [illegible] | 2 [illegible] |
| 3 | | 3 | 4 | | 4 |
| 5 | | 5 | Custody Seal 390 | Preserved where applicable | Cooler Temp [illegible] |

JC8154: Chain of Custody
Page 1 of 3

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC8154 **Client:** CH2MHILL **Project:** American Cyanamid

**Date / Time Received:** 11/10/2015 10:15:00 AM **Delivery Method:** FedEx **Airbill #'s:** 651491627944

Cooler Temps (Raw Measured) °C: Cooler 1: (5.3);

Cooler Temps (Corrected) °C: Cooler 1: (5.5);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☐ | ☑ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☐ ☑ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

1) -1,-2: 3 of 3 voa vials rec'd with macro bubbles, no screens provided.

2) -2: No labels on voa vials, set up by process of elimination.

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## Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC8154 **Initiator:** daveh

**CSR:** MV **Response Date:** 11/10/2015

**Response:** Proceed as noted:
Please provide one vial as a Screen.- Does not matter which vial is seleceted.

Lab will be provided with estimated concentrations as to what to expect when running these samples.



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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC9958

Sampling Date: 12/03/15

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **12**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC9958

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC9958-1 | 12/03/15 | 10:00 | JN | 12/04/15 | AQ | Water | LEACHATE A-0 DAY |
| JC9958-2 | 12/03/15 | 10:30 | JN | 12/04/15 | AQ | Water | LEACHATE B-0 DAY |

# Summary of Hits



**Job Number:** JC9958
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 12/03/15

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC9958-1** | **LEACHATE A-0 DAY** | | | | | |
| Acetone | | 2200 | 200 | 66 | ug/l | SW846 8260C |
| Benzene | | 367000 | 2500 | 1200 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 2120 | 20 | 3.7 | ug/l | SW846 8260C |
| Naphthalene | | 1940 | 100 | 4.0 | ug/l | SW846 8260C |
| Toluene | | 43100 | 1000 | 160 | ug/l | SW846 8260C |
| Xylene (total) | | 2420 | 20 | 3.3 | ug/l | SW846 8260C |
| Acetophenone | | 4480 | 100 | 14 | ug/l | SW846 8270D |
| **JC9958-2** | **LEACHATE B-0 DAY** | | | | | |
| Benzene | | 54500 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 819 | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 1800 | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 11600 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 1390 | 250 | 41 | ug/l | SW846 8260C |
| Acetophenone | | 4950 | 100 | 14 | ug/l | SW846 8270D |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A-0 DAY
**Lab Sample ID:** JC9958-1 **Date Sampled:** 12/03/15
**Matrix:** AQ - Water **Date Received:** 12/04/15
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A163848.D | 20 | 12/07/15 | TK | n/a | n/a | V2A6973 |
| Run #2 | 2A163867.D | 1000 | 12/08/15 | TK | n/a | n/a | V2A6974 |
| Run #3 | 2A163869.D | 5000 | 12/08/15 | TK | n/a | n/a | V2A6974 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |
| Run #3 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2200 | 200 | 66 | ug/l | |
| 71-43-2 | Benzene | 367000 [a] | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 2120 | 20 | 3.7 | ug/l | |
| 91-20-3 | Naphthalene | 1940 | 100 | 4.0 | ug/l | |
| 108-88-3 | Toluene | 43100 [b] | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | 2420 | 20 | 3.3 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 99% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 88% | 97% | 97% | 73-122% |
| 2037-26-5 | Toluene-D8 | 97% | 99% | 100% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 99% | 99% | 78-117% |

(a) Result is from Run# 3
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE A-0 DAY
**Lab Sample ID:** JC9958-1 **Date Sampled:** 12/03/15
**Matrix:** AQ - Water **Date Received:** 12/04/15
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P100913.D | 1 | 12/08/15 | LK | 12/07/15 | OP89514 | EP4414 |
| Run #2 | P100917.D | 50 | 12/08/15 | LK | 12/07/15 | OP89514 | EP4414 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 4480 [a] | 100 | 14 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 4165-60-0 | Nitrobenzene-d5 | 82% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 85% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 55% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B-0 DAY
**Lab Sample ID:** JC9958-2 **Date Sampled:** 12/03/15
**Matrix:** AQ - Water **Date Received:** 12/04/15
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A163866.D | 250 | 12/08/15 | TK | n/a | n/a | V2A6974 |
| Run #2 | 2A163869A.D | 1000 | 12/08/15 | TK | n/a | n/a | V2A6974 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 54500 [a] | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 819 | 250 | 46 | ug/l | |
| 91-20-3 | Naphthalene | 1800 | 1300 | 51 | ug/l | |
| 108-88-3 | Toluene | 11600 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 1390 | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 98% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 96% | 98% | 73-122% |
| 2037-26-5 | Toluene-D8 | 99% | 99% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 99% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B-0 DAY
**Lab Sample ID:** JC9958-2 **Date Sampled:** 12/03/15
**Matrix:** AQ - Water **Date Received:** 12/04/15
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P100914.D | 1 | 12/08/15 | LK | 12/07/15 | OP89514 | EP4414 |
| Run #2 | P100918.D | 50 | 12/08/15 | LK | 12/07/15 | OP89514 | EP4414 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 4950 [a] | 100 | 14 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 4165-60-0 | Nitrobenzene-d5 | 84% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 91% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 90% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

**ACCUTEST** LABORATORIES

# CHAIN OF CUSTODY

PAGE 1 OF 1

FED-EX Tracking # 5514 8222 7892 | Bottle Order Control # 10/31/2015-1055
Accutest Quote # | Accutest Job # JC9958

**Client / Reporting Information** | **Project Information** | **Requested Analysis (see TEST CODE sheet)** | **Matrix Codes**

Company Name: CH2M Hill
Project Name: Old American Cyanamid Superfund Site
Project Contact: Jeff Morrison
Phone #: 339-927-2102
Sampler(s) Name(s): Jarred Nelson 512-263-2101
Project Manager: Jeff Morrison

| Sample # | Field ID / Point of Collection | Date | Time | Sampled by | Matrix | # of bottles | LAB USE ONLY |
|---|---|---|---|---|---|---|---|
| 1 | Leachate A - 0 day | 12/3/15 | 10:00 | JMS | LIQ | 2 3 | GES |
| 2 | Leachate B - 0 day | 12/3/15 | 10:30 | JMS | LIQ | 2 3 | [illegible] |

Turnaround Time (Business days) | Data Deliverable Information | Comments / Special Instructions

INITIAL ASSESSMENT 1A 3m

LABEL VERIFICATION [illegible]

Contact Marty Vitanza (Accutest) or Jeff Morrison (CH2M Hill) for test / turnaround times

Sample Custody must be documented below each time samples change possession, including courier delivery.

| Relinquished by Sampler: | Date Time: | Received By: | Relinquished By: | Date Time: | Received By: |
|---|---|---|---|---|---|
| 1 [signature] | 12/3/15 | 1 [signature] | 2 FedEx | 12/5 | 2 [signature] |

Custody Seal # 792

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC9958 **Client:** **Project:**

**Date / Time Received:** 12/4/2015 9:15:00 AM **Delivery Method:** **Airbill #'s:**

Cooler Temps (Raw Measured) °C: Cooler 1: (4.0);

Cooler Temps (Corrected) °C: Cooler 1: (4.4);

| Cooler Security | Y | or | N | | Y | or | N |
|---|---|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | | ☐ | 3. COC Present: | ☑ | | ☐ |
| 2. Custody Seals Intact: | ☑ | | ☐ | 4. Smpl Dates/Time OK | ☑ | | ☐ |

| Cooler Temperature | Y | or | N |
|---|---|---|---|
| 1. Temp criteria achieved: | ☑ | | ☐ |
| 2. Cooler temp verification: | IR Gun | | |
| 3. Cooler media: | Ice (Bag) | | |
| 4. No. Coolers: | 1 | | |

| Quality Control Preservation | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | | ☐ | |
| 4. VOCs headspace free: | ☑ | | ☐ | ☐ |

| Sample Integrity - Documentation | Y | or | N |
|---|---|---|---|
| 1. Sample labels present on bottles: | ☑ | | ☐ |
| 2. Container labeling complete: | ☑ | | ☐ |
| 3. Sample container label / COC agree: | ☑ | | ☐ |

| Sample Integrity - Condition | Y | or | N |
|---|---|---|---|
| 1. Sample recvd within HT: | ☑ | | ☐ |
| 2. All containers accounted for: | ☑ | | ☐ |
| 3. Condition of sample: | Intact | | |

| Sample Integrity - Instructions | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | | ☐ | |
| 4. Compositing instructions clear: | ☐ | | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | | ☐ | ☑ |

Comments

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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC12057

Sampling Date: 01/05/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **14**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC12057

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Matrix Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC12057-1 | 01/05/16 | 14:00 | JAN | 01/06/16 | AQ | Water | LEACHATE A -30 DAY |
| JC12057-1R | 01/05/16 | 14:00 | JAN | 01/06/16 | AQ | Water | LEACHATE A -30 DAY |
| JC12057-2 | 01/05/16 | 14:15 | JAN | 01/06/16 | AQ | Water | LEACHATE B -30 DAY |
| JC12057-2R | 01/05/16 | 14:15 | JAN | 01/06/16 | AQ | Water | LEACHATE B -30 DAY |

# Summary of Hits

**Job Number:** JC12057
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 01/05/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC12057-1** | **LEACHATE A -30 DAY** | | | | | |
| Benzene | | 130000 | 500 | 240 | ug/l | SW846 8260C |
| Toluene | | 4990 | 1000 | 160 | ug/l | SW846 8260C |
| **JC12057-1R** | **LEACHATE A -30 DAY** | | | | | |
| Acetophenone | | 3560 | 100 | 14 | ug/l | SW846 8270D |
| **JC12057-2** | **LEACHATE B -30 DAY** | | | | | |
| Benzene | | 27700 | 100 | 47 | ug/l | SW846 8260C |
| Toluene | | 1780 | 200 | 32 | ug/l | SW846 8260C |
| Xylene (total) | | 70.2 J | 200 | 33 | ug/l | SW846 8260C |
| **JC12057-2R** | **LEACHATE B -30 DAY** | | | | | |
| Acetophenone | | 7150 | 400 | 55 | ug/l | SW846 8270D |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | LEACHATE A -30 DAY | | |
| **Lab Sample ID:** | JC12057-1 | **Date Sampled:** | 01/05/16 |
| **Matrix:** | AQ - Water | **Date Received:** | 01/06/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2B138095.D | 1000 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10000 | 3300 | ug/l | |
| 71-43-2 | Benzene | 130000 | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1000 | 190 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5000 | 200 | ug/l | |
| 108-88-3 | Toluene | 4990 | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1000 | 170 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | | 78-117% |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE A -30 DAY
**Lab Sample ID:** JC12057-1R
**Matrix:** AQ - Water
**Method:** SW846 8270D SW846 3510C
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

**Date Sampled:** 01/05/16
**Date Received:** 01/06/16
**Percent Solids:** n/a

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P101844.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |
| Run #2 | P101869.D | 50 | 01/12/16 | LK | 01/11/16 | OP90386 | EP4461 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 3560 [a] | 100 | 14 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 49% | 54% | 14-88% |
| 4165-62-2 | Phenol-d5 | 35% | 54% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 126% | 74% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 77% | 83% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 82% | 93% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 59% | 57% | 10-126% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B -30 DAY
**Lab Sample ID:** JC12057-2 **Date Sampled:** 01/05/16
**Matrix:** AQ - Water **Date Received:** 01/06/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2B138096.D | 200 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 2000 | 660 | ug/l | |
| 71-43-2 | Benzene | 27700 | 100 | 47 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 200 | 37 | ug/l | |
| 91-20-3 | Naphthalene | ND | 1000 | 40 | ug/l | |
| 108-88-3 | Toluene | 1780 | 200 | 32 | ug/l | |
| 1330-20-7 | Xylene (total) | 70.2 | 200 | 33 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | | 78-117% |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B -30 DAY
**Lab Sample ID:** JC12057-2R
**Matrix:** AQ - Water
**Method:** SW846 8270D SW846 3510C
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

**Date Sampled:** 01/05/16
**Date Received:** 01/06/16
**Percent Solids:** n/a

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P101843.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |
| Run #2 | P101881.D | 200 | 01/12/16 | LK | 01/11/16 | OP90386 | EP4461 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 7150 [a] | 400 | 55 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 43% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 28% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 119% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 81% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 87% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 75% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

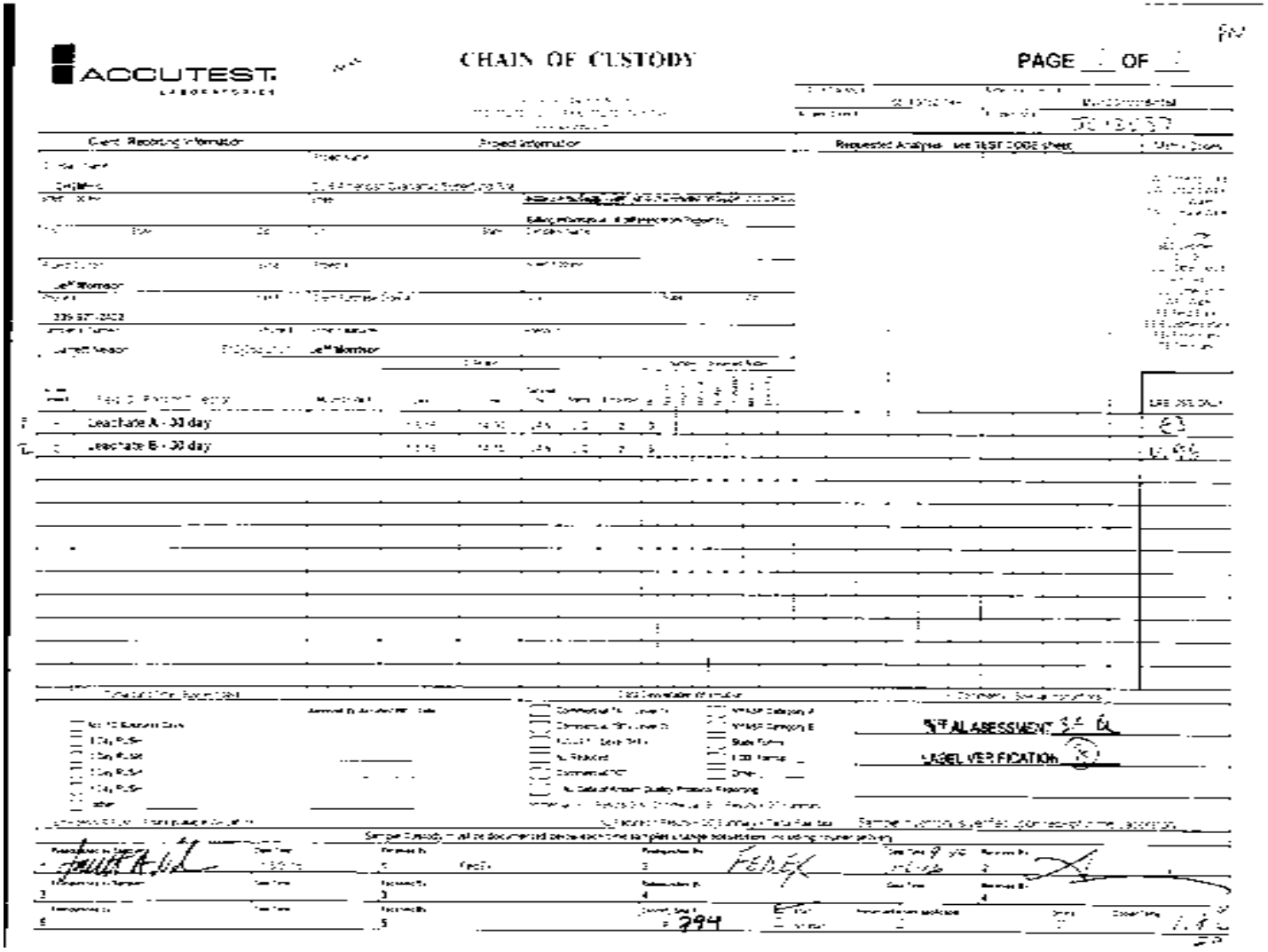
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



ACCUTEST LABORATORIES

# CHAIN OF CUSTODY

PAGE 1 OF 1

Client Reporting Information | Project Information | Requested Analysis - see TEST CODE sheet | Matrix Codes

Leachate A - 30 day

Leachate B - 30 day

Sample Custody must be documented below each time samples change possession, including courier delivery.

Sample Inventory is verified upon receipt of the laboratory.

**JC12057: Chain of Custody**
**Page 1 of 4**

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC12057 **Client:** CH2MHILL **Project:** OU8 American Cyanamid Superfund Site

**Date / Time Received:** 1/6/2016 9:40:00 AM **Delivery Method:** FedEx **Airbill #'s:** 651491627966

Cooler Temps (Raw Measured) °C: Cooler 1: (1.8);

Cooler Temps (Corrected) °C: Cooler 1: (2.2);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☐ | ☑ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments -1 & -2 No analysis noted on COC. Rec'd 2x 950ml unpreserved amber bottles and 3 HCL Preserved VOC's.

-2 2 of 3 VOC vials rec'd with macrobubbles.

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# Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC12057

**Initiator:** ANDREWS

**CSR:** MV

**Response Date:** 1/6/2016

**Response:** V8260ACE
VMS+12DCB
VMS+BENZ
VMS+NAP
VMS+TOLUEN
VMS+XYL

Also needs to be 48 hour t/a, which was not marked on the chain. COMMB Data deliverables.
Per Jeff Morrison



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ACCUTEST LABORATORIES

## Job Change Order: JC12057

| | | | |
|---|---|---|---|
| **Requested Date:** | 1/8/2016 | **Received Date:** | 1/6/2016 |
| **Account Name:** | CH2M Hill | **Due Date:** | 1/8/2016 |
| **Project Description:** | OU8 American Cyanamid Superfund Site, 20 Polhe | **Deliverable:** | COMMB |
| **CSR:** | martyw | **TAT (Days):** | 2 |

==========

**Sample #:** JC12057-1, 2

**Dept:**

**TAT:** 2

**Change:**
Relog for B8270ACEPHEN

==========

**Above Changes Per:** Jeff Morrison **Date/Time:** 1/8/2016 5:20:01 PM

To Client: This Change Order is confirmation of the revisions, previously discussed with the Accutest Client Service Representative.





**JC12057: Chain of Custody**
**Page 4 of 4**

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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC12676

Sampling Date: 01/14/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **11**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC12676

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC12676-1 | 01/14/16 | 14:30 | JAN | 01/15/16 | AQ | Water | LEACHATE A - 43 DAY |
| JC12676-2 | 01/14/16 | 15:00 | JAN | 01/15/16 | AQ | Water | LEACHATE B - 43 DAY |

# Summary of Hits

**Job Number:** JC12676
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 01/14/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC12676-1** | **LEACHATE A - 43 DAY** | | | | | |
| Acetone | | 3480 J | 5000 | 1700 | ug/l | SW846 8260C |
| Benzene | | 243000 | 1000 | 470 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 483 J | 500 | 93 | ug/l | SW846 8260C |
| Naphthalene | | 382 J | 2500 | 100 | ug/l | SW846 8260C |
| Toluene | | 14700 | 500 | 81 | ug/l | SW846 8260C |
| Xylene (total) | | 456 J | 500 | 83 | ug/l | SW846 8260C |
| **JC12676-2** | **LEACHATE B - 43 DAY** | | | | | |
| Acetone | | 1090 | 250 | 83 | ug/l | SW846 8260C |
| Benzene | | 48200 | 130 | 59 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 788 | 25 | 4.6 | ug/l | SW846 8260C |
| Naphthalene | | 2300 | 130 | 5.1 | ug/l | SW846 8260C |
| Toluene | | 6360 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 1050 | 25 | 4.1 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 43 DAY
**Lab Sample ID:** JC12676-1 **Date Sampled:** 01/14/16
**Matrix:** AQ - Water **Date Received:** 01/15/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 4B58800.D | 500 | 01/16/16 | TP | n/a | n/a | V4B2468 |
| Run #2 | 4B58801.D | 2000 | 01/16/16 | TP | n/a | n/a | V4B2468 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 3480 | 5000 | 1700 | ug/l | J |
| 71-43-2 | Benzene | 243000 [a] | 1000 | 470 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 483 | 500 | 93 | ug/l | J |
| 91-20-3 | Naphthalene | 382 | 2500 | 100 | ug/l | J |
| 108-88-3 | Toluene | 14700 | 500 | 81 | ug/l | |
| 1330-20-7 | Xylene (total) | 456 | 500 | 83 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 107% | 108% | 73-122% |
| 2037-26-5 | Toluene-D8 | 107% | 108% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 111% | 114% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 43 DAY
**Lab Sample ID:** JC12676-2 **Date Sampled:** 01/14/16
**Matrix:** AQ - Water **Date Received:** 01/15/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 4B58802.D | 25 | 01/16/16 | TP | n/a | n/a | V4B2468 |
| Run #2 | 4B58803.D | 250 | 01/16/16 | TP | n/a | n/a | V4B2468 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1090 | 250 | 83 | ug/l | |
| 71-43-2 | Benzene | 48200 [a] | 130 | 59 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 788 | 25 | 4.6 | ug/l | |
| 91-20-3 | Naphthalene | 2300 | 130 | 5.1 | ug/l | |
| 108-88-3 | Toluene | 6360 [a] | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 1050 | 25 | 4.1 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 105% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 110% | 107% | 73-122% |
| 2037-26-5 | Toluene-D8 | 107% | 108% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 111% | 111% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

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# CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information

Project Information

Requested Analyses (see TEST CODE sheet)

Billing Information

Jeff Morrison

Jarrod Nelson

Jeff Morrison

| Sample # | Field ID / Point of Collection | Date | Time | Matrix | # of bottles | LAB USE ONLY |
|---|---|---|---|---|---|---|
| 1 | Leachate A - 42 day | [illegible] | [illegible] | [illegible] | 1 | -1 |
| 2 | Leachate B - 42 day | [illegible] | [illegible] | [illegible] | 1 | -2 |

INITIAL ASSESSMENT

LABEL VERIFICATION

Turnaround Time (Business days)

Data Deliverable Information

Comments / Special Instructions

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:

Received By:

Relinquished By:

Received By:

Custody Seal #

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC12676 **Client:** CH2M HILL **Project:** OUB AMERICAN CYANAMID SUPERFUND SITE.

**Date / Time Received:** 1/15/2016 9:15:00 AM **Delivery Method:** 8094 7489 6548 **Airbill #'s:**

Cooler Temps (Raw Measured) °C: Cooler 1: (3.1);

Cooler Temps (Corrected) °C: Cooler 1: (3.5);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments 1) -2 LEACHATE B-43 DAY1 OF 3 VOA'S , MACROBUBBLE.

2) -1 & -2 VIALS ARE HCL PRESERVED, IS THIS OK?

## Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC12676 **Initiator:** BOBL

**CSR:** Michelle **Response Date:** 1/15/2016

**Response:** Per email sent out from Marty V, total VOA's are only being run on these samples



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**JC12676: Chain of Custody**
**Page 3 of 3**

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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC13584

Sampling Date: 02/02/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **15**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC13584

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC13584-1 | 02/02/16 | 14:30 | JAN | 02/03/16 | AQ | Water | LEACHATE A - 60 DAY |
| JC13584-2 | 02/02/16 | 14:45 | JAN | 02/03/16 | AQ | Water | LEACHATE B - 60 DAY |
| JC13584-3 | 02/02/16 | 15:00 | JAN | 02/03/16 | AQ | Water | ABSORPTION - 0 DAY |
| JC13584-4 | 02/02/16 | 15:15 | JAN | 02/03/16 | AQ | Water | ABSORPTION CONTROL - 0 DAY |

# Summary of Hits

**Job Number:** JC13584
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 02/02/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC13584-1** | **LEACHATE A - 60 DAY** | | | | | |
| Acetone | | 4220 | 2500 | 830 | ug/l | SW846 8260C |
| Benzene | | 166000 | 1300 | 590 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 148 J | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 54.0 J | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 8690 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 147 J | 250 | 41 | ug/l | SW846 8260C |
| Acetophenone | | 4790 | 100 | 14 | ug/l | SW846 8270D |
| **JC13584-2** | **LEACHATE B - 60 DAY** | | | | | |
| Acetone | | 841 J | 1000 | 330 | ug/l | SW846 8260C |
| Benzene | | 25100 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 55.3 J | 100 | 19 | ug/l | SW846 8260C |
| Naphthalene | | 60.2 J | 500 | 20 | ug/l | SW846 8260C |
| Toluene | | 2150 | 100 | 16 | ug/l | SW846 8260C |
| Xylene (total) | | 134 | 100 | 17 | ug/l | SW846 8260C |
| Acetophenone | | 6910 | 200 | 28 | ug/l | SW846 8270D |
| **JC13584-3** | **ABSORPTION - 0 DAY** | | | | | |
| Acetone | | 2740 J | 5000 | 1700 | ug/l | SW846 8260C |
| Benzene | | 213000 | 2500 | 1200 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 196 J | 500 | 93 | ug/l | SW846 8260C |
| Naphthalene | | 109 J | 2500 | 100 | ug/l | SW846 8260C |
| Toluene | | 12200 | 500 | 81 | ug/l | SW846 8260C |
| Xylene (total) | | 215 J | 500 | 83 | ug/l | SW846 8260C |
| **JC13584-4** | **ABSORPTION CONTROL - 0 DAY** | | | | | |
| Acetone | | 2940 | 2000 | 660 | ug/l | SW846 8260C |
| Benzene | | 181000 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 179 J | 200 | 37 | ug/l | SW846 8260C |
| Naphthalene | | 78.4 J | 1000 | 40 | ug/l | SW846 8260C |
| Toluene | | 11200 | 200 | 32 | ug/l | SW846 8260C |
| Xylene (total) | | 328 | 200 | 33 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 60 DAY
**Lab Sample ID:** JC13584-1 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | L279007.D | 250 | 02/05/16 | EH | n/a | n/a | VL7670 |
| Run #2 | L279008.D | 2500 | 02/05/16 | EH | n/a | n/a | VL7670 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 4220 | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 166000 [a] | 1300 | 590 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 148 | 250 | 46 | ug/l | J |
| 91-20-3 | Naphthalene | 54.0 | 1300 | 51 | ug/l | J |
| 108-88-3 | Toluene | 8690 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 147 | 250 | 41 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 105% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 111% | 110% | 73-122% |
| 2037-26-5 | Toluene-D8 | 106% | 103% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 106% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE A - 60 DAY
**Lab Sample ID:** JC13584-1 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P102381.D | 1 | 02/04/16 | SD | 02/03/16 | OP90955 | EP4491 |
| Run #2 | P102388.D | 50 | 02/04/16 | LK | 02/03/16 | OP90955 | EP4492 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 4790 [a] | 100 | 14 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 57% | 63% | 14-88% |
| 4165-62-2 | Phenol-d5 | 43% | 44% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 130% | 70% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 96% | 107% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 84% | 94% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 79% | 71% | 10-126% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 60 DAY
**Lab Sample ID:** JC13584-2 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | L279011.D | 100 | 02/05/16 | EH | n/a | n/a | VL7670 |
| Run #2 | L278996.D | 1000 | 02/05/16 | EH | n/a | n/a | VL7669 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 841 | 1000 | 330 | ug/l | J |
| 71-43-2 | Benzene | 25100 [a] | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 55.3 | 100 | 19 | ug/l | J |
| 91-20-3 | Naphthalene | 60.2 | 500 | 20 | ug/l | J |
| 108-88-3 | Toluene | 2150 | 100 | 16 | ug/l | |
| 1330-20-7 | Xylene (total) | 134 | 100 | 17 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 105% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 109% | 109% | 73-122% |
| 2037-26-5 | Toluene-D8 | 103% | 101% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 104% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 60 DAY
**Lab Sample ID:** JC13584-2 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P102380.D | 1 | 02/03/16 | SD | 02/03/16 | OP90955 | EP4491 |
| Run #2 | P102387.D | 100 | 02/04/16 | LK | 02/03/16 | OP90955 | EP4492 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 6910 [a] | 200 | 28 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 49% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 30% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 118% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 89% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 87% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 76% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** ABSORPTION - 0 DAY
**Lab Sample ID:** JC13584-3 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | L279005.D | 500 | 02/05/16 | EH | n/a | n/a | VL7670 |
| Run #2 | L279006.D | 5000 | 02/05/16 | EH | n/a | n/a | VL7670 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2740 | 5000 | 1700 | ug/l | J |
| 71-43-2 | Benzene | 213000 [a] | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 196 | 500 | 93 | ug/l | J |
| 91-20-3 | Naphthalene | 109 | 2500 | 100 | ug/l | J |
| 108-88-3 | Toluene | 12200 | 500 | 81 | ug/l | |
| 1330-20-7 | Xylene (total) | 215 | 500 | 83 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 109% | 109% | 73-122% |
| 2037-26-5 | Toluene-D8 | 106% | 102% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 105% | 105% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** ABSORPTION CONTROL - 0 DAY
**Lab Sample ID:** JC13584-4 **Date Sampled:** 02/02/16
**Matrix:** AQ - Water **Date Received:** 02/03/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | L279013.D | 200 | 02/05/16 | EH | n/a | n/a | VL7670 |
| Run #2 | L278991.D | 1000 | 02/05/16 | EH | n/a | n/a | VL7669 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2940 | 2000 | 660 | ug/l | |
| 71-43-2 | Benzene | 181000 [a] | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 179 | 200 | 37 | ug/l | J |
| 91-20-3 | Naphthalene | 78.4 | 1000 | 40 | ug/l | J |
| 108-88-3 | Toluene | 11200 | 200 | 32 | ug/l | |
| 1330-20-7 | Xylene (total) | 328 | 200 | 33 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 106% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 113% | 110% | 73-122% |
| 2037-26-5 | Toluene-D8 | 105% | 104% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 103% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

ACCUTEST LABORATORIES

# CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information

Company Name: CH2M HILL

Project Information

Project Name: 3-M American Dynamic Superfund Site

Requested Analysis (see TEST CODE sheet)

Project Contact: Jeff Morrison

Phone #: 315-...-...

Sampler(s) Name(s): Ahmed Nelson

Project Manager: Jeff Morrison

| # | Field ID / Point of Collection | Date | Time | Sampled by | Matrix | # of bottles | | | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Leachate A - 60 day | | | | | | 1 | 1 | E23 |
| 2 | Leachate B - 60 day | | | | | | 1 | 1 | 1/467 |
| 3 | Absorption - 2 day | | | | | | 1 | | |
| 4 | Absorption Control - 6 day | | | | | | 1 | | |

Turnaround Time (Business days)

INITIAL ASSESSMENT

LABEL VERIFICATION

Data Deliverable Information

Comments / Special Instructions

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler: 1

Received By: 1

Relinquished By: 2

Received By: 2

Relinquished by Sampler: 3

Received By: 3

Relinquished By: 4

Received By: 4

Relinquished by: 5

Received By: 5

Custody Seal #

Preserved where applicable

On Ice

Cooler Temp.

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC13584 **Client:** CH2MHILL **Project:** OU8 American Cyanamid

**Date / Time Received:** 2/3/2016 9:45:00 AM **Delivery Method:** FedEx **Airbill #'s:** 809474896592

Cooler Temps (Raw Measured) °C: Cooler 1: (5.2);

Cooler Temps (Corrected) °C: Cooler 1: (5.2);

| Cooler Security | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

| Cooler Temperature | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

| Quality Control Preservation | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☐ | ☑ | ☐ |

| Sample Integrity - Documentation | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

| Sample Integrity - Condition | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

| Sample Integrity - Instructions | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

1) -1: 2 of 3 vials rec'd with macrobubbles, no screen provided.

2) -3: 3 of 4 vials rec'd with macrobubbles, no screen provided.

Accutest Laboratories
V:732.329.0200

2235 US Highway 130
F: 732.329.3499

Dayton, New Jersey
www/accutest.com

## Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC13584

**Initiator:** daveh

**CSR:** MV

**Response Date:** 2/3/2016

**Response:** Client notified- Proceed as noted.



Accutest Laboratories
V:732.329.0200

2235 US Highway 130
F: 732.329.3499

Dayton, New Jersey
www/accutest.com

**JC13584: Chain of Custody**
**Page 3 of 3**

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*e-Hardcopy 2.0*
*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC14076

Sampling Date: 02/10/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **13**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC14076

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC14076-1 | 02/10/16 | 15:00 | JAN | 02/11/16 | AQ | Water | LEACHATE A - 70 DAY |
| JC14076-2 | 02/10/16 | 15:15 | JAN | 02/11/16 | AQ | Water | LEACHATE B - 70 DAY |
| JC14076-3 | 02/10/16 | 15:30 | JAN | 02/11/16 | AQ | Water | CONTROL 1 - 9 DAY |
| JC14076-4 | 02/10/16 | 15:45 | JAN | 02/11/16 | AQ | Water | CONTROL 2 - 9 DAY |

# Summary of Hits

**Job Number:** JC14076
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 02/10/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC14076-1** | **LEACHATE A - 70 DAY** | | | | | |
| Benzene | | 338000 | 1300 | 590 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 4190 | 2500 | 460 | ug/l | SW846 8260C |
| Naphthalene | | 4180 J | 13000 | 510 | ug/l | SW846 8260C |
| Toluene | | 53600 | 2500 | 410 | ug/l | SW846 8260C |
| Xylene (total) | | 3960 | 2500 | 410 | ug/l | SW846 8260C |
| **JC14076-2** | **LEACHATE B - 70 DAY** | | | | | |
| Acetone | | 1140 J | 2500 | 830 | ug/l | SW846 8260C |
| Benzene | | 40400 | 130 | 59 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 355 | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 1010 J | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 4470 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 408 | 250 | 41 | ug/l | SW846 8260C |
| **JC14076-3** | **CONTROL 1 - 9 DAY** | | | | | |
| Benzene | | 150000 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 508 J | 1000 | 190 | ug/l | SW846 8260C |
| Naphthalene | | 669 J | 5000 | 200 | ug/l | SW846 8260C |
| Toluene | | 8550 | 1000 | 160 | ug/l | SW846 8260C |
| Xylene (total) | | 552 J | 1000 | 170 | ug/l | SW846 8260C |
| **JC14076-4** | **CONTROL 2 - 9 DAY** | | | | | |
| Benzene | | 564000 | 2500 | 1200 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 8470 | 5000 | 930 | ug/l | SW846 8260C |
| Naphthalene | | 6330 J | 25000 | 1000 | ug/l | SW846 8260C |
| Toluene | | 90400 | 5000 | 810 | ug/l | SW846 8260C |
| Xylene (total) | | 4400 J | 5000 | 830 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 70 DAY
**Lab Sample ID:** JC14076-1 **Date Sampled:** 02/10/16
**Matrix:** AQ - Water **Date Received:** 02/11/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A165570.D | 2500 | 02/12/16 | TK | n/a | n/a | V2A7041 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 25000 | 8300 | ug/l | |
| 71-43-2 | Benzene | 338000 | 1300 | 590 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 4190 | 2500 | 460 | ug/l | |
| 91-20-3 | Naphthalene | 4180 | 13000 | 510 | ug/l | J |
| 108-88-3 | Toluene | 53600 | 2500 | 410 | ug/l | |
| 1330-20-7 | Xylene (total) | 3960 | 2500 | 410 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 95% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 104% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | | 78-117% |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 70 DAY
**Lab Sample ID:** JC14076-2 **Date Sampled:** 02/10/16
**Matrix:** AQ - Water **Date Received:** 02/11/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A165568.D | 250 | 02/12/16 | TK | n/a | n/a | V2A7041 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1140 | 2500 | 830 | ug/l | J |
| 71-43-2 | Benzene | 40400 | 130 | 59 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 355 | 250 | 46 | ug/l | |
| 91-20-3 | Naphthalene | 1010 | 1300 | 51 | ug/l | J |
| 108-88-3 | Toluene | 4470 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 408 | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 94% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 104% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | | 78-117% |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** CONTROL 1 - 9 DAY
**Lab Sample ID:** JC14076-3
**Matrix:** AQ - Water
**Method:** SW846 8260C
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

**Date Sampled:** 02/10/16
**Date Received:** 02/11/16
**Percent Solids:** n/a

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A165569.D | 1000 | 02/12/16 | TK | n/a | n/a | V2A7041 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10000 | 3300 | ug/l | |
| 71-43-2 | Benzene | 150000 | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 508 | 1000 | 190 | ug/l | J |
| 91-20-3 | Naphthalene | 669 | 5000 | 200 | ug/l | J |
| 108-88-3 | Toluene | 8550 | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | 552 | 1000 | 170 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 94% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 105% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | | 78-117% |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** CONTROL 2 - 9 DAY
**Lab Sample ID:** JC14076-4 **Date Sampled:** 02/10/16
**Matrix:** AQ - Water **Date Received:** 02/11/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2A165571.D | 5000 | 02/12/16 | TK | n/a | n/a | V2A7041 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 50000 | 17000 | ug/l | |
| 71-43-2 | Benzene | 564000 | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 8470 | 5000 | 930 | ug/l | |
| 91-20-3 | Naphthalene | 6330 | 25000 | 1000 | ug/l | J |
| 108-88-3 | Toluene | 90400 | 5000 | 810 | ug/l | |
| 1330-20-7 | Xylene (total) | 4400 | 5000 | 830 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 96% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 104% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | | 78-117% |

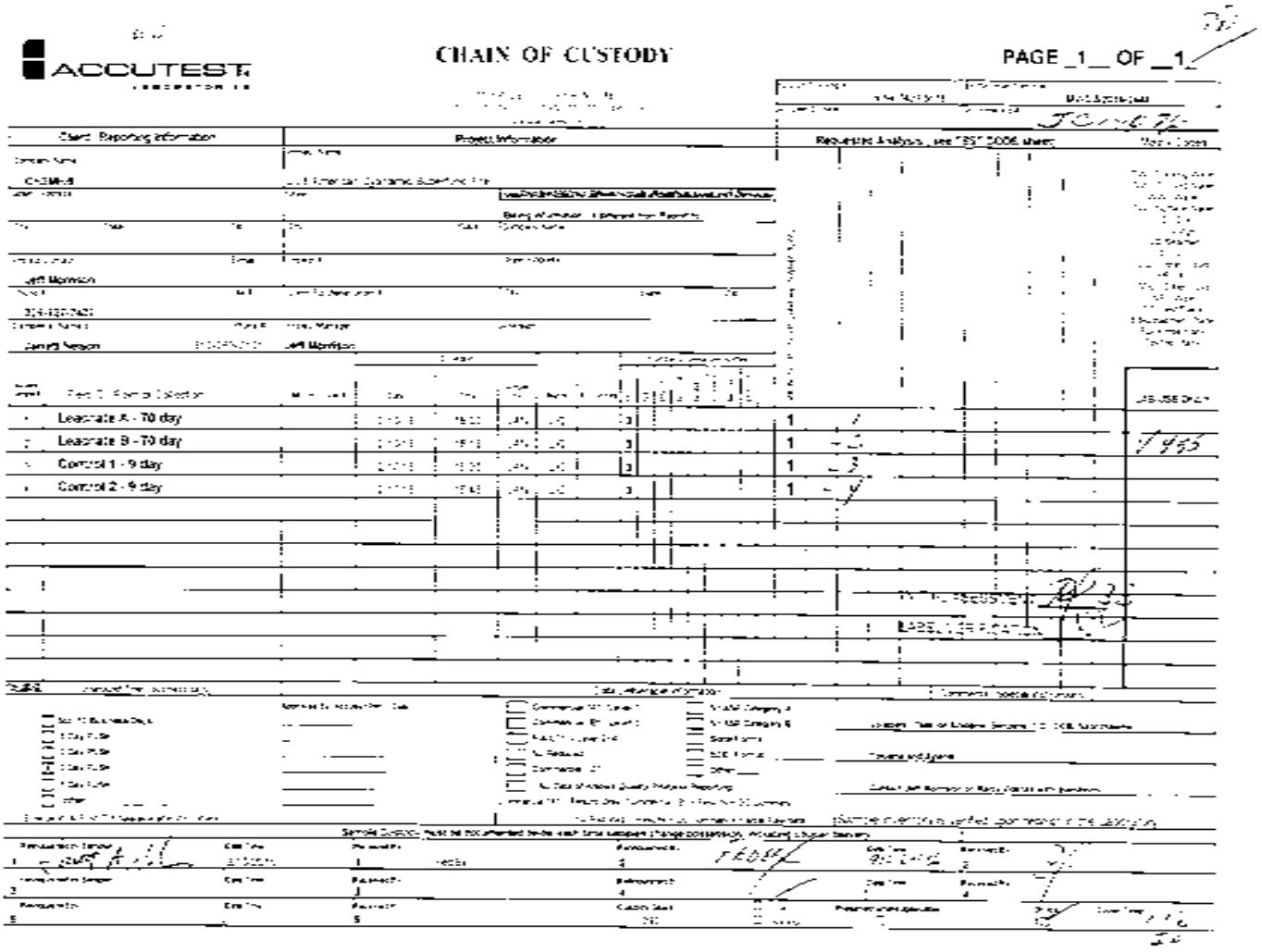
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody




**JC14076: Chain of Custody**
**Page 1 of 3**

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC14076 **Client:** CH2MHILL **Project:** OU8 AMERICAN CYANAMID SUPER FUND SITE

**Date / Time Received:** 2/11/2016 9:30:00 AM **Delivery Method:** FedEx **Airbill #'s:** 8094 7489 6618

Cooler Temps (Raw Measured) °C: Cooler 1: (1.1);

Cooler Temps (Corrected) °C: Cooler 1: (1.5);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments 1) -1 AND -4 3 OF 3 VOA'S HAVE MACROBUBBLES
-2 AND -3 2 OF 3 VOA'S VOA'S HAVE MACROBUBBLES

## Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC14076

**Initiator:** BOBL

**CSR:** MV

**Response Date:** 2/11/2016

**Response:** Proceed as noted...



Accutest Laboratories
V:732.329.0200

2235 US Highway 130
F: 732.329.3499

Dayton, New Jersey
www/accutest.com

**JC14076: Chain of Custody**
**Page 3 of 3**

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*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC15397

Sampling Date: 03/03/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **13**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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Test results relate only to samples analyzed.



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Sections: 1 2 3 4

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# Sample Summary

CH2M Hill

**Job No:** JC15397

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC15397-1 | 03/03/16 | 14:15 | JAN | 03/04/16 | AQ | Water | LEACHATE A - 92 DAY |
| JC15397-2 | 03/03/16 | 14:30 | JAN | 03/04/16 | AQ | Water | LEACHATE B - 92 DAY |
| JC15397-3 | 03/03/16 | 14:45 | JAN | 03/04/16 | AQ | Water | CONTROL 1 - 31 DAY |
| JC15397-4 | 03/03/16 | 15:00 | JAN | 03/04/16 | AQ | Water | CONTROL 2 - 31 DAY |

# Summary of Hits

**Job Number:** JC15397
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/03/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC15397-1** | **LEACHATE A - 92 DAY** | | | | | |
| Acetone | | 4520 | 2500 | 830 | ug/l | SW846 8260C |
| Benzene | | 230000 | 2500 | 1200 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 226 J | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 189 J | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 13400 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 295 | 250 | 41 | ug/l | SW846 8260C |
| **JC15397-2** | **LEACHATE B - 92 DAY** | | | | | |
| Acetone | | 1330 | 500 | 170 | ug/l | SW846 8260C |
| Benzene | | 36900 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 103 | 50 | 9.3 | ug/l | SW846 8260C |
| Naphthalene | | 184 J | 250 | 10 | ug/l | SW846 8260C |
| Toluene | | 3330 | 50 | 8.1 | ug/l | SW846 8260C |
| Xylene (total) | | 187 | 50 | 8.3 | ug/l | SW846 8260C |
| **JC15397-3** | **CONTROL 1 - 31 DAY** | | | | | |
| Acetone | | 2930 | 2500 | 830 | ug/l | SW846 8260C |
| Benzene | | 137000 | 2500 | 1200 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 99.2 J | 250 | 46 | ug/l | SW846 8260C |
| Toluene | | 5020 | 250 | 41 | ug/l | SW846 8260C |
| **JC15397-4** | **CONTROL 2 - 31 DAY** | | | | | |
| Acetone | | 4190 J | 5000 | 1700 | ug/l | SW846 8260C |
| Benzene | | 301000 | 5000 | 2400 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 875 | 500 | 93 | ug/l | SW846 8260C |
| Naphthalene | | 712 J | 2500 | 100 | ug/l | SW846 8260C |
| Toluene | | 20800 | 500 | 81 | ug/l | SW846 8260C |
| Xylene (total) | | 592 | 500 | 83 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 92 DAY
**Lab Sample ID:** JC15397-1 **Date Sampled:** 03/03/16
**Matrix:** AQ - Water **Date Received:** 03/04/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | U203966.D | 250 | 03/07/16 | NH | n/a | n/a | VU9376 |
| Run #2 | U203964.D | 5000 | 03/07/16 | NH | n/a | n/a | VU9376 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 4520 | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 230000 [a] | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 226 | 250 | 46 | ug/l | J |
| 91-20-3 | Naphthalene | 189 | 1300 | 51 | ug/l | J |
| 108-88-3 | Toluene | 13400 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 295 | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 103% | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | 99% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 101% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 92 DAY
**Lab Sample ID:** JC15397-2 **Date Sampled:** 03/03/16
**Matrix:** AQ - Water **Date Received:** 03/04/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | U203967.D | 50 | 03/07/16 | NH | n/a | n/a | VU9376 |
| Run #2 | U203965.D | 1000 | 03/07/16 | NH | n/a | n/a | VU9376 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1330 | 500 | 170 | ug/l | |
| 71-43-2 | Benzene | 36900 [a] | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 103 | 50 | 9.3 | ug/l | |
| 91-20-3 | Naphthalene | 184 | 250 | 10 | ug/l | J |
| 108-88-3 | Toluene | 3330 | 50 | 8.1 | ug/l | |
| 1330-20-7 | Xylene (total) | 187 | 50 | 8.3 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 102% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 103% | 73-122% |
| 2037-26-5 | Toluene-D8 | 100% | 98% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 101% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | CONTROL 1 - 31 DAY | | |
| **Lab Sample ID:** | JC15397-3 | **Date Sampled:** | 03/03/16 |
| **Matrix:** | AQ - Water | **Date Received:** | 03/04/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2D153492.D | 250 | 03/07/16 | AM | n/a | n/a | V2D6453 |
| Run #2 | 2D153490.D | 5000 | 03/07/16 | AM | n/a | n/a | V2D6453 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2930 | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 137000 [a] | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 99.2 | 250 | 46 | ug/l | J |
| 91-20-3 | Naphthalene | ND | 1300 | 51 | ug/l | |
| 108-88-3 | Toluene | 5020 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 73-122% |
| 2037-26-5 | Toluene-D8 | 102% | 99% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 100% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** CONTROL 2 - 31 DAY
**Lab Sample ID:** JC15397-4 **Date Sampled:** 03/03/16
**Matrix:** AQ - Water **Date Received:** 03/04/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2D153493.D | 500 | 03/07/16 | AM | n/a | n/a | V2D6453 |
| Run #2 | 2D153491.D | 10000 | 03/07/16 | AM | n/a | n/a | V2D6453 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 4190 | 5000 | 1700 | ug/l | J |
| 71-43-2 | Benzene | 301000 [a] | 5000 | 2400 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 875 | 500 | 93 | ug/l | |
| 91-20-3 | Naphthalene | 712 | 2500 | 100 | ug/l | J |
| 108-88-3 | Toluene | 20800 | 500 | 81 | ug/l | |
| 1330-20-7 | Xylene (total) | 592 | 500 | 83 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 99% | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 100% | 73-122% |
| 2037-26-5 | Toluene-D8 | 102% | 101% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 100% | 78-117% |

(a) Result is from Run# 2

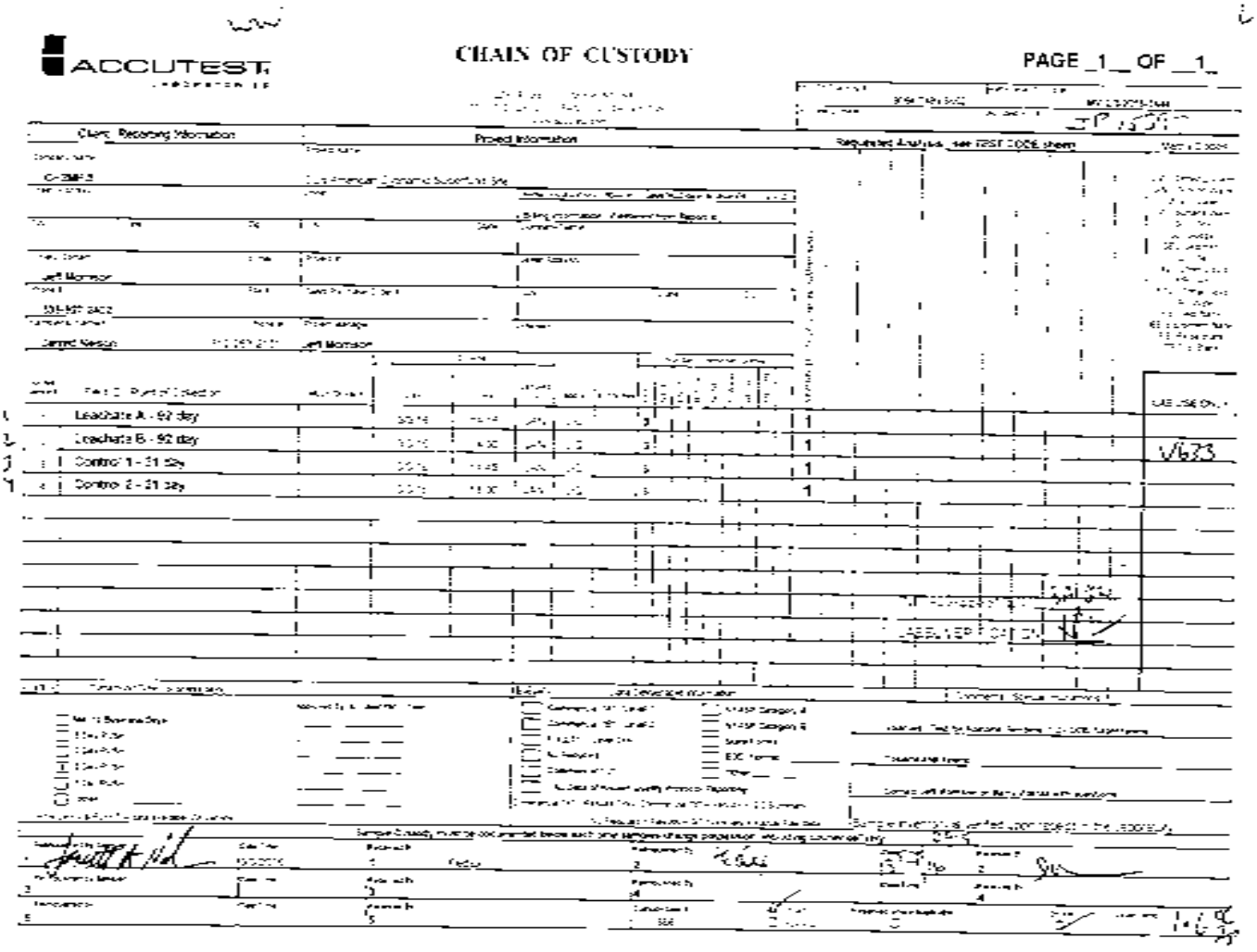
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody


ACCUTEST

CHAIN OF CUSTODY

PAGE _1_ OF _1_

Client / Reporting Information

Project Information

Requested Analysis - see TEST CODE sheet

Matrix Codes

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Field ID / Point of Collection | MeOH Vials # | Date Collected | Time Collected | Sampled by | # of bottles | | | | | LAB USE ONLY |
| 1 | Leachate A - 92 day | | | | | 1 | | | | | |
| 2 | Leachate B - 92 day | | | | | 1 | | | | | V623 |
| 3 | Control 1 - 31 day | | | | | 1 | | | | | |
| 4 | Control 2 - 31 day | | | | | 1 | | | | | |

COMMERCIAL / "A"

RESULTS "B"

Comments / Special Instructions

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by: 1 | Date/Time | Received by: 1 | Relinquished by: 2 | Date/Time | Received by: 2

Relinquished by: 3 | Date/Time | Received by: 3 | Relinquished by: 4 | Date/Time | Received by: 4

Relinquished by: 5 | Date/Time | Received by: 5

**JC15397: Chain of Custody**
**Page 1 of 3**

**Job Number:** JC15397 **Client:** CH2MHILL **Project:** QU8 American Cyanamid

**Date / Time Received:** 3/4/2016 9:15:00 AM **Delivery Method:** FedEx **Airbill #'s:** 809474896662

Cooler Temps (Raw Measured) °C: Cooler 1: (1.6);

Cooler Temps (Corrected) °C: Cooler 1: (2.0);

| Cooler Security | Y | or | N | | Y | or | N |
|---|---|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | | ☐ | 3. COC Present: | ☑ | | ☐ |
| 2. Custody Seals Intact: | ☑ | | ☐ | 4. Smpl Dates/Time OK | ☑ | | ☐ |

| Cooler Temperature | Y | or | N |
|---|---|---|---|
| 1. Temp criteria achieved: | ☑ | | ☐ |
| 2. Cooler temp verification: | IR Gun | | |
| 3. Cooler media: | Ice (Bag) | | |
| 4. No. Coolers: | 1 | | |

| Quality Control _Preservation | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | | ☐ | |
| 4. VOCs headspace free: | ☐ | | ☑ | ☐ |

| Sample Integrity - Documentation | Y | or | N |
|---|---|---|---|
| 1. Sample labels present on bottles: | ☑ | | ☐ |
| 2. Container labeling complete: | ☑ | | ☐ |
| 3. Sample container label / COC agree: | ☑ | | ☐ |

| Sample Integrity - Condition | Y | or | N |
|---|---|---|---|
| 1. Sample recvd within HT: | ☑ | | ☐ |
| 2. All containers accounted for: | ☑ | | ☐ |
| 3. Condition of sample: | Intact | | |

| Sample Integrity - Instructions | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | | ☐ | |
| 4. Compositing instructions clear: | ☐ | | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | | ☐ | ☑ |

Comments

1) 1-4: 3 of 3 vials rec'd with macrobubbles, no screen provided.





**JC15397: Chain of Custody**
**Page 2 of 3**

## Problem Resolution



**Accutest Job Number:** JC15397

**CSR:** _____ **Response Date:** 3/4/2016

**Response:** Proceed with analysis



**JC15397: Chain of Custody**
**Page 3 of 3**

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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC16132

Sampling Date: 03/11/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **10**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

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# Sample Summary

CH2M Hill

**Job No:** JC16132

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC16132-1 | 03/11/16 | 10:00 | JAN | 03/12/16 | AQ | Water | LEACHATE A - 100 DAY |
| JC16132-2 | 03/11/16 | 10:15 | JAN | 03/12/16 | AQ | Water | LEACHATE B - 100 DAY |

# Summary of Hits

**Job Number:** JC16132
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/11/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC16132-1** | **LEACHATE A - 100 DAY** | | | | | |
| Acetone | | 3810 | 2500 | 830 | ug/l | SW846 8260C |
| Benzene | | 282000 | 1300 | 590 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 853 | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 769 J | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 21800 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 797 | 250 | 41 | ug/l | SW846 8260C |
| **JC16132-2** | **LEACHATE B - 100 DAY** | | | | | |
| Acetone | | 1110 | 1000 | 330 | ug/l | SW846 8260C |
| Benzene | | 43200 | 500 | 240 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 155 | 100 | 19 | ug/l | SW846 8260C |
| Naphthalene | | 228 J | 500 | 20 | ug/l | SW846 8260C |
| Toluene | | 3900 | 100 | 16 | ug/l | SW846 8260C |
| Xylene (total) | | 238 | 100 | 17 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 100 DAY
**Lab Sample ID:** JC16132-1 **Date Sampled:** 03/11/16
**Matrix:** AQ - Water **Date Received:** 03/12/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2D153736.D | 250 | 03/16/16 | AM | n/a | n/a | V2D6463 |
| Run #2 | 2D153737.D | 2500 | 03/16/16 | AM | n/a | n/a | V2D6463 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 3810 | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 282000 [a] | 1300 | 590 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 853 | 250 | 46 | ug/l | |
| 91-20-3 | Naphthalene | 769 | 1300 | 51 | ug/l | J |
| 108-88-3 | Toluene | 21800 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 797 | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 104% | 73-122% |
| 2037-26-5 | Toluene-D8 | 103% | 102% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 100% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 100 DAY
**Lab Sample ID:** JC16132-2 **Date Sampled:** 03/11/16
**Matrix:** AQ - Water **Date Received:** 03/12/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2D153734.D | 100 | 03/16/16 | AM | n/a | n/a | V2D6463 |
| Run #2 | 2D153735.D | 1000 | 03/16/16 | AM | n/a | n/a | V2D6463 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 1110 | 1000 | 330 | ug/l | |
| 71-43-2 | Benzene | 43200 [a] | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 155 | 100 | 19 | ug/l | |
| 91-20-3 | Naphthalene | 228 | 500 | 20 | ug/l | J |
| 108-88-3 | Toluene | 3900 | 100 | 16 | ug/l | |
| 1330-20-7 | Xylene (total) | 238 | 100 | 17 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 101% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 102% | 73-122% |
| 2037-26-5 | Toluene-D8 | 103% | 101% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 99% | 78-117% |

(a) Result is from Run# 2

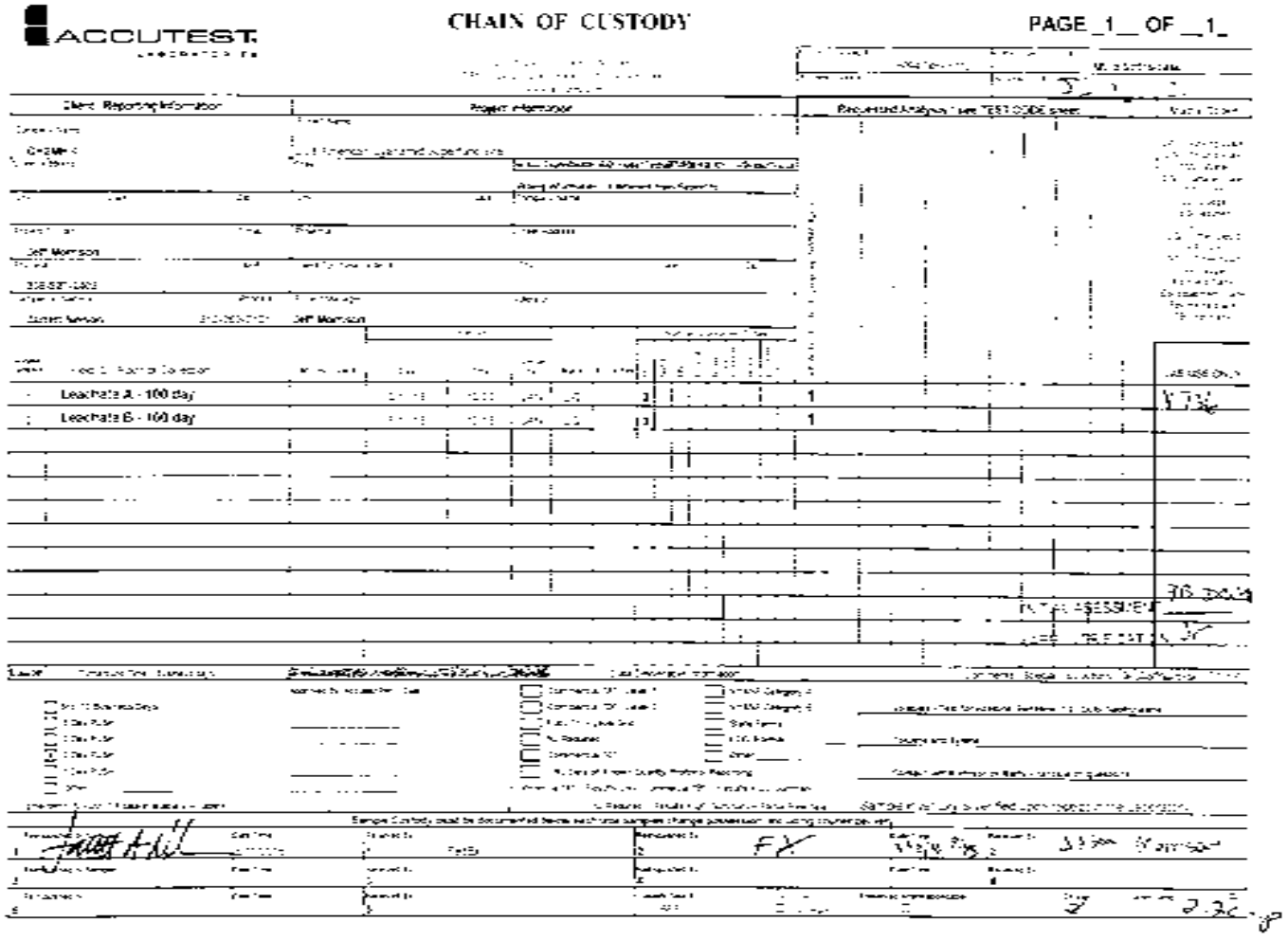
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody


ACCUTEST

CHAIN OF CUSTODY

PAGE _1__ OF __1_

Client / Reporting Information

Project Information

Requested Analyses / see TEST CODE sheet

Jeff Morrison

Jeff Morrison

Leachate A - 100 day 1

Leachate B - 100 day 1

FAX

# SGS Accutest Sample Receipt Summary

**Job Number:** JC16132 **Client:** _____ **Project:** _____

**Date / Time Received:** 3/12/2016 9:45:00 AM **Delivery Method:** _____ **Airbill #'s:** _____

Cooler Temps (Raw Measured) °C: Cooler 1: (2.2);

Cooler Temps (Corrected) °C: Cooler 1: (2.6);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No. Coolers: | 1 |

**Quality Control Preservation**

| | Y or N | N/A |
|---|---|---|
| 1. Trip Blank present / cooler: | ☐ ☐ | ☑ |
| 2. Trip Blank listed on COC: | ☐ ☐ | ☑ |
| 3. Samples preserved properly: | ☑ ☐ | |
| 4. VOCs headspace free: | ☐ ☐ | ☑ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y or N | N/A |
|---|---|---|
| 1. Analysis requested is clear: | ☑ ☐ | |
| 2. Bottles received for unspecified tests | ☐ ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ ☐ | |
| 4. Compositing instructions clear: | ☐ ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ ☐ | ☑ |

Comments

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Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC17412

Sampling Date: 03/31/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **13**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC17412

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC17412-1 | 03/31/16 | 14:00 | JAN | 04/01/16 | AQ | Water | LEACHATE A - 120 DAY |
| JC17412-2 | 03/31/16 | 14:15 | JAN | 04/01/16 | AQ | Water | LEACHATE B - 120 DAY |

# Summary of Hits

**Job Number:** JC17412
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/31/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC17412-1** | **LEACHATE A - 120 DAY** | | | | | |
| Acetone [a] | | 2630 J | 10000 | 2000 | ug/l | SW846 8260C |
| Benzene | | 275000 | 5000 | 2400 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 323 J | 1000 | 190 | ug/l | SW846 8260C |
| Toluene | | 18900 | 1000 | 160 | ug/l | SW846 8260C |
| Acetophenone | | 5470 | 400 | 42 | ug/l | SW846 8270D |
| **JC17412-2** | **LEACHATE B - 120 DAY** | | | | | |
| Benzene | | 48700 | 1300 | 590 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 180 J | 250 | 46 | ug/l | SW846 8260C |
| Naphthalene | | 303 J | 1300 | 51 | ug/l | SW846 8260C |
| Toluene | | 4930 | 250 | 41 | ug/l | SW846 8260C |
| Xylene (total) | | 273 | 250 | 41 | ug/l | SW846 8260C |
| Acetophenone | | 8070 | 400 | 42 | ug/l | SW846 8270D |

(a) MDL from current instrument.

## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A - 120 DAY
**Lab Sample ID:** JC17412-1 **Date Sampled:** 03/31/16
**Matrix:** AQ - Water **Date Received:** 04/01/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2C138061.D | 1000 | 04/02/16 | TP | n/a | n/a | V2C6202 |
| Run #2 | 2C138062.D | 10000 | 04/02/16 | TP | n/a | n/a | V2C6202 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone [a] | 2630 | 10000 | 2000 | ug/l | J |
| 71-43-2 | Benzene | 275000 [b] | 5000 | 2400 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 323 | 1000 | 190 | ug/l | J |
| 91-20-3 | Naphthalene | ND | 5000 | 200 | ug/l | |
| 108-88-3 | Toluene | 18900 | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1000 | 170 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 94% | 94% | 73-122% |
| 2037-26-5 | Toluene-D8 | 104% | 101% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 95% | 94% | 78-117% |

(a) MDL from current instrument.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | LEACHATE A - 120 DAY | | |
| **Lab Sample ID:** | JC17412-1 | **Date Sampled:** | 03/31/16 |
| **Matrix:** | AQ - Water | **Date Received:** | 04/01/16 |
| **Method:** | SW846 8270D SW846 3510C | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2P57867.D | 1 | 04/05/16 | SD | 04/04/16 | OP92746 | E2P2526 |
| Run #2 | 3P52203.D | 200 | 04/05/16 | RL | 04/04/16 | OP92746 | E3P2374 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 5470 [a] | 400 | 42 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 76% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 45% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 108% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 105% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 79% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 81% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 120 DAY
**Lab Sample ID:** JC17412-2 **Date Sampled:** 03/31/16
**Matrix:** AQ - Water **Date Received:** 04/01/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2C138059.D | 250 | 04/02/16 | TP | n/a | n/a | V2C6202 |
| Run #2 | 2C138060.D | 2500 | 04/02/16 | TP | n/a | n/a | V2C6202 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 2500 | 830 | ug/l | |
| 71-43-2 | Benzene | 48700 [a] | 1300 | 590 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 180 | 250 | 46 | ug/l | J |
| 91-20-3 | Naphthalene | 303 | 1300 | 51 | ug/l | J |
| 108-88-3 | Toluene | 4930 | 250 | 41 | ug/l | |
| 1330-20-7 | Xylene (total) | 273 | 250 | 41 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 101% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 94% | 94% | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | 100% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 94% | 96% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B - 120 DAY
**Lab Sample ID:** JC17412-2 **Date Sampled:** 03/31/16
**Matrix:** AQ - Water **Date Received:** 04/01/16
**Method:** SW846 8270D SW846 3510C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2P57868.D | 1 | 04/05/16 | SD | 04/04/16 | OP92746 | E2P2526 |
| Run #2 | 3P52204.D | 200 | 04/05/16 | RL | 04/04/16 | OP92746 | E3P2374 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 8070 [a] | 400 | 42 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 56% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 34% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 118% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 86% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 83% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 73% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

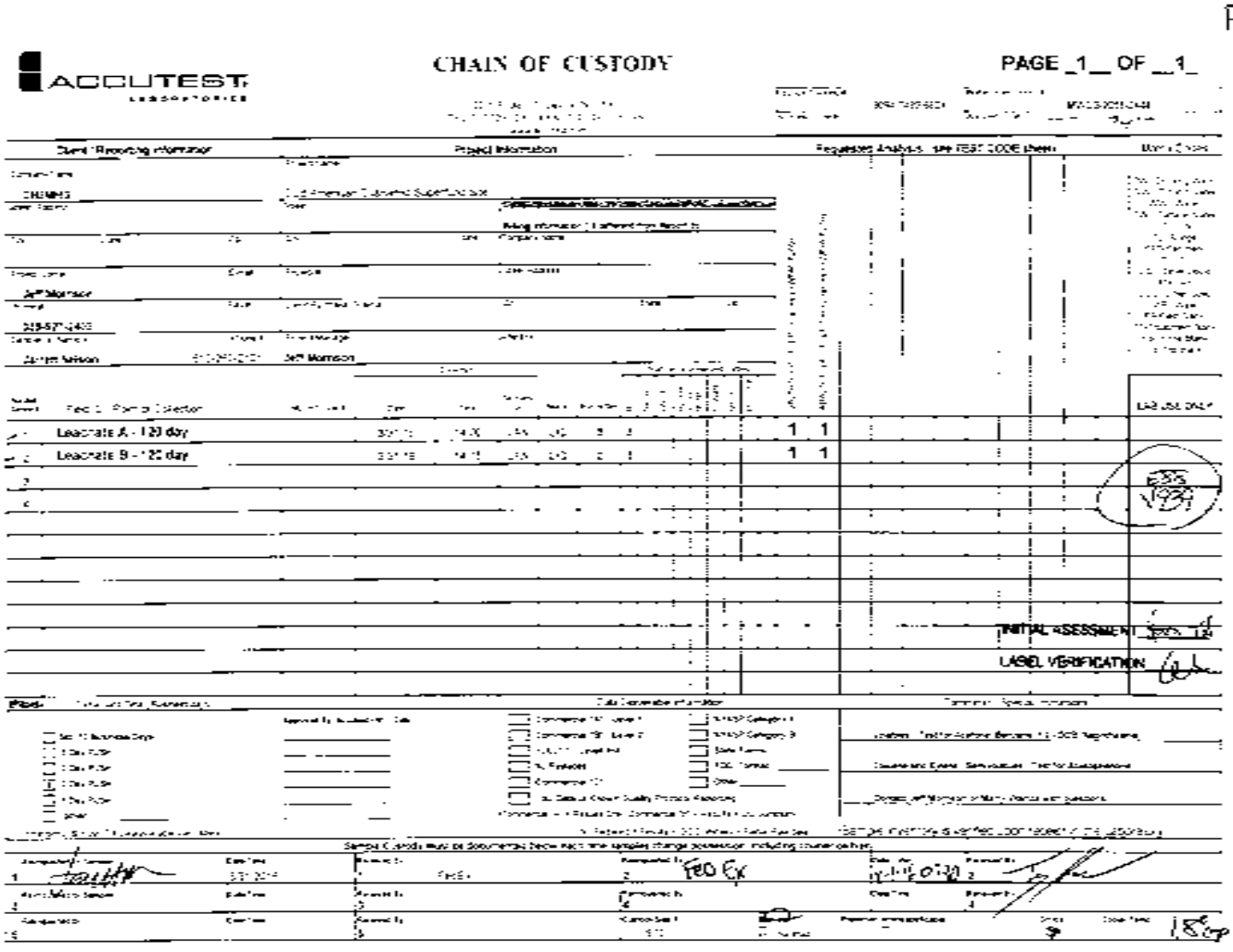
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



ACCUTEST LABORATORIES

CHAIN OF CUSTODY

PAGE _1_ OF _1_

| | | | |
|---|---|---|---|
| Leachate A - 120 day | | 1 | 1 |
| Leachate B - 120 day | | 1 | 1 |

INITIAL ASSESSMENT

LABEL VERIFICATION

FED EX

# SGS Accutest Sample Receipt Summary

**Job Number:** JC17412 **Client:** CH2MHill **Project:** OU8 American Cyanamid Superfund

**Date / Time Received:** 4/1/2016 9:30:00 AM **Delivery Method:** FedEx **Airbill #'s:** 8094 7489 6824

Cooler Temps (Raw Measured) °C: Cooler 1: (1.8);

Cooler Temps (Corrected) °C: Cooler 1: (2.2);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☐ | ☑ | |
| 4. VOCs headspace free: | ☐ | ☑ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☐ | ☑ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

Received HCL voa vials although TCLP Volatiles would require unpreserved volume.
The matrix is most likely an odorous wastewater although it is listed as LIQ. Can we confirm what the matrix should be.
-1: 2 of 3 voa vials have macrobubbles; -2: 1 of 3 voa vials has macrobubble.

## Sample Receipt Summary - Problem Resolution

**Job Number:** JC17412 **Initiator:** timh

**CSR:** MV **Response Date:** 4/1/2016

**Response:** These are already leached and submitted to us for VOC's and SVOC. To be logged in for the tests listed in the lower right section of the chain (in the comments field)



**JC17412: Chain of Custody**
**Page 3 of 3**

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*e-Hardcopy 2.0*
*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC17413

Sampling Date: 03/31/16

Report to:

CH2M Hill

Alexandra.SalterBlanc@ch2m.com

ATTN: Alexandra SalterBlanc

Total number of pages in report: **11**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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Test results relate only to samples analyzed.



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Sections: 1 2 3 4

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# Sample Summary

CH2M Hill

**Job No:** JC17413

OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC17413-1 | 03/31/16 | 14:30 | JAN | 04/01/16 | AQ | Water | CONTROL 1 - 59 DAY |
| JC17413-2 | 03/31/16 | 14:45 | JAN | 04/01/16 | AQ | Water | CONTROL 2 - 59 DAY |

# Summary of Hits

**Job Number:** JC17413
**Account:** CH2M Hill
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/31/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC17413-1** | **CONTROL 1 - 59 DAY** | | | | | |
| Acetone | | 2000 J | 5000 | 1700 | ug/l | SW846 8260C |
| Benzene | | 122000 | 2500 | 1200 | ug/l | SW846 8260C |
| Toluene | | 4340 | 500 | 81 | ug/l | SW846 8260C |
| **JC17413-2** | **CONTROL 2 - 59 DAY** | | | | | |
| Benzene | | 258000 | 5000 | 2400 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 529 J | 1000 | 190 | ug/l | SW846 8260C |
| Naphthalene | | 460 J | 5000 | 200 | ug/l | SW846 8260C |
| Toluene | | 15300 | 1000 | 160 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | CONTROL 1 - 59 DAY | | |
| **Lab Sample ID:** | JC17413-1 | **Date Sampled:** | 03/31/16 |
| **Matrix:** | AQ - Water | **Date Received:** | 04/01/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2C138063.D | 500 | 04/02/16 | TP | n/a | n/a | V2C6202 |
| Run #2 | 2C138064.D | 5000 | 04/02/16 | TP | n/a | n/a | V2C6202 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2000 | 5000 | 1700 | ug/l | J |
| 71-43-2 | Benzene | 122000 [a] | 2500 | 1200 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 500 | 93 | ug/l | |
| 91-20-3 | Naphthalene | ND | 2500 | 100 | ug/l | |
| 108-88-3 | Toluene | 4340 | 500 | 81 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 500 | 83 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 99% | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 93% | 93% | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | 100% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 94% | 78-117% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** CONTROL 2 - 59 DAY
**Lab Sample ID:** JC17413-2 **Date Sampled:** 03/31/16
**Matrix:** AQ - Water **Date Received:** 04/01/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 AmCy CAMU Liner, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2C138065.D | 1000 | 04/02/16 | TP | n/a | n/a | V2C6202 |
| Run #2 | 2C138066.D | 10000 | 04/02/16 | TP | n/a | n/a | V2C6202 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10000 | 3300 | ug/l | |
| 71-43-2 | Benzene | 258000 [a] | 5000 | 2400 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 529 | 1000 | 190 | ug/l | J |
| 91-20-3 | Naphthalene | 460 | 5000 | 200 | ug/l | J |
| 108-88-3 | Toluene | 15300 | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1000 | 170 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 93% | 93% | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | 102% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 92% | 96% | 78-117% |

(a) Result is from Run# 2

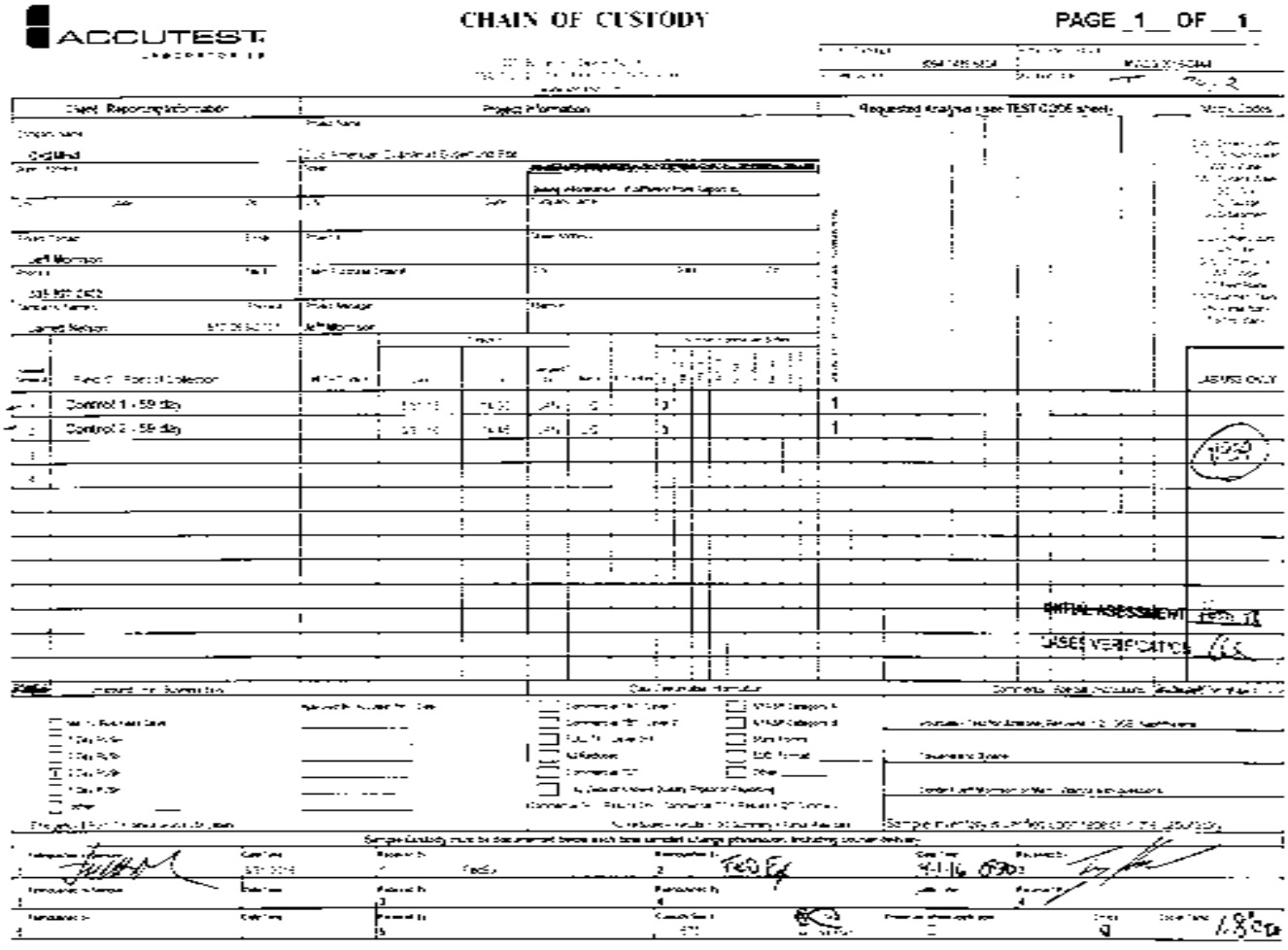
ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



ACCUTEST

CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information | Project Information | Requested Analyses (see TEST CODE sheet) | Matrix Codes

Control 1 - 59 day

Control 2 - 59 day

JASUS ONLY

INITIAL ASSESSMENT

JASUS VERIFICATION

Sample Custody must be documented below each time samples change possession, including courier delivery.

# SGS Accutest Sample Receipt Summary

**Job Number:** JC17413 **Client:** CH2MHill **Project:** OU8 American Cyanamid Superfund

**Date / Time Received:** 4/1/2016 9:30:00 AM **Delivery Method:** FedEx **Airbill #'s:** 8094 7489 6824

Cooler Temps (Raw Measured) °C: Cooler 1: (1.8);

Cooler Temps (Corrected) °C: Cooler 1: (2.2);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☐ | ☑ | |
| 4. VOCs headspace free: | ☐ | ☑ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☐ | ☑ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

Received HCL voa vials although TCLP Volatiles would require unpreserved volume.
The matrix is most likely an odorous wastewater although it is listed as LIQ. Can we confirm what the matrix should be.
-1: 1 of 3 voa vials has macrobubble; -2: 3 of 3 voa vials have macrobubbles.

## Sample Receipt Summary - Problem Resolution

**Job Number:** JC17413 **Initiator:** timh

**CSR:** MV **Response Date:** 4/1/2016

**Response:** These are already leached and submitted to us for VOC's (not TCLP VOC) To be logged in for the tests listed in the lower right section of the chain (in the comments field)

# Attachment 2
# Compatibility Study Results

Table A2-1. Leachate A and Leachate B Concentrations with Time

*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

| COC: | Acetone* | | Benzene* | | 1,2-DCB* | | Naphthalene | | Toluene* | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Leachate ID:** | **A** | **B** | **A** | **B** | **A** | **B** | **A** | **B** | **A** | **B** |
| ***Time (days)*** | ***Concentration (µg/L)*** | | | | | | | | | |
| Prespike | 926 | 142 J | 28,900 | 8,700 | 76 | 75.7 | 198 J | 193 | 2,680 | 1,170 |
| 0 | 2,200 | 552 | 367,000 | 54,500 | 2,120 | 819 | 1,940 | 1,800 | 43,100 | 11,600 |
| 10 | 3,042 C | 552 C | 507,000 C | 102,395 C | 2,120 C | 1,010 C | 2,003 C | 2,011 C | 50,363 C | 15,179 C |
| 30 | 1,650 † | 330 † | 130,000 | 27,700 | 95 † | 18 † | 100 † | 20 † | 4,990 | 1780 |
| 43 | 3,480 J | 1090 | 243,000 | 48,200 | 483 J | 788 | 382 J | 2,300 | 14,700 | 6,360 |
| 60 | 4,220 | 841 J | 166,000 | 25,100 | 55 J | 148 J | 54 J | 60 J | 8,690 | 2150 |
| 70 | 4,150 † | 1,140 J | 338,000 | 40,400 | 4,190 | 355 | 4,180 J | 1,010 J | 53,600 | 4,470 |
| 92 | 4,520 | 1,330 | 230,000 | 36,900 | 226 J | 103 | 189 J | 184 J | 13,400 | 3,330 |
| 100 | 3,810 | 1,110 | 282,000 | 43,200 | 853 | 155 | 769 J | 228 J | 21,800 | 3,900 |
| 120 | 2,630 J | 572 Q | 275,000 | 48,700 | 323 J | 180 | 100 † | 303 J | 18,900 | 4,930 |

| COC: | Xylene* | | Acetophenone | | Total VOCs | |
|---|---|---|---|---|---|---|
| **Leachate ID:** | **A** | **B** | **A** | **B** | **A** | **B** |
| ***Time (days)*** | ***Concentration (µg/L)*** | | | | | |
| Prespike | 199 | 117 | 5,250 | 6,600 | 32,781 | 10,205 |
| 0 | 2,420 | 1390 | 4,480 | 4,950 | 416,840 | 68,861 |
| 10 | 3,031 C | 2,032 C | 4,480 C | 8,161 C | 565,556 | 121,167 |
| 30 | 85 † | 70.2 J | 3,560 | 7150 | 136,820 | 29,898 |
| 43 | 456 J | 1,050 | NA | NA | 262,119 | 57,488 |
| 60 | 147 J | 134 | 4,790 | 6,910 | 179,112 | 28,373 |
| 70 | 3,960 | 408 | NA | NA | 403,900 | 46,773 |
| 92 | 295 | 187 | NA | NA | 248,441 | 41,850 |
| 100 | 797 | 238 | NA | NA | 309,260 | 48,603 |
| 120 | 85 † | 273 | 5,470 | 8,070 | 296,938 | 54,655 |

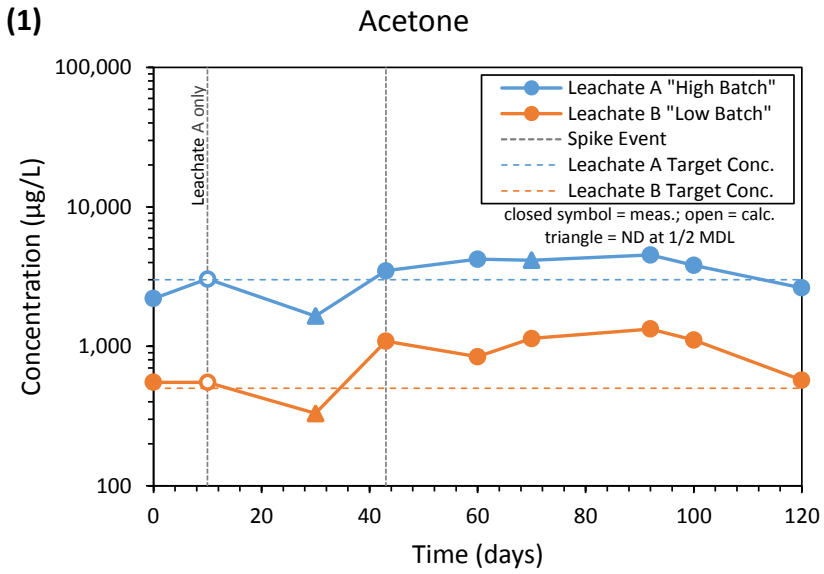
* = Included in total VOCs

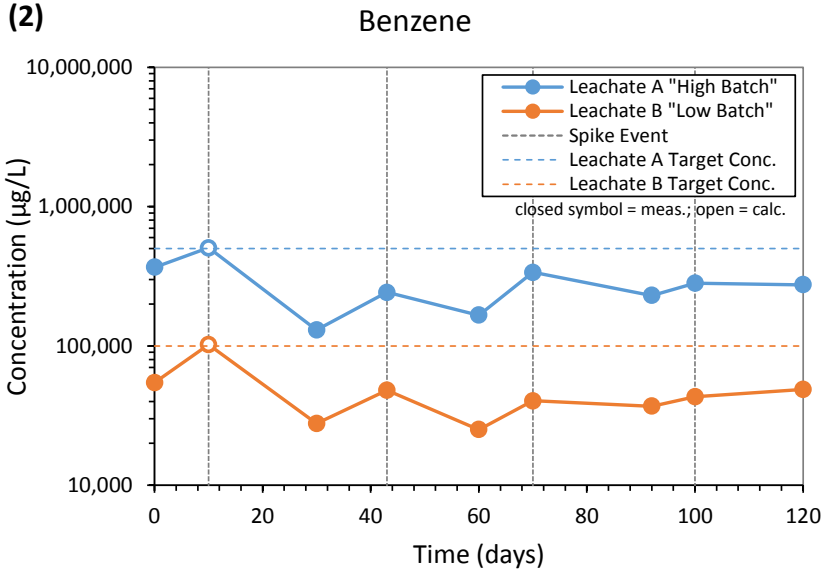
C = Calculated based on spike amount

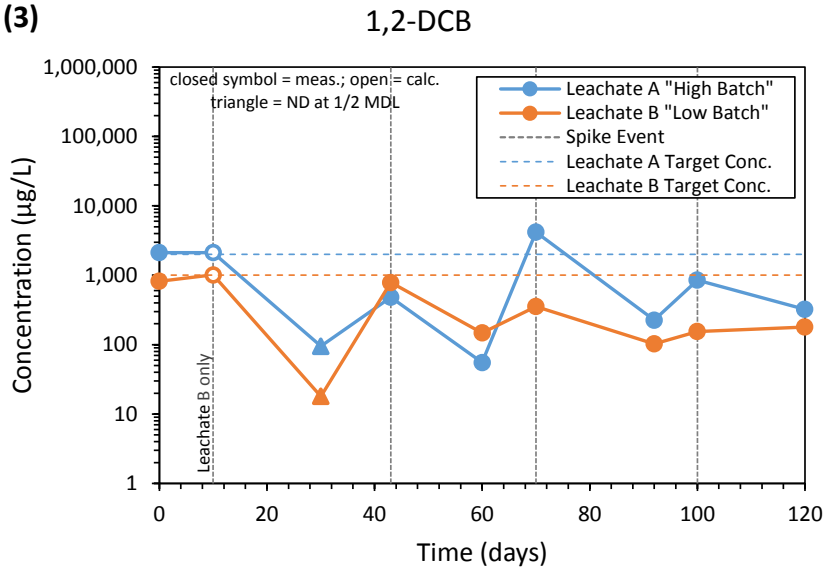
† = non-detect value reported at half the method detection limit

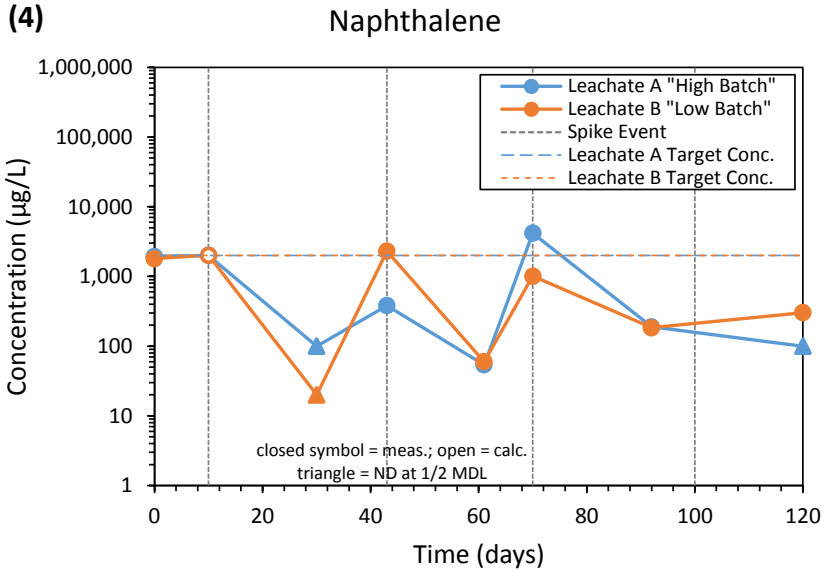
J = Estimated value below reporting limit

Q = Special qualifier: unofficial results far below detection limit



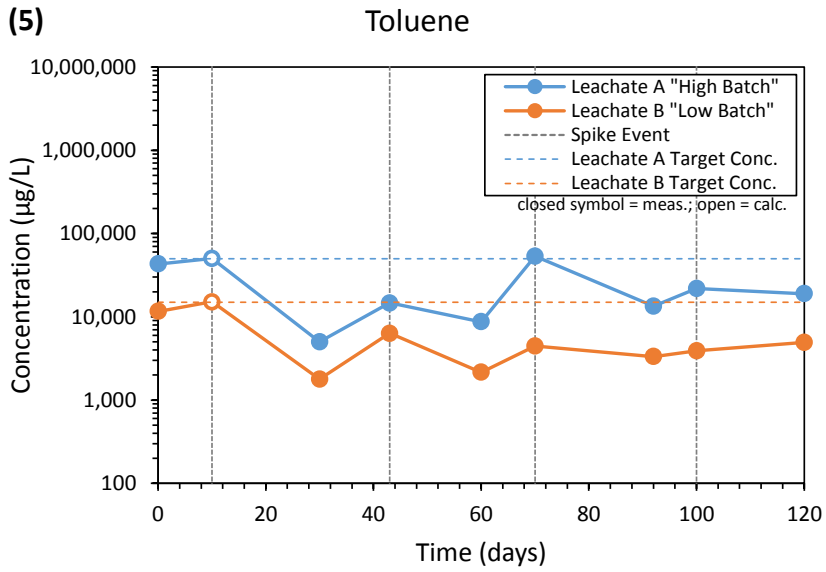



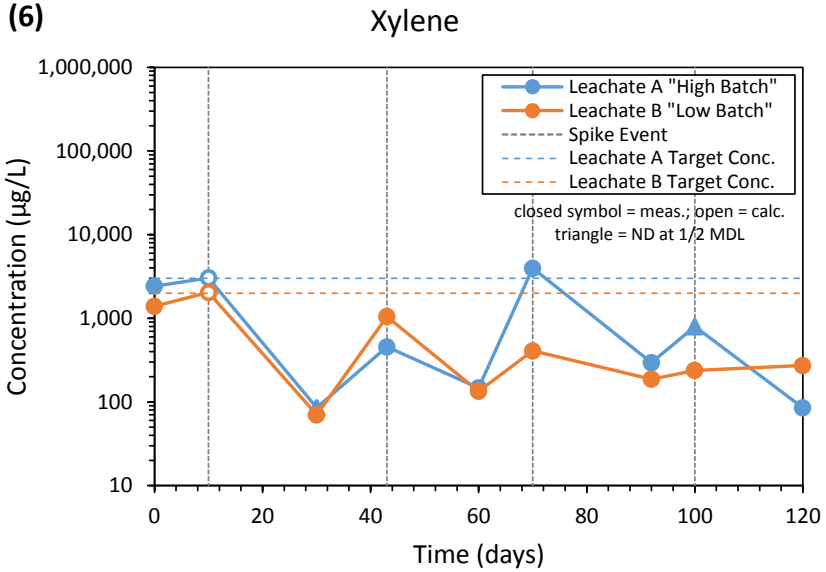



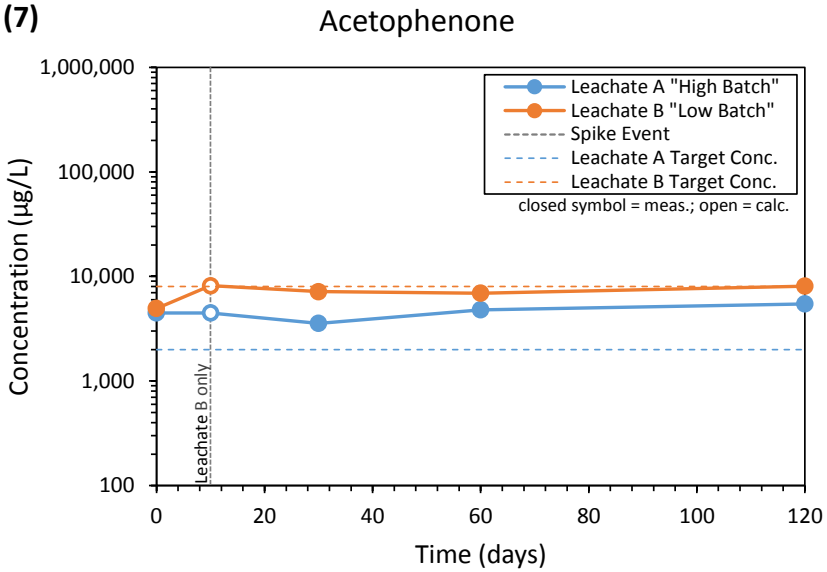



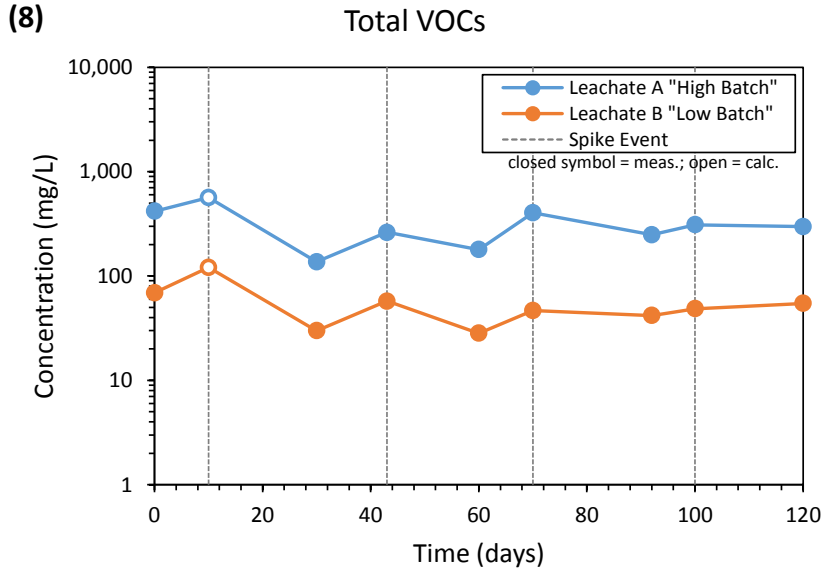

ND = not detected above reporting limit
MDL = method detection limit

**Figures A2-1,2,3,4.** Compatibility Study Concentration Time-series Plots
*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*




ND = not detected above reporting limit
MDL = method detection limit

**Figures A2-5,6,7,8.** Compatibility Study Concentration Time-series Plots
*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

# Attachment 3
# Control Study Results

Table A3-1. Control Study Concentrations with Time

*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

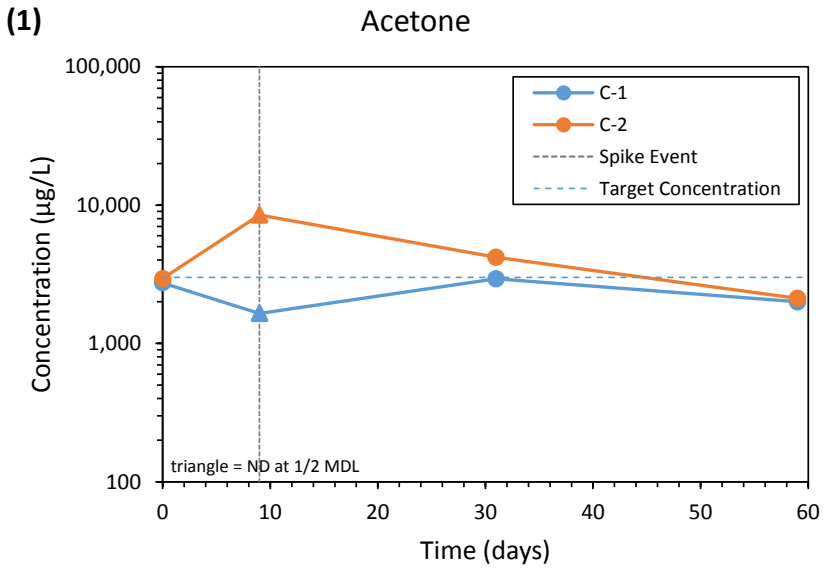
| COC: | Acetone* | | Benzene* | | 1,2-DCB* | | Naphthalene | | Toluene* | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Control ID:** | **C-1** | **C-2** | **C-1** | **C-2** | **C-1** | **C-2** | **C-1** | **C-2** | **C-1** | **C-2** |
| ***Time (days)*** | ***Concentration (µg/L)*** | | | | | | | | | |
| 0 | 2740 J | 2940 | 213000 | 181000 | 196 J | 179 J | 109 | 78.4 J | 12200 | 11200 |
| 9 | 1100 † | 8500 † | 150000 | 564000 | 508 J | 8470 | 669 J | 6330 J | 8550 | 90400 |
| 31 | 2930 | 4190 J | 137000 | 301000 | 99.2 J | 875 | 25.5 † | 712 J | 5020 | 20800 |
| 59 | 2000 J | 2120 Q | 122000 | 258000 | 46.5 † | 529 | 50 † | 460 | 4340 | 15300 |

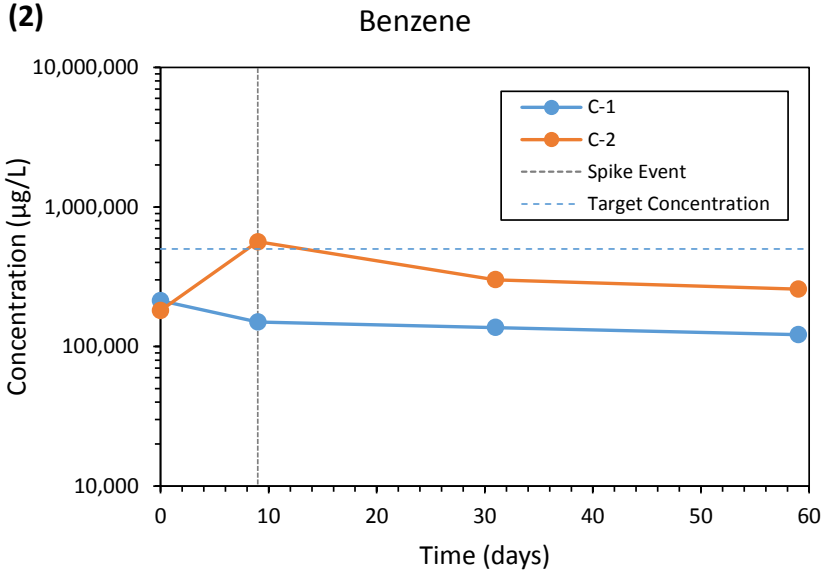
| COC: | Xylene* | | Total VOCs | |
|---|---|---|---|---|
| **Control ID:** | **C-1** | **C-2** | **C-1** | **C-2** |
| ***Time (days)*** | ***Concentration (µg/L)*** | | | |
| 0 | 215 J | 328 | 228351 | 195647 |
| 9 | 552 J | 4400 J | 161260 | 675770 |
| 31 | 20.5 † | 592 | 145070 | 327457 |
| 59 | 41.5 † | 85 † | 128428 | 276034 |

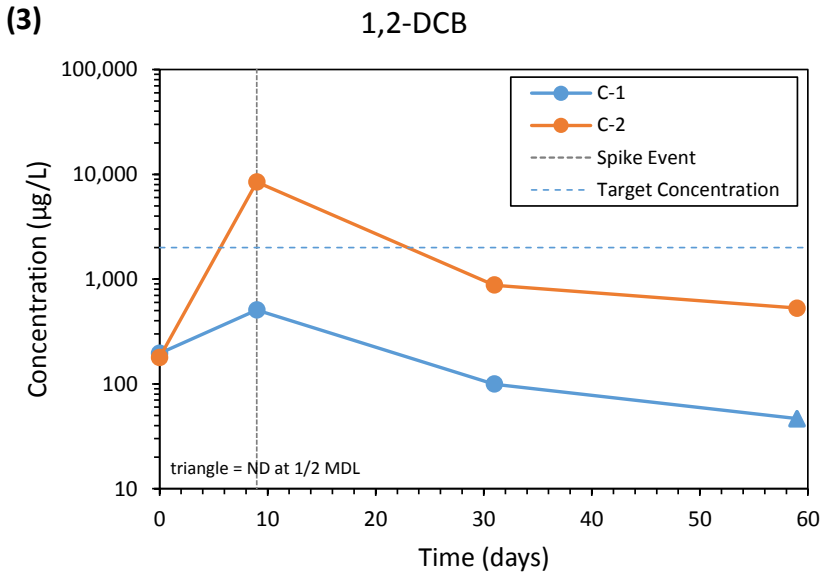
* = Included in total VOCs

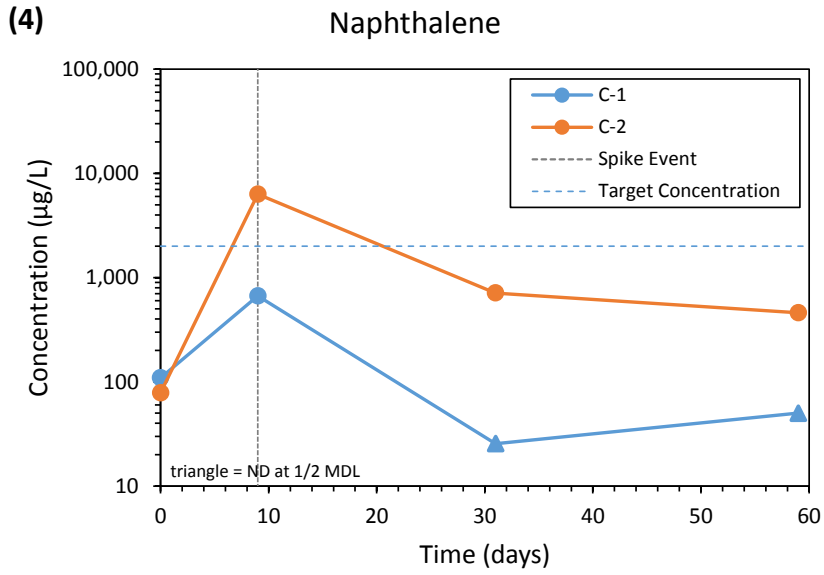
† = non-detect value reported at half the method detection limit

J = Estimated value below reporting limit



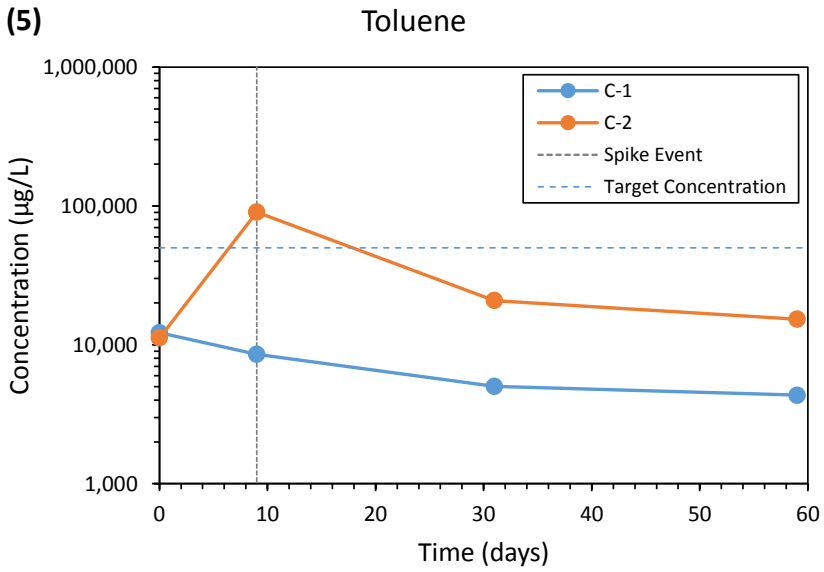



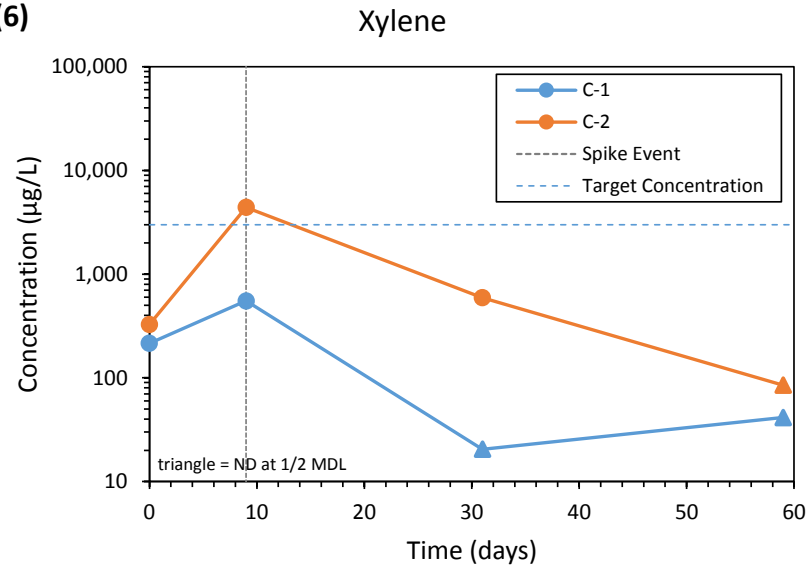



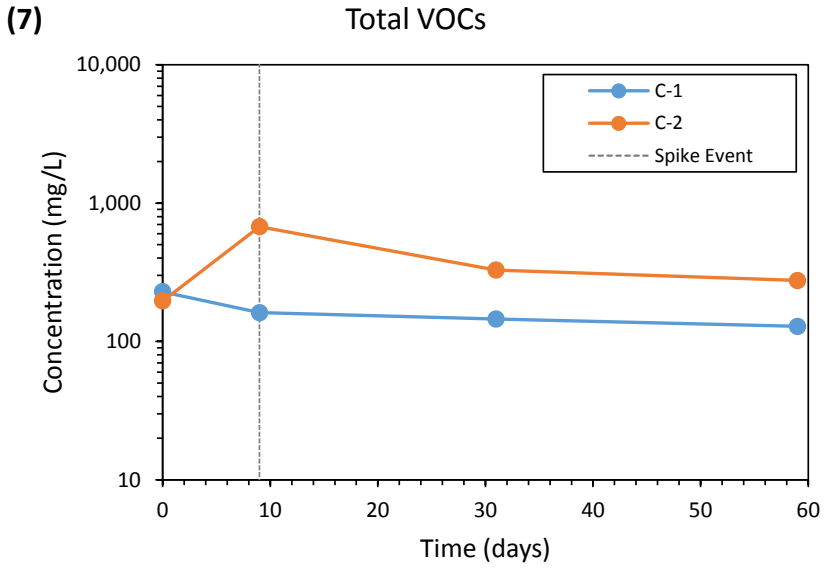




C-1 = Control 1 (with liner coupons)
C-2 = Control 2 (without liner coupons)
ND = not detected above reporting limit
MDL = method detection limit

**Figures A3-1,2,3,4.** Control Study Concentration Time-series Plots
*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*




C-1 = Control 1 (with liner coupons)
C-2 = Control 2 (without liner coupons)
ND = not detected above reporting limit
MDL = method detection limit

**Figures A3-5,6,7.** Control Study Concentration Time-series Plots
*Focused Feasibility Study Results Summary: Liner Compatibility Testing*
*American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

# Attachment 4
# Statistical (ANOVA) Evaluation

## ANOVA Methodology

Temporal differences for each of the measured properties were statistically evaluated with a methodology known as analysis of variance (ANOVA). In this procedure, the total variation in the measured properties is partitioned into different potential sources of variation. In this study, the potential sources are limited to the immersion time and the random scatter of the replicate specimens for any given immersion time. When the variation due to changes in immersion time is sufficiently large, relative to the variation in the replicates, those changes are considered to be significant.

The ANOVA approach used in this evaluation is two-staged. The first stage determines whether significant differences exist in the average values for the various immersion times. The null or default hypothesis was that the average for each test property at each immersion period (including the initial average) is the same. If this null hypothesis was rejected, then the conclusion was that at least one of the means is different from the others. A nonparametric ANOVA approach based on ranks of the data (known as the Kruskal-Wallis test) was used with the results reported in Table A5-1.

A probability value was calculated, indicating the probability that the observed differences would occur if the actual responses for each immersion time were equivalent. That is, the probability that the observed differences occurred merely due to random variability in the data. Thus, a low probability suggests that the null hypothesis (that each immersion time is centered the same) be rejected, while a high probability suggests that there is no significant difference between the average response across different immersion times.

When a significant difference was determined to exist between the measured response means of the immersion times, this initial testing was followed up with a *post hoc* test, using Tukey multiple comparison technique, to determine which immersion times were different from one another and which were the same. The results from this *post hoc* test are shown as alphabetic characters. For instance, if each category is listed as an "A," then none of the categories were significantly different from one another. If a statistically significant difference does exist, then at least one of the categories is listed as a "B," and other possibly as "C," "D", etc. (By convention, the highest response average are always associated with the "A" category, while the lower averages are provided subsequent alphabetic characters.) It is, of course, possible for the average concentration of a category to fall between two other statistically significant categories, where the intermediate category is not statistically different from either of the other two. In this case, one category would be listed as an 'A', one as a 'B', and the intermediate category as an "AB."

A review of this ANOVA output identified a number of statistical differences between events for the majority of properties. Identifying such differences, however, does not indicate that leachates are imposing deterioration unless a consistent worsening pattern appears. Alternate increases and decreases in a property's measured values represent variability that is due to some unexplained factors besides temporal values (30 days, 60 days, etc.). A review of the differences identified by ANOVA did not identify patterns of increase or decrease in material properties with exposure time for coupons exposed to either Leachate A or Leachate B.

**Table 1: ANOVA Results from Comparison Between Events**

| | | | | | Tukey *Post Hoc* Groupings | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Property | Description | Leachate | Calculated Probability * | Event Decision | Initial | 30 Days | 60 Days | 90 Days | 120 Days |
| Density | | A | 0.009 | Statistical Difference | AB | B | AB | A | B |
| Density | | B | 0.001 | Statistical Difference | A | AB | A | A | B |
| Elongation @ Break (%) | Machine Direction | A | 0.079 | | - | - | - | - | - |
| Elongation @ Break (%) | Machine Direction | B | 0.939 | | - | - | - | - | - |
| Elongation @ Break (%) | Transverse Direction | A | 0.286 | | - | - | - | - | - |
| Elongation @ Break (%) | Transverse Direction | B | 0.228 | | - | - | - | - | - |
| Elongation @ Yield (%) | Machine Direction | A | 0.003 | Statistical Difference | B | A | A | A | AB |
| Elongation @ Yield (%) | Machine Direction | B | 0.000 | Statistical Difference | B | A | A | A | A |
| Elongation @ Yield (%) | Transverse Direction | A | 0.028 | Statistical Difference | AB | AB | AB | B | A |
| Elongation @ Yield (%) | Transverse Direction | B | 0.000 | Statistical Difference | A | B | AB | B | B |
| Hydrostatic Resistance (psi) | | A | 0.000 | Statistical Difference | B | A | B | A | B |
| Hydrostatic Resistance (psi) | | B | 0.000 | Statistical Difference | C | A | AB | A | B |
| Indentation Hardness | | A | 0.002 | Statistical Difference | A | A | B | AB | A |
| Indentation Hardness | | B | 0.261 | | - | - | - | - | - |
| Load @ Rupture (lbs) | Puncture Resistance | A | 0.000 | Statistical Difference | AB | AB | BC | A | C |
| Load @ Rupture (lbs) | Puncture Resistance | B | 0.004 | Statistical Difference | AB | A | B | A | AB |
| Modulus of Elasticity | Machine Direction | A | 0.070 | | - | - | - | - | - |
| Modulus of Elasticity | Machine Direction | B | 0.001 | Statistical Difference | AB | A | B | AB | A |
| Modulus of Elasticity | Transverse Direction | A | 0.000 | Statistical Difference | BC | A | C | AB | C |
| Modulus of Elasticity | Transverse Direction | B | 0.001 | Statistical Difference | B | A | B | AB | AB |
| Set after Break (%) | Machine Direction | A | 0.028 | Statistical Difference | A | A | A | A | A |
| Set after Break (%) | Machine Direction | B | 0.005 | Statistical Difference | A | B | A | AB | AB |
| Set after Break (%) | Transverse Direction | A | 0.017 | Statistical Difference | B | B | B | A | B |
| Set after Break (%) | Transverse Direction | B | 0.711 | | - | - | - | - | - |
| Stress @ 100% Elongation (psi) | Machine Direction | A | 0.006 | Statistical Difference | B | B | B | A | B |
| Stress @ 100% Elongation (psi) | Machine Direction | B | 0.000 | Statistical Difference | C | A | BC | AB | AB |
| Stress @ 100% Elongation (psi) | Transverse Direction | A | 0.163 | | - | - | - | - | - |
| Stress @ 100% Elongation (psi) | Transverse Direction | B | 0.087 | | - | - | - | - | - |
| Stress @ 200% Elongation (psi) | Machine Direction | A | 0.007 | Statistical Difference | B | B | B | A | B |
| Stress @ 200% Elongation (psi) | Machine Direction | B | 0.000 | Statistical Difference | B | A | AB | A | A |
| Stress @ 200% Elongation (psi) | Transverse Direction | A | 0.299 | | - | - | - | - | - |
| Stress @ 200% Elongation (psi) | Transverse Direction | B | 0.280 | | - | - | - | - | - |
| Tear Resistance (lbs) | Machine Direction | A | 0.059 | | - | - | - | - | - |
| Tear Resistance (lbs) | Machine Direction | B | 0.000 | Statistical Difference | C | B | BC | A | B |
| Tear Resistance (lbs) | Transverse Direction | A | 0.000 | Statistical Difference | B | B | B | A | A |
| Tear Resistance (lbs) | Transverse Direction | B | 0.005 | Statistical Difference | B | A | AB | A | A |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Tensile Strength @ Break (psi) | Machine Direction | A | 0.398 | | - | - | - | - | - |
| Tensile Strength @ Break (psi) | Machine Direction | B | 0.000 | Statistical Difference | B | A | AB | A | A |
| Tensile Strength @ Break (psi) | Transverse Direction | A | 0.259 | | - | - | - | - | - |
| Tensile Strength @ Break (psi) | Transverse Direction | B | 0.386 | | - | - | - | - | - |
| Tensile Stress @ Yield (psi) | Machine Direction | A | 0.094 | | - | - | - | - | - |
| Tensile Stress @ Yield (psi) | Machine Direction | B | 0.042 | Statistical Difference | A | A | A | A | A |
| Tensile Stress @ Yield (psi) | Transverse Direction | A | 0.026 | Statistical Difference | A | A | A | A | A |
| Tensile Stress @ Yield (psi) | Transverse Direction | B | 0.002 | Statistical Difference | B | A | B | AB | A |
| % Extractables | Volatiles and Extractables ** | A | 0.003 | Statistical Difference | BC | C | ABC | AB | A |
| % Extractables | Volatiles and Extractables ** | B | 0.028 | Statistical Difference | B | AB | AB | AB | A |
| % Volatiles | Volatiles and Extractables ** | A | 0.000 | Statistical Difference | D | BC | AB | DC | A |
| % Volatiles | Volatiles and Extractables ** | B | 0.000 | Statistical Difference | D | AB | BC | DC | A |
| Machine Diameter  Change (%) | Volatiles and Extractables ** | A | 0.057 | | - | - | - | - | - |
| Machine Diameter  Change (%) | Volatiles and Extractables ** | B | 0.042 | Statistical Difference | A | A | A | A | A |
| Transverse Diameter Change (%) | Volatiles and Extractables ** | A | 0.347 | | - | - | - | - | - |
| Transverse Diameter Change (%) | Volatiles and Extractables ** | B | 0.589 | | - | - | - | - | - |

Notes:

* ANOVA probability that significant shifts between events do not exist (reject if probability < 0.05)

** The volatile and extractable evaluations included only two analyses per leachate, so statistical conclusions are not as well supported as the other properties.

# Attachment 5
# TRI Laboratory Reports

# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A**

Report Date: April 2016

Exposure Time and Temperature

| Test Parameters | Temp. | Baseline | 30 Day Exposed | % Change | Baseline | 60 Day Exposed | % Change | Baseline | 90 Day Exposed | % Change | Baseline | 120 Day Exposed | % Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | | | | | |
| Thickness (mils) | 23C | 61.2 | 61.0 | -0.2 | 60.7 | 60.4 | -0.5 | 60.7 | 60.9 | 0.3 | 61.8 | 60.7 | -1.7 |
| Length (inches) | 23C | 10.07 | 10.03 | -0.40 | 10.01 | 10.02 | 0.19 | 10.00 | 10.02 | 0.20 | 10.00 | 10.03 | 0.28 |
| Width (inches) | 23C | 8.02 | 8.03 | 0.15 | 8.02 | 8.04 | 0.16 | 8.02 | 8.03 | 0.16 | 8.02 | 8.04 | 0.21 |
| Mass (g) | 23C | 78.44 | 78.68 | 0.31 | 72.36 | 72.78 | 0.58 | 73.11 | 73.46 | 0.48 | 74.24 | 74.66 | 0.57 |



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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate B**

Report Date: April 2016

Exposure Time and Temperature

| Test Parameters | Temp. | Baseline | 30 Day Exposed | % Change | Baseline | 60 Day Exposed | % Change | Baseline | 90 Day Exposed | % Change | Baseline | 120 Day Exposed | % Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | | | | | |
| Thickness (mils) | 23C | 61.2 | 61.0 | -0.2 | 60.9 | 60.4 | -0.7 | 61.8 | 61.3 | -0.7 | 60.7 | 61.4 | 1.2 |
| Length (inches) | 23C | 10.00 | 10.01 | 0.04 | 10.01 | 10.01 | 0.08 | 10.00 | 10.01 | 0.07 | 10.00 | 10.02 | 0.19 |
| Width (inches) | 23C | 8.03 | 8.03 | 0.07 | 8.02 | 8.03 | 0.09 | 8.02 | 8.03 | 0.09 | 8.03 | 8.03 | 0.01 |
| Mass (g) | 23C | 79.60 | 79.70 | 0.13 | 74.80 | 74.90 | 0.13 | 80.44 | 80.54 | 0.12 | 79.52 | 79.77 | 0.31 |



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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Tensile Properties:** | | | | | | | | | |
| Tensile Stress @ Yield (psi) | 2546 | 2359 | 2476 | 2348 | 2388 | 2502 | 2455 | 2349 | 2446 |
| ASTM D638 | 2610 | 2463 | 2528 | 2323 | 2367 | 2473 | 2400 | 2368 | 2528 |
| Machine Direction | 2464 | 2375 | 2513 | 2120 | 2446 | 2504 | 2483 | 2423 | 2511 |
| | 2388 | 2418 | 2501 | 2432 | 2457 | 2332 | 2442 | 2517 | 2585 |
| | 2476 | 2465 | 2475 | 2434 | 2479 | 2457 | 2425 | 2587 | 2515 |
| | 2438 | | | | | | | | |
| Average | 2487 | 2416 | 2499 | 2331 | 2427 | 2454 | 2441 | 2449 | 2517 |
| STD | 79 | 49 | 23 | 128 | 48 | 71 | 31 | 101 | 50 |
| Coefficient of Variation | 3 | 2 | 1 | 5 | 2 | 3 | 1 | 4 | 2 |
| % Change | | -3 | 0 | -6 | -2 | -1 | -2 | -2 | 1 |
| Tensile Strength @ Break (psi) | 3238 | 3510 | 3903 | 2906 | 3269 | 3710 | 3695 | 3209 | 3906 |
| ASTM D638 | 3207 | 3174 | 3734 | 2712 | 3457 | 3675 | 3848 | 2730 | 3821 |
| Machine Direction | 2817 | 2863 | 3398 | 3108 | 3639 | 3687 | 3837 | 2960 | 3551 |
| | 2777 | 2949 | 3959 | 3695 | 3510 | 2026 | 3821 | 3174 | 3365 |
| | 2975 | 3525 | 3893 | 3665 | 3684 | 3665 | 3779 | 2970 | 3418 |
| | 2892 | | | | | | | | |
| Average | 2984 | 3204 | 3777 | 3217 | 3512 | 3353 | 3796 | 3009 | 3612 |
| STD | 197 | 308 | 228 | 445 | 164 | 742 | 62 | 193 | 241 |
| Coefficient of Variation | 7 | 10 | 6 | 14 | 5 | 22 | 2 | 6 | 7 |
| % Change | | 7 | 27 | 8 | 18 | 12 | 27 | 1 | 21 |
| Elongation @ Yield (%) | 17.1 | 17.9 | 20.8 | 16.5 | 19.3 | 20.1 | 20.6 | 17.4 | 19.8 |
| ASTM D638 | 16.4 | 18.9 | 19.5 | 17.2 | 18.1 | 20.6 | 20.2 | 17.1 | 20.1 |
| Machine Direction | 16.1 | 17.7 | 17.9 | 19.6 | 18.8 | 20.8 | 20.5 | 18.3 | 18.8 |
| | 15.4 | 17.1 | 20.3 | 20.9 | 20.0 | 16.3 | 20.9 | 17.6 | 17.6 |
| | 16.8 | 18.6 | 21.1 | 19.6 | 19.0 | 19.6 | 19.2 | 17.1 | 18.7 |
| | 15.3 | | | | | | | | |
| Average | 16.2 | 18.0 | 19.9 | 18.8 | 19.0 | 19.5 | 20.3 | 17.5 | 19.0 |
| STD | 0.7 | 0.7 | 1.3 | 1.8 | 0.7 | 1.8 | 0.7 | 0.5 | 1.0 |
| Coefficient of Variation | 4.5 | 4.0 | 6.4 | 9.8 | 3.7 | 9.4 | 3.2 | 2.8 | 5.2 |
| % Change | | 11.5 | 23.1 | 15.9 | 17.7 | 20.4 | 25.3 | 8.1 | 17.4 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Tensile Properties:** | | | | | | | | | |
| Elongation @ Break (%) | 506 | 476 | 463 | 510 | 423 | 465 | 464 | 514 | 484 |
| ASTM D638 | 489 | 464 | 464 | 478 | 481 | 450 | 470 | 455 | 470 |
| Machine Direction | 459 | 464 | 438 | 458 | 511 | 453 | 454 | 480 | 463 |
| | 445 | 480 | 471 | 453 | 464 | 336 | 468 | 503 | 414 |
| | 453 | 479 | 460 | 471 | 463 | 454 | 450 | 486 | 459 |
| | 490 | | | | | | | | |
| Average | 474 | 473 | 459 | 474 | 468 | 432 | 461 | 488 | 458 |
| STD | 25 | 8 | 13 | 23 | 32 | 54 | 9 | 23 | 26 |
| Coefficient of Variation | 5 | 2 | 3 | 5 | 7 | 12 | 2 | 5 | 6 |
| % Change | | 0 | -3 | 0 | -1 | -9 | -3 | 3 | -3 |
| Set after Break (%) | 520 | 450 | 450 | 500 | 550 | 450 | 470 | 500 | 450 |
| ASTM D638 | 500 | 430 | 450 | 500 | 500 | 450 | 540 | 450 | 430 |
| Machine Direction | 460 | 460 | 430 | 480 | 500 | 450 | 450 | 400 | 460 |
| | 460 | 450 | 450 | 400 | 480 | 430 | 550 | 500 | 420 |
| | 480 | 450 | 450 | 500 | 450 | 410 | 450 | 480 | 460 |
| | 490 | | | | | | | | |
| Average | 485 | 448 | 446 | 476 | 496 | 438 | 492 | 466 | 444 |
| STD | 23 | 11 | 9 | 43 | 36 | 18 | 49 | 42 | 18 |
| Coefficient of Variation | 5 | 2 | 2 | 9 | 7 | 4 | 10 | 9 | 4 |
| % Change | | -8 | -8 | -2 | 2 | -10 | 1 | -4 | -8 |
| Stress @ 100% Elongation (psi) | 2064 | 2185 | 2391 | 1933 | 2162 | 2298 | 2292 | 1995 | 2351 |
| ASTM D638 | 2159 | 2084 | 2310 | 1956 | 2141 | 2295 | 2258 | 1978 | 2348 |
| Machine Direction | 2061 | 1973 | 2243 | 1970 | 2137 | 2359 | 2354 | 2043 | 2227 |
| | 1933 | 2017 | 2377 | 2271 | 2181 | 2895 | 2354 | 2120 | 2334 |
| | 2092 | 2178 | 2313 | 2268 | 2325 | 2293 | 2268 | 2098 | 2162 |
| | 2017 | | | | | | | | |
| Average | 2054 | 2087 | 2327 | 2080 | 2189 | 2428 | 2305 | 2047 | 2284 |
| STD | 76 | 95 | 59 | 174 | 78 | 263 | 46 | 62 | 85 |
| Coefficient of Variation | 4 | 5 | 3 | 8 | 4 | 11 | 2 | 3 | 4 |
| % Change | | 2 | 13 | 1 | 7 | 18 | 12 | 0 | 11 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Tensile Properties:** | | | | | | | | | |
| Stress @ 200% Elongation (psi) | 2033 | 2197 | 2420 | 2005 | 2253 | 2315 | 2302 | 2057 | 2404 |
| ASTM D638 | 2208 | 2117 | 2341 | 2024 | 2281 | 2329 | 2277 | 2006 | 2385 |
| Machine Direction | 2134 | 2063 | 2332 | 2004 | 2180 | 2385 | 2413 | 2129 | 2349 |
| | 2084 | 2079 | 2458 | 2316 | 2212 | 2948 | 2389 | 2126 | 2382 |
| | 2126 | 2275 | 2328 | 2305 | 2378 | 2358 | 2315 | 2114 | 2243 |
| | 2030 | | | | | | | | |
| Average | 2103 | 2146 | 2376 | 2131 | 2261 | 2467 | 2339 | 2086 | 2353 |
| STD | 68 | 89 | 59 | 164 | 76 | 270 | 59 | 54 | 64 |
| Coefficient of Variation | 3 | 4 | 3 | 8 | 3 | 11 | 3 | 3 | 3 |
| % Change | | 2 | 13 | 1 | 8 | 17 | 11 | -1 | 12 |
| Tensile Stress @ Yield (psi) | 2530 | 2682 | 2635 | 2555 | 2723 | 2563 | 2727 | 2594 | 2707 |
| ASTM D638 | 2638 | 2656 | 2631 | 2590 | 2376 | 2631 | 2713 | 2555 | 2821 |
| Transverse Direction | 2576 | 2569 | 2857 | 2547 | 2612 | 2564 | 2685 | 2506 | 2799 |
| | 2648 | 2568 | 2821 | 2417 | 2422 | 2580 | 2725 | 2513 | 2750 |
| | 2623 | 2592 | 2759 | 2462 | 2577 | 2617 | 2557 | 2471 | 2730 |
| | 2552 | | | | | | | | |
| Average | 2595 | 2613 | 2741 | 2514 | 2542 | 2591 | 2681 | 2528 | 2761 |
| STD | 49 | 52 | 104 | 72 | 142 | 31 | 72 | 48 | 48 |
| Coefficient of Variation | 2 | 2 | 4 | 3 | 6 | 1 | 3 | 2 | 2 |
| % Change | | 1 | 6 | -3 | -2 | 0 | 3 | -3 | 6 |
| Tensile Strength @ Break (psi) | 2738 | 3130 | 2841 | 3197 | 3339 | 3296 | 3111 | 3016 | 3164 |
| ASTM D638 | 3382 | 3055 | 3277 | 3081 | 2936 | 2804 | 3262 | 1999 | 3518 |
| Transverse Direction | 2796 | 2786 | 3017 | 2898 | 3180 | 2979 | 3156 | 2901 | 3538 |
| | 2673 | 3242 | 2717 | 2480 | 3408 | 3001 | 1869 | 2977 | 1915 |
| | 2756 | 3499 | 3238 | 2920 | 3099 | 3110 | 3182 | 3067 | 3143 |
| | 2823 | | | | | | | | |
| Average | 2861 | 3142 | 3018 | 2915 | 3192 | 3038 | 2916 | 2792 | 3056 |
| STD | 260 | 261 | 244 | 272 | 189 | 181 | 588 | 447 | 665 |
| Coefficient of Variation | 9 | 8 | 8 | 9 | 6 | 6 | 20 | 16 | 22 |
| % Change | | 10 | 5 | 2 | 12 | 6 | 2 | -2 | 7 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Tensile Properties:** | | | | | | | | | |
| Elongation @ Yield (%) | 13.9 | 14.4 | 12.9 | 12.8 | 13.6 | 13.4 | 12.2 | 14.1 | 13.1 |
| ASTM D638 | 14.1 | 13.9 | 12.4 | 13.4 | 13.2 | 12.5 | 12.0 | 14.7 | 12.2 |
| Transverse Direction | 13.4 | 14.2 | 12.1 | 13.0 | 12.2 | 13.2 | 12.7 | 14.6 | 12.0 |
| | 13.5 | 13.1 | 12.9 | 15.2 | 13.7 | 14.0 | 12.6 | 14.3 | 12.5 |
| | 15.0 | 13.9 | 12.9 | 14.0 | 14.2 | 13.5 | 12.7 | 15.8 | 12.4 |
| | 14.1 | | | | | | | | |
| Average | 14.0 | 13.9 | 12.6 | 13.7 | 13.4 | 13.3 | 12.4 | 14.7 | 12.4 |
| STD | 1 | 0.5 | 0.4 | 1.0 | 0.7 | 0.5 | 0.3 | 0.7 | 0.4 |
| Coefficient of Variation | 4 | 3.6 | 2.9 | 7.1 | 5.6 | 4.1 | 2.6 | 4.5 | 3.3 |
| % Change | | -0.7 | -9.7 | -2.3 | -4.4 | -4.9 | -11.1 | 5.0 | -11.1 |
| Elongation @ Break (%) | 533 | 580 | 546 | 595 | 610 | 618 | 609 | 565 | 595 |
| ASTM D638 | 610 | 589 | 603 | 610 | 578 | 549 | 613 | 353 | 625 |
| Transverse Direction | 516 | 509 | 573 | 566 | 626 | 563 | 585 | 568 | 639 |
| | 501 | 611 | 481 | 456 | 650 | 578 | 351 | 563 | 238 |
| | 498 | 641 | 615 | 595 | 586 | 580 | 595 | 585 | 566 |
| | 564 | | | | | | | | |
| Average | 537 | 586 | 564 | 565 | 610 | 577 | 551 | 527 | 533 |
| STD | 43 | 49 | 53 | 63 | 30 | 26 | 112 | 98 | 167 |
| Coefficient of Variation | 8 | 8 | 9 | 11 | 5 | 4 | 20 | 19 | 31 |
| % Change | | 9 | 5 | 5 | 14 | 8 | 3 | -2 | -1 |
| Set after Break (%) | 550 | 550 | 550 | 600 | 600 | 650 | 600 | 580 | 620 |
| ASTM D638 | 620 | 580 | 600 | 600 | 600 | 600 | 620 | 450 | 610 |
| Transverse Direction | 560 | 530 | 600 | 580 | 650 | 625 | 600 | 590 | 630 |
| | 570 | 600 | 470 | 500 | 600 | 675 | 425 | 580 | 390 |
| | 510 | 580 | 600 | 550 | 550 | 620 | 600 | 550 | 590 |
| | 600 | | | | | | | | |
| Average | 568 | 568 | 564 | 566 | 600 | 634 | 569 | 550 | 568 |
| STD | 39 | 28 | 57 | 42 | 35 | 29 | 81 | 58 | 101 |
| Coefficient of Variation | 7 | 5 | 10 | 7 | 6 | 5 | 14 | 11 | 18 |
| % Change | | 0 | -1 | 0 | 6 | 12 | 0 | -3 | 0 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Tensile Properties:** | | | | | | | | | |
| Stress @ 100% Elongation (psi) | 1839 | 1899 | 1871 | 1949 | 2018 | 1832 | 1910 | 1828 | 2065 |
| ASTM D638 | 1902 | 1791 | 1807 | 1845 | 1745 | 1800 | 1949 | 1837 | 1986 |
| Transverse Direction | 1908 | 1814 | 1928 | 1882 | 1895 | 1881 | 1893 | 1814 | 1976 |
| | 1869 | 1838 | 1998 | 1809 | 1707 | 1830 | 1854 | 1817 | 1925 |
| | 1939 | 1914 | 1915 | 1799 | 1817 | 1863 | 1795 | 1818 | 1928 |
| | 1861 | | | | | | | | |
| Average | 1886 | 1851 | 1904 | 1857 | 1836 | 1841 | 1880 | 1823 | 1976 |
| STD | 37 | 53 | 71 | 61 | 124 | 31 | 59 | 10 | 57 |
| Coefficient of Variation | 2 | 3 | 4 | 3 | 7 | 2 | 3 | 1 | 3 |
| % Change | | -2 | 1 | -2 | -3 | -2 | 0 | -3 | 5 |
| Stress @ 200% Elongation (psi) | 1933 | 1981 | 1806 | 1913 | 2006 | 1950 | 1955 | 1928 | 2041 |
| ASTM D638 | 1917 | 1905 | 1870 | 1944 | 1853 | 1917 | 1842 | 1889 | 2033 |
| Transverse Direction | 1946 | 1800 | 1946 | 1898 | 1933 | 1988 | 1963 | 1892 | 2120 |
| | 1903 | 1922 | 2020 | 1824 | 1864 | 1905 | 1899 | 1854 | 1898 |
| | 1935 | 1964 | 1845 | 1807 | 1892 | 1901 | 1844 | 1871 | 1937 |
| | 1810 | | | | | | | | |
| Average | 1907 | 1914 | 1897 | 1877 | 1910 | 1932 | 1901 | 1887 | 2006 |
| STD | 50 | 71 | 86 | 59 | 62 | 37 | 58 | 28 | 89 |
| Coefficient of Variation | 3 | 4 | 5 | 3 | 3 | 2 | 3 | 1 | 4 |
| % Change | | 0 | -1 | -2 | 0 | 1 | 0 | -1 | 5 |
| **Modulus of Elasticity:** | | | | | | | | | |
| ASTM D882 (psi) | 51239 | 45770 | 54321 | 45839 | 51137 | 52733 | 56044 | 51183 | 58246 |
| Machine Direction | 51677 | 50934 | 55359 | 45530 | 49367 | 56137 | 50948 | 54720 | 54719 |
| 2% Secant | 53349 | 48791 | 53561 | 46809 | 50608 | 52168 | 53706 | 42585 | 52598 |
| | 49760 | 55021 | 57566 | 48360 | 51084 | 50663 | 51645 | 51543 | 53681 |
| | 55196 | 56142 | 57874 | 49454 | 49735 | 48952 | 51142 | 51847 | 53495 |
| | 52610 | | | | | | | | |
| Average | 52305 | 51332 | 55736 | 47198 | 50386 | 52131 | 52697 | 50376 | 54548 |
| STD | 1873 | 4310 | 1923 | 1675 | 800 | 2677 | 2168 | 4576 | 2200 |
| Coefficient of Variation | 4 | 8 | 3 | 4 | 2 | 5 | 4 | 9 | 4 |
| % Change | | -2 | 7 | -10 | -4 | 0 | 1 | -4 | 4 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Modulus of Elasticity:** | | | | | | | | | |
| ASTM D882 (psi) | 55753 | 63000 | 63096 | 50581 | 54145 | 62712 | 63885 | 53571 | 62994 |
| Transverse Direction | 58153 | 61666 | 66542 | 57982 | 57360 | 65564 | 64517 | 57609 | 68108 |
| 2% Secant | 59375 | 61457 | 64193 | 52203 | 57849 | 60114 | 58601 | 55008 | 64539 |
| | 59522 | 67124 | 69097 | 52588 | 55795 | 56368 | 61259 | 58614 | 64672 |
| | 54224 | 64335 | 72651 | 58037 | 60334 | 60811 | 63676 | 53567 | 50443 |
| | 57070 | | | | | | | | |
| Average | 57350 | 63516 | 67116 | 54278 | 57097 | 61114 | 62388 | 55674 | 62151 |
| STD | 2091 | 2325 | 3860 | 3489 | 2320 | 3390 | 2452 | 2329 | 6807 |
| Coefficient of Variation | 4 | 4 | 6 | 6 | 4 | 6 | 4 | 4 | 11 |
| % Change | | 11 | 17 | -5 | 0 | 7 | 9 | -3 | 8 |
| **Indentation Hardness:** | | | | | | | | | |
| Reading | 43 | 44 | 43 | 42 | 43 | 44 | 43 | 46 | 44 |
| ASTM D2240 | 45 | 45 | 43 | 41 | 46 | 43 | 44 | 44 | 42 |
| (with TYPE D DUROMETER) | 44 | 46 | 46 | 43 | 42 | 44 | 44 | 45 | 45 |
| | 47 | 46 | 43 | 44 | 43 | 44 | 43 | 44 | 46 |
| | 48 | 47 | 46 | 42 | 44 | 44 | 44 | 45 | 47 |
| | 48 | | | | | | | | |
| Average | 46 | 46 | 44 | 42 | 44 | 44 | 44 | 45 | 45 |
| STD | 2 | 1 | 2 | 1 | 2 | 0 | 1 | 1 | 2 |
| Coefficient of Variation | 5 | 3 | 4 | 3 | 3 | 1 | 1 | 2 | 4 |
| % Change | | -1 | -4 | -7 | -5 | -4 | -5 | -2 | -2 |
| **Density:** | | | | | | | | | |
| ASTM D1505 | 0.944 | 0.944 | 0.943 | 0.944 | 0.944 | 0.944 | 0.944 | 0.943 | 0.944 |
| | 0.944 | 0.943 | 0.943 | 0.944 | 0.944 | 0.944 | 0.944 | 0.943 | 0.943 |
| | 0.944 | 0.943 | 0.944 | 0.944 | 0.944 | 0.945 | 0.944 | 0.943 | 0.943 |
| | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.945 | 0.944 | 0.944 | 0.943 |
| | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.943 |
| | 0.944 | | | | | | | | |
| Average | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 | 0.943 | 0.943 |
| STD | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 |
| Coefficient of Variation | 0.000 | 0.058 | 0.058 | 0.000 | 0.000 | 0.058 | 0.000 | 0.058 | 0.047 |
| % Change | | -0.042 | -0.042 | 0.000 | 0.000 | 0.042 | 0.000 | -0.064 | -0.085 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Puncture Resistance:** | | | | | | | | | |
| Load @ Rupture (lbs) | 130 | 131 | 136 | 131 | 129 | 140 | 136 | 120 | 131 |
| ASTM D4833 | 135 | 132 | 130 | 128 | 127 | 138 | 138 | 118 | 131 |
| | 139 | 128 | 128 | 128 | 127 | 139 | 137 | 120 | 130 |
| | 131 | 139 | 138 | 127 | 129 | 136 | 139 | 120 | 135 |
| | 132 | 134 | 140 | 127 | 129 | 134 | 136 | 122 | 135 |
| | 125 | | | | | | | | |
| Average | 132 | 133 | 134 | 128 | 128 | 137 | 137 | 120 | 132 |
| STD | 5 | 4 | 5 | 2 | 1 | 2 | 1 | 1 | 2 |
| Coefficient of Variation | 4 | 3 | 4 | 1 | 1 | 2 | 1 | 1 | 2 |
| % Change | | 1 | 2 | -3 | -3 | 4 | 4 | -9 | 0 |
| **Tear Resistance:** | | | | | | | | | |
| ASTM D1004 | 53 | 54 | 59 | 52 | 57 | 60 | 63 | 52 | 59 |
| (lbs) | 51 | 56 | 56 | 51 | 57 | 58 | 62 | 55 | 56 |
| Machine Direction | 53 | 52 | 58 | 46 | 58 | 60 | 62 | 51 | 58 |
| | 52 | 51 | 59 | 45 | 54 | 49 | 65 | 53 | 58 |
| | 50 | 57 | 58 | 53 | 52 | 59 | 63 | 53 | 57 |
| | 53 | | | | | | | | |
| Average | 52 | 54 | 58 | 49 | 56 | 57 | 63 | 53 | 58 |
| STD | 1 | 3 | 1 | 4 | 3 | 5 | 1 | 1 | 1 |
| Coefficient of Variation | 2 | 5 | 2 | 7 | 5 | 8 | 2 | 3 | 2 |
| % Change | | 4 | 12 | -5 | 7 | 10 | 21 | 2 | 11 |
| **Tear Resistance:** | | | | | | | | | |
| ASTM D1004 | 49 | 51 | 53 | 49 | 51 | 51 | 58 | 52 | 51 |
| (lbs) | 49 | 51 | 53 | 47 | 53 | 58 | 52 | 56 | 57 |
| Transverse Direction | 52 | 49 | 52 | 49 | 50 | 52 | 53 | 55 | 57 |
| | 47 | 51 | 54 | 49 | 47 | 56 | 52 | 57 | 54 |
| | 48 | 51 | 52 | 46 | 50 | 54 | 52 | 54 | 49 |
| | 48 | | | | | | | | |
| Average | 49 | 51 | 53 | 48 | 50 | 54 | 53 | 55 | 54 |
| STD | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 4 |
| Coefficient of Variation | 4 | 2 | 2 | 3 | 4 | 5 | 5 | 4 | 7 |
| % Change | | 4 | 8 | -2 | 3 | 11 | 9 | 12 | 10 |


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# GEOMEMBRANE TEST RESULTS

## TABLE OF CHEMICAL COMPATIBILITY TEST RESULTS

**TRI Client: CH2MHill**

**Chemical: Leachate A and B**

Report Date: April 2016

| Test Parameters | Baseline Leachate | Exposure Time and Temperature 23C: 30 Day A | 30 Day B | 60 Day A | 60 Day B | 90 Day A | 90 Day B | 120 Day A | 120 Day B |
|---|---|---|---|---|---|---|---|---|---|
| **60 mil textured HDPE geomembrane: Roll # G15F334051** | | | | | | | | | |
| **Hydrostatic Resistance:** | | | | | | | | | |
| ASTM D751 | 435 | 440 | 480 | 430 | 465 | 465 | 485 | 430 | 480 |
| (psi) | 445 | 455 | 475 | 430 | 460 | 465 | 470 | 430 | 450 |
| | 430 | 450 | 470 | 425 | 465 | 470 | 470 | 440 | 450 |
| | 430 | 455 | 480 | 435 | 465 | 465 | 470 | 430 | 440 |
| | 425 | 460 | 465 | 435 | 470 | 460 | 475 | 450 | 460 |
| | 410 | | | | | | | | |
| Average | 429 | 452 | 474 | 431 | 465 | 465 | 474 | 436 | 456 |
| STD | 12 | 8 | 7 | 4 | 4 | 4 | 7 | 9 | 15 |
| Coefficient of Variation | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |
| % Change | | 5 | 10 | 0 | 8 | 8 | 10 | 2 | 6 |
| **Volatiles and Extractables:** | | | | | | | | | |
| Machine Diameter Change (%) | -0.80 | -1.63 | -1.75 | -0.88 | -1.88 | -1.00 | -2.43 | -1.13 | -1.00 |
| SW 870 - Appendix III-D | -0.65 | -0.75 | -1.95 | -0.97 | -0.58 | -1.42 | -2.06 | -1.79 | -1.79 |
| | -0.20 | | | | | | | | |
| | -0.75 | | | | | | | | |
| Average | -0.60 | -1.19 | -1.85 | -0.93 | -1.23 | -1.21 | -2.25 | -1.46 | -1.40 |
| STD | 0.27 | 0.62 | 0.14 | 0.06 | 0.92 | 0.30 | 0.26 | 0.47 | 0.56 |
| Transverse Diameter Change (%) | -0.32 | -0.07 | -0.22 | -0.13 | -0.20 | -0.87 | 0.10 | -0.38 | -0.30 |
| SW 870 - Appendix III-D | -0.27 | -0.53 | -0.13 | -0.47 | -0.85 | -0.80 | -0.25 | -0.30 | -0.08 |
| | -0.55 | | | | | | | | |
| | -0.20 | | | | | | | | |
| Average | -0.34 | -0.30 | -0.18 | -0.30 | -0.53 | -0.84 | -0.08 | -0.34 | -0.19 |
| STD | 0.15 | 0.33 | 0.06 | 0.24 | 0.46 | 0.05 | 0.25 | 0.06 | 0.16 |
| % Volatiles | 0.06 | 0.36 | 0.15 | 0.38 | 0.11 | 0.23 | 0.10 | 0.43 | 0.20 |
| SW 870 - Appendix III-D | 0.05 | 0.36 | 0.13 | 0.39 | 0.13 | 0.25 | 0.10 | 0.45 | 0.23 |
| | 0.08 | | | | | | | | |
| | 0.06 | | | | | | | | |
| Average | 0.06 | 0.36 | 0.14 | 0.39 | 0.12 | 0.24 | 0.10 | 0.44 | 0.22 |
| STD | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.02 |
| % Extractables | 0.11 | 0.10 | 0.20 | 0.23 | 0.12 | 0.20 | 0.22 | 0.27 | 0.34 |
| SW 870 - Appendix III-D | 0.10 | 0.11 | 0.11 | 0.19 | 0.18 | 0.23 | 0.19 | 0.32 | 0.27 |
| | 0.13 | | | | | | | | |
| | 0.11 | | | | | | | | |
| Average | 0.11 | 0.11 | 0.16 | 0.21 | 0.15 | 0.22 | 0.21 | 0.30 | 0.31 |
| STD | 0.01 | 0.01 | 0.06 | 0.03 | 0.04 | 0.02 | 0.02 | 0.04 | 0.05 |


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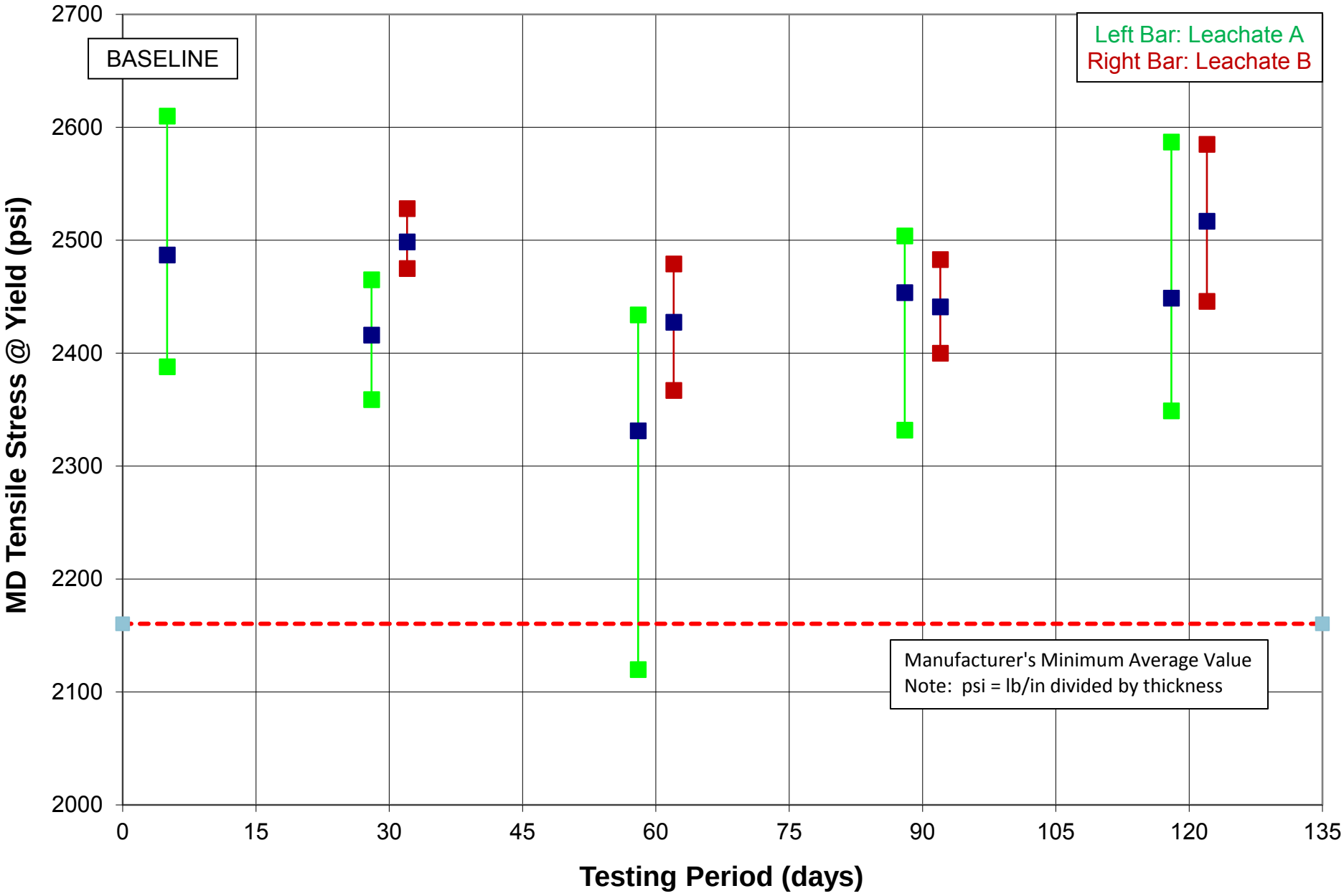
# CH2MHill, Figure 1
## 60 mil textured HDPE vs Leachate A & B

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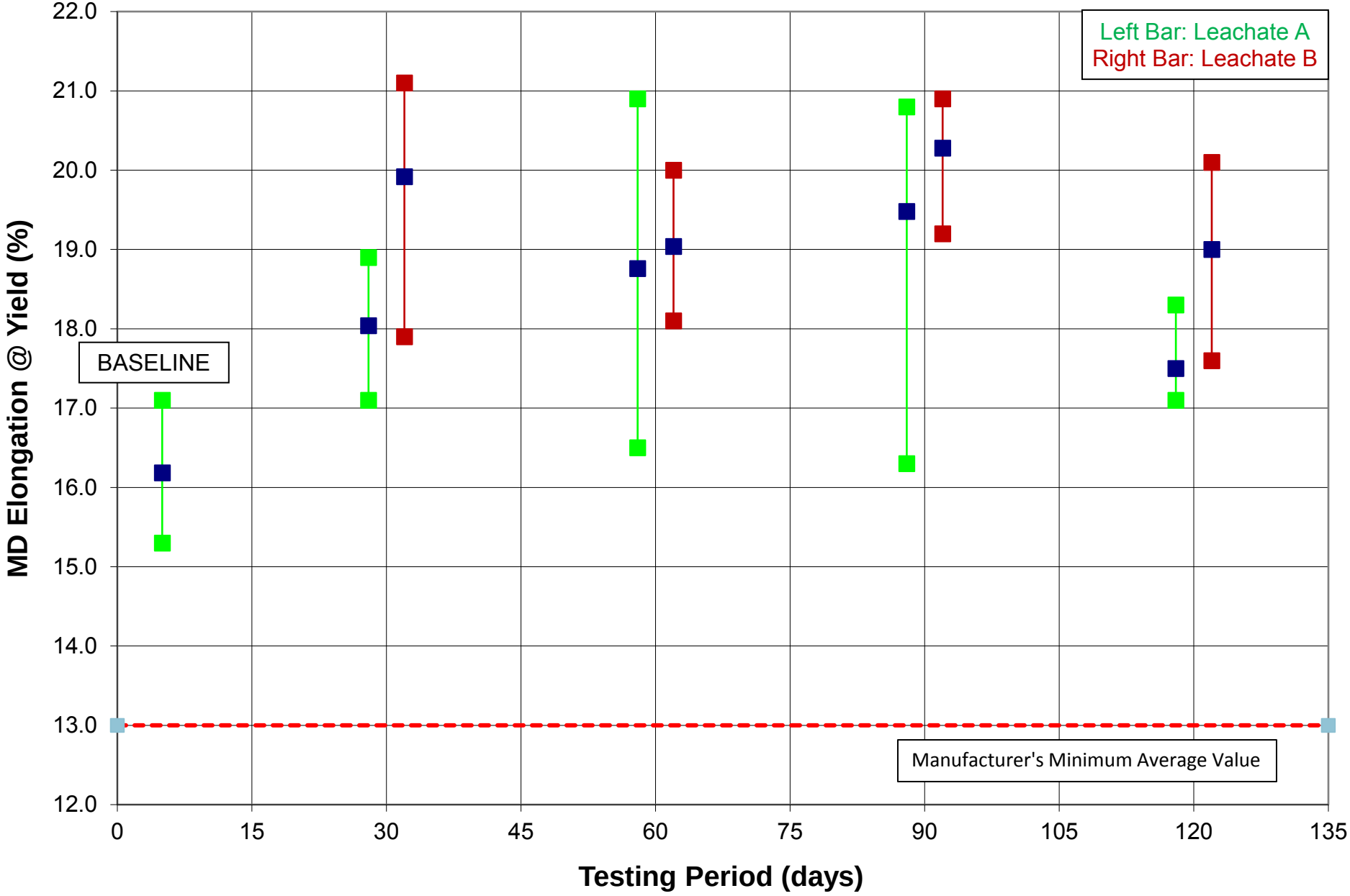
# CH2MHill, Figure 2
## 60 mil textured HDPE vs Leachate A & B

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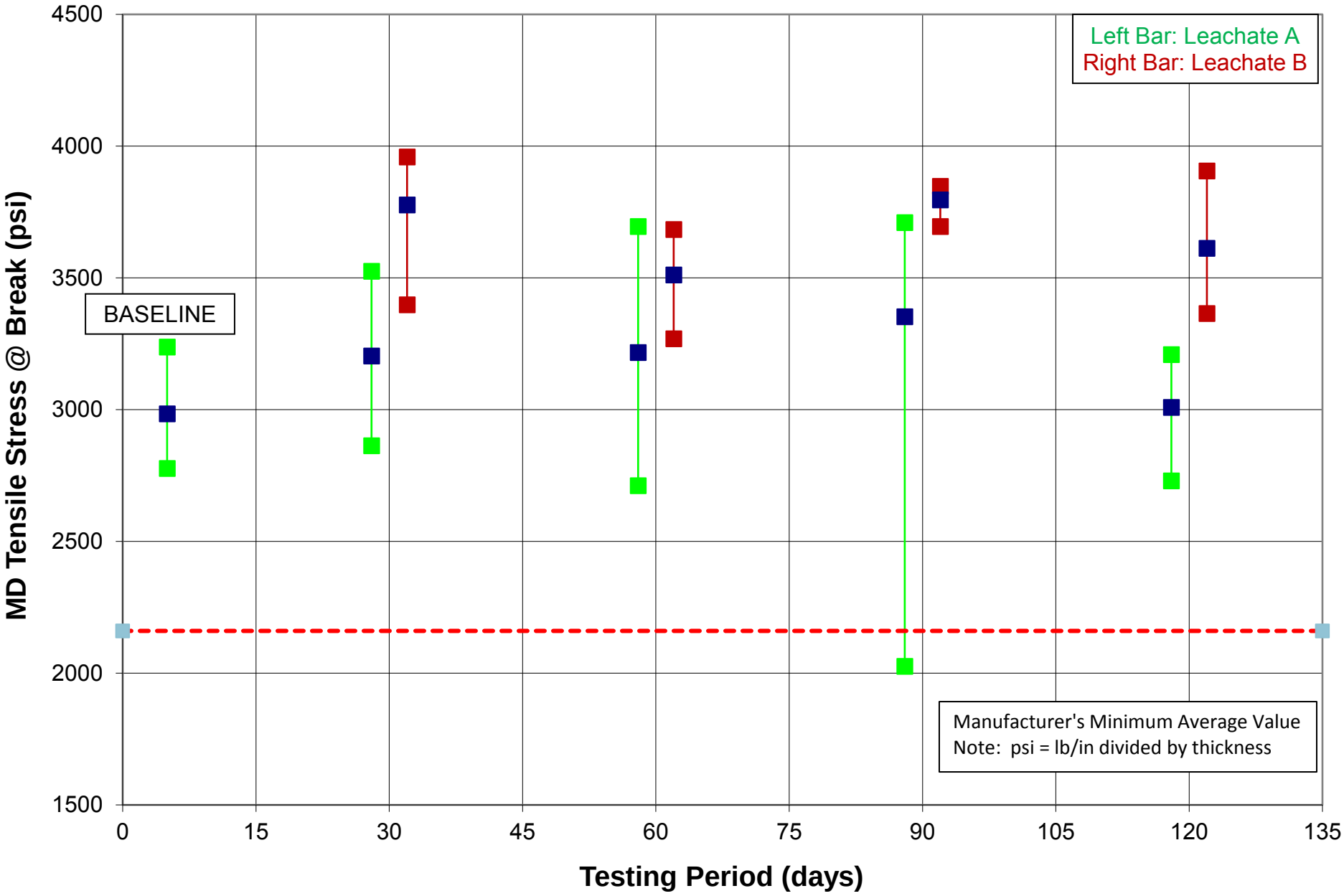
# CH2MHill, Figure 3
## 60 mil textured HDPE vs Leachate A & B

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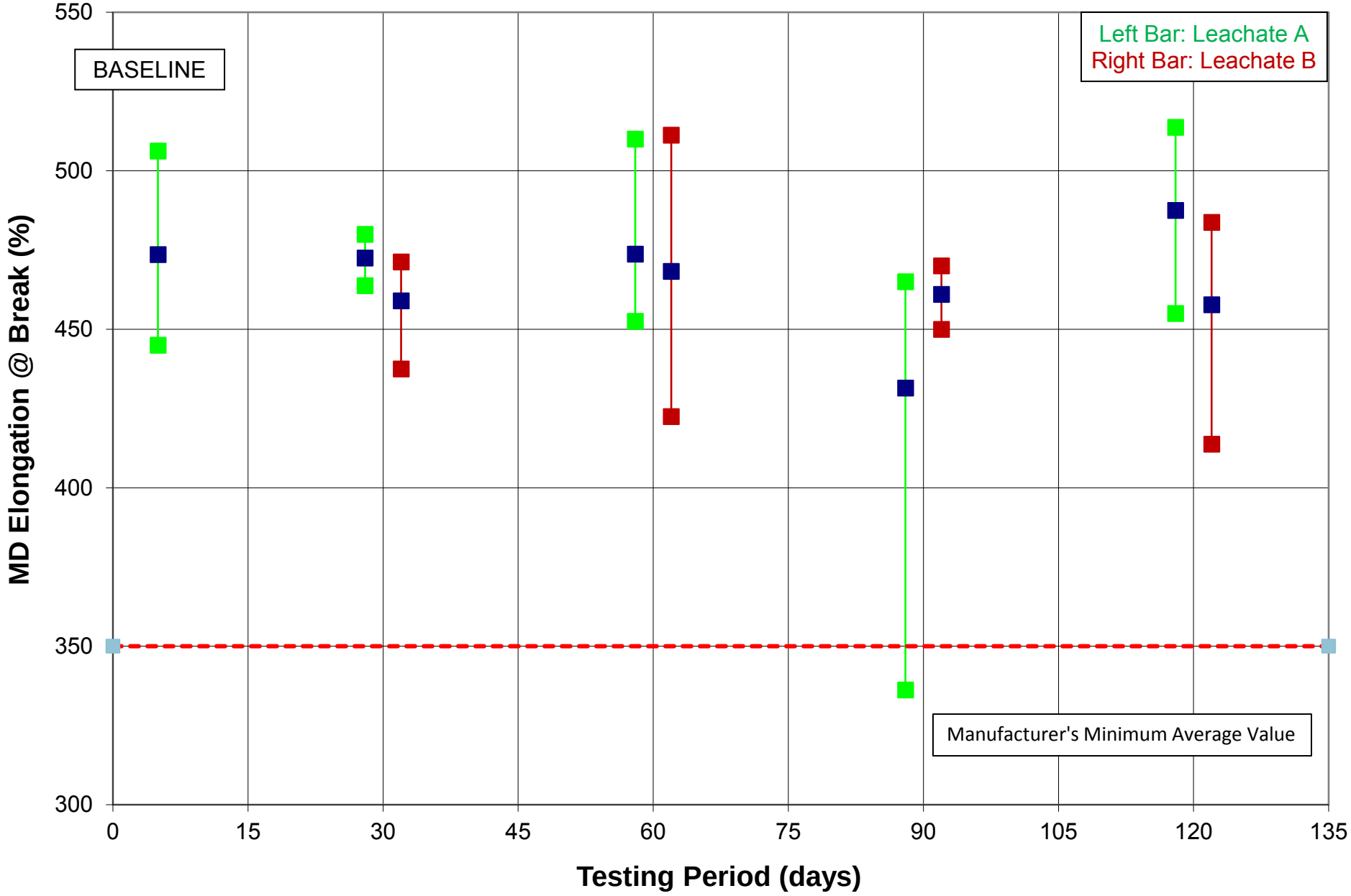
# CH2MHill, Figure 4
## 60 mil textured HDPE vs Leachate A & B

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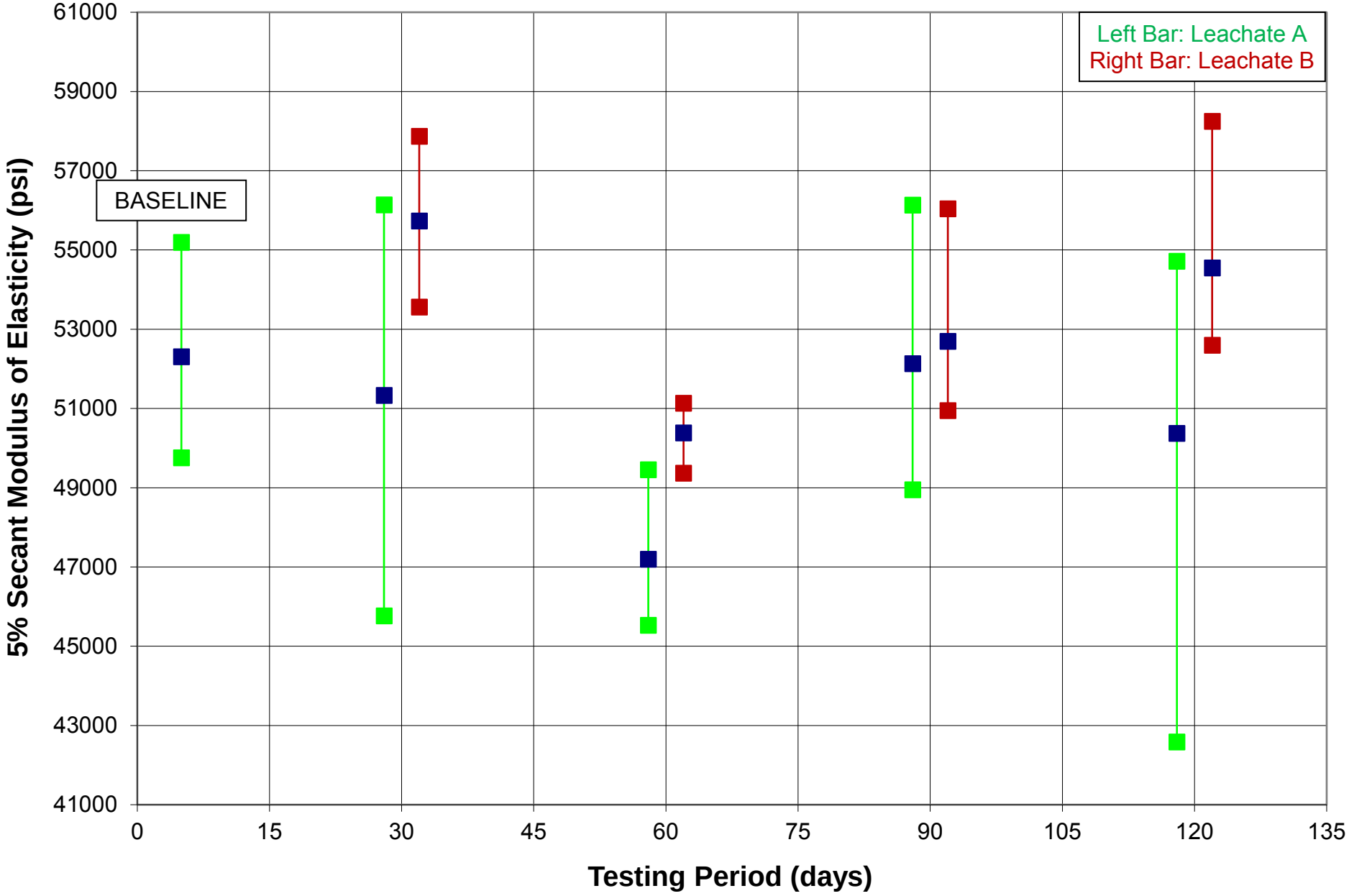
# CH2MHill, Figure 5
## 60 mil textured HDPE vs Leachate A & B

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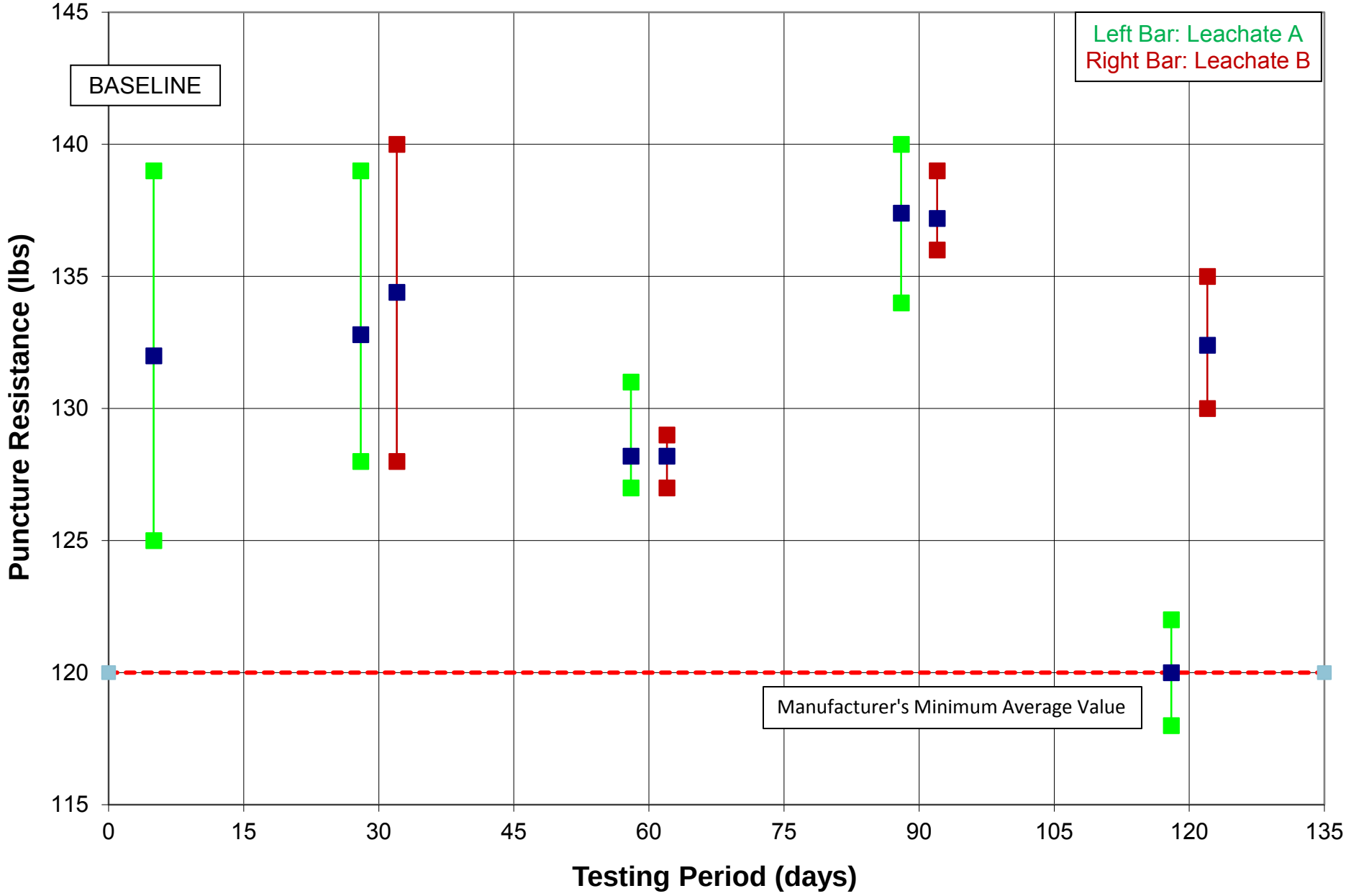
# CH2MHill, Figure 6
## 60 mil textured HDPE vs Leachate A & B

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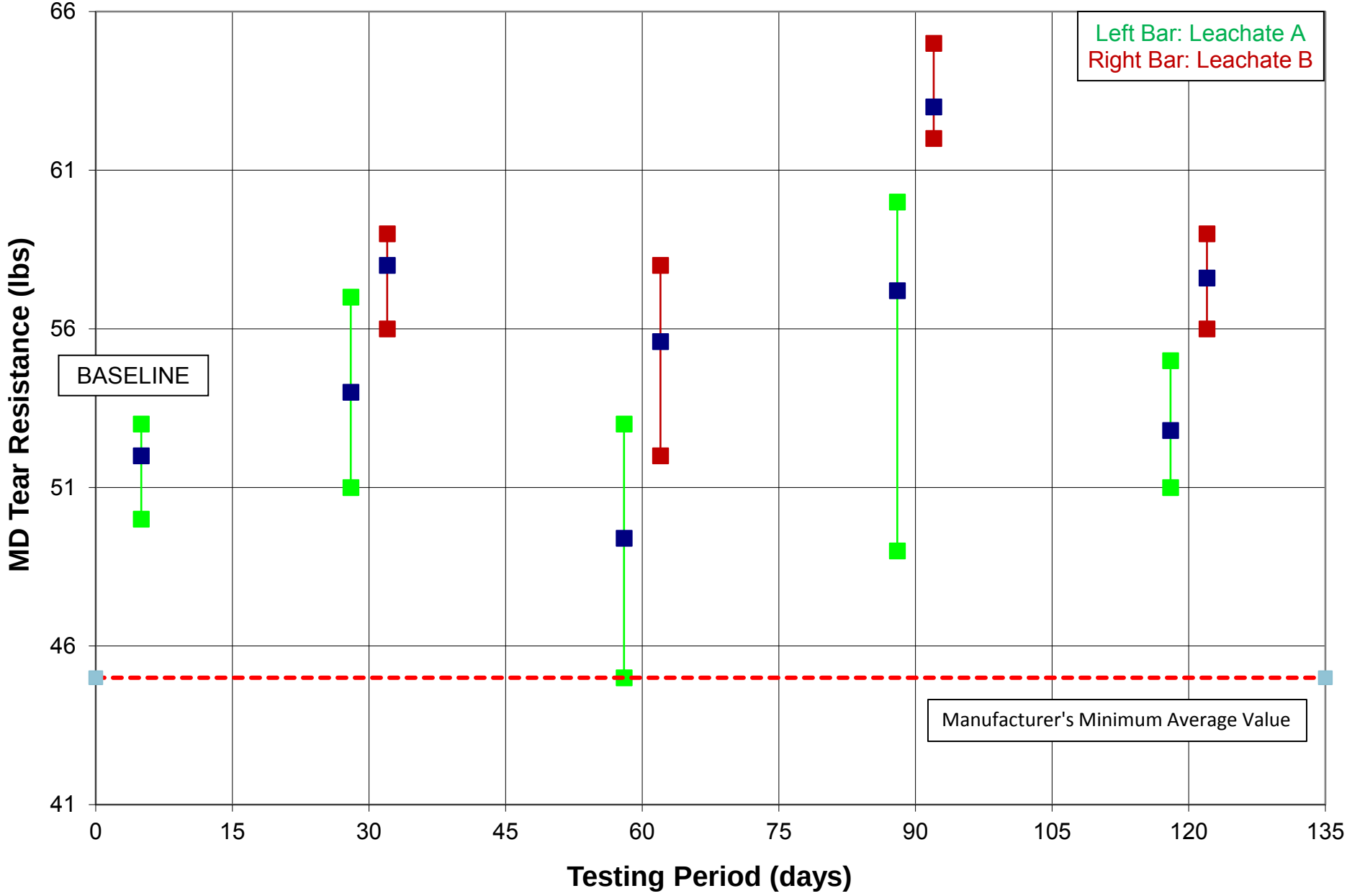
# CH2MHill, Figure 7
## 60 mil textured HDPE vs Leachate A & B

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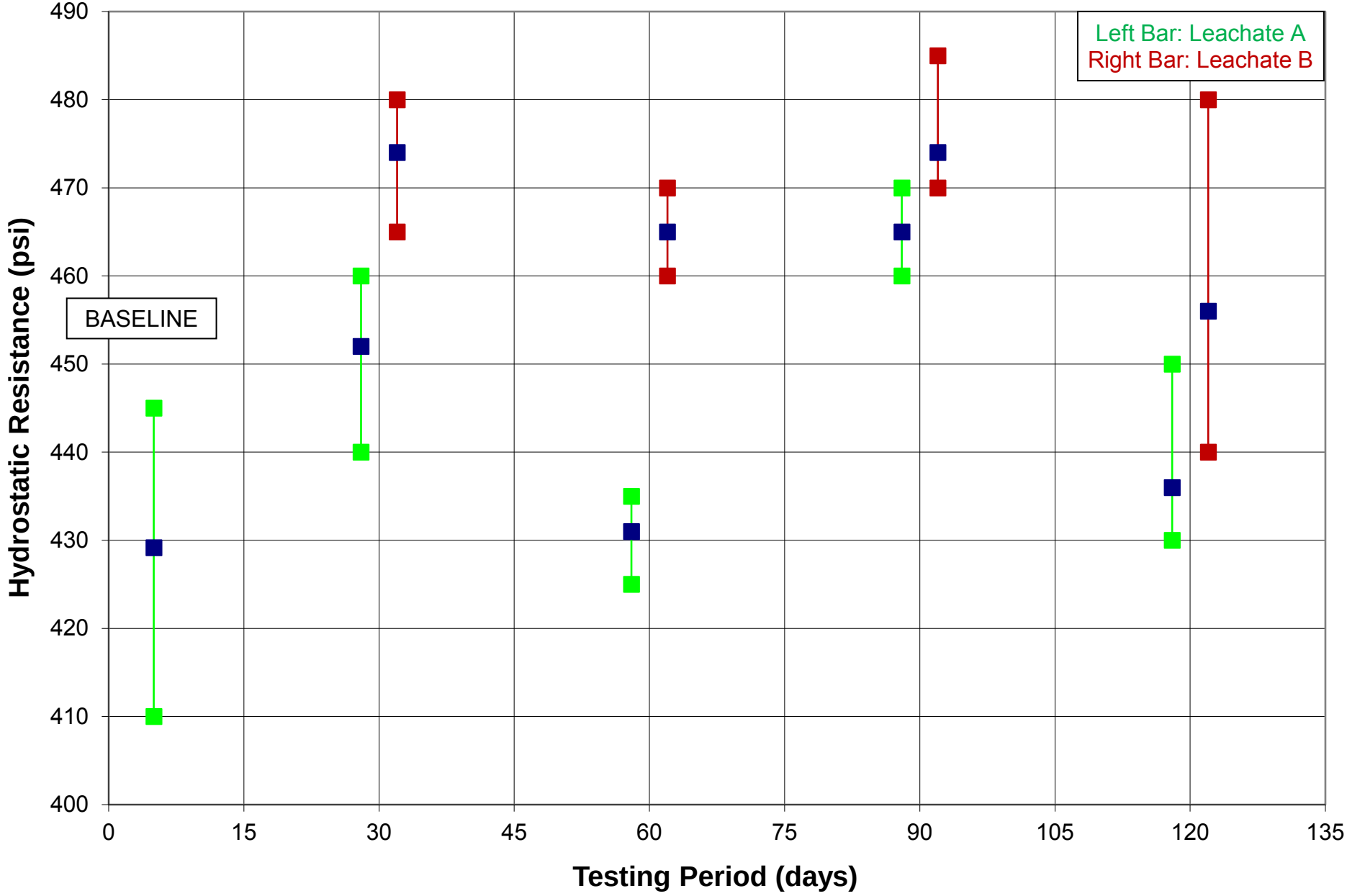
# CH2MHill, Figure 8
## 60 mil textured HDPE vs Leachate A & B

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# Appendix E2
# 2016 Steam-Enhanced ISS Bench Study

TECHNICAL MEMORANDUM

# Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Test Results, American Cyanamid Superfund Site, Bridgewater, New Jersey

| | |
|---|---|
| PREPARED FOR: | Mark Austin/U.S. Environmental Protection Agency |
| COPY TO: | Russell Downey/Pfizer Inc.<br>Vince D'Aco/Quantum Management Group |
| PREPARED BY: | CH2M HILL Operable Unit 8 Project Team |
| DATE: | May 27, 2016 |

# Introduction

This memorandum describes the results of a thermally enhanced in-situ solidification/stabilization (ISS) bench-scale study, conducted on behalf of Wyeth Holdings LLC, in support of the focused feasibility study (FFS) for Operable Unit 8 (Impoundments 1 and 2) at the American Cyanamid Superfund Site in Bridgewater, New Jersey (Site). The study approach and methods are detailed in the *Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan* (CH2M HILL [CH2M] 2015a), the *Response to the U.S. Environmental Protection Agency's (USEPA's) December 10, 2015 Comments on the Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan* (CH2M 2015b), and the updated *Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan* (CH2M 2015c). The updated Work Plan was approved by USEPA on January 13, 2016.

Several remedial alternatives are being evaluated as part of the FFS process that involve in-situ treatment followed by removal of the material and placement into the Impoundment 8 Facility corrective action management unit (CAMU). One of the primary considerations regarding the feasibility of these alternatives is the ability of in-situ treatment to reduce volatile organic compound (VOC) concentrations and to improve materials handling characteristics and the overall feasibility of removal and placement in the CAMU. This study was specifically conducted to assess the viability of in-situ treatment using a dual-phase approach involving thermally enhanced mixing to promote VOC removal followed by ISS to increase pH and compressive strength.

# Executive Summary

Combined treatment of Impoundment 2 materials using thermally-enhanced mixing followed by ISS was tested at the bench scale. The study evaluated the effectiveness of VOC removal using steam to heat the materials to 70 degrees Celsius (°C) and 90°C, followed by the addition of several ISS amendments. The extent of benzene removal was found to be a function of temperature and mixing time; treatment at 90°C resulted in a benzene half-life of 1.3 hours. Based on this half-life, 41 percent removal of benzene in impoundment material is predicted after one hour of mixing time and 66 percent removal is predicted after two hours of mixing time. Overall, treatment was found to be viable, resulting in reduced benzene concentrations and improved physical properties including increased compressive strength and pH adjustment. Additional benzene concentration reduction due to dilution is expected following reagent addition. Type I Portland cement at a 15 percent dose performed the best of the amendments tested, resulting in post-treated materials exhibiting a 21-day UCS ranging from 18.0 to 26.4 psi and pH ranging

from 6.64 to 10.54. Reagent performance was not affected by temperature of the heated impoundment material and rapid (flash) setting of the stabilized material was not observed. Flash setting characteristics for stabilized material are undesirable and could potentially complicate the application of thermally enhanced mixing at field scale.

# Testing Program Methods and Results

The testing program was completed in three phases:

- Phase I: Preliminary testing (method refinement)
- Phase II: Initial testing (evaluation of various treatment conditions)
- Phase III: Confirmatory testing (replicate testing of most favorable treatment conditions)

Since the objective of the preliminary testing phase was to develop and refine test methods, archived Impoundment 2 material was used in this phase. The initial and confirmation phases utilized Impoundment 2 material collected from the field on January 6 and January 7, 2016 and submitted to the laboratory specifically for use in this bench study.

Detailed methods for each phase of the testing program are provided in the *Steam Mixing and Solidification Study Report* (Kemron Environmental Services 2016) included as Attachment 1. The remainder of this section provides an overview of the testing methods and results for each phase of the bench study. This section also includes a description of work plan deviations.

## Phase I: Preliminary Testing

The preliminary testing phase was conducted to develop and refine test methods to best simulate full-scale treatment of impoundment materials using the dual-phase treatment approach. For this, specialized equipment capable of mixing steam and hot air directly into the impoundment materials was designed and fabricated in the laboratory. Figure 1 shows a general depiction of the testing equipment developed and applied for this study, and Figure 2 shows a photograph of the actual apparatus used.

The archived impoundment material used in the preliminary phase was a 1:1 composite (by weight) of hard crumbly (HC) and viscous rubbery (VR) material from Impoundment 2. Attachment 1 contains a description of the preliminary testing, including apparatus refinements.

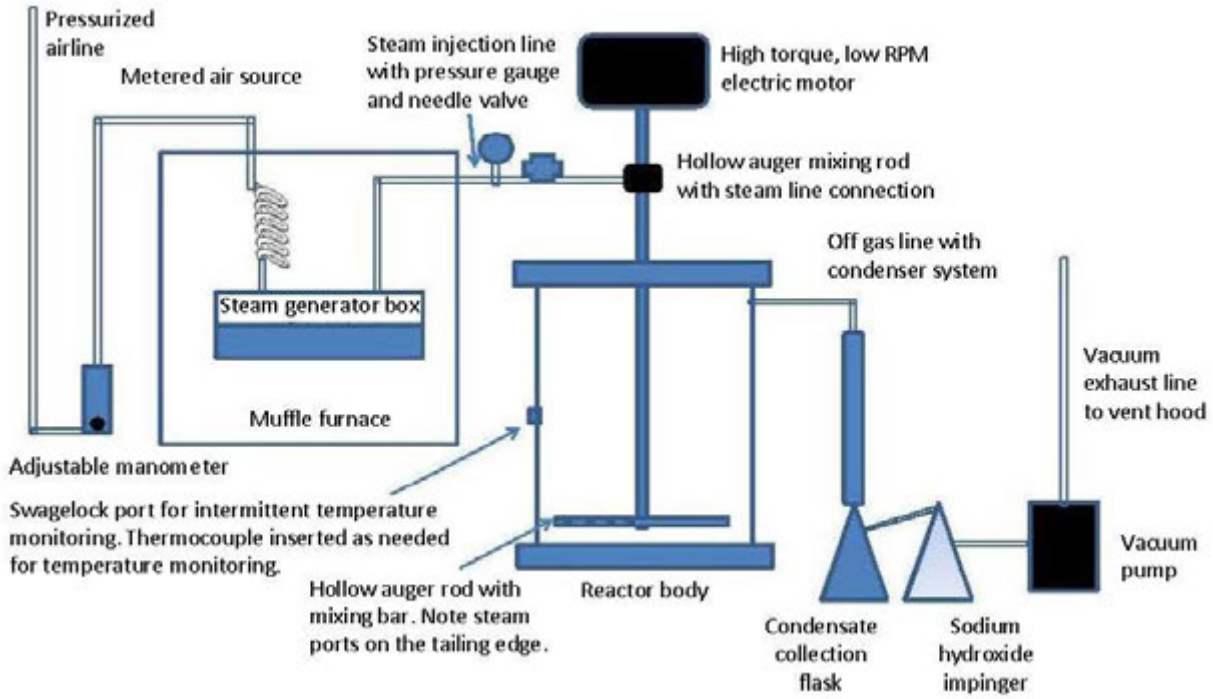


Figure 1. Thermally Enhanced ISS Testing Configuration
*Material is placed inside the reactor body during testing.*

Figure 2. Thermally Enhanced ISS Bench-Scale Treatment System Apparatus

The following ISS reagents were evaluated during the preliminary phase to determine candidate amendment reagents for subsequent testing phases:

- Type I Portland cement
- Calciment
- Lime kiln dust (LKD)
- Cement kiln dust (CKD)
- Granulated blast furnace slag
- No. 1 corn cobb grit

For these tests, archived Impoundment 2 material (1:1 HC:VR, by weight) was first heated to 70°C to simulate conditions following thermal treatment, and then ISS reagents were mixed into the material by hand. Visual observations of material stability were used to select ISS reagents for further testing (Attachment 1). Based on the preliminary results, Type I Portland cement, LKD, and CKD were selected for further testing in the initial phase.

# Phase II: Initial Testing

## Thermally Enhanced Mixing

The initial testing phase consisted of four thermally enhanced mixing simulations identified as SI-01 through SI-04. For simulation SI-01, material was neutralized with powdered quicklime before beginning

thermally enhanced mixing. This step was omitted for subsequent simulations as it reduced material manageability (discussed in more detail under Work Plan Deviations). Table 1 lists the materials and test conditions evaluated in the initial testing phase (HC/VR materials were 1:1 composites by weight).

Table 1. Initial Testing Phase Simulation Summary

| Test Name | Material | Target Temperature (°C) | Neutralization (yes/no) |
|---|---|---|---|
| SI-01 | HC/VR | 90 | Yes * |
| SI-02 | HC/VR | 90 | No |
| SI-03 | HC/VR | 70 | No |
| SI-04 | VR | 90 | No |

* Neutralization of material was performed with powdered quicklime.

Before and during the thermally enhanced mixing process, material aliquots were collected and submitted to Accutest laboratories in Dayton, New Jersey for analysis of VOCs, by EPA Method 8260B, to determine baseline conditions and changes to VOC concentrations during treatment. Simulation SI-01 was completed primarily to verify the experimental setup; therefore, sample analytical results and parameter monitoring testing was limited and the results are not discussed in this document. For simulations SI-02, SI-03, and SI-04, time course samples were collected at 20-minute intervals over the course of 2 hours after the target temperature was achieved. Sampling operations were supplemented with monitoring of extracted vapor with a flame ionization detector (FID). Temperature in the mixing apparatus was monitored using thermocouples placed in contact with the impoundment materials and within the vapor collection and conveyance tubing.

Figures 3 and 4a/4b show changes in benzene and naphthalene concentrations before and during thermally enhanced mixing for simulations run at 70°C and 90°C, respectively. The blue and orange horizontal lines in Figures 3 and 4a/4b represent the average benzene and naphthalene concentrations, respectively, detected in the field samples of 1:1 HC:VR mix material collected on January 6 and January 7, 2016. Table 2 summarizes the comprehensive analytical results, and Attachment 2 contains the analytical reports. Figures 3 and 4a/4b also show fits of the data to an exponential model (consistent with first-order disappearance). The fit includes an initial data point, which presents the baseline condition before initiation of steam injection for thermal treatment. Once steam injection commenced there was a ramp up period until the target temperature was achieved. Time zero in these figures is the point at which temperature ramp up was complete and the desired temperature was attained. The results show that benzene and naphthalene loss over time generally followed first-order kinetics. As expected, a greater decrease in VOC concentration occurred in tests performed at 90°C versus 70°C.

Figures 3 and 4a/4b also illustrate that the time to reach the target temperature varied. The duration of the temperature ramp up was approximately 1 hour for 1:1 HC:VR samples and close to 6 hours for the VR-only material. For these laboratory tests, temperature ramp up time was constrained by equipment size since the laboratory boiler was small and had limited energy output. Heating the VR-only was further challenged by the absence of porosity, which is present when HC and VR materials are mixed. Heated VR is a fluid and the output pressure of the laboratory steam generator was not capable of displacing the fluid from the injection points on the mixer assembly. In the absence of steam flow, convective heat transfer from the mixer to the VR was significantly reduced which translated to extended heating time observed in the test. Under field conditions, a temperature ramp up time of 30 minutes is commonly reported for applications of thermally enhanced mixing (Johnson 2009). If encountered under field conditions, heating of a VR-only pocket is predicted to occur in a similar timeframe since as HC/VR mix since injection pressure and mixing dynamics could be altered to improve the distribution of steam and improve convective heat transfer to the materials.

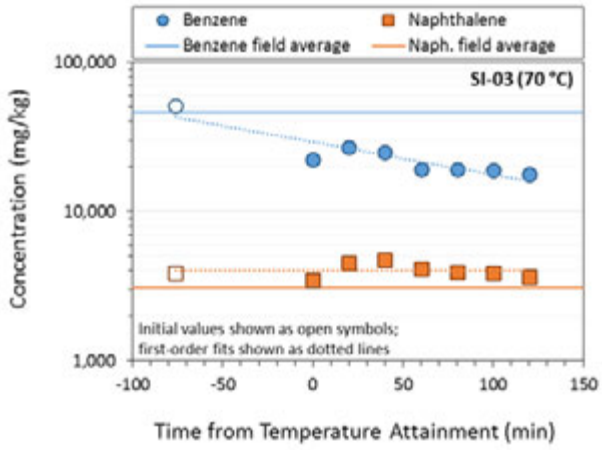


Figure 3. Benzene and Naphthalene Concentrations vs. Time in the 70-degree-Celsius Simulation (SI-03, 1:1 HC: VR)

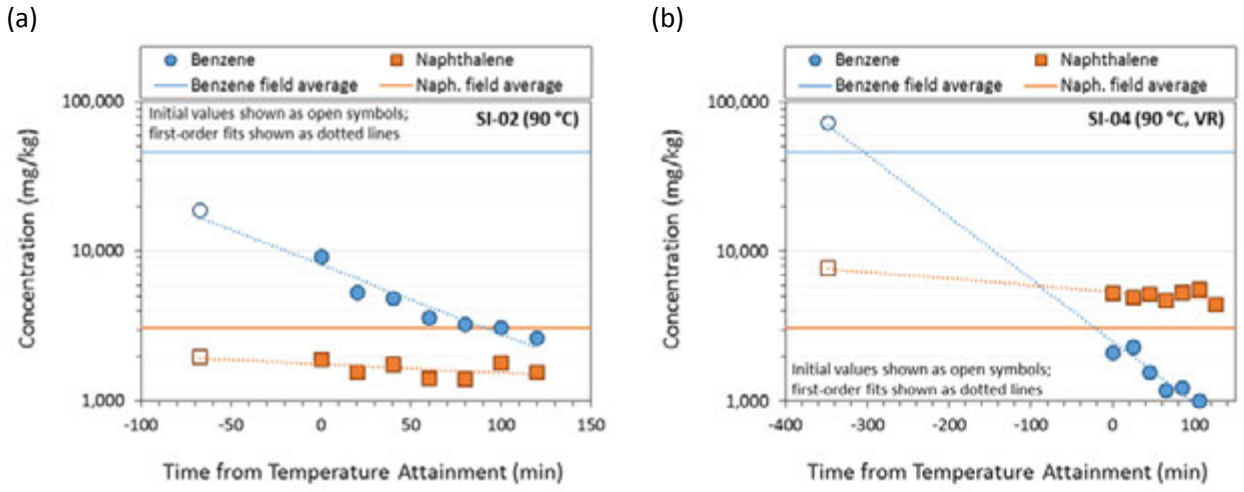


Figure 4. Benzene and Naphthalene Concentrations vs. Time in the 90-degree-Celsius Simulations
*For (a) SI-02 (1:1 HC:VR) and (b) SI-04 (VR only)*

The cumulative change in benzene and naphthalene concentrations from baseline conditions, as represented by the time which heating and mixing started to post-treatment, as represented by the time heating and mixing ended, are shown in Figures 5 and 6 for simulations run at 70°C and 90°C, respectively. The post-treatment concentrations reflect volatile losses that occurred during both the temperature ramp-up period and the subsequent 120 minutes of mixing at the target temperature. In all simulations, a greater change in concentration was seen for benzene than naphthalene, as expected based on benzene's higher volatility.

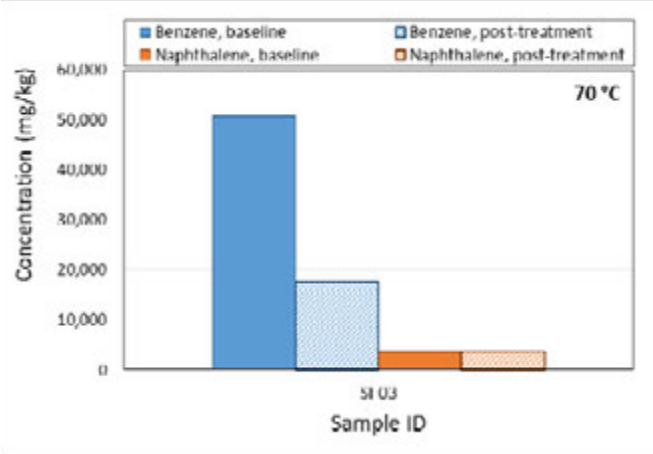


Figure 5. Benzene and Naphthalene Mass Reduction at 70 Degrees Celsius

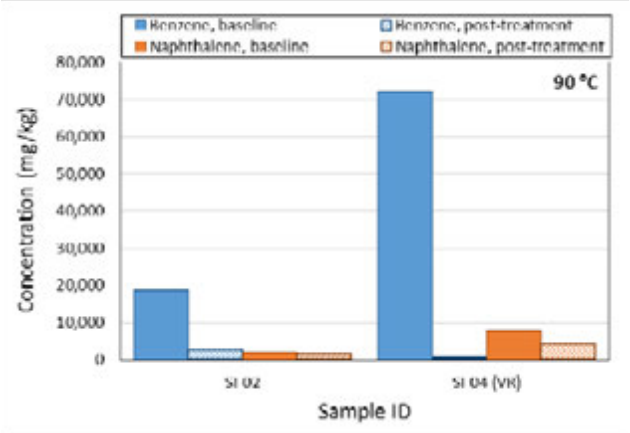


Figure 6. Benzene and Naphthalene Mass Reduction at 90 Degrees Celsius

Results of temperature and extracted vapor monitoring are summarized in Figures 7a through 7c with full results presented in Attachment 1. These figures show the temperature of the material over time along with FID-measured VOC concentrations exiting the testing apparatus. In general, FID-measured concentrations decrease with time, which is consistent with the decreasing concentration data presented on Figures 3 and 4a/4b. Lower FID measurements are observed for SI-04 (90 °C, VR only), which is consistent with the low benzene concentration measured in the material at the time the target temperature was attained (see Figure 4b). Some variation was seen in the temperature of the material during treatment, especially for SI-03, which was performed at 70°C. Variation is considered the result of thermocouple placement and interference with the mixing assembly within the reactor body. At selected intervals when temperature measurements were desired for the soil matrix, the mixer was positioned at its maximum vertical stroke height to allow insertion of the thermocouple to reach the center of the reactor body contents. After temperature measurement, the thermocouple was retracted to eliminate mixer interference. Due the change in thermocouple position, temperatures recorded vary between the reactor body center (highest) and reactor body wall temperature.

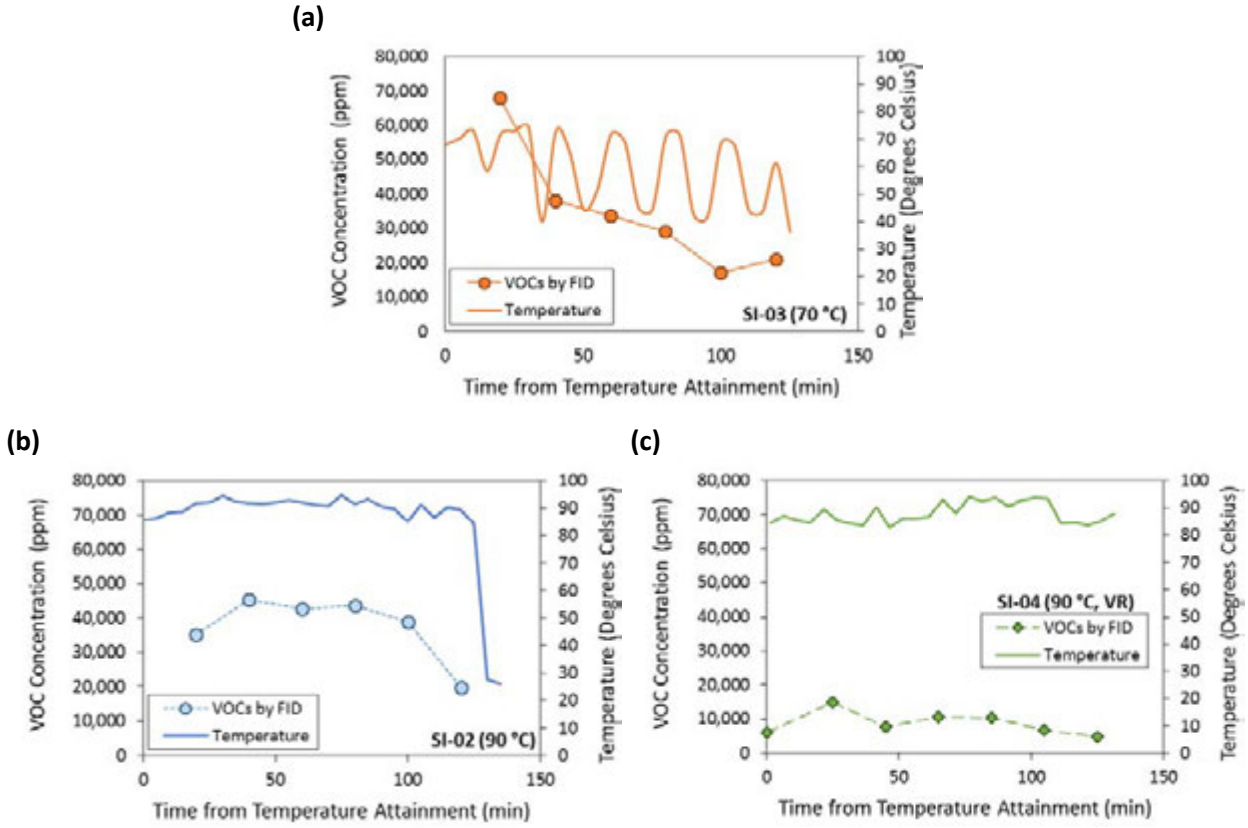


Figure 7. FID VOC Concentrations vs. Time Data
*For (a) SI-03 (70-degree HC/VR simulation), (b) SI-02 (90-degree HC/VR simulation), and (c) SI-04 (90-degree VR-only simulation).*

## Material Solidification/Stabilization

After thermally enhanced mixing operations were complete, thermally treated material from simulations run at 90°C was removed from the reactor body and subjected to simulated ISS using a number of ISS reagents. Detailed evaluation of the selected ISS reagents (Type I Portland cement, LKD, and CKD) was performed using material treated in thermally enhanced mixing simulations SI-01 (neutralized HC/VR), SI-02 (HC/VR), and SI-04 (VR only). Before adding a reagent, the thermally treated material was reheated to approximately 70 to 80°C. Reagents were then added at doses of 10 to 15 percent by weight. Reagents were added dry and in some cases as a slurry prepared with an equivalent mass of water. Table 3 provides reagent addition details. Materials and reagents were mixed by hand and then compacted into plastic cylindrical molds. Materials were tested to determine post-treatment pH and 21-day unconfined compressive strength (UCS).

During simulated ISS treatment, SI-01 materials were treated with a 10 percent dose of LKD, CKD, or Type I Portland cement (dry or as a slurry), and SI-02 materials were treated with a 15 percent dose of the same reagents. Figures 8 and 9 and Attachment 1 summarize the UCS and pH results for treatment of materials from simulations SI-01 and SI-02. The values are also summarized in Table 3 along with visual observations of the treated material. Treatment of material from simulation SI-02 with a 15 percent dose of Type I Portland cement as a slurry showed the best combination of high 21-day UCS (18.0 pounds per square inch [psi]) and pH of 6.64 standard units [SU].

ISS reagent addition to material from simulation SI-04 (VR only) showed minimal improvement in physical handling and working characteristics, so additional ISS reagents were evaluated. Despite the evaluation of numerous amendments under a range of concentration values, treated VR-only materials did not exhibit similar physical characteristics as observed in prior simulations using VR and HC mixtures. In general, reagent addition to VR-only treated materials produced a soft and plastic matrix with handling characteristics that differed significantly from all prior simulations. For this reason, only one solidified sample was tested for pH and 21-day UCS (material treated with a 15 percent dose of Type Portland cement as a slurry). This sample exhibited a pH of 11.63 SU and a 21-day UCS of 1.2 psi. UCS testing results confirmed prior laboratory observations that reagent addition to VR-only heated material would likely yield a solid matrix with low compressive strength and poor handling characteristics.

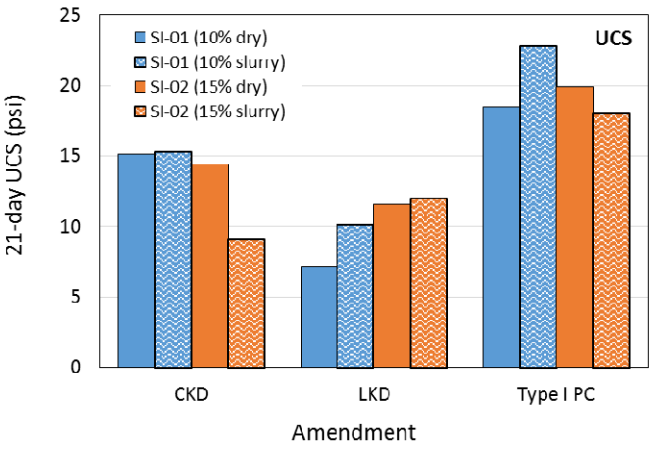


Figure 8. Preliminary Screening Results: UCS

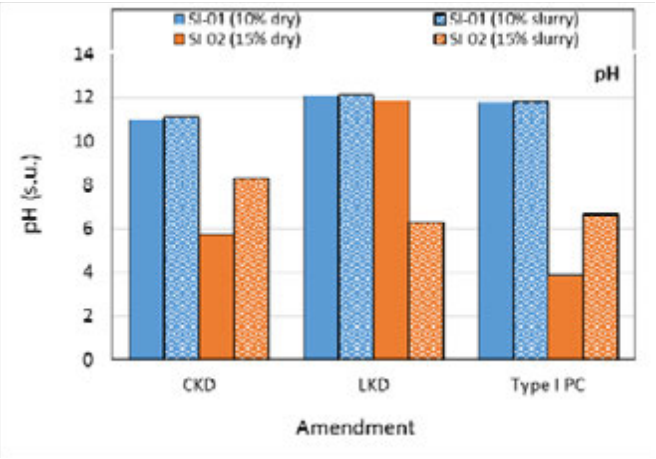


Figure 9. Preliminary Screening Results: pH

## Phase III: Confirmatory Testing

Based on the results of initial testing in Phase II, the following conditions were identified to be repeated during confirmatory testing:

- Treatment of HC/VR material without a preliminary neutralization step
- Thermally enhanced mixing at 90°C
- Simulated ISS treatment with a 15 percent dose of Type I Portland cement added as a slurry

Two additional test simulations, SI-05 and SI-06 were completed in the confirmatory phase to replicate simulation SI-02 from the initial testing phase. Table 4 summarizes the thermally enhanced mixing portion of these tests.

Table 4. Bench-Scale Simulation Summary

| Test Name | Material | Target Temperature (°C) | Neutralization (yes/no) |
|---|---|---|---|
| SI-05 | HC/VR | 90 | No |
| SI-06 | HC/VR | 90 | No |

All methods and analyses were analogous to those described under Phase II: Initial Testing. In addition, the treated materials were tested using the toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP) for analysis of VOC leaching (Attachment 1).

Benzene and naphthalene removal was similar in the replicate tests to the results observed during initial testing in SI-02. Concentration versus time plots are shown on Figure 10 along with first-order fits of the

data. Although initial baseline concentrations (shown as open symbols) vary, the rate of benzene and naphthalene disappearance (slopes of fit curves) are similar.

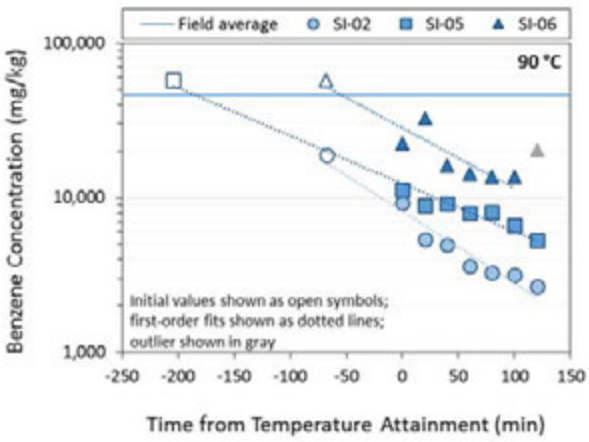


Figure 10a. Benzene Concentrations vs. Time in During Thermally Enhanced Mixing

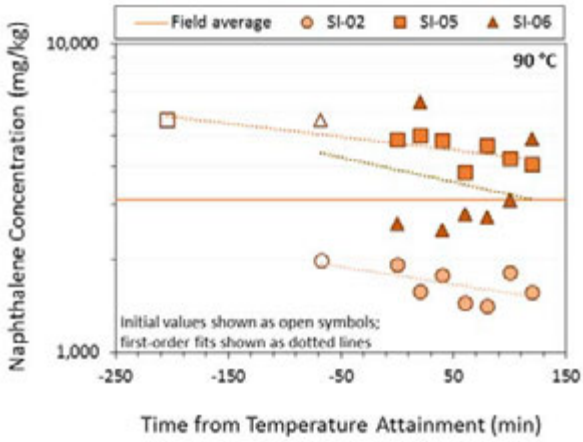


Figure 10b. Naphthalene Concentrations vs. Time in During Thermally Enhanced Mixing

As noted during initial testing, benzene and naphthalene removal exhibited first-order decay characteristics. Table 5 summarizes the rate constants, regression coefficients ($R^2$), and half-lives determined from fits to the data sets. These results indicate reasonable agreement of the benzene data with a first-order disappearance model with $R^2$ ranging from 0.86 to 0.98. Naphthalene removal was less predictable and possessed significantly lower data correlations.

Table 5. Summary of Disappearance Rates

| Temperature (°C) | Experiment ID | $C_0$ (mg/kg) | $k$ (1/min) | $R^2$ on fit | $k_{average}$ (1/min) | Half-life (min) | Average Half-life (min) | Average Half-life (h) |
|---|---|---|---|---|---|---|---|---|
| ***Benzene*** | | | | | | | | |
| 90 | SI-02 | 8166 | 0.0107 | 0.95 | 0.0089 | 65 | 78 | 1.3 |
| | SI-05 | 12346 | 0.0071 | 0.98 | | 98 | | |
| | SI-06 * | 28207 | 0.0090 | 0.86 | | 77 | | |
| ***Naphthalene*** | | | | | | | | |
| 90 | SI-02 | 1770 | 0.0013 | 0.36 | 0.0014 | 533 | 495 | 8.3 |
| | SI-05 | 4740 | 0.0010 | 0.64 | | 693 | | |
| | SI-06 | 3895 | 0.0019 | 0.084 | | 365 | | |

Notes:
*Final SI-06 data point at 120 minutes was identified as an outlier and excluded from fitting analysis.
mg/kg = milligram per kilogram
min = minute
h = hour

To further illustrate the potential effects of steam-enhanced mixing on the concentration of benzene and naphthalene in impoundment materials, the average half-life values measured in the 90°C laboratory study were used to model removal as a function of total mixing time (including temperature ramp up). The model assumed simple first-order (exponential) removal ($C=C_0e^{-kt}$) where: $C$ is the concentration at time $t$, $C_0$ is the initial concentration at $t_0$, and $k$ is the rate (in 1/min) of benzene and

naphthalene disappearance under treatment conditions (half-lives of 1.3 hours and 8.3 hours for benzene and naphthalene, respectively). Note that in this case, *t* is the total mixing time including temperature ramp up, rather than the time from target temperature attainment. The results are shown in Figure 11. The model predicts that 59 percent of the initial benzene concentration will remain after 1 hour of total mixing time and 34 percent will remain after 2 hours of total mixing time (percent reductions of 41 and 66 percent, respectively). Additional concentration reductions will occur when adding ISS amendments. Temperature and extracted vapor monitoring results were similar to those noted during initial testing (Attachment 1).

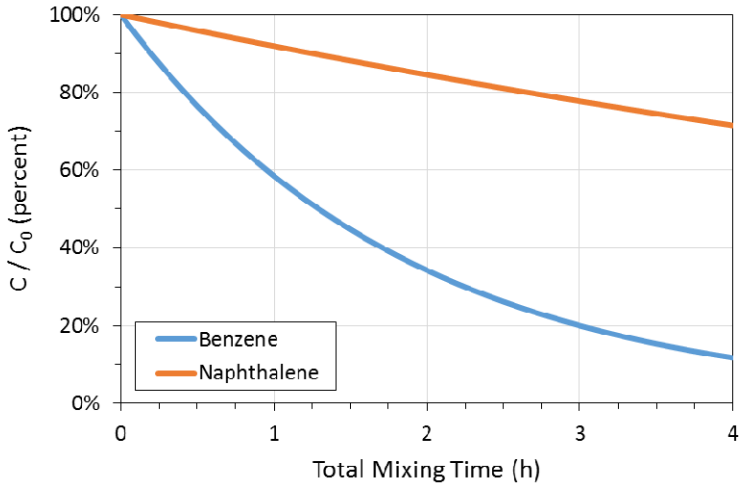


Figure 11. Projected Loss of Benzene and Naphthalene Based on 90ºC Average Rate Constants

Treatment of material from simulations SI-02, SI-05, and SI-06 with a 15 percent dose of Type I Portland cement as a slurry showed 21-day UCS results ranging from 18.0 to 26.4 psi and pH ranging from 6.64 to 10.54 as shown in Figures 12 and 13.

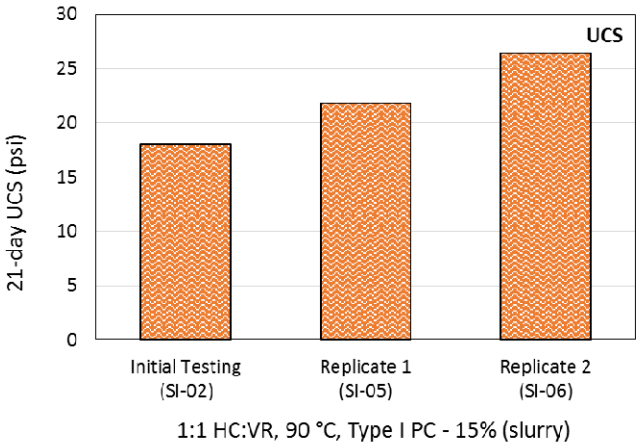


Figure 12. Confirmatory Testing Results: UCS

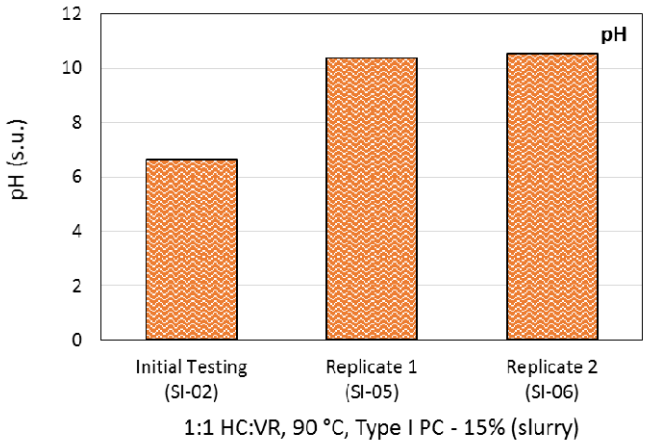


Figure 13. Confirmatory Testing Results: pH

In addition to evaluating the ISS-treated SI-05 and SI-06 material for UCS and pH, the materials were subjected to TCLP and SPLP testing to evaluate post-treatment conditions. The results of this analysis are presented in Attachment 2 and summarized in Table 7 (benzene and naphthalene). These results show

that benzene TCLP values in post-treated material are above the maximum concentration of contaminants for the toxicity characteristic of 0.5 milligram per liter (mg/L) (CFR 2016). However, it is important to note that materials placed in the Impoundment 8 Facility CAMU are not required to meet TCLP values. A comparison of TCLP and SPLP laboratory results from this bench study to results observed in the post thermally treated material following completion of the 2014 OU8 pilot study revealed that similar concentration reductions could be achieved by the thermally enhanced mixing approach (CH2M 2015d). Overall, laboratory testing of the thermally enhanced ISS process returned lower values for TCLP and SPLP compared to average benzene values measured during the OU8 pilot study following completion of thermal treatment, (63 mg/l and 38 mg/L, respectively). Although the objective of amendment addition was not intended for leachability reduction, it may provide supplemental benefit for materials subjected to thermally enhanced mixing.

Table 7. TCLP and SPLP Results

| | TCLP Concentration (mg/L) | | SPLP Concentration (mg/L) | |
|---|---|---|---|---|
| **Analyte** | ***SI-05*** | ***SI-06*** | ***SI-05*** | ***SI-06*** |
| Benzene | 1.88 | 39.4 | 45.3 | 92.9 |
| Naphthalene | 1.41 | 3.15 | 3.09 | 3.32 |

## Work Plan Deviations

During implementation of the laboratory testing program, experimental observations required minor adjustments to the approved work plan (CH2M 2015a, 2015b, 2015c). Pfizer and CH2M identified and discussed work plan deviations with USEPA representatives during a conference call on March 24, 2016, and USEPA provided approval for the deviations via email on March 24, 2016. Deviations to the work plan were as follows:

- The work plan specified neutralization of the impoundment material before thermally enhanced mixing. During the preliminary testing phase, the handling characteristics of thermally treated material were found to be more manageable if the material was not neutralized before steam injection. Although neutralization was successfully demonstrated using the laboratory-scale equipment in SI-01, the process was unnecessary to fulfill the primary study objectives to assess VOC reduction by the combined thermally enhanced mixing and ISS treatment process. Subsequent tests therefore were performed without neutralizing the impoundment material before thermal treatment.
- The work plan specified that bench-scale tests would be performed at three temperatures: ambient, 70°C, and 90°C. Based on observations made in the preliminary testing phase, it was determined that thermally enhanced mixing of the VR material alone would pose more of a technical challenge than treating the HC or VR/HC mix because the HC adds porosity to the material, allowing better contact with the steam. As a result, the test run allocated for ambient air treatment of a VR/HC mixture was replaced with a 90°C test run of VR material only.

# Conclusions

The bench-scale study results demonstrate that steam-enhanced mixing is viable to enhance VOC removal during in-situ treatment of impoundment materials. The following conclusions were drawn from this study:

- Removal of VOCs from VR/HC mixtures obtained from Impoundment 2 appear to follow first-order behavior at treatment temperatures evaluated by the laboratory study.

- Steam-enhanced mixing at a target temperature of 90°C resulted in an average benzene half-life of 1.3 hours.
- Assuming 2 hours of thermally enhanced mixing (including temperature ramp up), the average benzene concentration in the impoundment material may be reduced by 66 percent.
- Steam-enhanced mixing at a target temperature of 90°C resulted in an average naphthalene half-life of 8.3 hours.
- Assuming 2 hours of thermally enhanced mixing (including temperature ramp up), the average naphthalene concentration in the impoundment material may be reduced by 15 percent.
- Laboratory study observations indicate the addition of ISS reagents to post thermally treated VR/HC mixtures obtained from Impoundment 2 was feasible. Reagent addition to post thermally treated VR-only material produced a soft and plastic solid with low UCS and poor handling properties.
- Treatment of material from simulations SI-02, SI-05, and SI-06 showed that a 15 percent dose of Type I Portland cement as a slurry resulted in post-treated materials exhibiting a 21-day UCS ranging from 18.0 to 26.4 psi and pH ranging from 6.64 to 10.54. Post treatment UCS results in this range are expected to be sufficient to support mixing equipment advancing across the impoundments as required to implement the full scale remedy.

# References

CH2M HILL (CH2M). 2015a. *Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan, Operable Unit 8 Pilot Study, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*. December 2.

CH2M HILL (CH2M). 2015b. *Response to USEPA's December 10, 2015 Comments on the Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan*. December 17.

CH2M HILL (CH2M). 2015c. *Thermally Enhanced In-Situ Solidification/Stabilization Bench-Scale Testing Work Plan, Operable Unit 8 Pilot Study, American Cyanamid Superfund Site, Bridgewater Township, New Jersey*. December 17.

CH2M HILL (CH2M). 2015d. *Field-Scale Demonstration Study Results Report for Operable Unit 8 Pilot Study. American Cyanamid Superfund Site.* February 26.Code of Federal Regulations (CFR) (2016). Identification and Listing of Hazardous Waste. Title 40, Part 261. Section 24, Paragraph (b).

Johnson, P., Dahlen, P., Triplett Kingston, J. 2009. Critical Evaluation of State-of-the-Art In Situ Thermal Treatment Technologies for DNAPL Source Zone Treatment. ESTCP Project ER-0314. Environmental Security Technology Certification Program.

Kemron Environmental Services. 2016. *Draft Steam Mixing and Solidification Study Report*. May.

# Tables

Table 2. Master Table of Sample VOC Concentrations

*Focused Feasibility Study Results Summary: Bench-scale Thermally Enhanced ISS Testing*

*Operable Unit 8, American Cyanamid Superfund Site*

*Bridgewater, New Jersey*

| **Test ID** | **SI-01/SI-02** | **SI-01** | | **SI-02** | | | | | | | **SI-03** | | | | | | | | **SI-04** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Date** | 3/17/2016 | 3/17/2016 | | 3/17/2016 | | | | | | | 3/21/2016 | 3/22/2016 | | | | | | | 4/6/2016 | | | | | | | |
| **Sample Time (HH:MM)** | 17:00 | 17:30 | 19:15 | 12:37 | 12:57 | 13:17 | 13:37 | 13:57 | 14:17 | 14:37 | 12:45 | 9:22 | 9:42 | 10:02 | 10:22 | 10:42 | 11:02 | 11:22 | 8:30 | 15:08 | 15:08 | 15:33 | 15:53 | 16:13 | 16:53 | 17:13 |
| **Sample ID** | SI-01+SI-02 BASELINE | SI-01-90N-60 | SI-01-90N-POST | SI-02-90-INITIAL | SI-02-90-20 | SI-02-90-40 | SI-02-90-60 | SI-02-90-80 | SI-02-90-100 | SI-02-90-POST | SI-03 BASELINE | SI-03-70-INITIAL | SI-03-70-20 | SI-03-70-40 | SI-03-70-60 | SI-03-70-80 | SI-03-70-100 | SI-03-70-POST | SI-04 BASELINE | SI-04-90VR-INITIAL | SI-04-90VR-20 | SI-04-90VR-40 | SI-04-90VR-60 | SI-04-90VR-80 | SI-04-90VR-100 | SI-04-90VR-POST |
| **Lab Sample ID** | JC16619-10 | JC16619-1 | JC16619-2 | JC16619-3 | JC16619-4 | JC16619-5 | JC16619-6 | JC16619-7 | JC16619-8 | JC16619-9 | JC16773-1 | JC16773-2 | JC16773-3 | JC16773-4 | JC16773-5 | JC16773-6 | JC16773-7 | JC16773-8 | JC17894-1 | JC17894-2 | JC17894-3 | JC17894-4 | JC17894-5 | JC17894-6 | JC17894-7 | JC17894-8 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **VOCs (µg/kg)** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acetone | < 22000 | < 22000 | < 23000 | < 23000 | < 21000 | < 22000 | < 22000 | < 23000 | < 22000 | < 23000 | < 230000 | < 220000 | < 28000 | < 24000 | < 22000 | < 22000 | < 22000 | < 23000 | < 23000 | < 22000 | < 21000 | < 21000 | < 20000 | < 23000 | < 22000 | < 16000 |
| Benzene | **18800000** | **8460000** | **5440000** | **9270000** | **5360000** | **4940000** | **3620000** | **3270000** | **3140000** | **2660000** | **50700000** | **22400000** | **27000000** | **24900000** | **19300000** | **19200000** | **19000000** | **17700000** | **72100000** | **2110000** | **2320000** | **1560000** | **1190000** | **1240000** | **1010000** | **746000** |
| Bromochloromethane | < 3000 | < 3100 | < 3200 | < 3200 | < 2900 | < 3100 | < 3100 | < 3200 | < 3100 | < 3200 | < 32000 | < 30000 | < 3900 | < 3300 | < 3000 | < 3100 | < 3000 | < 3200 | < 3200 | < 3100 | < 2900 | < 2900 | < 2800 | < 3200 | < 3000 | < 2300 |
| Bromodichloromethane | < 1500 | < 1600 | < 1600 | < 1600 | < 1500 | < 1600 | < 1600 | < 1600 | < 1600 | < 1600 | < 16000 | < 15000 | < 2000 | < 1700 | < 1500 | < 1600 | < 1500 | < 1600 | < 1600 | < 1600 | < 1500 | < 1500 | < 1400 | < 1600 | < 1500 | < 1100 |
| Bromoform | < 2300 | < 2400 | < 2400 | < 2400 | < 2200 | < 2400 | < 2400 | < 2400 | < 2400 | < 2400 | < 24000 | < 23000 | < 3000 | < 2500 | < 2300 | < 2400 | < 2300 | < 2400 | < 2500 | < 2400 | < 2200 | < 2200 | < 2100 | < 2400 | < 2300 | < 1700 |
| Bromomethane | < 3500 | < 3600 | < 3700 | < 3700 | < 3400 | < 3600 | < 3600 | < 3700 | < 3600 | < 3700 | < 37000 | < 36000 | < 4600 | < 3900 | < 3500 | < 3600 | < 3600 | < 3700 | < 3800 | < 3600 | < 3400 | < 3400 | < 3200 | < 3700 | < 3600 | < 2700 |
| 2-Butanone (MEK | < 18000 | < 19000 | < 19000 | < 19000 | < 18000 | < 19000 | < 19000 | < 19000 | < 19000 | < 19000 | < 190000 | < 190000 | < 24000 | < 20000 | < 18000 | < 19000 | < 19000 | < 19000 | < 20000 | < 19000 | < 18000 | < 18000 | < 17000 | < 19000 | < 19000 | < 14000 |
| Carbon disulfide | **29100** | < 2300 | < 2300 | **8270 J** | **3910 J** | < 2300 | < 2300 | < 2300 | < 2300 | < 2300 | **77000 J** | < 22000 | **32900** | **29500** | **21300** | **22400** | **20500** | **20600** | **102000** | < 2300 | < 2200 | < 2200 | < 2000 | < 2300 | < 2200 | < 1700 |
| Carbon tetrachloride | < 2200 | < 2300 | < 2300 | < 2300 | < 2200 | < 2300 | < 2300 | < 2300 | < 2300 | < 2300 | < 23000 | < 23000 | < 2900 | < 2400 | < 2200 | < 2300 | < 2300 | < 2300 | < 2400 | < 2300 | < 2200 | < 2200 | < 2100 | < 2300 | < 2300 | < 1700 |
| Chlorobenzene | **5020 J** | < 1600 | < 1600 | **3110 J** | **2220 J** | < 1600 | < 1600 | < 1600 | < 1600 | < 1600 | < 16000 | < 15000 | **9900 J** | **9480 J** | **7480 J** | **7690 J** | **7440 J** | **7160 J** | **21600** | **3600 J** | **2880 J** | **2730 J** | < 1400 | < 1600 | < 1500 | < 1100 |
| Chloroethane | < 4600 | < 4800 | < 4900 | < 4900 | < 4500 | < 4800 | < 4800 | < 4900 | < 4800 | < 4900 | < 49000 | < 47000 | < 6000 | < 5100 | < 4600 | < 4800 | < 4700 | < 4900 | < 5000 | < 4800 | < 4500 | < 4500 | < 4300 | < 4900 | < 4700 | < 3500 |
| Chloroform | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 | < 1500 | < 15000 | < 15000 | < 1900 | < 1600 | < 1400 | < 1500 | < 1500 | < 1500 | < 1600 | < 1500 | < 1400 | < 1400 | < 1300 | < 1500 | < 1500 | < 1100 |
| Chloromethane | **19400 J** | < 2600 | < 2700 | < 2700 | < 2500 | < 2600 | < 2600 | < 2700 | < 2600 | < 2700 | < 27000 | < 26000 | < 3300 | < 2800 | < 2500 | < 2600 | < 2600 | < 2700 | **11100 J** | < 2600 | < 2500 | < 2500 | < 2300 | < 2700 | < 2600 | < 1900 |
| Cyclohexane | **14300 J** | **4460 J** | < 3200 | **5390 J** | < 3000 | < 3200 | < 3200 | < 3200 | < 3200 | < 3200 | < 32000 | < 31000 | **20000 J** | **18700 J** | **15800 J** | **15800 J** | **16500 J** | **13500 J** | **29100** | < 3200 | < 3000 | < 3000 | < 2800 | < 3200 | < 3100 | < 2300 |
| 1,2-Dibromo-3-chloropropane | < 5200 | < 5400 | < 5600 | < 5600 | < 5100 | < 5400 | < 5400 | < 5600 | < 5400 | < 5600 | < 56000 | < 53000 | < 6800 | < 5800 | < 5200 | < 5400 | < 5300 | < 5600 | < 5700 | < 5400 | < 5100 | < 5100 | < 4900 | < 5600 | < 5300 | < 4000 |
| Dibromochloromethane | < 2000 | < 2100 | < 2100 | < 2100 | < 1900 | < 2100 | < 2100 | < 2100 | < 2100 | < 2100 | < 21000 | < 20000 | < 2600 | < 2200 | < 2000 | < 2100 | < 2000 | < 2100 | < 2100 | < 2100 | < 1900 | < 1900 | < 1800 | < 2100 | < 2000 | < 1500 |
| 1,2-Dibromoethane | < 1300 | < 1300 | < 1300 | < 1300 | < 1200 | < 1300 | < 1300 | < 1300 | < 1300 | < 1300 | < 13000 | < 13000 | < 1600 | < 1400 | < 1300 | < 1300 | < 1300 | < 1300 | < 1400 | < 1300 | < 1200 | < 1200 | < 1200 | < 1300 | < 1300 | < 960 |
| 1,2-Dichlorobenzene | **850000** | **855000** | **715000** | **686000** | **519000** | **560000** | **444000** | **439000** | **524000** | **468000** | **1730000** | **1410000** | **1790000** | **1810000** | **1470000** | **1570000** | **1520000** | **1410000** | **3480000** | **1700000** | **1460000** | **1500000** | **1260000** | **1380000** | **1350000** | **1070000** |
| 1,3-Dichlorobenzene | **12800** | **12500** | **10200** | **10200** | **7520 J** | **7940 J** | **6570 J** | **5780 J** | **7490 J** | **5730 J** | **27700 J** | **19900 J** | **26800** | **28500** | **22100** | **23600** | **22600** | **21500** | **54100** | **23100** | **20500** | **19700** | **16800** | **18000** | **17400** | **14100** |
| 1,4-Dichlorobenzene | **74700** | **71300** | **57800** | **56200** | **41100** | **44900** | **36400** | **34400** | **42400** | **35000** | **159000** | **124000** | **150000** | **157000** | **126000** | **134000** | **130000** | **121000** | **310000** | **138000** | **122000** | **120000** | **102000** | **112000** | **105000** | **83600** |
| Dichlorodifluoromethane | < 3500 | < 3600 | < 3700 | < 3700 | < 3400 | < 3600 | < 3600 | < 3700 | < 3600 | < 3700 | < 37000 | < 35000 | < 4500 | < 3800 | < 3500 | < 3600 | < 3500 | < 3700 | < 3800 | < 3600 | < 3400 | < 3400 | < 3200 | < 3700 | < 3500 | < 2700 |
| 1,1-Dichloroethane | < 1400 | < 1400 | < 1400 | < 1400 | < 1300 | < 1400 | < 1400 | < 1400 | < 1400 | < 1400 | < 14000 | < 14000 | < 1800 | < 1500 | < 1400 | < 1400 | < 1400 | < 1400 | < 1500 | < 1400 | < 1300 | < 1300 | < 1300 | < 1400 | < 1400 | < 1000 |
| 1,2-Dichloroethane | < 1300 | < 1300 | < 1400 | < 1400 | < 1300 | < 1300 | < 1300 | < 1400 | < 1300 | < 1400 | < 14000 | < 13000 | < 1700 | < 1400 | < 1300 | < 1300 | < 1300 | < 1400 | < 1400 | < 1300 | < 1300 | < 1300 | < 1200 | < 1400 | < 1300 | < 990 |
| 1,1-Dichloroethene | < 5700 | < 5900 | < 6000 | < 6000 | < 5600 | < 5900 | < 5900 | < 6000 | < 5900 | < 6000 | < 60000 | < 58000 | < 7400 | < 6300 | < 5700 | < 5900 | < 5800 | < 6000 | < 6200 | < 5900 | < 5600 | < 5600 | < 5300 | < 6000 | < 5800 | < 4400 |
| cis-1,2-Dichloroethene | < 7500 | < 7800 | < 7900 | < 7900 | < 7300 | < 7800 | < 7800 | < 7900 | < 7800 | < 7900 | < 79000 | < 76000 | < 9700 | < 8300 | < 7500 | < 7800 | < 7600 | < 7900 | < 8100 | < 7800 | < 7300 | < 7300 | < 7000 | < 7900 | < 7600 | < 5700 |
| trans-1,2-Dichloroethene | < 5700 | < 5900 | < 6100 | < 6100 | < 5600 | < 5900 | < 5900 | < 6100 | < 5900 | < 6100 | < 61000 | < 58000 | < 7400 | < 6300 | < 5700 | < 5900 | < 5800 | < 6100 | < 6200 | < 5900 | < 5600 | < 5600 | < 5300 | < 6100 | < 5800 | < 4400 |
| 1,2-Dichloropropane | < 2300 | < 2400 | < 2400 | < 2400 | < 2200 | < 2400 | < 2400 | < 2400 | < 2400 | < 2400 | < 24000 | < 23000 | < 3000 | < 2500 | < 2300 | < 2400 | < 2300 | < 2400 | < 2500 | < 2400 | < 2200 | < 2200 | < 2100 | < 2400 | < 2300 | < 1700 |
| cis-1,3-Dichloropropene | < 1100 | < 1200 | < 1200 | < 1200 | < 1100 | < 1200 | < 1200 | < 1200 | < 1200 | < 1200 | < 12000 | < 12000 | < 1500 | < 1300 | < 1100 | < 1200 | < 1200 | < 1200 | < 1200 | < 1200 | < 1100 | < 1100 | < 1100 | < 1200 | < 1200 | < 870 |
| trans-1,3-Dichloropropene | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 | < 1800 | < 18000 | < 17000 | < 2200 | < 1900 | < 1700 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1700 | < 1600 | < 1800 | < 1700 | < 1300 |
| Ethylbenzene | **101000** | **64000** | **48700** | **58200** | **39200** | **40100** | **30500** | **28600** | **32900** | **27900** | **239000** | **132000** | **177000** | **172000** | **139000** | **143000** | **139000** | **131000** | **325000** | **45200** | **41900** | **38400** | **30000** | **30200** | **28100** | **22100** |
| Freon 113 | < 4300 [a] | < 4500 [a] | < 4600 [a] | < 4600 [a] | < 4200 [a] | < 4500 [a] | < 4500 [a] | < 4600 [a] | < 4500 [a] | < 4600 [a] | < 46000 [a] | < 44000 [a] | < 5600 [a] | < 4800 [a] | < 4300 [a] | < 4500 [a] | < 4400 [a] | < 4600 [a] | < 4700 | < 4500 | < 4200 | < 4200 | < 4000 | < 4600 | < 4400 | < 3300 |
| 2-Hexanone | < 13000 | < 13000 | < 14000 | < 14000 | < 13000 | < 13000 | < 13000 | < 14000 | < 13000 | < 14000 | < 140000 | < 130000 | < 17000 | < 14000 | < 13000 | < 13000 | < 13000 | < 14000 | < 14000 | < 13000 | < 13000 | < 13000 | < 12000 | < 14000 | < 13000 | < 9900 |
| Isopropylbenzene | **267000** | **195000** | **153000** | **162000** | **115000** | **119000** | **92300** | **86200** | **102000** | **83000** | **546000** | **336000** | **454000** | **456000** | **365000** | **395000** | **376000** | **346000** | **748000** | **157000** | **135000** | **131000** | **110000** | **116000** | **107000** | **83300** |
| Methyl Acetate | **118000** | **95600** | **100000** | **103000** | **84900** | **89900** | **92000** | **85900** | **83800** | **81600** | **256000 J** | < 84000 | **254000** | **162000** | **138000** | **131000** | **123000** | **147000** | **227000** | **63700** | **54300** | **55500** | **48100** | **52700** | **54200** | **44400** |
| Methylcyclohexane | **24800** | **10600 J** | **7290 J** | **10000 J** | **6200 J** | **6710 J** | **4360 J** | **4460 J** | **5170 J** | **4000 J** | **51100 J** | < 22000 | **35200** | **36300** | **28800** | **31200** | **29500** | **25300** | **62800** | **4680 J** | **4080 J** | **3030 J** | **2580 J** | **2420 J** | < 2200 | < 1700 |
| Methyl Tert Butyl Ether | < 1500 | < 1500 | < 1600 | < 1600 | < 1400 | < 1500 | < 1500 | < 1600 | < 1500 | < 1600 | < 16000 | < 15000 | < 1900 | < 1600 | < 1500 | < 1500 | < 1500 | < 1600 | < 1600 | < 1500 | < 1400 | < 1400 | < 1400 | < 1600 | < 1500 | < 1100 |
| 4-Methyl-2-pentanone(MIBK | < 4400 | < 4600 | < 4700 | < 4700 | < 4300 | < 4600 | < 4600 | < 4700 | < 4600 | < 4700 | < 47000 | < 45000 | < 5700 | < 4900 | < 4400 | < 4600 | < 4500 | < 4700 | < 4800 | < 4600 | < 4300 | < 4300 | < 4100 | < 4700 | < 4500 | < 3400 |
| Methylene chloride | < 9400 | < 9800 | < 10000 | < 10000 | < 9300 | < 9800 | < 9800 | < 10000 | < 9800 | < 10000 | < 100000 | < 96000 | < 12000 | < 10000 | < 9400 | < 9800 | < 9600 | < 10000 | < 10000 | < 9800 | < 9300 | < 9300 | < 8800 | < 10000 | < 9600 | < 7200 |
| Naphthalene | **1980000** | **2500000** | **2760000** | **1920000** | **1570000** | **1780000** | **1440000** | **1410000** | **1810000** | **1560000** | **3860000** | **3470000** | **4490000** | **4760000** | **4130000** | **3910000** | **3890000** | **3660000** | **7730000** | **5330000** | **4990000** | **5240000** | **4730000** | **5410000** | **5620000** | **4440000** |
| Styrene | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 | < 1800 | < 18000 | < 17000 | < 2200 | < 1900 | < 1700 | < 1800 | < 1700 | < 1800 | < 1900 | < 1800 | < 1700 | < 1700 | < 1600 | < 1800 | < 1700 | < 1300 |
| 1,1,2,2-Tetrachloroethane | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 | < 1800 | < 18000 | < 17000 | < 2200 | < 1900 | < 1700 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1700 | < 1600 | < 1800 | < 1700 | < 1300 |
| Tetrachloroethene | < 2900 | < 3000 | < 3100 | < 3100 | < 2800 | < 3000 | < 3000 | < 3100 | < 3000 | < 3100 | < 31000 | < 30000 | < 3800 | < 3200 | < 2900 | < 3000 | < 3000 | < 3100 | **9190 J** | < 3000 | < 2800 | < 2800 | < 2700 | < 3100 | < 3000 | **4340 J** |
| Toluene | **5580000** | **3240000** | **1960000** | **3030000** | **1870000** | **1830000** | **1360000** | **1280000** | **1370000** | **1160000** | **13600000** | **6910000** | **9020000** | **8470000** | **6870000** | **6660000** | **6600000** | **6100000** | **16800000** | **1140000** | **1060000** | **883000** | **690000** | **711000** | **626000** | **473000** |
| 1,2,3-Trichlorobenzene | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 | < 1800 | < 18000 | < 17000 | < 2200 | < 1900 | < 1700 | < 1800 | < 1700 | < 1800 | < 1800 | < 1800 | < 1700 | < 1700 | < 1600 | < 1800 | < 1700 | < 1300 |
| 1,2,4-Trichlorobenzene | < 1600 | < 1700 | < 1700 | < 1700 | < 1600 | < 1700 | < 1700 | < 1700 | < 1700 | < 1700 | < 17000 | < 17000 | < 2100 | < 1800 | < 1600 | < 1700 | < 1700 | < 1700 | **8890 J** | < 1700 | < 1600 | < 1600 | < 1500 | < 1700 | < 1700 | **4630 J** |
| 1,1,1-Trichloroethane | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 | < 1500 | < 15000 | < 15000 | < 1900 | < 1600 | < 1400 | < 1500 | < 1500 | < 1500 | < 1600 | < 1500 | < 1400 | < 1400 | < 1300 | < 1500 | < 1500 | < 1100 |
| 1,1,2-Trichloroethane | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 | < 1500 | < 15000 | < 14000 | < 1800 | < 1600 | < 1400 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1400 | < 1300 | < 1500 | < 1400 | < 1100 |
| Trichloroethene | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 | < 1500 | < 15000 | < 14000 | < 1800 | < 1600 | < 1400 | < 1500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1400 | < 1400 | < 1300 | < 1500 | < 1400 | < 1100 |
| Trichlorofluoromethane | < 2400 | < 2500 | < 2500 | < 2500 | < 2300 | < 2500 | < 2500 | < 2500 | < 2500 | < 2500 | < 25000 | < 24000 | < 3100 | < 2600 | < 2400 | < 2500 | < 2400 | < 2500 | < 2600 | < 2500 | < 2300 | < 2300 | < 2200 | < 2500 | < 2400 | < 1800 |
| Vinyl chloride | < 1900 | < 2000 | < 2000 | < 2000 | < 1900 | < 2000 | < 2000 | < 2000 | < 2000 | < 2000 | < 20000 | < 19000 | < 2500 | < 2100 | < 1900 | < 2000 | < 1900 | < 2000 | < 2100 | < 2000 | < 1900 | < 1900 | < 1800 | < 2000 | < 1900 | < 1400 |
| m,p-Xylene | **1080000** | **716000** | **525000** | **625000** | **421000** | **433000** | **327000** | **316000** | **355000** | **307000** | **2350000** | **1360000** | **1770000** | **1740000** | **1410000** | **1460000** | **1430000** | **1350000** | **3090000** | **485000** | **440000** | **402000** | **319000** | **327000** | **298000** | **236000** |
| o-Xylene | **285000** | **206000** | **156000** | **176000** | **119000** | **125000** | **96300** | **93900** | **105000** | **92200** | **615000** | **358000** | **496000** | **481000** | **391000** | **407000** | **396000** | **375000** | **856000** | **163000** | **146000** | **137000** | **110000** | **114000** | **107000** | **83400** |
| Xylene (total | **1370000** | **922000** | **682000** | **801000** | **541000** | **558000** | **423000** | **410000** | **460000** | **399000** | **2970000** | **1720000** | **2270000** | **2220000** | **1800000** | **1870000** | **1820000** | **1720000** | **3940000** | **648000** | **586000** | **539000** | **429000** | **440000** | **406000** | **319000** |

**Notes;**

VOC = volatile organic compound

ug/kg = micrograms per kilogram

J = estimated detected result

a This compound in blank spike is outside laboratory in-house quality control limits, bias high

Table 2. Master Table of Sample VOC

*Focused Feasibility Study Results Sum*

*Operable Unit 8, American Cyanamid*

*Bridgewater, New Jersey*

| **Test ID** | **SI-05/SI-06** | | | **SI-05** | | | | | | | **SI-06** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Date** | 4/13/2016 | | | | | | | | | | 4/15/2016 | | | | | | |
| **Sample Time (HH:MM)** | 10:30 | 10:32 | 10:33 | 14:00 | 14:20 | 14:40 | 15:00 | 15:20 | 15:40 | 16:00 | 13:30 | 13:50 | 14:10 | 14:30 | 14:50 | 15:10 | 15:30 |
| **Sample ID** | SI-05+SI-06 BASELINE(A) | SI-05+SI-06 BASELINE(B) | SI-05+SI-06 BASELINE(C) | SI-05-90-INITIAL | SI-05-90-20 | SI-05-90-40 | SI-05-90-60 | SI-05-90-80 | SI-05-90-100 | SI-05-90-POST | SI-06-90-INITAL | SI-06-90-20 | SI-06-90-40 | SI-06-90-60 | SI-06-90-80 | SI-06-90-100 | SI-06-90-POST |
| **Lab Sample ID** | JC18297-1 | JC18297-2 | JC18297-3 | JC18297-4 | JC18297-5 | JC18297-6 | JC18297-7 | JC18297-8 | JC18297-9 | JC18297-10 | JC18511-1 | JC18511-2 | JC18511-3 | JC18511-4 | JC18511-5 | JC18511-6 | JC18511-7 |
| | | | | | | | | | | | | | | | | | |
| **VOCs (µg/kg)** | | | | | | | | | | | | | | | | | |
| Acetone | **42000** | **47700** | **23900** | **5530 J** | < 110000 | < 110000 | < 98000 | < 110000 | < 100000 | < 110000 | < 20000 | < 37000 | < 21000 | < 22000 | < 22000 | < 23000 | < 23000 |
| Benzene | **67200000** | **56300000** | **47800000** | **11200000** | **8940000** | **9150000** | **7880000** | **8030000** | **6580000** | **5310000** | **22500000** | **32700000** | **16200000** | **14300000** | **13700000** | **13700000** | **20300000** |
| Bromochloromethane | < 310 | < 300 | < 310 | < 300 | < 16000 | < 15000 | < 14000 | < 15000 | < 14000 | < 15000 | < 2800 | < 5200 | < 2900 | < 3100 | < 3100 | < 3200 | < 3200 |
| Bromodichloromethane | < 160 | < 150 | < 160 | < 150 | < 8000 | < 7600 | < 6800 | < 7800 | < 7200 | < 7500 | < 1400 | < 2600 | < 1500 | < 1600 | < 1600 | < 1600 | < 1600 |
| Bromoform | < 240 | < 230 | < 240 | < 230 | < 12000 | < 12000 | < 10000 | < 12000 | < 11000 | < 11000 | < 2100 | < 3900 | < 2200 | < 2400 | < 2400 | < 2400 | < 2400 |
| Bromomethane | < 360 | < 350 | < 360 | < 360 | < 19000 | < 18000 | < 16000 | < 18000 | < 17000 | < 17000 | < 3200 | < 6100 | < 3400 | < 3600 | < 3600 | < 3700 | < 3700 |
| 2-Butanone (MEK | **10200** | **8920 J** | **5660 J** | < 1900 | < 97000 | < 94000 | < 84000 | < 96000 | < 88000 | < 92000 | < 17000 | < 32000 | < 18000 | < 19000 | < 19000 | < 19000 | < 19000 |
| Carbon disulfide | **105000** | **87900** | **76000** | **5940** | < 12000 | < 11000 | < 10000 | < 11000 | < 11000 | < 11000 | **19000** | **23500 J** | **9440 J** | **6780 J** | **7500 J** | **7730 J** | **9620 J** |
| Carbon tetrachloride | < 230 | < 220 | < 230 | < 230 | < 12000 | < 11000 | < 10000 | < 12000 | < 11000 | < 11000 | < 2100 | < 3800 | < 2200 | < 2300 | < 2300 | < 2300 | < 2300 |
| Chlorobenzene | **15000** | **13900** | **16100** | **5570** | < 7900 | < 7600 | < 6800 | < 7800 | < 7200 | < 7500 | **8170 J** | **10100 J** | **5140 J** | **4920 J** | **4290 J** | **5110 J** | **6150 J** |
| Chloroethane | **3190 J** | **2410 J** | **1430 J** | < 470 | < 25000 | < 24000 | < 21000 | < 24000 | < 22000 | < 23000 | < 4300 | < 8000 | < 4500 | < 4800 | < 4800 | < 4900 | < 4900 |
| Chloroform | **568 J** | **467 J** | **449 J** | < 150 | < 7600 | < 7300 | < 6500 | < 7500 | < 6900 | < 7200 | < 1300 | < 2500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 |
| Chloromethane | **47200** | **34600** | **14800** | **568 J** | < 13000 | < 13000 | < 11000 | < 13000 | < 12000 | < 13000 | < 2300 | < 4400 | < 2500 | < 2600 | < 2600 | < 2700 | < 2700 |
| Cyclohexane | **22800** | **18200** | **17900** | **5620** | < 16000 | < 15000 | < 14000 | < 16000 | < 15000 | < 15000 | **10300 J** | **18100 J** | **7420 J** | **5500 J** | **5920 J** | **6940 J** | **9640 J** |
| 1,2-Dibromo-3-chloropropane | < 540 | < 520 | < 540 | < 530 | < 28000 | < 27000 | < 24000 | < 27000 | < 25000 | < 26000 | < 4900 | < 9100 | < 5100 | < 5400 | < 5400 | < 5600 | < 5600 |
| Dibromochloromethane | < 210 | < 200 | < 210 | < 200 | < 10000 | < 10000 | < 9000 | < 10000 | < 9500 | < 9900 | < 1800 | < 3400 | < 1900 | < 2100 | < 2100 | < 2100 | < 2100 |
| 1,2-Dibromoethane | < 130 | < 130 | < 130 | < 130 | < 6700 | < 6400 | < 5700 | < 6600 | < 6100 | < 6300 | < 1200 | < 2200 | < 1200 | < 1300 | < 1300 | < 1300 | < 1300 |
| 1,2-Dichlorobenzene | **2250000** | **2110000** | **2590000** | **1590000** | **1560000** | **1490000** | **1170000** | **1390000** | **1190000** | **1130000** | **1490000** | **2370000** | **1140000** | **1110000** | **1020000** | **1240000** | **1560000** |
| 1,3-Dichlorobenzene | **35300** | **31200** | **41700** | **21700** | **22100 J** | **20000 J** | **16500 J** | **17900 J** | **16200 J** | **14500 J** | **22300** | **34800** | **15700** | **15700** | **14200** | **17400** | **22300** |
| 1,4-Dichlorobenzene | **202000** | **176000** | **233000** | **127000** | **122000** | **114000** | **89500** | **103000** | **91500** | **85900** | **123000** | **206000** | **94000** | **90000** | **82700** | **105000** | **128000** |
| Dichlorodifluoromethane | < 360 | < 350 | < 360 | < 350 | < 18000 | < 18000 | < 16000 | < 18000 | < 17000 | < 17000 | < 3200 | < 6000 | < 3400 | < 3600 | < 3600 | < 3700 | < 3700 |
| 1,1-Dichloroethane | < 140 | < 140 | < 140 | < 140 | < 7200 | < 6900 | < 6200 | < 7100 | < 6500 | < 6800 | < 1300 | < 2400 | < 1300 | < 1400 | < 1400 | < 1400 | < 1400 |
| 1,2-Dichloroethane | < 130 | < 130 | < 130 | < 130 | < 6800 | < 6600 | < 5900 | < 6700 | < 6200 | < 6400 | < 1200 | < 2200 | < 1300 | < 1300 | < 1300 | < 1400 | < 1400 |
| 1,1-Dichloroethene | < 590 | < 570 | < 590 | < 580 | < 30000 | < 29000 | < 26000 | < 30000 | < 27000 | < 28000 | < 5300 | < 9900 | < 5600 | < 5900 | < 5900 | < 6000 | < 6000 |
| cis-1,2-Dichloroethene | < 780 | < 750 | < 780 | < 760 | < 40000 | < 38000 | < 34000 | < 39000 | < 36000 | < 37000 | < 7000 | < 13000 | < 7300 | < 7800 | < 7800 | < 7900 | < 7900 |
| trans-1,2-Dichloroethene | < 590 | < 570 | < 590 | < 580 | < 30000 | < 29000 | < 26000 | < 30000 | < 28000 | < 29000 | < 5300 | < 9900 | < 5600 | < 5900 | < 5900 | < 6100 | < 6100 |
| 1,2-Dichloropropane | < 240 | < 230 | < 240 | < 230 | < 12000 | < 12000 | < 10000 | < 12000 | < 11000 | < 11000 | < 2100 | < 4000 | < 2200 | < 2400 | < 2400 | < 2400 | < 2400 |
| cis-1,3-Dichloropropene | < 120 | < 110 | < 120 | < 120 | < 6000 | < 5800 | < 5200 | < 5900 | < 5500 | < 5700 | < 1100 | < 2000 | < 1100 | < 1200 | < 1200 | < 1200 | < 1200 |
| trans-1,3-Dichloropropene | < 180 | < 170 | < 180 | < 170 | < 9000 | < 8700 | < 7800 | < 8900 | < 8200 | < 8500 | < 1600 | < 3000 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 |
| Ethylbenzene | **302000** | **260000** | **237000** | **99700** | **93600** | **83800** | **68600** | **74500** | **63600** | **56000** | **146000** | **214000** | **101000** | **95500** | **88200** | **109000** | **131000** |
| Freon 113 | < 450 | < 430 | < 450 | < 440 | < 23000 | < 22000 | < 20000 | < 22000 | < 21000 | < 22000 | < 4000 | < 7500 | < 4200 | < 4500 | < 4500 | < 4600 | < 4600 |
| 2-Hexanone | < 1300 | < 1300 | < 1300 | < 1300 | < 68000 | < 66000 | < 59000 | < 67000 | < 62000 | < 64000 | < 12000 | < 22000 | < 13000 | < 13000 | < 13000 | < 14000 | < 14000 |
| Isopropylbenzene | **746000** | **632000** | **544000** | **280000** | **271000** | **261000** | **204000** | **230000** | **200000** | **178000** | **417000** | **665000** | **300000** | **287000** | **259000** | **313000** | **423000** |
| Methyl Acetate | **305000** | **358000** | **197000** | **223000** | < 44000 | **187000 J** | **187000 J** | **162000 J** | **174000 J** | **152000 J** | **293000** | **307000** | **214000** | **221000** | **201000** | **207000** | **192000** |
| Methylcyclohexane | **59100** | **44800** | **46400** | **15000** | **13100 J** | **12000 J** | < 10000 | < 11000 | < 11000 | < 11000 | **24800** | **44600** | **17000 J** | **14600 J** | **15600 J** | **19800 J** | **26300** |
| Methyl Tert Butyl Ether | **299 J** | **433 J** | < 150 | < 150 | < 7800 | < 7500 | < 6700 | < 7700 | < 7100 | < 7400 | < 1400 | < 2600 | < 1400 | < 1500 | < 1500 | < 1600 | < 1600 |
| 4-Methyl-2-pentanone(MIBK | < 460 | < 440 | < 460 | < 450 | < 23000 | < 22000 | < 20000 | < 23000 | < 21000 | < 22000 | < 4100 | < 7700 | < 4300 | < 4600 | < 4600 | < 4700 | < 4700 |
| Methylene chloride | < 980 | < 940 | < 980 | < 960 | < 50000 | < 48000 | < 43000 | < 49000 | < 45000 | < 47000 | < 8800 | < 16000 | < 9300 | < 9800 | < 9800 | < 10000 | < 10000 |
| Naphthalene | **5230000** | **4750000** | **6940000** | **4870000** | **5030000** | **4850000** | **3830000** | **4660000** | **4230000** | **4070000** | **2610000** | **6470000** | **2480000** | **2800000** | **2730000** | **3110000** | **4910000** |
| Styrene | < 180 | < 170 | < 180 | < 170 | < 9100 | < 8700 | < 7800 | < 8900 | < 8200 | < 8600 | < 1600 | < 3000 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 |
| 1,1,2,2-Tetrachloroethane | < 180 | < 170 | < 180 | < 170 | < 8900 | < 8600 | < 7700 | < 8800 | < 8100 | < 8400 | < 1600 | < 2900 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 |
| Tetrachloroethene | **1130 J** | **312 J** | **372 J** | < 300 | < 15000 | < 15000 | < 13000 | < 15000 | < 14000 | < 14000 | < 2700 | < 5000 | < 2800 | < 3000 | < 3000 | < 3100 | < 3100 |
| Toluene | **15600000** | **13500000** | **11600000** | **3690000** | **3680000** | **3230000** | **2700000** | **2780000** | **2300000** | **1950000** | **6330000** | **10700000** | **5030000** | **4730000** | **4560000** | **4630000** | **7200000** |
| 1,2,3-Trichlorobenzene | < 180 | < 170 | < 180 | < 170 | < 9000 | < 8600 | < 7700 | < 8800 | < 8100 | < 8500 | < 1600 | < 2900 | < 1700 | < 1800 | < 1800 | < 1800 | < 1800 |
| 1,2,4-Trichlorobenzene | **4330 J** | **3730 J** | **5010** | **3860 J** | < 8600 | < 8300 | < 7400 | < 8500 | < 7800 | < 8100 | **4640 J** | **7720 J** | < 1600 | < 1700 | < 1700 | < 1700 | **4100 J** |
| 1,1,1-Trichloroethane | **266 J** | **263 J** | **469 J** | < 150 | < 7600 | < 7300 | < 6500 | < 7500 | < 6900 | < 7200 | < 1300 | < 2500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 |
| 1,1,2-Trichloroethane | < 150 | < 140 | < 150 | < 140 | < 7500 | < 7200 | < 6400 | < 7400 | < 6800 | < 7100 | < 1300 | < 2500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 |
| Trichloroethene | < 150 | < 140 | < 150 | < 140 | < 7500 | < 7200 | < 6400 | < 7400 | < 6800 | < 7100 | < 1300 | < 2500 | < 1400 | < 1500 | < 1500 | < 1500 | < 1500 |
| Trichlorofluoromethane | < 250 | < 240 | < 250 | < 240 | < 13000 | < 12000 | < 11000 | < 12000 | < 12000 | < 12000 | < 2200 | < 4200 | < 2300 | < 2500 | < 2500 | < 2500 | < 2500 |
| Vinyl chloride | < 200 | < 190 | < 200 | < 190 | < 10000 | < 9700 | < 8600 | < 9900 | < 9100 | < 9500 | < 1800 | < 3300 | < 1900 | < 2000 | < 2000 | < 2000 | < 2000 |
| m,p-Xylene | **2820000** | **2440000** | **2190000** | **912000** | **896000** | **803000** | **648000** | **712000** | **602000** | **529000** | **1400000** | **2100000** | **971000** | **914000** | **846000** | **1040000** | **1270000** |
| o-Xylene | **724000** | **625000** | **581000** | **286000** | **265000** | **242000** | **189000** | **218000** | **184000** | **166000** | **403000** | **606000** | **281000** | **266000** | **250000** | **304000** | **371000** |
| Xylene (total | **3540000** | **3060000** | **2770000** | **1200000** | **1160000** | **1050000** | **838000** | **931000** | **786000** | **695000** | **1800000** | **2700000** | **1250000** | **1180000** | **1100000** | **1340000** | **1640000** |

**Notes;**

VOC = volatile organic compound

ug/kg = micrograms per kilogram

J = estimated detected result

a This compound in blank spike is outside laboratory in-house quality control limits, bias high

Table 3. S/S-treated Material Observations

*Focused Feasibility Study Results Summary: Bench-scale Thermally Enhanced ISS Testing*
*Operable Unit 8, American Cyanamid Superfund Site*
*Bridgewater, New Jersey*

| KEMRON Sample Number | Untreated Material Type[(1)] | Reagent Type and Identification Number(s) | Reagent Addition % by Wet Soil wt. | Water Addition % by Reagent wt. | Mixture Observations | Material pH EPA 9045 (s.u.) | 21-day UCS ASTM D2166 ($lb/in^2$) |
|---|---|---|---|---|---|---|---|
| EXP-012 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 0.0 | Very dry and soil like. Reaction fast. | 12.07 | 7.2 |
| EXP-013 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 100.0 | Moist and soil like. Reaction fast. | 12.09 | 10.1 |
| EXP-014 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 0.0 | Very dry and soil like. Reaction fast. | 10.99 | 15.1 |
| EXP-015 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 100.0 | Moist and soil like. Reaction fast. | 11.12 | 15.3 |
| EXP-016 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 0.0 | Moist with a shredded rubber consistency. Reaction fast. | 11.76 | 18.5 |
| EXP-017 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 100.0 | Moist and soil like. Reaction fast. | 11.79 | 22.8 |
| EXP-018 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 100.0 | Wet and soil like. Moderate reaction. | 8.33 | 9.1 |
| EXP-019 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 0.0 | Dry and fine grain soil like. Reaction fast. | 5.77 | 14.4 |
| EXP-020 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 0.0 | Dry and soil like. Moderate reaction | 11.85 | 11.6 |
| EXP-021 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 100.0 | Wet and soil like. Moderate reaction. | 6.28 | 12.0 |
| EXP-022 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | Wet and crumbly soil like material. Moderate reaction | 6.64 | 18.0 |
| EXP-023 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 0.0 | Moist and crumbly soil like material. Moderate reaction. | 3.85 | 19.9 |
| EXP-028 | VR | LaFarge Type I PC #1005 | 15.0 | 100.0 | Rubbery dense material. Not soil like | 11.63 | 1.2 |
| EXP-025 | VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 30.0 | 0.0 | Rubbery dense material. Not soil like | - | - |
| EXP-026 | VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 30.0 | 0.0 | Rubbery dense material. Not soil like | - | - |
| EXP-027 | VR 90 | LaFarge Type I PC #1005 | 15.0 | 0.0 | Rubbery dense material. Not soil like | - | - |
| EXP-028 | VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | Rubbery dense material. Not soil like. Water released. | - | - |
| EXP-029 | VR 90 | Corn Cobb / Type I PC | 20 / 15 | 0.0 | 2-step process. Sticky after corn cobb, stiff and rubbery after cement addition. Difficult to mix well. | - | - |
| EXP-030 | VR 90 | Hydrated Lime / PC | 10 / 10 | 0.0 | 2-step process. Stiff and rubbery after lime addition. Cement was difficult to work into mixture. Very stiff and rubbery with the release of liquid. | - | - |
| EXP-031 | VR 90 | Hydrated Lime / PC | 10 / 10 | 100.0 | 1-step process. Material becomes stringy and taffy-like. Lots of free liquid not absorbed in mixture. | - | - |
| EXP-032 | VR 90 | Hydrated Lime / PC | 15 / 10 | 100.0 | 1-step process. Material becomes stringy and taffy-like. Lots of free liquid not absorbed in mixture. | - | - |
| SI-05-ISS | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | - | 10.38 | 21.8 |
| SI-06-ISS | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | - | 10.54 | 26.4 |

Notes:

% = Percent

$lb/ft^3$ = pounds per cubic foot

$lb/in^2$ = pounds per square inch

UCS = Unconfined Compressive Strength

Wt= Weight

s.u. = Standard Units

(1) = Untreated material is a 50:50 Ration of HR and VR after steam treatment
90N = 90°C Treatment Temperature with neutralization
90 = 90°C Treatment Temperature with out neutralization
SI5-90= Steam Injection Run # - treatment temperature

Attachment 1

**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**

# FINAL REPORT

**KEMRON PROJECT #: SH0605**

**May 15, 2016**

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APPENDIX A Sample Shipping and Chain of Custody Documents
APPENDIX B Physical Characterization Data Sheets
APPENDIX C Treatability Study Photographic Log



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## 1.0 INTRODUCTION

The American Cyanamid Superfund Site Steam Mixing and Stabilization (ISS) Treatability Study, as outlined in this final report, has been developed to present the results of bench-scale testing performed on materials from the American Cyanamid Superfund Site, located in Bridgewater New Jersey, (the Site). The treatability study was performed based on information provided by CH2M, and in accordance with KEMRON's Proposal Number 15-ATG-3917, and subsequent modifications requested or agreed upon by CH2M. The objectives of the study were to:

1. Characterize the physical and chemical properties of impoundment material sampled from the site. Note that all analytical evaluations of the untreated and treated materials were managed by CH2M and have not been included in this report at the request of CH2M;
2. Evaluate the contaminant mass reduction through the use of in-situ steam injection during auger mixing;
3. Evaluate potential solidification reagents and reagent addition rates capable of improving the physical properties, primarily workability and strength, of the steam treated impoundment materials.

The following sections of this report present information regarding the tasks and protocols followed in completing the treatability study. All testing conducted during this study was performed by KEMRON Environmental Services, Inc, located in Atlanta, Georgia, and SGS Accutest Laboratories (Accutest), located in Dayton, New Jersey. Note that Accutest was selected by CH2M for all analytical testing associated with this project. Management of analytical testing and analytical data was performed by CH2M, and as such the results of analyses performed on the test materials have not been presented by KEMRON.


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## 2.0 TEST SAMPLES

KEMRON utilized archived test materials from the site which were provided to KEMRON for a previous treatability study conducted in 2012. These archived materials were used for planning operations including, equipment performance evaluations, and trial treatment testing to identify potential equipment deficiencies, and to finalize treatment procedures and protocol. On January 12, 20016, KEMRON received aliquots of two materials from the site for use during the steam mixing study.

Materials provided for the Treatability study included:

- HC – Hard Crumbly
- VR – Viscous Rubbery

Copies of the Sample Shipping Documents are included in **Appendix A** of this report.

### 2.1. Sample Receipt and Handling

Upon receipt by KEMRON, the untreated site materials were photographed, logged in, and placed into refrigerated secure storage maintained at a temperature of approximately 4 degrees Celsius (C).

Prior to testing, each individual sample material was homogenized prior to any testing to obtain a uniform starting material. Homogenization of the site test materials was conducted by placing the contents of each specific test material shipping container into a large mixing bin. The test material was then gently mixed by hand using stainless steel utensils. Large or agglomerated particles were broken by hand into more manageable sizes. Any free liquids present in the site material, at this stage of homogenization, were re-incorporated in the test materials during homogenization. Because of the physical consistency of the test materials (tarry, rubbery, hardened), homogenization was performed by hand to the extent possible.

For this study KEMRON utilized a composite of the HC and VR material at a one to one ratio (1:1). Compositing was conducted on a by-weight basis where equal portions of both materials were placed into a large mixing bin and blended together by hand until visually homogeneous.


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Note that all homogenization activities were conducted on the chilled materials in order to reduce potential volatilization of contaminate mass. However, thorough homogenization of the site samples is critical for accurate and meaningful results. As previously mentioned homogenization and compositing of the site materials was difficult and potential sample heterogeneity should be anticipated.

KEMRON performed characterization testing of the untreated materials as outlined in the cost proposal. The following is a summary of physical properties testing performed on the untreated site materials:

**Untreated Physical Properties Testing**

| Parameter | Method |
|---|---|
| Moisture Content @ 60C for 72 Hours | ASTM D2216 MOD |
| Moisture Content @ 110C for 16 Hours | ASTM D2216 |
| Bulk Density | ASTM D7263 |

In addition to the physical properties testing, aliquots of the untreated composite material were forwarded to Acutest.

Moisture content testing performed by KEMRON was conducted at temperatures of both 60 and 110 degrees Celsius. Because of the high organic content of the site materials KEMRON believed that testing only at the ASTM D2216 temperature of 110C would provide erroneously high moisture content values because of the potential for volatilizing organic compounds as well as removing water moisture. The results of untreated physical properties testing conducted by KEMRON are included in **Table 1** found in the TABLES section attached to this text. Characterization data sheets for physical testing is included in **Appendix B**. Photographic documentation of the As-Received material is included in **Appendix C**.

Review of **Table 1** indicates that the HC/VR Composite material exhibited a moisture content of 22.62 percent (%) at the 60C temperature, and a 40.84% moisture content at the 110C temperature. The bulk unit weight (density) of the composite material was 70.1 pounds per cubic foot (PCF).


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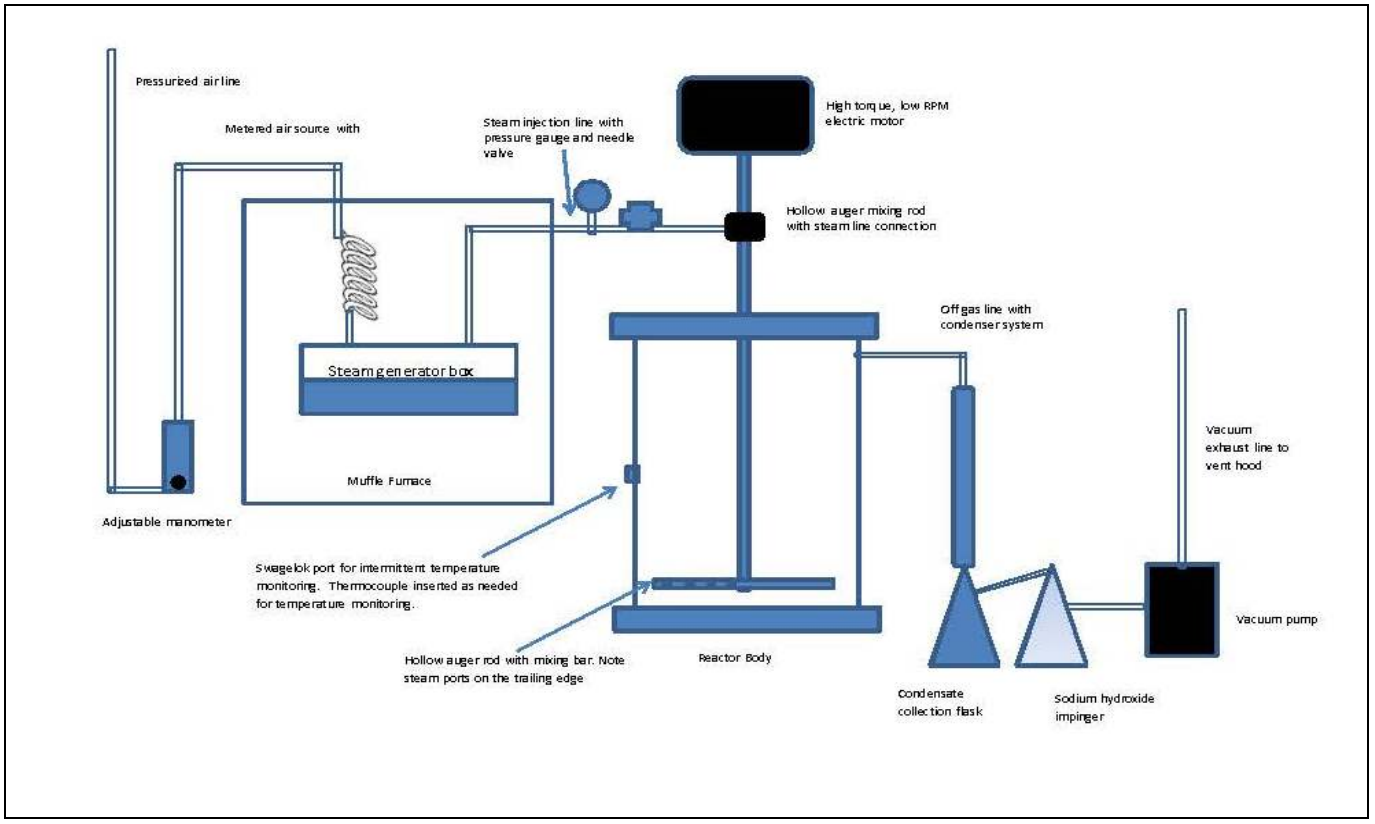
# 3.0 STEAM INJECTION EQUIPMENT PREPARATION AND TRIAL TESTING

## 3.1. Steam Injection Equipment Preparation

The primary purpose of the treatability study was to determine if the injection of steam, during an in-situ material mixing application, could reduce the total mass of volatile organic compounds present in the impoundment materials. Specialized equipment was designed and fabricated to simulate potential full-scale activities, including the injection of steam through a mixing auger capable of horizontal rotation and vertical movement during blending, a method for sampling the material being treated at various treatment time intervals, and a method for off-gas monitoring. The following is a general depiction of the testing equipment utilized in the study. This depiction is also included in the appendices.




To provide the vertical movement of the auger and mixing bar to simulate actual full-scale activities, the auger and power motor remained stable, and the reactor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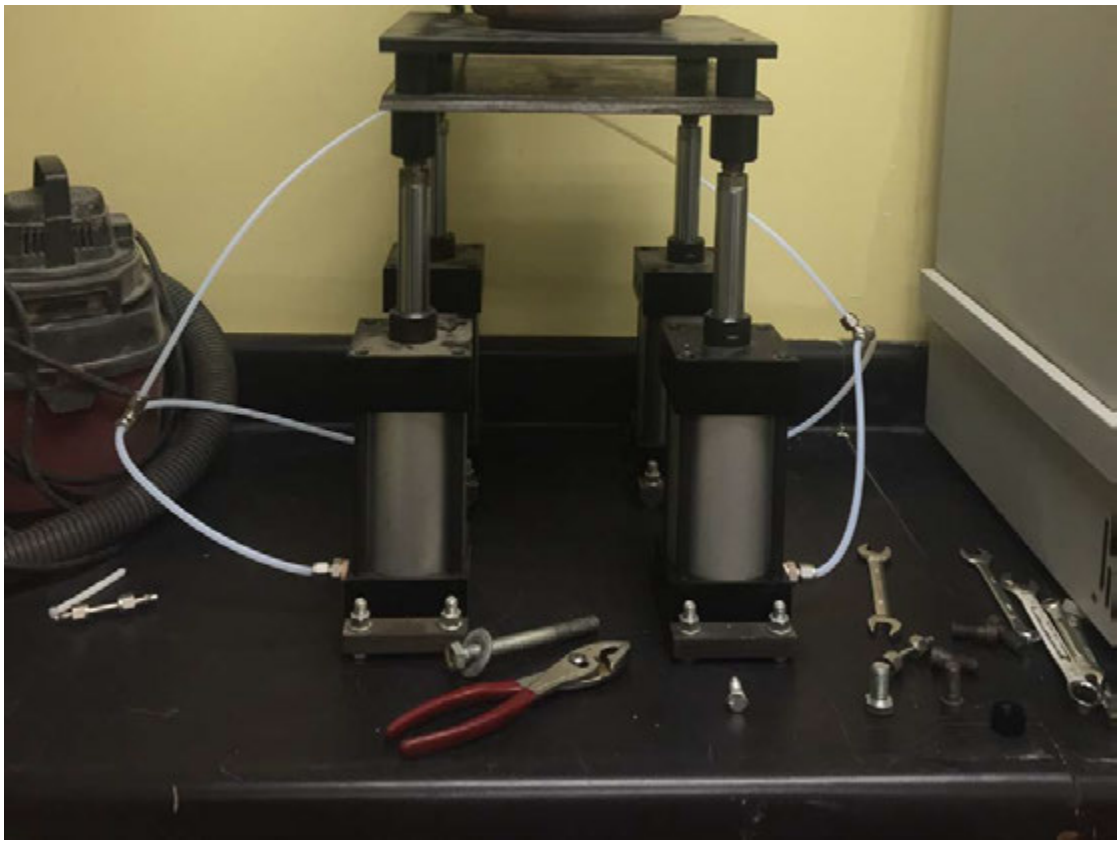
body was raised or lowered in relation to the auger by placing the reactor body on a base which was raised and lowered using pneumatic pistons.



Photographs recording activities associated with the construction and preparation of the testing equipment are provided in **Appendix C**.

### 3.2. Steam Injection Trial Evaluations

On March 3, 2016 KEMRON initiated trial testing of the treatment equipment to identify potential issues that would require corrective action prior to beginning the actual treatment of the site materials. The initial trial test (Trial Test #1) was conducted using a standard laboratory heating oven to pre-heat pressurized air going into the steam generator box as well as heating the steam box. A 3,000 gram aliquot of the archived VR/HC composite was placed inside the testing reactor, and the treatment system was assembled. During this test KEMRON observed that a substantial amount of time was required to heat the water in the steam box to approximately 100C. Additionally, an increase in air flow into the steam box lowered the steam temperature which was an indication that the oven being used did not provide adequate heating. Once the steam box temperature indicated that steam was being produced, testing was continued for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approximately 6 hours of steam injection, with the temperature of the site material inside the reactor reaching a maximum temperature of approximately 78C. KEMRON observed that condensate production began at a composite temperature of approximately 75C.

After discontinuing testing, KEMRON allowed the material to cool overnight to ambient temperature while continuing to pass air through the system. The following day KEMRON observed a large volume of condensate had been collected. The top fraction of condensate was relatively clear and highly organic and the bottom layer was a bluish green aqueous material. Material pH testing conducted on the condensate material indicated that the pH was significantly higher than anticipated. KEMRON believes that during cooling a vacuum was created from the cooling steam inside the steam box even though there was a positive air flow continued through the system. The treated site material was removed from the reactor for visual observations and it was noticed that the bottom portion of the site material was significantly different than the upper layer of material. It was determined that the mixing rod was not able to reach the bottom of the reactor at the maximum vertical stroke.

As a result of Trial Test #1, KEMRON and CH2M identified several alterations to the treatment system that required resolution. Among the issues identified were:

- The standard heating oven used to heat the steam box was insufficient to provide the amount of energy necessary to create and maintain the production of steam. The standard heating oven was replaced with a high temperature muffle furnace.
- Air being injected into the steam box may potentially lower the temperature in the steam box if the flow rate is too high. Additional pre-heating tubing coils were added to the air line inside the muffle furnace.
- The length of the auger rod was slightly too short to allow the mixing paddle to reach the bottom of the reactor, and subsequently to mix and inject steam into the bottom 1.5 inches of site material into the reactor when the vertical stroke of the mixing rod was at its maximum range. This was resolved by casting a cement disc using Type I Portland cement that filled this void area.
- A substantial amount of heat energy was likely being pulled from the composite material by the metal reactor body. It was determined that additional heat application, via the use of electrical heating tape, to the outside of the metal reactor body would reduce potential heat loss.
- Alterations to the frame of the treatment system were needed to prevent flexing of the frame during testing, and a method for centering the auger


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motor directly over the reactor was needed. KEMRON altered the frame by adding support braces and a method for moving the motor.

- While the packing material surrounding the auger rod at the insertion point where the auger penetrated the top flange lid prevented substantial release of steam and organic vapors during heating, area PID monitoring indicated that vapors were escaping. KEMRON prepared a portable vacuum exhaust to remove any vapors that may be release from the reactor during sampling events.
- A simple method was needed for sampling the treated material inside the reactor without removing the top lid of the reactor. This was accomplished by sending the reactor lid to a metal fabricator and having a one inch diameter sampling port bored through the lid. A threaded tube was then welded to the lid to extend the port above the surface of the lid and allow the port to be closed using a threaded cap.
- Additional consumable materials such as Swagelok fittings, tubing, sealing o-rings, etc. were obtained to prevent interruptions during testing.

KEMRON conducted a second trial run (Trial Test #2) with the archived site material after replacing the heating oven with the muffle furnace, adding additional air pre-heating coils, and wrapping the reactor body with electrical heating tape operating at a temperature of 100C. During this second test, the muffle furnace was set to a temperature of 500C to heat the water in the steam box, but was reduced to a temperature of 300C during steam introduction into the reactor. KEMRON observed significantly faster heating times than the previous test for both the steam box and the impoundment material. The transfer of steam through the system was visually observed and documented by real-time temperature changes measured by multiple system thermocouples. Throughout testing, the steam box temperature remained in the 105 to 110C range and KEMRON was able to increase the flow of air into the steam box without reducing the temperature of the steam. Following approximately 2 hours of steam injection KEMRON discontinued heating and allowed the composite material to cool to ambient temperature.

Treated impoundment material was removed from the reactor the following day by reheating the reactor using the electrical heating tape, and digging out the treated material. The treated impoundment material had a sticky rubber consistency. The condensate from this test had a flammable organic layer on top and a slightly pink aqueous layer underneath. Material pH testing conducted on the condensate indicated a pH value of less than 1.0 standard units (s.u.) for both layers.


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The trial run testing identified that the changes made to the system provided substantial reductions in heating time, maintained the appropriate target temperature of the impoundment material during steam injection, and allowed for increased air flow with steam provided to the mixer without significantly reducing the temperature of steam introduced to the test reactor.

Throughout the trial testing, KEMRON conducted quality assurance operations to ensure that the system was operating as anticipated. The top flange of the reactor was removed and visual observations showed that steam was being successfully delivered through the ports in the mixing bar into the test material. Condensate production indicated that a significant amount of steam was being passed through the test material, and organic emissions monitoring using an FID indicated that a significant amount of organic volatilization was occurring. At intervals during testing when the top flange was removed to observe the production of steam, KEMRON observed a notable increase in odor within the laboratory; ambient air monitoring performed with a gas Photoionization multimeter also indicated measureable change in the VOC concentration within the laboratory workspace. As such, KEMRON added a portable vapor extraction vacuum system to remove organic vapors during sampling events.


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## 4.0 PRELIMINARY FULL-SCALE STEAM INJECTION TREATMENT SIMULATIONS

The following photograph is a presentation of the laboratory scale treatment system to simulate impoundment material treatment by steam enhanced mixing.

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KEMRON performed a total of four (4) preliminary steam enhanced mixing simulations using a new HC/VR composite of impoundment material developed from site samples received on [January 12, 2016. These simulations included;

- SI-01 - Steam injection treatment applied to the HC/VR composite with a target treatment temperature of 90C and with the introduction of powdered quicklime as a pH neutralizing agent.
- SI-02 - Steam injection treatment applied to the HC/VR composite with a target treatment temperature of 90C and with no pH neutralization.
- SI-03 - Steam injection treatment applied to the HC/VR composite with a target treatment temperature of 70C and with no pH neutralization.
- SI-04 - Steam injection treatment applied to the VR material only with a target treatment temperature of 90C and with no pH neutralization.

Additional photographs for the steam injection treatment are provided in **Appendix C**.

## SI-01 - HC/VR Composite 90C with pH Neutralization

SI-01 testing was conducted on March 16, 2016. This test was performed to verify the changes made to the reactor system were suitable for testing, and to observe the effects that testing had on the new samples of the site materials. Testing was initiated by placing 1,630 grams (g) of De-ionized (DI) water into the steam generating box and pre-heating the oven to ready the system for steam production. Once the temperature of the steam box indicated that steam was close to production, KEMRON placed a 3,000g aliquot of the HC/VR impoundment material composite into the reactor, the top flange was secured and all necessary tubing was connected. The temperature of the muffle furnace was then increased to a temperature of approximately 270C to begin steam production and the heating tapes wrapped around the steam line and the reactor body was turned on.

After approximately 55 minutes of steam injection, 163g of quicklime (approximately 5.4% quicklime addition relative to the 3,000g aliquot of the site material being treated) was introduced into the reactor through the sampling port located on the top flange of the reactor. KEMRON immediately observed a noticeable temperature increase from the reaction of the quicklime with the acidic impoundment material. At a steam injection duration of 70 minutes the temperature of the impoundment material reached a temperature of 90.6C, and the 120 minute treatment duration was started. At durations of 60 and 120 minutes, KEMRON removed aliquots of treated composite material for pH and analytical testing. These samples were removed by opening the sampling port on the lid of the reactor and inserting a section of Nalgene tubing. The majority of material was removed as material adhering to the outside of the tubing but a small amount of material was collected from inside the tubing. Following removal


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of the 120 minute analytical sample, heating was discontinued and the material was allowed to cool to ambient temperature.

Approximately 100 ml of clear organic condensate and 800ml of clear to milky aqueous condensate were collected during the treatment simulation. Material pH testing showed that at the 60 minute sampling interval, the treated impoundment material had a pH value of 12.1 s.u. At the conclusion of testing, the 120 minute impoundment material sample had a pH of 4.2 s.u. The top layer of condensate had a pH of 10.8 and the aqueous layer pH value was 4.2 s.u. The results of material pH testing conducted on the treated composite material is summarized in Table 2. A graphical presentation of temperature monitoring activities is included as **Figure 1**.

Following a cooling period, the experimental system was disassembled and the reactor was re-heated to facilitate the removal of the treated composite material. KEMRON weighed the steam generator and determined that approximately 1,380 grams of water was utilized in the testing as steam. The treated composite material was then re-heated in a standard heating oven and subjected to solidification/stabilization treatment. The results and procedures utilized in the In-Situ Solidification/Stabilization (ISS) treatment are presented in **Section 5.0** of this report.

## SI-02 - HC/VR Composite 90C Without pH Neutralization

SI-02 testing was conducted on March 17, 2016. Prior to initiating testing an untreated aliquot of the composite material to be tested was sampled for baseline analytical evaluations. The steam injection testing was conducted in the same manner as described in the SI-01 treatment simulation but without pH adjustment using quicklime. Once the impoundment material in the reactor reached the target temperature of approximately 90C an aliquot of the impoundment material was removed for analytical and pH evaluations to establish the initial treatment characteristics. Over the following 120 minute treatment time, aliquots of the treated material were removed for analytical and pH sampling at 20 minute intervals, a total of 6 treatment sampling events were collected. In addition, organic vapor emissions monitoring were performed using an FID. The organic vapor emissions samples were collected or analyzed from the exhaust line running from the vacuum pump to the laboratory fume hood. This line was located post condenser and post sodium hydroxide impinger. Measurements represent the relative composition of volatile vapors which did not condense or dissolve into the caustic impinger. Emissions samples were either collected in Tedlar bags at a 10:1 dilution using breathing quality air if the concentration of organics exceeded the detection limit of the FID instrument, or were direct read samples if the concentration of organics were below the equipment detection limit. The results of FID monitoring activities are presented in **Table 3**.


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The SI-02 test utilized an aliquot of the HC/VR impoundment material weighing approximately 3,000g. The steam generator charged with 1,630g of water. The steam generator was heated for a period of 230 minutes prior to introduction of steam into the reactor. The impoundment material reached the target temperature of approximately 86C following a steam injection period of 65 minutes, and KEMRON removed the "Initial" sample aliquot from the reactor. Over the next 120 minutes the composite material temperature remained relatively stable, ranging from approximately 85 to 95C. Summaries of pH and FID monitoring activities are presented in Tables 2 and 3 respectively. **Figure 2** is a graphical presentation of temperature monitoring activities performed during the testing.

Following termination of the testing the treated impoundment material was removed from the reactor. The treated sample was slightly sticky and rubbery in consistency. Aliquots of the treated sample were then subjected to ISS treatment as described in **Section 5.0**.

## SI-03 - HC/VR Composite 70C Without pH Neutralization

SI-03 testing was conducted on March 21, 2016 with a target treatment temperature of 70C. KEMRON sampled the baseline untreated sample and began heating the 1,630g aliquot of water in the steam generator; A 3,000g aliquot of the impoundment sample was subsequently placed into the reactor and the testing system assembled. The steam generator achieved a temperature of approximately 100C after 40 minutes of heating, and the steam flow into the reactor was started. Note that because of the lower target temperature the electrical heating tape wrapped around the reactor body was not utilized during the initial heating of the reactor. After approximately 50 minutes of steam injection the heating tape was turned on and adjusted to approximately 60C to help maintain the temperature of the composite material during treatment. At a treatment time of 75 minutes from the initiation of the steam injection the impoundment material achieved a temperature of 69.8C and the initial test sample was removed from the reactor for analytical and pH testing. Over the remaining duration of the testing the intermediate 20 minute samples were collected for analytical and pH evaluations. The results of material pH and FID monitoring activities are summarized in **Tables 2** and **3** respectively.

Figure 3 is a graphical presentation of temperature monitoring activities conducted during testing. Note that because the reactor temperature thermocouple would contact the mixing bar during vertical movement of the reactor, it was necessary to retract the thermocouple during times of vertical mixing. As such the temperature graph shows variability in the temperature of impoundment material during testing. This variability is due to periods of temperature monitoring where the thermocouple was retracted from the center of the impoundment material and was likely monitoring the temperature along the


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exterior wall of the reactor body. The maximum temperatures of the impoundment material during testing, as well as manual recordings taken at each sampling interval show that the material maintained an operating temperature of 70 to 74C throughout treatment.

At the completion of testing the reactor was disassembled to remove the treated material for visual observations. KEMRON observed a significant amount of free liquid on the surface of the impoundment material inside the reactor which was likely steam which had condensed due to the lower reactor operating temperature. Additionally, only 300 milliliters of condensate was collected from the treatment process. A total of 1,275g of water was removed from the steam generator box in the form of steam. In addition to the free liquid inside the reactor, the treated impoundment material appeared to be significantly stickier than the treated composite from the 90C testing.

## SI-04 - VR Material Only 90C Without pH Neutralization

SI-04 testing was conducted on April 4, 2016 to evaluate the potential treatment of the VR material only at a target treatment temperature of 90C. Testing was conducted in general accordance with the protocol utilized in the SI-02 testing. KEMRON placed 1,630g of water inside the steam generator and charged the reactor with 3,000g of the VR material. At approximately 80 minutes of heating, the steam temperature was 146C and the valves were opened to allow steam into the reactor. The steam temperature readings inside the steam box were significantly higher during the SI-04 testing than those previously observed. However; KEMRON had some difficulty in reaching the treatment target temperature of 90C, requiring a steam injection time of almost 6 hours to reach the target temperature. KEMRON believes that some team was being passed through the mixing auger, but may not have been at the volumes achieved in the previous testing. The collection of approximately 1,050 ml of aqueous condensate at the end of the testing is a likely indication that at least this quantity of water in the form of steam was passed through the auger and impoundment material. The high steam box temperature exhibited in this test may indicate that the air flow into the steam generating box was too high and created pressure inside the steam box which inhibited the formation of large quantities of steam. It is possible that the mechanism for the primary heating of the impoundment material during the 6 hour heating time was a combination of low steam, hot air injection, and conductive heating from the external heating tape rather than a high volume steam injection. Once the VR material reached a temperature of approximately 87C, KEMRON removed the initial test sample for analytical and pH evaluations. Over the remaining 120 minutes of treatment the intermediate samples were removed from the reactor. These samples were significantly more fluid than the treated HC/VR impoundment material previously discussed. The heated VR sample was a thick liquid with the consistency of syrup. The results of pH and FID monitoring data are presented in **Tables 2** and **3**. A total of 1,200


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milliliters of condensate were collected from the treatment simulation. The condensate consisted of 150ml of a flammable organic top layer, and a 1,050ml layer of aqueous liquid. **Figure 4** summarizes the results of temperature monitoring activities.

The treated VR material was removed from the reactor and subjected to solidification/stabilization treatment as described in **Section 5.0**.

## 5.0 PRELIMINARY TREATED SOLIDIFICATION/STABILIZATION EVALUATIONS

Steam treatment operations simulated in the laboratory improved the physical characteristics of the impoundment materials. Specifically, impoundment material workability and unconfined compressive strength, following addition of solidification/stabilization (S/S) binders (pozzolanic materials) and bulking agents proposed for evaluation during the study. Throughout the project KEMRON prepared various mixture designs to determine the most appropriate additives or reagents and the most effective addition rates to increase the compressive strength and handling properties of the treated impoundment material. Photographs of the ISS treated soil are presented in **Appendix C**.

### 5.1.1. Experimental Solidification/Stabilization Evaluations

Under the guidance of CH2M, KEMRON developed eleven (11) small experimental mixtures of the treated and untreated archived HC/VR impoundment material to evaluate potential candidate reagents capable of improving the physical characteristics of the site material. The reagents included, Type I Portland Cement (local source), Calciment (Mintek), Lime Kiln Dust (LKD) and Cement Kiln Dust (CKD) from Sheppard Materials, Granulated Blast furnace Slag (GBFS) from Holcim NJ, and Corn Cobb #1 from Agsco Corp. Regents applied underwent limited testing and KEMRON and CH2M mainly relied on visual observations to select stabilization agents/approaches for further evaluation.

The treated material utilized in these experimental mixtures consisted of post treatment archive impoundment material from Trial Test #1 as described in **Section 3.2**. Following the removal of the steam treated material from the test reactor, the material was re-heated to approximately 70C and maintained at a temperature of 70C to 85C prior to introducing the reagents. The preparation of each mixture was initiated while the treated impoundment material was hot but the samples were not continually heated during the mixing process. Sample cooling occurred under ambient conditions. The mixing process was completed within approximately one minute.


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The “Untreated” material consisted of a 50/50 composite of the archived VR and HC impoundment material (IMP 2, 2012). To simulate heat treatment, the composite impoundment material was heated in an open box reactor to approximately 70 C over a period of about 3 hours in a drying oven. Stabilization characteristics for selected reagents then were evaluated using 100 to 200 gram aliquots of the oven heated impoundment material mixture. Reagents were added either dry or as a slurry to the heated impoundment material and thoroughly mixed by hand using a stainless steel spoon and by finger kneading. Following homogenization with the selected reagents, treated impoundment materials were compacted into cylindrical plastic molds. Slurries were developed using a 1:1 ratio of reagent to tap water. The experimental mixtures developed during the Trial Test #1 are summarized below. Review of this data indicates that cement kiln dust (CKD), lime kiln dust (LKD), and Portland cement significantly improved the physical characteristics of the treated material. Additionally, KEMRON did not observe flash setting (immediate hardening) of pozzonlic materials introduced to hot, treated impoundment materials.

Table I
Experimental Solidification/Stabilization Mixtures

| KEMRON Sample Number | Untreated Material Type | Reagent Type and Addition Rate | Water Addition % by Reagent wt. | Observations |
|---|---|---|---|---|
| EX-001 | Archived HC/VR 90C | CKD 5% | 0 | Workable, moist, but compactable, with mild rubbery characteristics |
| EX-002 | Archived HC/VR 90C | CKD 10% | 0 | Becomes soil like fairly quickly with mixing, mild rubbery characteristic |
| EX-003 | Archived HC/VR 90C | CKD 10% | 1:1 | Becomes soil like fairly quickly with mixing mild rubbery characteristics |
| EX-004 | Archived HC/VR 90C | Calcimet 7.5% | 0 | Soft and tacky, retains tarry characteristics |
| EX-005 | Archived HC/VR 90C | PC 7.5% | 0 | Soft, wet, plastic, |
| EX-006 | Archived HC/VR 90C | GBFS | 0 | Soft, wet, plastic |
| EX-007 | Archived HC/VR 90C | Corn Cobb #1 20% | 0 | Soft, some moisture absorption, minimal stiffening, no substantial change in material |
| EX-008 | Archived HC/VR 90C | LKD 10% | 0 | Becomes workable and soil like rapidly. |
| EX-009 | Archived HC/VR 90C | LKD 10% | 1:1 | Becomes workable and soil like rapidly. |
| EX-010 | Untreated Archived HC/VR Composite | LKD 10% | 1:1 | Becomes workable and soil like, but not as quickly as the treated |
| EX-011 | Untreated Archived HC/VR Composite (limited mild mixing- no finger kneading) | LKD 10% | 1:1 | Wet, shows signs of becoming soil like. Not quite workable with the limited mixing |

LKD= Lime Kiln Dust
GBFS= Ground Blast Furnace Slag
PC= Portland Cement Type I
CKD= Cement Kiln Dust


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## 5.2. Preliminary Steam Injection Solidification/Stabilization Evaluations

SI-01 - HC/VR Composite 90C with pH Neutralization (referred to as SI-01-90N)

KEMRON prepared 6 mixtures (EX-012-EX-017) using the SI-01-90N steam treated material. Prior to mixture evaluation, the treated impoundment material was re-heated using a laboratory hot plate to a temperature of 70 to 80C. The mixtures utilized included a 10 percent (%) dry addition of Type I Portland cement, a 10% dry addition of CKD, and a 10% dry addition of LKD. Additionally, these mixtures were reproduced using a reagent slurry with a 1:1 ratio of reagent to tap water. For example with a dry reagent addition utilizing a 10% reagent addition rate, 10g of reagent was added to every 100g of composite material being treated. For the slurried reagent additions, 10g of reagent was slurried with 10g of tap water, and added to every 100g of the steam treated composite material. The results of testing conducted on these mixtures are presented in Table 4. This table presents the mixture development formulation, and the results of testing conducted on the mixtures at a 21 day curing interval. Testing performed on the 21 day cured materials included material pH and Unconfined Compressive Strength (UCS). Review of this data indicates that all of the treated materials exhibited a pH value in the range of approximately 11 to 12 s.u., and UCS values ranging from 7.2 to 22.8 pounds per square inch (psi). The highest UCS results were accomplished using a 10% Portland cement slurry. In general testing indicated that introduction of the reagents as a slurry yielded slightly higher UCS values than the same mixtures where the reagents were added dry to the treated impoundment materials.

SI-02 - HC/VR Composite 90C without pH Neutralization (referred to as SI-02-90)

The mixtures (EX-018-EX023) applied to the SI-02-90 treated material were similar to those used for the SI-01-90 material. However, since this material was not subjected to pH neutralization during steam treatment the reagent addition rates were increased to 15%. The results of testing performed on these mixtures are also presented in Table 4. Review of the results show that the pH values of the treated materials were significantly lower than the pH results from material treated in SI-01-90N, but exhibited a significant pH increase compared to untreated impoundment materials. The UCS values for the treated SI-02-90 ISS samples were also slightly lower than the SI-01-90N ISS samples, with values ranging from 9.1 to almost 20 psi. The highest UCS results were reported for the 15% dry addition of Portland cement.

SI-03 - HC/VR Composite 70C without pH Neutralization (referred as SI-03-70)

KEMRON did not develop any ISS mixtures using the SI-03-70 steam treated material.


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SI-04 - VR Material Only 90C without pH Neutralization (referred as SI-04-90)

SI-04 testing was conducted on April 4, 2016 to evaluate the potential treatment of the VR only material. Initially KEMRON evaluated reagents and addition rates similar to those employed with the SI-02-90 ISS testing. However during mixture evaluation it was evident that these addition rates were insufficient to improve the steam treated VR material. After consulting with CH2M, KEMRON was requested to evaluate a variety of reagent addition rates as well as reagent combinations to determine if a more soil like material was achievable with the VR only sample. KEMRON prepared an additional 9 (EX-024 –EX-032) mixtures with the steam treated VR material using reagents including:

- 25% and 30% dry additions of CKD,
- 30% dry addition of LKD,
- 15% dry and 15% slurry addition of Portland cement,
- a two-step treatment using a 20% dry addition of corn cobb grit followed by a 15% dry addition of Portland cement,
- a two-step treatment using a 10% addition of powdered hydrated lime followed by a 10% addition of dry Portland cement,
- a one step process using a combination of 10% hydrated lime and 10% Portland cement slurried with water at a 1:1 ratio, and
- a 15% hydrated lime and 10% Portland cement slurry.

The following is a presentation of the ISS mixtures prepared during the preliminary treatment phase of the study. This summary provides the reagent and reagent addition rates as well as observations regarding the physical characteristics of the material at the time of mixture development. Observations regarding reactivity of the mixture indicate how easily the mixture transforms into a more soil like material. Mixtures developed using the VR only steam treated material did not exhibit any significant physical change to a more soil like material. At 21 days of curing, one mixture, EX-28 consisting of 15% Portland cement was tested for soil pH and Unconfined Compressive Strength (UCS). The results revealed a compressive strength of 1.2 psi and a soil pH of 11.63 s.u.


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# Table II
## Preliminary Phase Solidification Mixtures

| KEMRON Sample Number | Untreated Material Type | Reagent Type and Identification Number(s) | Reagent Addition % by Wet Soil wt. | Water Addition % by Reagent wt. | Mixture Observations |
|---|---|---|---|---|---|
| EXP-012 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 0.0 | Very dry and soil like. Reaction fast. |
| EXP-013 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 100.0 | Moist and soil like. Reaction fast. |
| EXP-014 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 0.0 | Very dry and soil like. Reaction fast. |
| EXP-015 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 100.0 | Moist and soil like. Reaction fast. |
| EXP-016 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 0.0 | Moist with a shredded rubber consistency. Reaction fast. |
| EXP-017 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 100.0 | Moist and soil like. Reaction fast. |
| EXP-018 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 100.0 | Wet and soil like. Moderate reaction. |
| EXP-019 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 0.0 | Dry and fine grain soil like. Reaction fast. |
| EXP-020 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 0.0 | Dry and soil like. Moderate reaction |
| EXP-021 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 100.0 | Wet and soil like. Moderate reaction. |
| EXP-022 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | Wet and crumbly soil like material. Moderate reaction |
| EXP-023 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 0.0 | Moist and crumbly soil like material. Moderate reaction. |
| EXP-024 | VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 25.0 | 0.0 | Rubbery dense material. Not soil like |
| EXP-025 | VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 30.0 | 0.0 | Rubbery dense material. Not soil like |
| EXP-026 | VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 30.0 | 0.0 | Rubbery dense material. Not soil like |
| EXP-027 | VR 90 | LaFarge Type I PC #1005 | 15.0 | 0.0 | Rubbery dense material. Not soil like |
| EXP-028 | VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | Rubbery dense material. Not soil like. Water released. |
| EXP-029 | VR 90 | Corn Cobb / Type I PC | 20 / 15 | 0.0 | 2-step process. Sticky after corn cobb, stiff and rubbery after cement addition. Difficult to mix well. |
| EXP-030 | VR 90 | Hydrated Lime / PC | 10 / 10 | 0.0 | 2-step process. Stiff and rubbery after lime addition. Cement was difficult to work into mixture. Very stiff and rubbery with the release of liquid. |
| EXP-031 | VR 90 | Hydrated Lime / PC | 10 / 10 | 100.0 | 1-step process. Material becomes stringy and taffy-like. Lots of free liquid not absorbed in mixture. |
| EXP-032 | VR 90 | Hydrated Lime / PC | 15 / 10 | 100.0 | 1-step process. Material becomes stringy and taffy-like. Lots of free liquid not absorbed in mixture. |


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In general all of the mixtures exhibited significant heat generation with the exception of the corn cobb grit addition. The mixtures that included the hydrated lime resulted in materials that were much less sticky, and rubbery than the LKD, CKD and Portland cement alone mixtures, and showed evidence, even with the dry addition applications, of moisture release from the VR material. The two mixtures utilizing a Portland cement and hydrated lime slurry formed a stringy material that was not sticky and had a noticeable amount of free liquid after mixing which suggested that much of the water used in the reagent slurry was not absorbed or bound in the mixture.


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## 6.0 CONFIRMATION STEAM TREATMENT EVALUATIONS AND ISS TREATMENT

Based on the results of testing conducted throughout the study, KEMRON conducted two additional steam injection simulations on the HC/ VR composite to confirm treatment results. These treatments were conducted in accordance with the steam injection protocol previously described.

Confirmation steam test SI-05-90 was conducted on 4/12 and 4/13/2016. The steam generator was charged with 1,630g of water late in the afternoon of the 12th and heated to a temperature of approximately 75C to facilitate an early testing start on 4/13/2016. On the morning of the 13th the steam generator oven temperature was increased to 225C and resulting in the immediate production of steam 103C. Steam flow into the reactor was initiated shortly thereafter. At this time, KEMRON believes that the thermocouple measuring the temperature inside the steam box was situated so that the thermocouple was in contact with the bottom of the steam box and was actually measuring the temperature of the steam box bottom where it contacted the heating surface of the muffle furnace. This was not realized by KEMRON and testing in this manner was continued. **Figure 5** summarizes the results of temperature monitoring data collected from the test.

A steam injection period of 205 minutes was required to increase the composite material to a temperature of 86C, at which time KEMRON removed the initial test sample for analytical and pH testing. Over the remaining 120 minutes of testing, KEMRON removed the intermediate analytical and pH test samples at 20 minute intervals. The results of pH and FID monitoring activities are presented in **Tables 2 and 3**. At the conclusion of testing KEMRON had collected a total of 1,300ml of condensate consisting of a 300ml top organic flammable layer, and a 1,000ml aqueous bottom layer.

Confirmation steam test SI-06-90 was performed on 4/14/2016 using the previously outlined protocol. Prior to testing the steam generator thermocouple was replaced and repositioned inside the steam box. Once the steam generator temperature reached an operating temperature of 107C, steam flow was introduced into the test reactor. Over a period of approximately 60 minutes of steam injection, the composite material inside the reactor increased to a temperature of 85.7C at which time KEMRON removed the initial test sample for analytical and pH evaluation. The remaining test aliquots were removed at 20 minute intervals for the remaining 120 minutes of testing. The results of pH and FID monitoring activities are presented in **Tables 3 and 4**. The results of temperature monitoring data are included in **Figure 6**.


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As requested by CH2M , KEMRON conducted stabilization treatments on the steam treated materials from the SI-05-90 and SI-06-90 materials. For SI-05-90, material was allowed to cool down and then re-heated to a temperature of 70 to 80C similar to previous simulations as described in Section 5.1 of this report, with the exception of a larger aliquot of 600 grams was prepared. A single mixture design was used for both of the test materials consisting of a 15% Type I Portland cement addition slurried with water at a 1:1 reagent to water ratio. The mixtures were prepared in the same manner as in the previous phases. Immediately following mixture development the steam treated and stabilized material was compacted into cylindrical plastic molds for curing.

After 7 days of curing, stabilized samples were tested for pH and chemically analyzed for VOCs using SPLP and TCLP test protocols. The pH results are included in **Table 4**. At 21 days of curing of the SI-05-90 and SI-06-90 of the stabilized confirmation samples, KEMRON performed UCS testing resulting in an unconfined compressive strength of 21.8 pcf and 26.4 pcf, respectively. The results of the UCS testing are provided in **Table 4**.


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# TABLES

**CH2M**
**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**
**KEMRON Project No. SH0605**

**Table 1**

**Untreated Material Characterization – Physical Properties**

| TESTING | TEST | UNIT | SAMPLE |
|---|---|---|---|
| | | | HC-VR Composite |
| Modified Moisture Content(1) | ASTM D2216 (Mod.) | | |
| ASTM Moisture Content @ 60C | | % | 22.62 |
| Percent Solids @60C | | % | 81.59 |
| ASTM Moisture Content @ 100C | | % | 40.84 |
| Percent Solids @ 100C | | % | 71.02 |
| Bulk Unit Weight | ASTM D7263 | $lb/ft^3$ | 70.1 |

Notes
% = Percent
$lb/ft^3$ = pounds per cubic foot
Testing performed on a 50:50 composite of the HC and VR materials
(1) = Sample dried @ 60C for approximately 72 hours and 110C for approximately 16 hours

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**Table 2**

**Summary of Steam Injection pH Monitoring Testing**

| Time Interval | Parameter | | | | | |
|---|---|---|---|---|---|---|
| | pH (s.u.) | | | | | |
| | SI-01-90N | SI-02-90 | SI-03-70 | SI-04-90VR | SI-05-90 | SI-06-90 |
| **Baseline** | | | 1.48 | 1.80 | 1.31 | 1.21 |
| **Initial**(1) | | 0.81 | 1.32 | 2.13 | 1.28 | 1.27 |
| **20 Minutes** | | 0.79 | 1.23 | 2.58 | 1.29 | 1.30 |
| **40 Minutes** | | 0.89 | 1.29 | 2.28 | 1.30 | 1.28 |
| **60 Minutes** | 12.10* | 0.91 | 1.30 | 2.51 | 1.27 | 1.31 |
| **80 Minutes** | | 0.98 | 1.46 | 2.52 | 1.32 | 1.30 |
| **100 Minutes** | | 0.89 | 1.37 | 2.62 | 1.32 | 1.35 |
| **Post**(2) | 4.2 | 0.98 | 1.33 | 2.30 | 1.34 | 1.36 |
| **CONDENSATE** | | | | | | |
| **Top Organic Layer** | | 3.15 | | 2.96 | 3.47 | 3.17 |
| **Bottom Aqueous Layer** | | 3.13 | 3.32 | 3.05 | 3.32 | 2.85 |

Notes:
s.u. = standard units
* = pH tested after addition of 163 grams of quicklime to 3,000 grams of material
(1) = Sample taken when the material reached the target treatment temperature
(2) = Sample taken after 120 of steam addition at the target treatment temperature
SI-01 = Steam Injection Run 1
90 = 90°C Treatment Temperature
70 = 70°C Treatment Temperature
N = Neutralized Material
90VR = 90°C Treatment Temperature on VR only material
no data collected

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**Table 3**

**Summary of Steam Injection FID Monitoring Testing**

| Time Interval | Steam Injection Run | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SI-02-90[3] | | SI-03-70[3] | | SI-04-90VR[4] | | SI-05-90 | | SI-06-90 | |
| | Sampling Time | VOC (ppm) | Sampling Time | VOC (ppm) | Sampling Time | VOC (ppm) | Sampling Time | VOC (ppm) | Sampling Time | VOC (ppm) |
| **Steam Injection Started** | 11:30 | | 8:06 | | 9:20 | | 10:36 | | 12:22 | |
| **Initial[1]** | 12:37 | | 9:22 | 1,393 | 15:08 | 6,064 | 14:00 | 50,970 | 13:30 | 25,600 |
| **20 Minutes** | 12:57 | 35,100 | 9:42 | 6,809 | 15:33 | 15,000 | 14:20 | 61,000 | 13:50 | 46,800 |
| **40 Minutes** | 13:17 | 45,260 | 10:02 | 3,811 | 15:53 | 7,700 | 14:40 | 61,500 | 14:10 | 21,020 |
| **60 Minutes** | 13:37 | 42,640 | 10:22 | 3,387 | 16:13 | 10,700 | 15:00 | 58,000 | 14:30 | 11,080 |
| **80 Minutes** | 13:57 | 43,710 | 10:42 | 2,908 | 16:33 | 10,320 | 15:20 | 46,080 | 14:50 | 7,640 |
| **100 Minutes** | 14:17 | 38,760 | 11:02 | 1,715 | 16:53 | 6,783 | 15:40 | 42,360 | 15:10 | 5,150 |
| **Post[2]** | 14:37 | 19,750 | 11:22 | 2,092 | 17:13 | 4,785 | 16:00 | 11,825 | 15:30 | 4,829 |

Notes:
(1) = Reading taken when the material reached the target treatment temperature
(2) = Reading taken after 120 of steam addition at the target treatment temperature
(3) = Readings taken using a 10:1 dilution using clean breathing quality air
(4) = Readings taken straight from off-gas line post condenser
SI-02 = Steam Injection Run 2
90 = 90°C Treatment Temperature
70 = 70°C Treatment Temperature
90VR = 90°C Treatment Temperature on VR only material
= Data point not collected

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**Table 4**

**Summary of ISS Screening Evaluations**
**Mixture Designs and Unconfined Compressive Strength**

| KEMRON Sample Number | Untreated Material Type[1] | Reagent Type and Identification Number(s) | Reagent Addition % by Wet Soil wt. | Water Addition % by Reagent wt. | Cure Day | Material pH EPA 9045 | Unconfined Compressive Strength ASTM D2166 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (s.u.) | Moisture Content (%) | Bulk Density ($lb/ft^3$) | Dry Density ($lb/ft^3$) | UCS ($lb/in^2$) |
| EXP-012 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 0.0 | 21 | 12.07 | 22.91 | 59.4 | 48.3 | 7.2 |
| EXP-013 | HC/VR 90N | Sheppard Materials Lime Kiln Dust #1054 | 10.0 | 100.0 | 21 | 12.09 | 25.35 | 65.6 | 52.3 | 10.1 |
| EXP-014 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 0.0 | 21 | 10.99 | 20.81 | 63.4 | 52.5 | 15.1 |
| EXP-015 | HC/VR 90N | Sheppard Materials Cement Kiln Dust #1052 | 10.0 | 100.0 | 21 | 11.12 | 27.90 | 67.0 | 52.4 | 15.3 |
| EXP-016 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 0.0 | 21 | 11.76 | 17.32 | 65.3 | 55.7 | 18.5 |
| EXP-017 | HC/VR 90N | LaFarge Type I PC #1005 | 10.0 | 100.0 | 21 | 11.79 | 26.01 | 82.1 | 65.2 | 22.8 |
| EXP-018 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 100.0 | 21 | 8.33 | 39.41 | 73.4 | 52.7 | 9.1 |
| EXP-019 | HC/VR 90 | Sheppard Materials Cement Kiln Dust #1052 | 15.0 | 0.0 | 21 | 5.77 | 32.10 | 69.0 | 52.2 | 14.4 |
| EXP-020 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 0.0 | 21 | 11.85 | 36.95 | 63.5 | 46.4 | 11.6 |
| EXP-021 | HC/VR 90 | Sheppard Materials Lime Kiln Dust #1054 | 15.0 | 100.0 | 21 | 6.28 | 30.12 | 72.8 | 56.0 | 12.0 |
| EXP-022 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | 21 | 6.64 | 27.61 | 74.1 | 58.0 | 18.0 |
| EXP-023 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 0.0 | 21 | 3.85 | 18.01 | 73.1 | 62.0 | 19.9 |
| EXP-028 | VR | LaFarge Type I PC #1005 | 15.0 | 100.0 | 21 | 11.63 | 43.43 | 74..3 | 51.8 | 1.2 |
| SI-05-90 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | 21 | 10.38 | 51.71 | 70.1 | 46.2 | 21.8 |
| SI-06-90 | HC/VR 90 | LaFarge Type I PC #1005 | 15.0 | 100.0 | 21 | 10.54 | 51.11 | 71.2 | 47.1 | 26.4 |

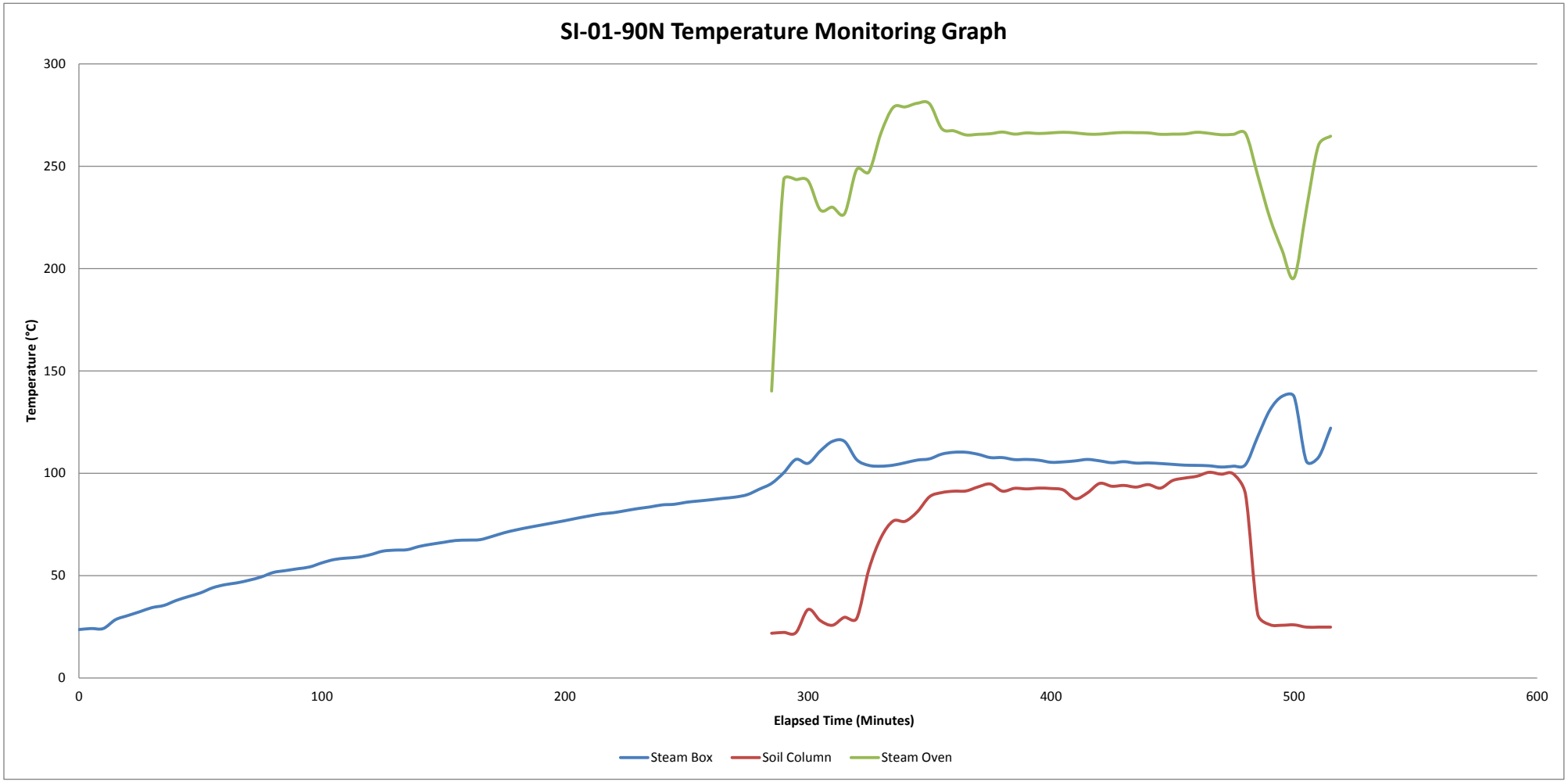
Notes:
% = Percent
$lb/ft^3$ = pounds per cubic foot
$lb/in^2$ = pounds per square inch
UCS = Unconfined Compressive Strength
Wt= Weight

# FIGURES

**CH2M**
**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**
**KEMRON PROJECT No. SH0605**

**Figure 1**

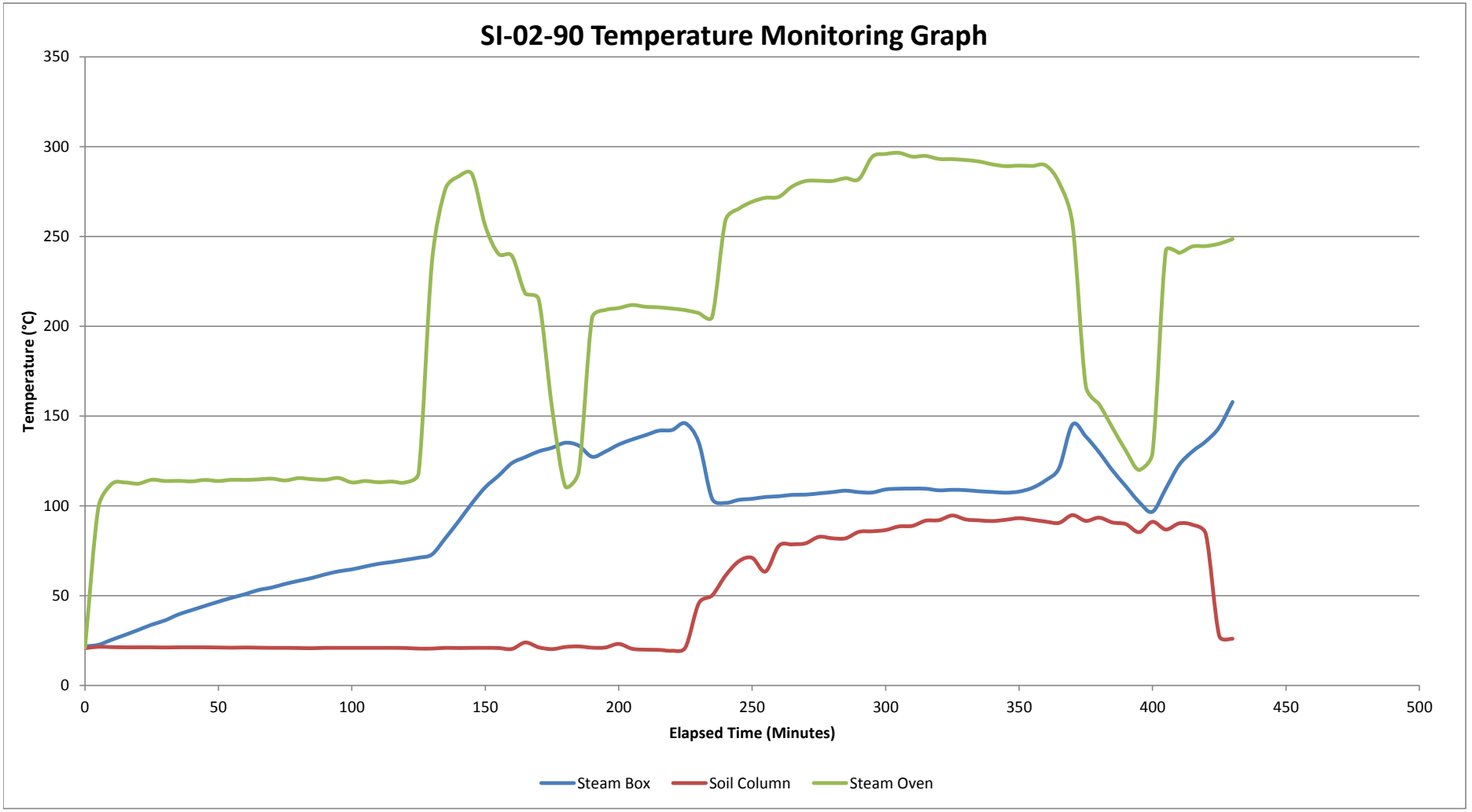
**SI-01-90N – HC/VR Composite 90C with Neutralization - Temperature Graph**



**CH2M**
**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**
**KEMRON PROJECT No. SH0605**

**Figure 2**

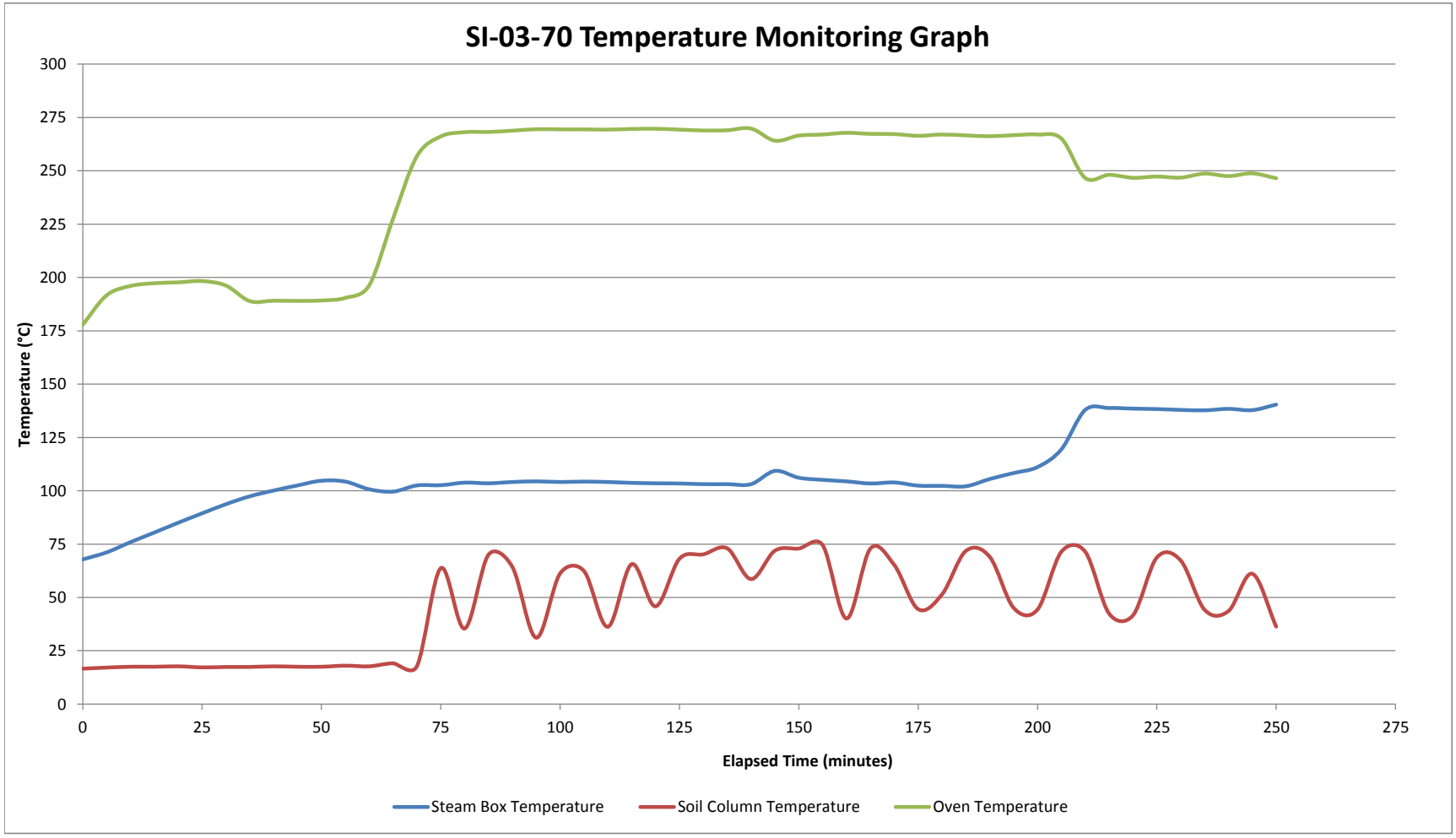
**SI-02-90 – HC/VR Composite 90C no Neutralization - Temperature Graph**



**CH2M**
**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**
**KEMRON PROJECT No. SH0605**

**Figure 3**

**SI-03-70 – HC/VR Composite 70C no Neutralization - Temperature Graph**



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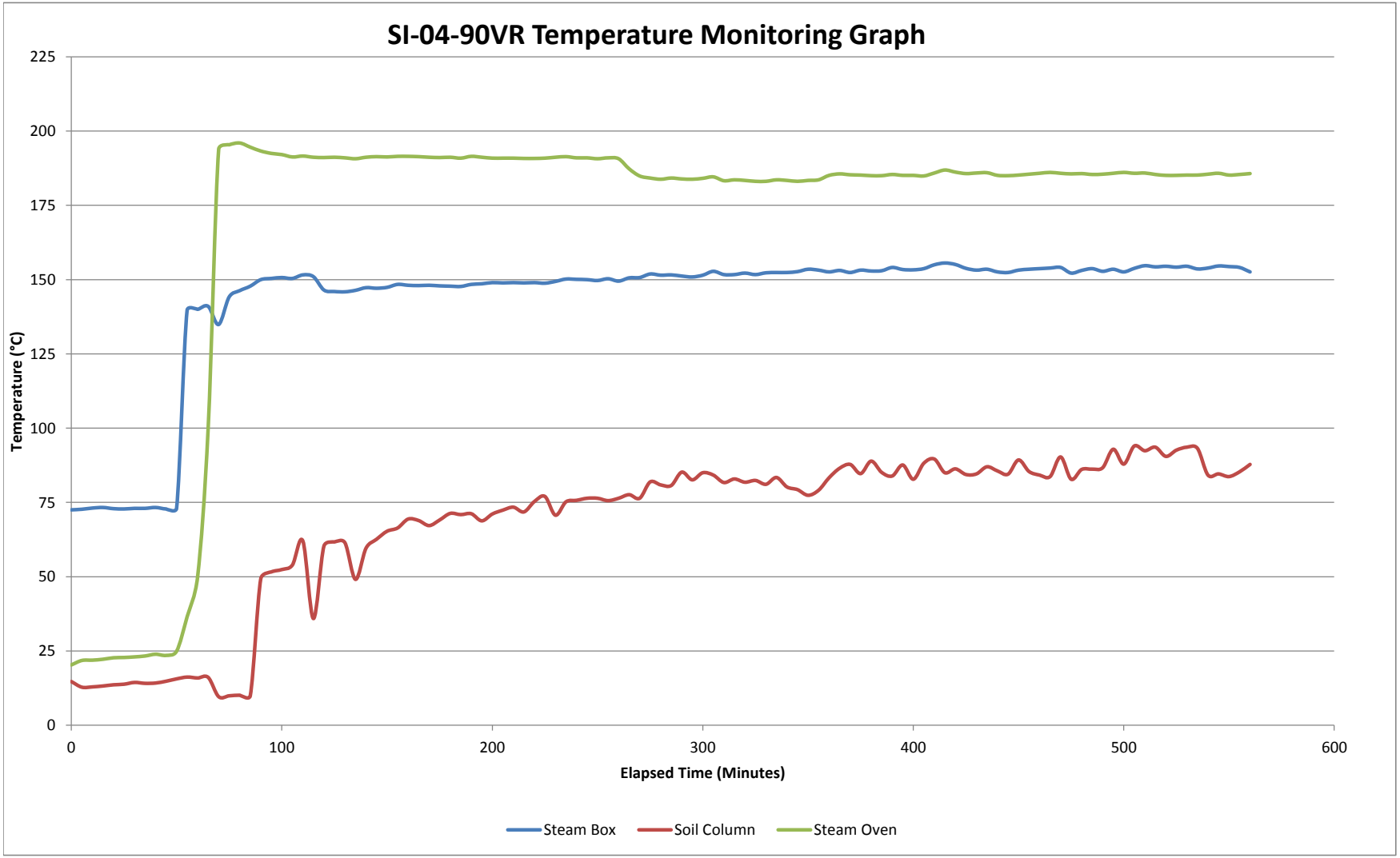
AMERICAN CYANAMID SUPERFUND SITE
STEAM MIXING AND STABILIZATION TREATABILITY STUDY
KEMRON PROJECT No. SH0605

Figure 4

SI-04-90 – VR Only 90C no Neutralization – Temperature Graph



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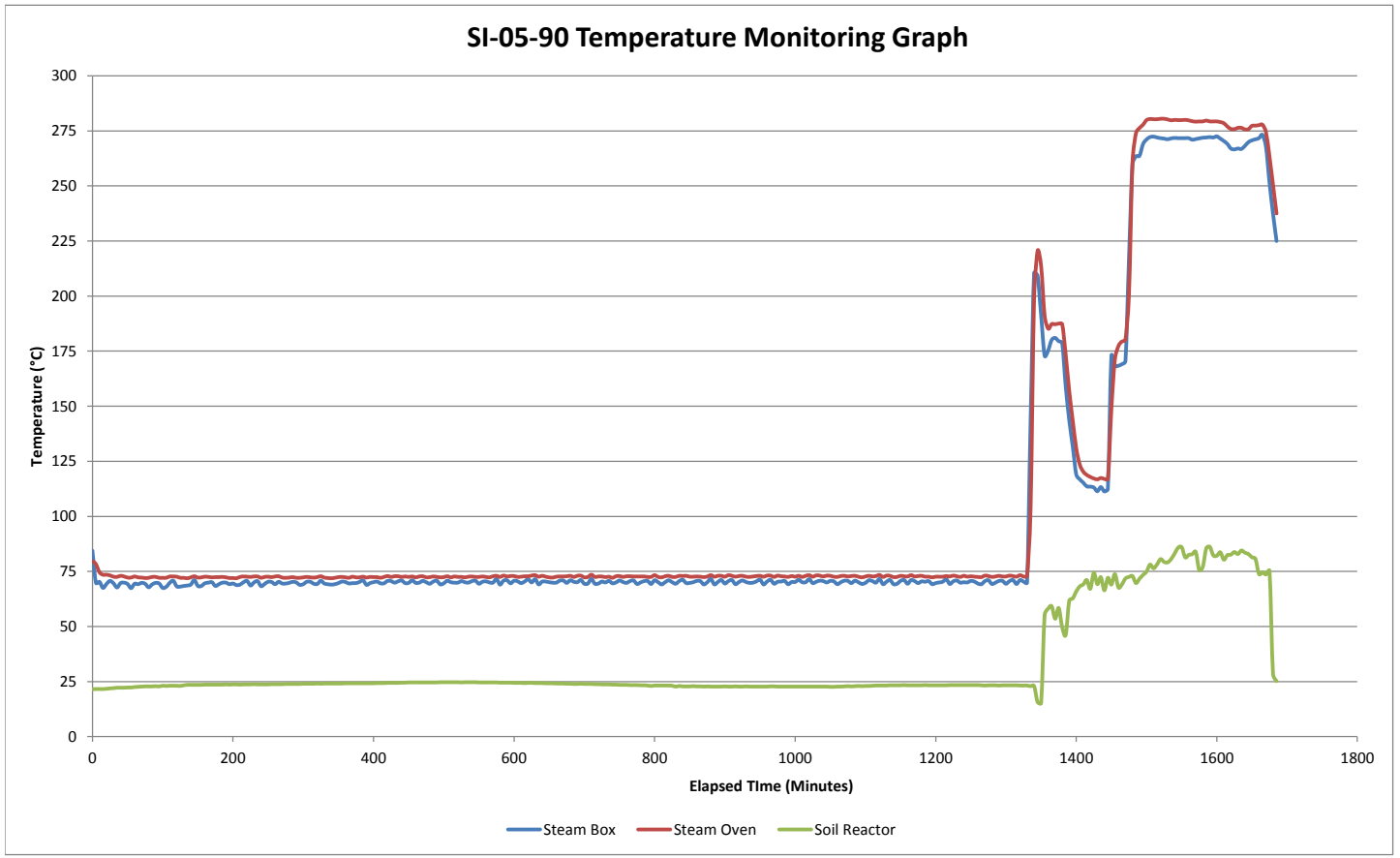
**AMERICAN CYANAMID SUPERFUND SITE**
**STEAM MIXING AND STABILIZATION TREATABILITY STUDY**
**KEMRON PROJECT No. SH0605**

**Figure 5**

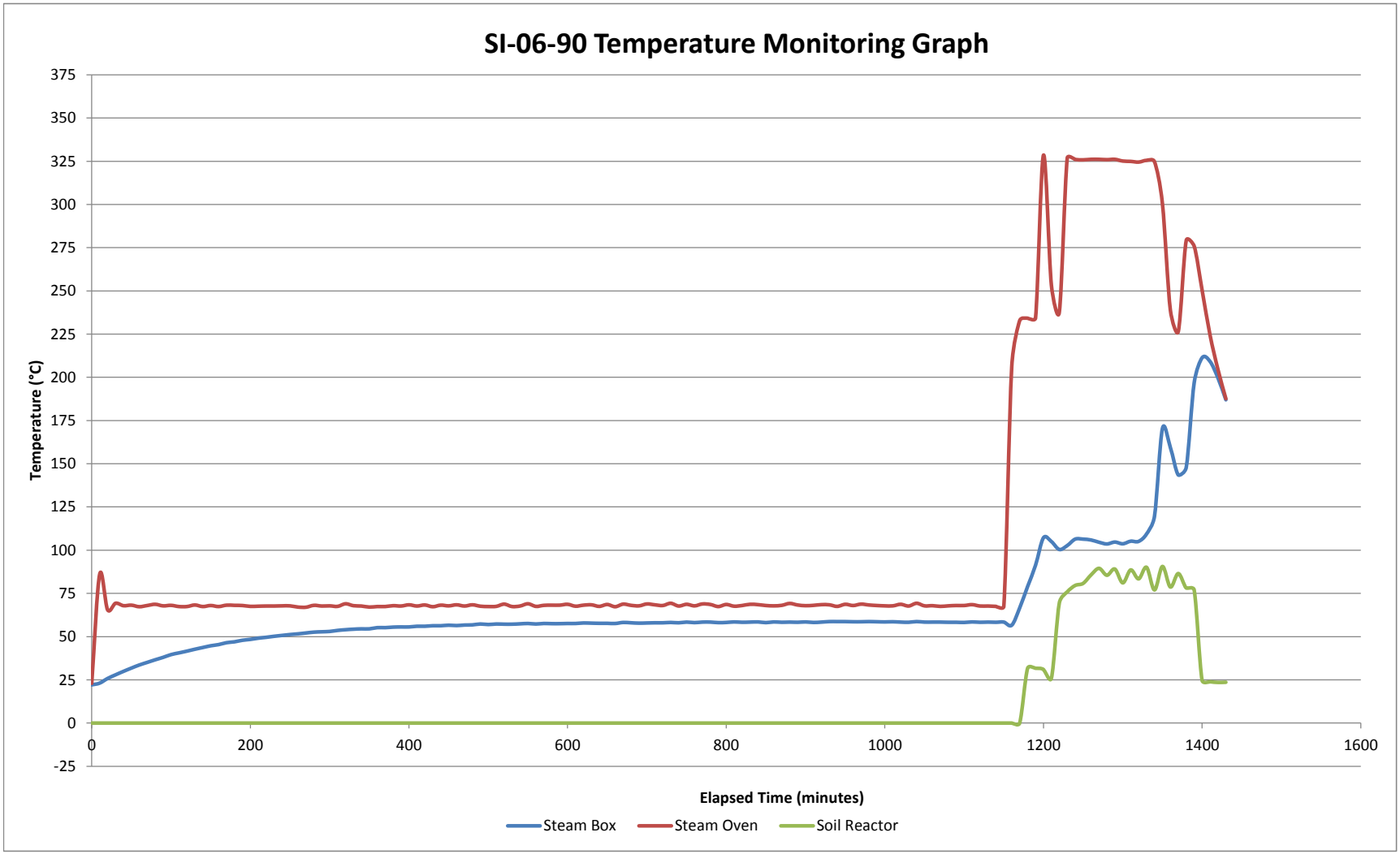
**SI-05-90 – HC/VR Composite 90C no Neutralization Confirmation- Temperature Graph**



CH2M
AMERICAN CYANAMID SUPERFUND SITE
STEAM MIXING AND STABILIZATION TREATABILITY STUDY
KEMRON PROJECT No. SH0605

Figure 6

SI-06-90 – HC/VR Composite 90C no Neutralization Confirmation- Temperature Graph



# APPENDIX A

# SAMPLE SHIPPING AND CHAIN OF CUSTODY DOCUMENTS

SHIPPER PLEASE NOTE ▶ FREIGHT CHARGES ARE PREPAID ON THIS BILL UNLESS MARKED COLLECT



STRAIGHT BILL OF LADING – ORIGINAL – NOT NEGOTIABLE

ABF FREIGHT SYSTEM, INC.
P.O. BOX 10048
FORT SMITH, AR 72917

www.abf.com

PLACE PRO LABEL HERE

Shipper's Bill of Lading No.
477213.TB.01.02
Consignee's Reference/PO No.

On 'Collect On Delivery' shipments, the letters "COD" must appear before consignee's name or as otherwise provided in item 430, Sec.1.

TO:
CONSIGNEE: KEMRON ENVIRONMENTAL SERVICES, INC
SAMPLE RECEIVING
STREET: 1359-A ELLSWORTH INDUSTRIAL BOULEVARD
DESTINATION CITY/ST/ZIP: ATLANTA GA 30318 US

☐ Check box if consignee contact required prior to delivery. Consignee phone: (404) 636-0928

TRAILER

B/L DATE: 2016-01-08

ROUTE

SPECIAL INSTRUCTIONS
QUOTE ID: LPWG020066 - TIMEKEEPER SERVICE REQUESTED (TK)

FROM:
SHIPPER: CH2M HILL
STREET: 20 POLHEMUS LANE
ORIGIN CITY/ST/ZIP: BRIDGEWATER NJ 08807 US

FOR PAYMENT, SEND BILL TO:
NAME
STREET
CITY/ST/ZIP

Collect on Delivery $ _____ and remit to _____
Street _____ City _____ State _____
Carrier must collect cash, money order, bank cashier's check, or bank certified check unless shipper signs here to accept company check.
Signed: _____

C.O.D. Charge to be paid by: ☐ Shipper ☐ Consignee

ABF TimeKeeper (Electronic)

CONTACT NAME: MARY I VELASQUEZ
QUOTE ID# (if applicable): LPWG020066
DATE: ☒ BY ☐ ON ☐ BETWEEN: Tue, Jan 12, 2016
TIME: ☒ BY ☐ BETWEEN: 5:00 PM
PHONE NUMBER/EMAIL: (201) 936-0586 / mary.velasquez@ch2m.com

| Hdlg. Units No. Type | Packages No. Type | * HM | Kind of Package, Description of Articles, Special Marks and Exceptions (Subject to Correction) | Weight Subj. to Correction) (Lbs) | Class or Rate Ref. (For Info. Only) | Cube (Optional) ft³ |
|---|---|---|---|---|---|---|
| 6 BX | 6 BX | X | UN1759, CORROSIVE SOLID, N.O.S (SULFURIC ACID), 8, PGIII<br>EMERGENCY CONTACT: CHEMTEL MIS0001537<br>EMERGENCY PHONE #: (800) 255-3924<br>6 BX @ 16 x 16 x 16 | 30 | 110 | |

Total Handling Pieces: 6 | Individual Pieces: 6 | Weight: 30 Lbs | Cube: ft³

* Mark "X" to designate Hazardous Materials as defined in DOT Regulations.

NOTE(1) Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property as follows:

"The agreed or declared value of the property is specifically stated by the shipper to be not exceeding _____ per _____."

NOTE (2) Liability Limitation for loss and damage on this shipment may be applicable. See 49 U.S.C. 14706 (c)(1)(A) and (B).

NOTE (3) Commodities requiring special or additional care or attention in handling or stowing must be so marked and packaged as to ensure safe transportation with ordinary care. See Sec. 2(e) of NMFC Item 360.

Freight Charges are PREPAID unless marked collect

CHECK HERE IF COLLECT ☐

FOR FREIGHT COLLECT SHIPMENTS:
If this shipment is to be delivered to the consignee, without recourse on the consignor, the consignor shall sign the following statement:
The carrier may decline to make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

Notify if problem enroute or at delivery: MARY I VELASQUEZ (Name) (201) 936-0586 (Tel No.) (Fax No.) (for informational purposes only)

RECEIVED, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request. Every service to be performed hereunder shall be subject to all terms and conditions of the uniform bill of lading set forth in the National Motor Freight Classification. The shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns. See Item 780-1 of ABF 111 rules for general liability limitations and for additional coverage available at additional expense.

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation. Additionally, by signature on this bill of lading, Shipper authorizes consent to the Transportation Security Administration (TSA) to screen the shipment when transportation of the shipment requires movement via an air carrier.

SHIPPER CH2M HILL

PER(SIGNATURE REQUIRED)

CARRIER ABF FREIGHT SYSTEM, INC.

PER

DATE

Driver signature acknowledges receipt of freight

# CHAIN OF CUSTODY

KEMRON
ENVIRONMENTAL SERVICES

KEMRON ENVIRONMENTAL SERVICES, INC.
1359-A Ellsworth Industrial Boulevard, Atlanta, GA 30318
TEL.: (404) 636-0928 FAX: (404) 636-7162
www.KEMRON.com

FED-EX Tracking #
Freight Pickup

COC#: KEMRON-TAR-010816-01

**IMPOUNDMENT TAR**

## Client / Reporting Information

Company Name / Billing Information: CH2M HILL

Street Address: 1717 Arch Street, Suite #4400

City: Philadelphia | State: PA | Zip: 19103

Project Contact: Jim Arthur | E-mail: jim.arthur@ch2m.com

Phone #: (215) 640-9108 | Fax #: 215-640-9330

Sampler(s) Name(s): Mary Velasquez | Phone #: 201-936-0586

## Project Information

Project Name: **American Cyanamid OU8 Pilot Study**

Street: 20 Polhemus Lane

City: Bridgewater | State: NJ

Project #: 477213.PS.01.IM

Client Purchase Order #:

Project Manager: Tommy Jordan | tjordan@kemron.com

Project Chemist: Shane Lowe | Phone #: (314) 335-3024

Sample Receipt Acknowledgement/Preliminary Data To:
shane.lowe@ch2m.com
mary.velasquez@ch2m.com

EDD To:
shane.lowe@ch2m.com
amy.klopper@ch2m.com

Email Address for Result Reporting:
shane.lowe@ch2m.com
mary.velasquez@ch2m.com

## Requested Analysis

| Kemron Sample # | Field ID / Point of Collection | Date | Time | Sampled by | Collection: Sample Type | Matrix | grab/composite | # of bottles | Preservative: HCl | NaOH | HNO3 | H2SO4 | NONE | DI Water | MEOH | ENCORE | Thermally Enhanced Bench-Scale Testing | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 010616-HC-IMP2-B01 | 1/6/2016 | 12:30 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |
| | 010616-HC-IMP2-B02 | 1/6/2016 | 12:45 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |
| | 010716-HC-IMP2-B03 | 1/7/2016 | 9:45 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |
| | 010616-VR-IMP2-B01 | 1/6/2016 | 12:55 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |
| | 010716-VR-IMP2-B02 | 1/7/2016 | 13:00 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |
| | 010616-INT-IMP2-B01 | 1/6/2016 | 13:05 | MV | SD | SOL | GRAB | 1 | | | | | X | | | | X | |

Turnaround Time ( Business days)

Std. 10 Business Days
5 Day RUSH
3 Day EMERGENCY
2 Day EMERGENCY
1 Day EMERGENCY
other
Emergency & Rush T/A data available VIA Lablink

Approved By (Kemron PM): / Date: X

Data Deliverable Information

- [ ] Commercial "A" (Level 1)
- [ ] Commercial "B" ( Level 2)
- [x] FULLT1 ( Level 3+4 )
- [ ] NJ Reduced
- [ ] Commercial "C"
- [ ] NYASP Category A
- [ ] NYASP Category B
- [ ] State Forms
- [X] EDD Form
- [ ] Other

Commercial "A" = Results Only
Commercial "B" = Results + QC Summary
NJ Reduced = Results + QC Summary + Partial Raw data

Raw HC - approximately 22 gallons
Raw VR - approximately 20 gallons
Raw INT - approximately 4 gallons

**Testing to be performed in accordance with workplan.**

**Sample Custody must be documented below each time samples change possession, including courier delivery.**

| | | | | |
|---|---|---|---|---|
| Relinquished by Sampler: 1 | Date Time: 1/8/16 1430 | Received By: James Mayer | Relinquished By: 2 | Date Time: 1/12/16 1030 |
| Relinquished by Sampler: 3 | Date Time: | Received By: 3 | Relinquished By: 4 | Date Time: |
| Relinquished by: 5 | Date Time: | Received By: 5 | Custody Seal # | Intact / Not Intact; Preserved where applicable: ☐; On Ice: NONE; Cooler Temp. |

DANGEROUS GOODS SHIPMENT: YES / NO

# APPENDIX B

# PHYSICAL CHARACTERIZATION DATA SHEETS

# MODIFIED MOISTURE CONTENT

## ASTM D2216 (Mod.)*

| | |
|---|---|
| PROJECT: | American Cyanamid Superfund Site |
| PROJECT No.: | SH0605 |
| SAMPLE No.: | HC&VR Composite |
| TESTING DATE: | 3/16/16 |
| TESTED BY: | JDM |
| TRACKING CODE: | A680_MC |

| MODIFIED MOISTURE CONTENT | | | | | | |
|---|---|---|---|---|---|---|
| 1. MOISTURE TIN NO. | A | | B | | C | |
| 2. WT MOISTURE TIN (tare weight) | 1.292 | g | 1.293 | g | 1.295 | g |
| 3. WT WET SOIL + TARE | 21.687 | g | 23.642 | g | 30.808 | g |
| 4. WT DRY SOIL + TARE | 17.647 | g | 19.315 | g | 26.069 | g |
| 5. WT WATER, Ww (@ 60C) | 4.040 | g | 4.328 | g | 4.739 | g |
| 6. WT DRY SOIL, Ws | 16.355 | g | 18.021 | g | 24.774 | g |
| 7. WT FINAL SOIL + TARE | 15.519 | g | 17.050 | g | 22.785 | g |
| 8. WT FINAL SOIL, Wf | 14.227 | g | 15.757 | g | 21.490 | g |
| 9. WT WATER, Ww (@ 110C) | 2.128 | g | 2.265 | g | 3.284 | g |
| 10. MOISTURE CONTENT (@ 60C) | 24.70 | % | 24.01 | % | 19.13 | % |
| 11. MOISTURE CONTENT (@ 110C) | 43.36 | % | 41.84 | % | 37.33 | % |
| **12. AVERAGE MOISTURE CONTENT @ 60C** | 22.62 | % | | | | |
| **13. AVERAGE MOISTURE CONTENT @ 110C** | 40.84 | % | | | | |

*** Samples dried in oven @ 60C for approximately 72 hours and @ 110C for approximately 16 hours**

# UNIT WEIGHT DETERMINATION

**DATA SHEET**
**ASTM D7263**

| | |
|---|---|
| PROJECT: | American Cyanamid Superfund Site |
| PROJECT No.: | SH0605 |
| SAMPLE No.: | HC&VR Composite |
| TESTING DATE: | 3/16/16 |
| TESTED BY: | JDM |
| TRACKING CODE: | A680_UW |

| UNIT WEIGHT (DENSITY) | | | | | | |
|---|---|---|---|---|---|---|
| 1. SAMPLE NO. | A | | B | | C | |
| 2. WT OF MOLD (tare weight) | 67.02 | g | 67.02 | g | 67.02 | g |
| 3. WT OF MOLD + SOIL | 847.52 | g | 845.68 | g | 847.96 | g |
| 4. WT OF WET SOIL, W | 780.50 | g | 778.66 | g | 780.94 | g |
| 5. DIAMETER OF SPECIMEN, D | 3.00 | in | 3.00 | in | 3.00 | in |
| 6. HEIGHT OF SPECIMEN, H | 6.00 | in | 6.00 | in | 6.00 | in |
| 7. VOLUME OF SPECIMEN | 42.41 | $in^3$ | 42.41 | $in^3$ | 42.41 | $in^3$ |
| 8. BULK UNIT WEIGHT | 70.1 | pcf | 69.9 | pcf | 70.1 | pcf |
| 9. BULK SPECIFIC GRAVITY | 1.1 | | 1.1 | | 1.1 | |
| 10. AVERAGE BULK UNIT WEIGHT | 70.1 | pcf | | | | |
| 11. AVERAGE BULK SPECIFIC GRAVITY | 1.1 | | | | | |

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-012 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A765_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.45 | g |
| 3. WT WET SOIL + TARE | 127.64 | g |
| 4. WT DRY SOIL + TARE | 118.10 | g |
| 5. WT WATER, Ww | 9.54 | g |
| 6. WT DRY SOIL, Ws | 41.65 | g |
| **7. MOISTURE CONTENT, W** | **22.91** | **%** |

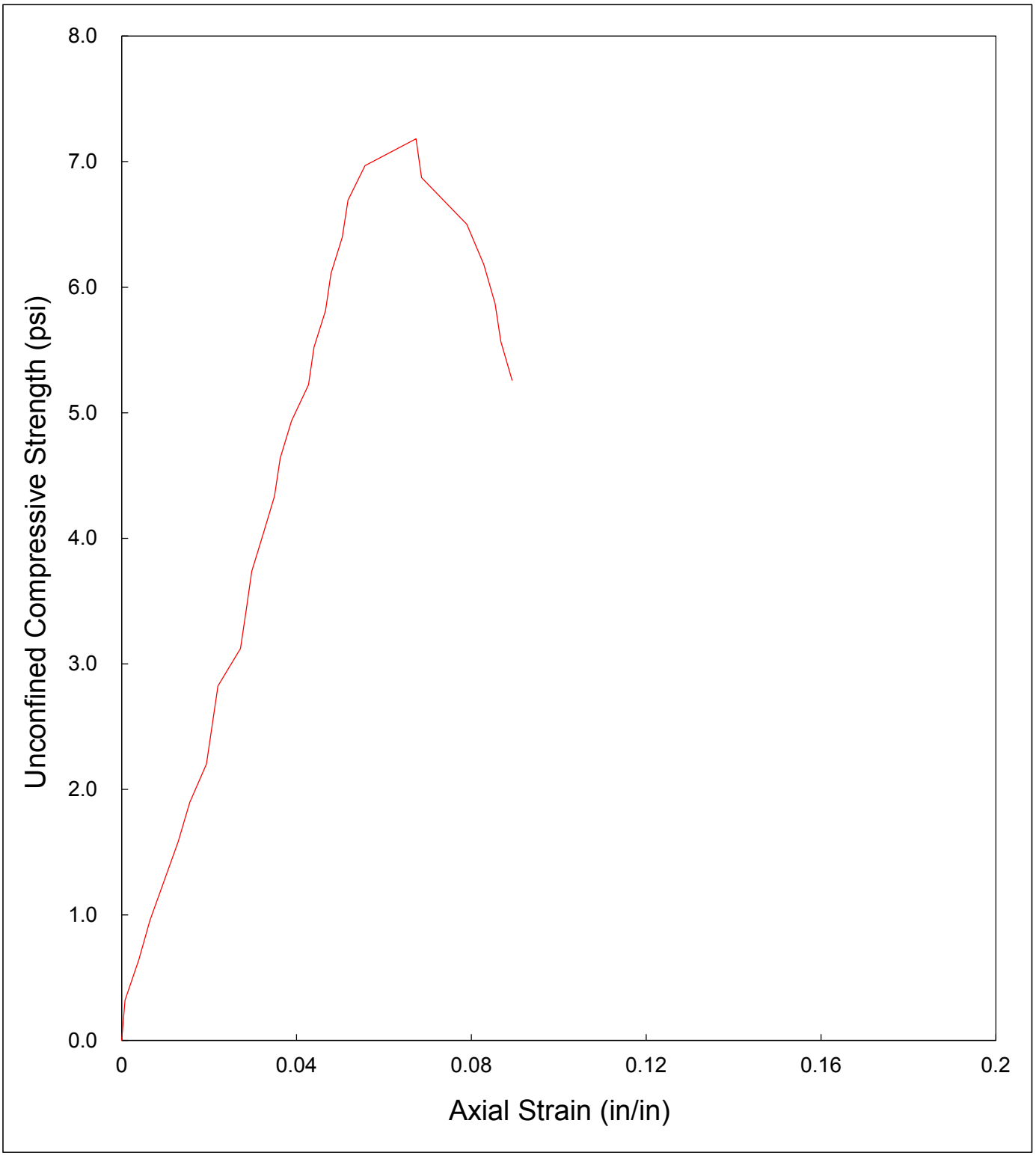
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | ***DIAMETER*** | | ***LENGTH*** | |
| No. 1 | 1.99 | in. | 3.82 | in. |
| No. 2 | 1.99 | in. | 3.85 | in. |
| No. 3 | 2.00 | in. | 3.91 | in. |
| **Average** | **1.99** | **in.** | **3.86** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***187.69*** | ***g*** |
| Initial Area, Ao | 3.12 | in² |
| Initial Volume, Vo | 12.04 | in³ |
| Initial Bulk Unit Weight, | 59.4 | lb/ft³ |
| Initial Dry Unit Weight | 48.3 | lb/ft³ |
| 15 % Strain (0.15 Lo) | 0.58 | in. |
| UCS | 7.2 | lb/in² |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA (in²) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH (lb/in²) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.117 | 0.0000 | 0.0 |
| 1 | 0.003 | 0.003 | 3.119 | 0.0008 | 0.3 |
| 2 | 0.015 | 0.015 | 3.129 | 0.0039 | 0.6 |
| 3 | 0.025 | 0.025 | 3.137 | 0.0065 | 1.0 |
| 5 | 0.050 | 0.050 | 3.157 | 0.0129 | 1.6 |
| 6 | 0.060 | 0.060 | 3.166 | 0.0155 | 1.9 |
| 7 | 0.075 | 0.075 | 3.178 | 0.0194 | 2.2 |
| 8 | 0.080 | 0.080 | 3.182 | 0.0207 | 2.5 |
| 9 | 0.085 | 0.085 | 3.187 | 0.0220 | 2.8 |
| 10 | 0.105 | 0.105 | 3.204 | 0.0272 | 3.1 |
| 11 | 0.110 | 0.110 | 3.208 | 0.0285 | 3.4 |
| 12 | 0.115 | 0.115 | 3.212 | 0.0298 | 3.7 |
| 13 | 0.125 | 0.125 | 3.221 | 0.0324 | 4.0 |
| 14 | 0.135 | 0.135 | 3.229 | 0.0350 | 4.3 |
| 15 | 0.140 | 0.140 | 3.234 | 0.0363 | 4.6 |
| 16 | 0.150 | 0.150 | 3.242 | 0.0388 | 4.9 |
| 17 | 0.165 | 0.165 | 3.256 | 0.0427 | 5.2 |
| 18 | 0.170 | 0.170 | 3.260 | 0.0440 | 5.5 |
| 19 | 0.180 | 0.180 | 3.269 | 0.0466 | 5.8 |
| 20 | 0.185 | 0.185 | 3.273 | 0.0479 | 6.1 |
| 21 | 0.195 | 0.195 | 3.282 | 0.0505 | 6.4 |
| 22 | 0.200 | 0.200 | 3.287 | 0.0518 | 6.7 |
| 23 | 0.215 | 0.215 | 3.300 | 0.0557 | 7.0 |
| 24 | 0.260 | 0.260 | 3.341 | 0.0673 | 7.2 |
| 23 | 0.265 | 0.265 | 3.346 | 0.0686 | 6.9 |
| 22 | 0.305 | 0.305 | 3.384 | 0.0790 | 6.5 |
| 21 | 0.320 | 0.320 | 3.398 | 0.0829 | 6.2 |
| 20 | 0.330 | 0.330 | 3.408 | 0.0854 | 5.9 |
| 19 | 0.335 | 0.335 | 3.413 | 0.0867 | 5.6 |
| 18 | 0.345 | 0.345 | 3.422 | 0.0893 | 5.3 |
| | | | | | |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-012



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-012 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A765_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 22.9 | **%** |
| **BULK UNIT WEIGHT** | 59.4 | lb/ft³ |
| **DRY UNIT WEIGHT** | 48.3 | lb/ft³ |
| **UCS *** | 7.2 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-013 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A766_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.78 | g |
| 3. WT WET SOIL + TARE | 130.83 | g |
| 4. WT DRY SOIL + TARE | 119.90 | g |
| 5. WT WATER, Ww | 10.93 | g |
| 6. WT DRY SOIL, Ws | 43.12 | g |
| **7. MOISTURE CONTENT, W** | **25.35** | **%** |

| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 2.01 | in. | 3.82 | in. |
| No. 2 | 1.99 | in. | 3.91 | in. |
| No. 3 | 1.98 | in. | 4.06 | in. |
| **Average** | **1.99** | **in.** | **3.93** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***211.43*** | ***g*** |
| Initial Area, Ao | 3.12 | $in^2$ |
| Initial Volume, Vo | 12.28 | $in^3$ |
| Initial Bulk Unit Weight, | 65.6 | $lb/ft^3$ |
| Initial Dry Unit Weight | 52.3 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.59 | in. |
| UCS | 10.1 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.124 | 0.0000 | 0.0 |
| 1 | 0.020 | 0.020 | 3.140 | 0.0051 | 0.3 |
| 3 | 0.030 | 0.030 | 3.148 | 0.0076 | 1.0 |
| 7 | 0.050 | 0.050 | 3.165 | 0.0127 | 2.2 |
| 10 | 0.065 | 0.065 | 3.177 | 0.0165 | 3.1 |
| 15 | 0.095 | 0.095 | 3.202 | 0.0242 | 4.7 |
| 20 | 0.125 | 0.125 | 3.227 | 0.0318 | 6.2 |
| 25 | 0.165 | 0.165 | 3.261 | 0.0420 | 7.7 |
| 26 | 0.170 | 0.170 | 3.266 | 0.0433 | 8.0 |
| 27 | 0.185 | 0.185 | 3.279 | 0.0471 | 8.2 |
| 28 | 0.190 | 0.190 | 3.283 | 0.0484 | 8.5 |
| 28 | 0.200 | 0.200 | 3.292 | 0.0509 | 8.5 |
| 30 | 0.210 | 0.210 | 3.301 | 0.0534 | 9.1 |
| 31 | 0.225 | 0.225 | 3.314 | 0.0573 | 9.4 |
| 33 | 0.235 | 0.235 | 3.323 | 0.0598 | 9.9 |
| 34 | 0.265 | 0.265 | 3.350 | 0.0674 | 10.1 |
| 33 | 0.280 | 0.280 | 3.364 | 0.0713 | 9.8 |
| 34 | 0.290 | 0.290 | 3.373 | 0.0738 | 10.1 |
| 33 | 0.300 | 0.300 | 3.383 | 0.0763 | 9.8 |
| 31 | 0.320 | 0.320 | 3.401 | 0.0814 | 9.1 |
| 30 | 0.325 | 0.325 | 3.406 | 0.0827 | 8.8 |
| 29 | 0.335 | 0.335 | 3.416 | 0.0853 | 8.5 |
| 25 | 0.355 | 0.355 | 3.435 | 0.0903 | 7.3 |
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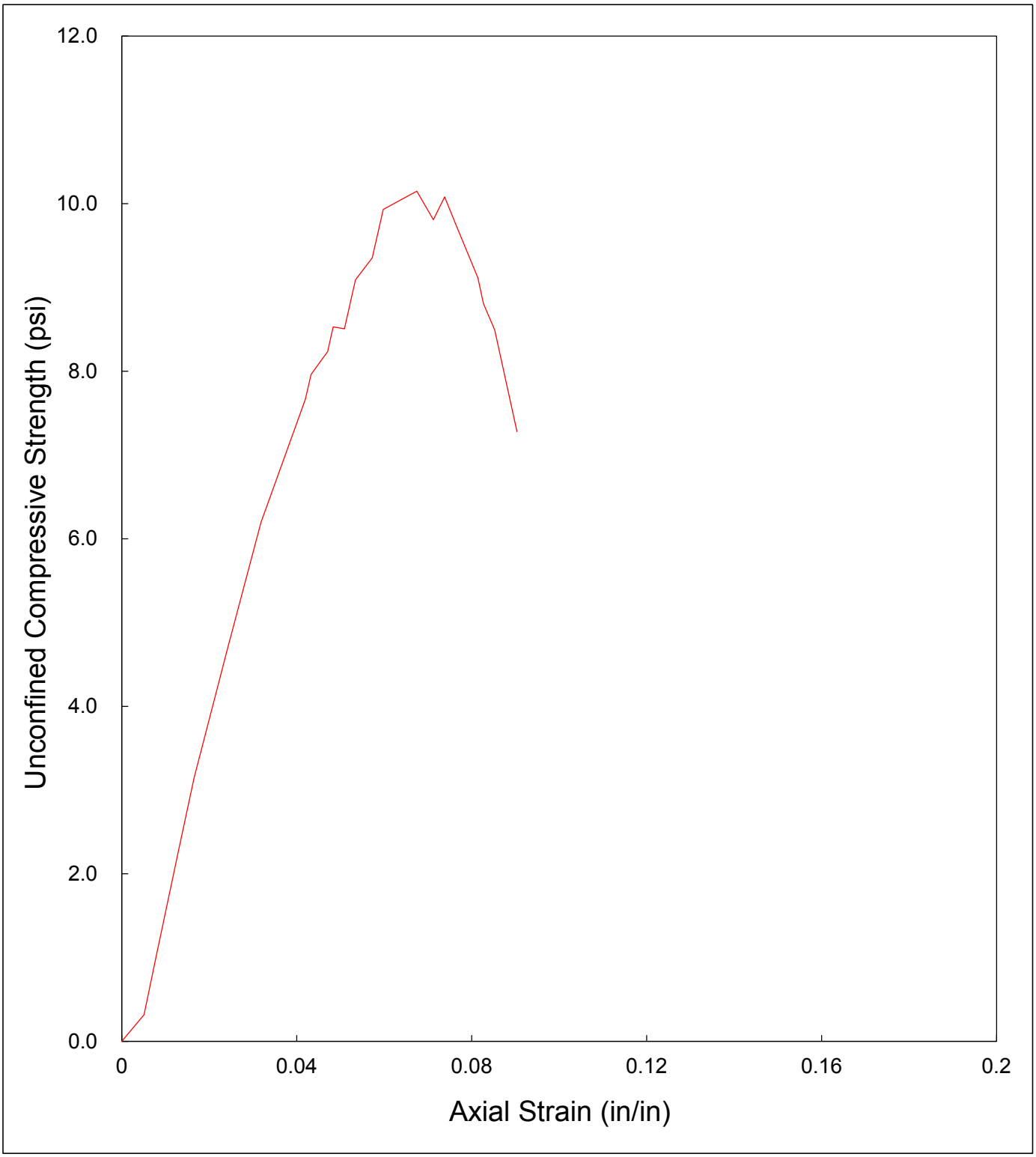
# UNCONFINED COMPRESSION TESTING

Sample No. EXP-013



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-013 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A766_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 25.3 | **%** |
| **BULK UNIT WEIGHT** | 65.6 | lb/ft³ |
| **DRY UNIT WEIGHT** | 52.3 | lb/ft³ |
| **UCS *** | 10.1 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-014 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A767_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 77.56 | g |
| 3. WT WET SOIL + TARE | 131.60 | g |
| 4. WT DRY SOIL + TARE | 122.29 | g |
| 5. WT WATER, Ww | 9.31 | g |
| 6. WT DRY SOIL, Ws | 44.73 | g |
| **7. MOISTURE CONTENT, W** | **20.81** | **%** |

| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 2.00 | in. | 3.97 | in. |
| No. 2 | 2.00 | in. | 3.86 | in. |
| No. 3 | 2.00 | in. | 3.94 | in. |
| **Average** | **2.00** | **in.** | **3.93** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***204.80*** | ***g*** |
| Initial Area, Ao | 3.14 | $in^2$ |
| Initial Volume, Vo | 12.31 | $in^3$ |
| Initial Bulk Unit Weight, | 63.4 | $lb/ft^3$ |
| Initial Dry Unit Weight | 52.5 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.59 | in. |
| UCS | 15.1 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.136 | 0.0000 | 0.0 |
| 1 | 0.010 | 0.010 | 3.144 | 0.0025 | 0.3 |
| 3 | 0.030 | 0.030 | 3.160 | 0.0076 | 0.9 |
| 6 | 0.055 | 0.055 | 3.180 | 0.0140 | 1.9 |
| 10 | 0.085 | 0.085 | 3.205 | 0.0217 | 3.1 |
| 15 | 0.110 | 0.110 | 3.226 | 0.0280 | 4.6 |
| 22 | 0.140 | 0.140 | 3.252 | 0.0357 | 6.8 |
| 26 | 0.160 | 0.160 | 3.269 | 0.0408 | 8.0 |
| 32 | 0.195 | 0.195 | 3.300 | 0.0497 | 9.7 |
| 36 | 0.215 | 0.215 | 3.318 | 0.0548 | 10.9 |
| 40 | 0.245 | 0.245 | 3.345 | 0.0624 | 12.0 |
| 42 | 0.255 | 0.255 | 3.354 | 0.0650 | 12.5 |
| 44 | 0.275 | 0.275 | 3.372 | 0.0701 | 13.0 |
| 46 | 0.290 | 0.290 | 3.386 | 0.0739 | 13.6 |
| 48 | 0.315 | 0.315 | 3.409 | 0.0802 | 14.1 |
| 49 | 0.325 | 0.325 | 3.419 | 0.0828 | 14.3 |
| 50 | 0.335 | 0.335 | 3.428 | 0.0853 | 14.6 |
| 51 | 0.345 | 0.345 | 3.438 | 0.0879 | 14.8 |
| 52 | 0.360 | 0.360 | 3.452 | 0.0917 | 15.1 |
| 53 | 0.415 | 0.415 | 3.507 | 0.1057 | 15.1 |
| 51 | 0.450 | 0.450 | 3.542 | 0.1146 | 14.4 |
| 49 | 0.465 | 0.465 | 3.557 | 0.1185 | 13.8 |
| 48 | 0.480 | 0.480 | 3.573 | 0.1223 | 13.4 |
| 47 | 0.490 | 0.490 | 3.583 | 0.1248 | 13.1 |
| 46 | 0.495 | 0.495 | 3.588 | 0.1261 | 12.8 |
| 45 | 0.515 | 0.515 | 3.609 | 0.1312 | 12.5 |
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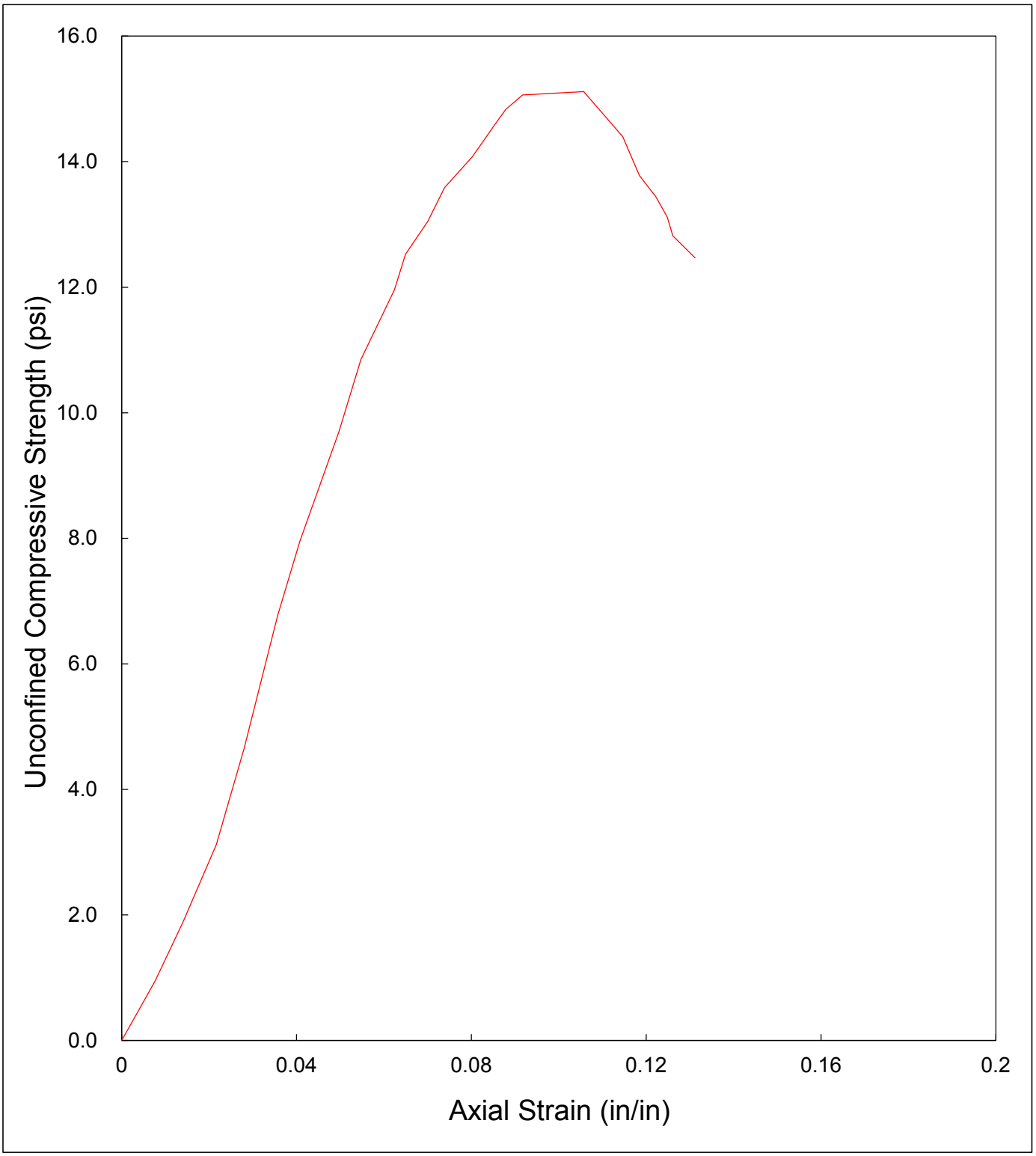
# UNCONFINED COMPRESSION TESTING

Sample No. EXP-014



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-014 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A767_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 20.8 | **%** |
| **BULK UNIT WEIGHT** | 63.4 | lb/ft³ |
| **DRY UNIT WEIGHT** | 52.5 | lb/ft³ |
| **UCS *** | 15.1 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-015 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A768_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.26 | g |
| 3. WT WET SOIL + TARE | 124.99 | g |
| 4. WT DRY SOIL + TARE | 114.36 | g |
| 5. WT WATER, Ww | 10.63 | g |
| 6. WT DRY SOIL, Ws | 38.10 | g |
| **7. MOISTURE CONTENT, W** | **27.90** | **%** |

| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.99 | in. | 3.88 | in. |
| No. 2 | 1.99 | in. | 4.00 | in. |
| No. 3 | 1.99 | in. | 3.98 | in. |
| **Average** | **1.99** | **in.** | **3.95** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***216.15*** | ***g*** |
| Initial Area, Ao | 3.11 | $in^2$ |
| Initial Volume, Vo | 12.28 | $in^3$ |
| Initial Bulk Unit Weight, | 67.0 | $lb/ft^3$ |
| Initial Dry Unit Weight | 52.4 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.59 | in. |
| UCS | 15.3 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.106 | 0.0000 | 0.0 |
| 1 | 0.003 | 0.003 | 3.108 | 0.0008 | 0.3 |
| 3 | 0.015 | 0.015 | 3.118 | 0.0038 | 1.0 |
| 5 | 0.025 | 0.025 | 3.126 | 0.0063 | 1.6 |
| 10 | 0.050 | 0.050 | 3.146 | 0.0126 | 3.2 |
| 15 | 0.070 | 0.070 | 3.162 | 0.0177 | 4.7 |
| 19 | 0.090 | 0.090 | 3.178 | 0.0228 | 6.0 |
| 25 | 0.110 | 0.110 | 3.195 | 0.0278 | 7.8 |
| 30 | 0.130 | 0.130 | 3.212 | 0.0329 | 9.3 |
| 35 | 0.155 | 0.155 | 3.233 | 0.0392 | 10.8 |
| 40 | 0.180 | 0.180 | 3.254 | 0.0455 | 12.3 |
| 41 | 0.185 | 0.185 | 3.259 | 0.0468 | 12.6 |
| 42 | 0.195 | 0.195 | 3.267 | 0.0493 | 12.9 |
| 43 | 0.205 | 0.205 | 3.276 | 0.0518 | 13.1 |
| 44 | 0.210 | 0.210 | 3.280 | 0.0531 | 13.4 |
| 45 | 0.215 | 0.215 | 3.285 | 0.0544 | 13.7 |
| 46 | 0.230 | 0.230 | 3.298 | 0.0582 | 13.9 |
| 47 | 0.235 | 0.235 | 3.302 | 0.0594 | 14.2 |
| 48 | 0.240 | 0.240 | 3.307 | 0.0607 | 14.5 |
| 50 | 0.260 | 0.260 | 3.325 | 0.0658 | 15.0 |
| 51 | 0.275 | 0.275 | 3.338 | 0.0695 | 15.3 |
| 51 | 0.330 | 0.330 | 3.389 | 0.0835 | 15.0 |
| 50 | 0.335 | 0.335 | 3.394 | 0.0847 | 14.7 |
| 48 | 0.345 | 0.345 | 3.403 | 0.0873 | 14.1 |
| 47 | 0.365 | 0.365 | 3.422 | 0.0923 | 13.7 |
| 46 | 0.370 | 0.370 | 3.427 | 0.0936 | 13.4 |
| 45 | 0.375 | 0.375 | 3.432 | 0.0948 | 13.1 |
| 44 | 0.385 | 0.385 | 3.441 | 0.0974 | 12.8 |
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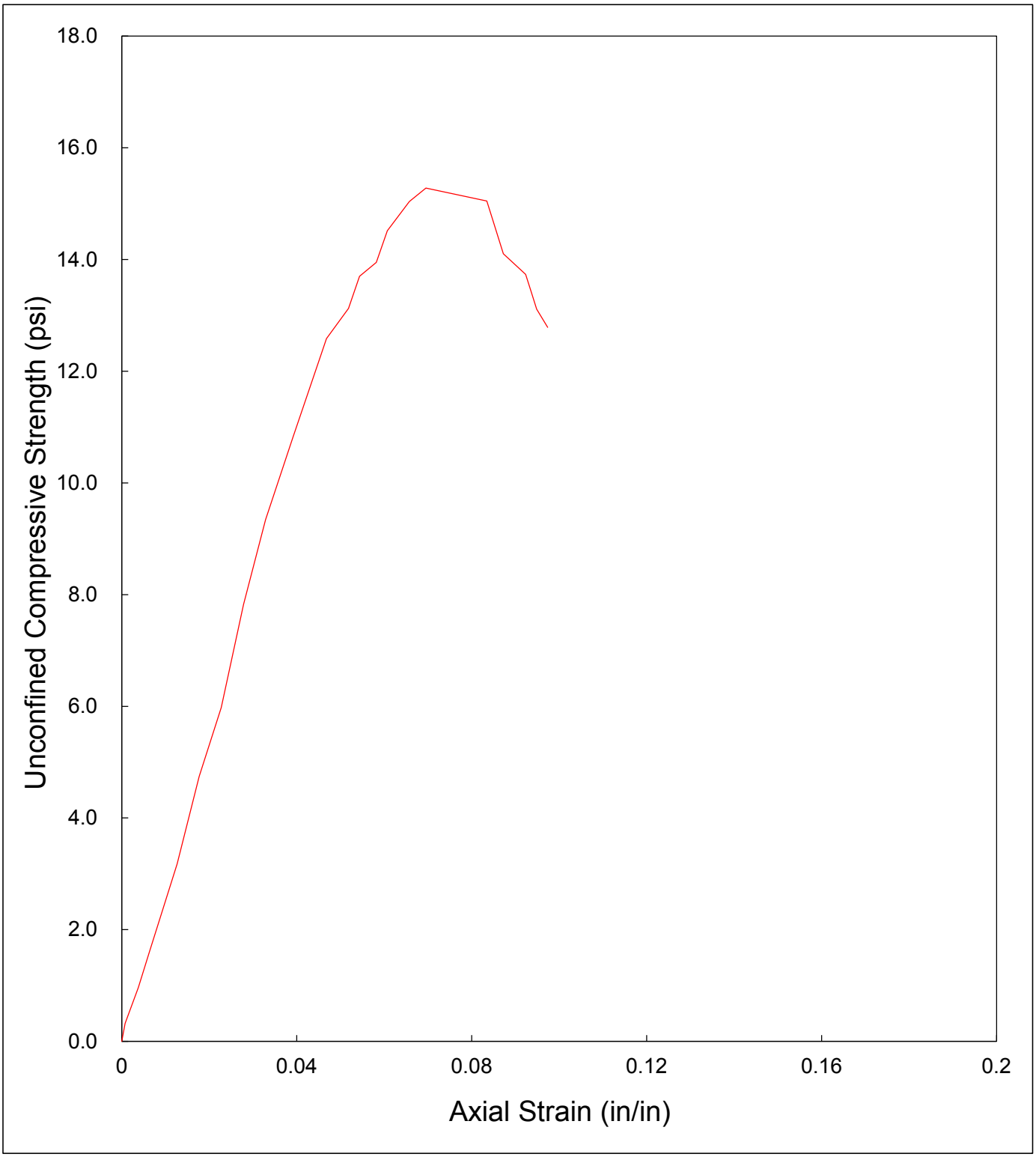
# UNCONFINED COMPRESSION TESTING

Sample No. EXP-015



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-015 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A768_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 27.9 | **%** |
| **BULK UNIT WEIGHT** | 67.0 | lb/ft³ |
| **DRY UNIT WEIGHT** | 52.4 | lb/ft³ |
| **UCS *** | 15.3 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-016 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A769_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 70.21 | g |
| 3. WT WET SOIL + TARE | 128.40 | g |
| 4. WT DRY SOIL + TARE | 119.81 | g |
| 5. WT WATER, Ww | 8.59 | g |
| 6. WT DRY SOIL, Ws | 49.60 | g |
| **7. MOISTURE CONTENT, W** | **17.32** | **%** |

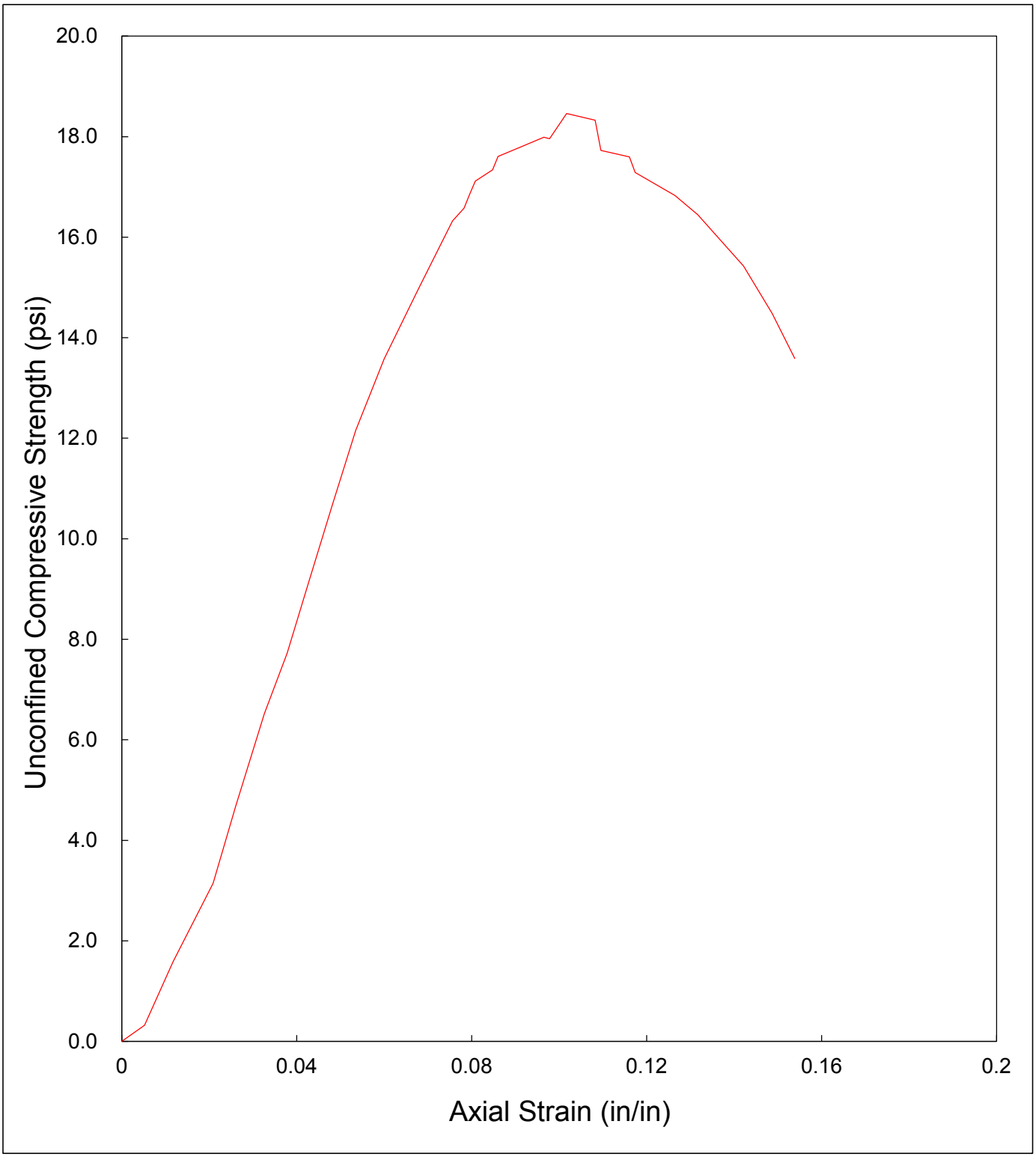
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.98 | in. | 3.85 | in. |
| No. 2 | 2.00 | in. | 3.85 | in. |
| No. 3 | 1.99 | in. | 3.81 | in. |
| **Average** | **1.99** | **in.** | **3.83** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***204.86*** | ***g*** |
| Initial Area, Ao | 3.11 | $in^2$ |
| Initial Volume, Vo | 11.94 | $in^3$ |
| Initial Bulk Unit Weight, | 65.3 | $lb/ft^3$ |
| Initial Dry Unit Weight | 55.7 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.58 | in. |
| UCS | 18.5 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.114 | 0.0000 | 0.0 |
| 1 | 0.020 | 0.020 | 3.131 | 0.0052 | 0.3 |
| 5 | 0.045 | 0.045 | 3.151 | 0.0117 | 1.6 |
| 10 | 0.080 | 0.080 | 3.181 | 0.0209 | 3.1 |
| 15 | 0.100 | 0.100 | 3.198 | 0.0261 | 4.7 |
| 21 | 0.125 | 0.125 | 3.219 | 0.0326 | 6.5 |
| 25 | 0.145 | 0.145 | 3.237 | 0.0378 | 7.7 |
| 30 | 0.165 | 0.165 | 3.254 | 0.0430 | 9.2 |
| 35 | 0.185 | 0.185 | 3.272 | 0.0482 | 10.7 |
| 40 | 0.205 | 0.205 | 3.290 | 0.0535 | 12.2 |
| 45 | 0.230 | 0.230 | 3.313 | 0.0600 | 13.6 |
| 50 | 0.260 | 0.260 | 3.341 | 0.0678 | 15.0 |
| 55 | 0.290 | 0.290 | 3.369 | 0.0756 | 16.3 |
| 56 | 0.300 | 0.300 | 3.379 | 0.0782 | 16.6 |
| 57 | 0.305 | 0.305 | 3.384 | 0.0795 | 16.8 |
| 58 | 0.310 | 0.310 | 3.388 | 0.0808 | 17.1 |
| 59 | 0.325 | 0.325 | 3.403 | 0.0848 | 17.3 |
| 60 | 0.330 | 0.330 | 3.408 | 0.0861 | 17.6 |
| 61 | 0.350 | 0.350 | 3.427 | 0.0913 | 17.8 |
| 62 | 0.370 | 0.370 | 3.447 | 0.0965 | 18.0 |
| 62 | 0.375 | 0.375 | 3.452 | 0.0978 | 18.0 |
| 64 | 0.390 | 0.390 | 3.467 | 0.1017 | 18.5 |
| 64 | 0.415 | 0.415 | 3.492 | 0.1082 | 18.3 |
| 62 | 0.420 | 0.420 | 3.497 | 0.1095 | 17.7 |
| 62 | 0.445 | 0.445 | 3.523 | 0.1160 | 17.6 |
| 61 | 0.450 | 0.450 | 3.528 | 0.1174 | 17.3 |
| 60 | 0.485 | 0.485 | 3.565 | 0.1265 | 16.8 |
| 59 | 0.505 | 0.505 | 3.587 | 0.1317 | 16.4 |
| 56 | 0.545 | 0.545 | 3.630 | 0.1421 | 15.4 |
| 53 | 0.570 | 0.570 | 3.658 | 0.1486 | 14.5 |
| 50 | 0.590 | 0.590 | 3.681 | 0.1539 | 13.6 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-016



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-016 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A769_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 17.3 | **%** |
| **BULK UNIT WEIGHT** | 65.3 | lb/ft³ |
| **DRY UNIT WEIGHT** | 55.7 | lb/ft³ |
| **UCS *** | 18.5 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-017 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A770_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 77.52 | g |
| 3. WT WET SOIL + TARE | 117.59 | g |
| 4. WT DRY SOIL + TARE | 109.32 | g |
| 5. WT WATER, Ww | 8.27 | g |
| 6. WT DRY SOIL, Ws | 31.80 | g |
| **7. MOISTURE CONTENT, W** | **26.01** | **%** |

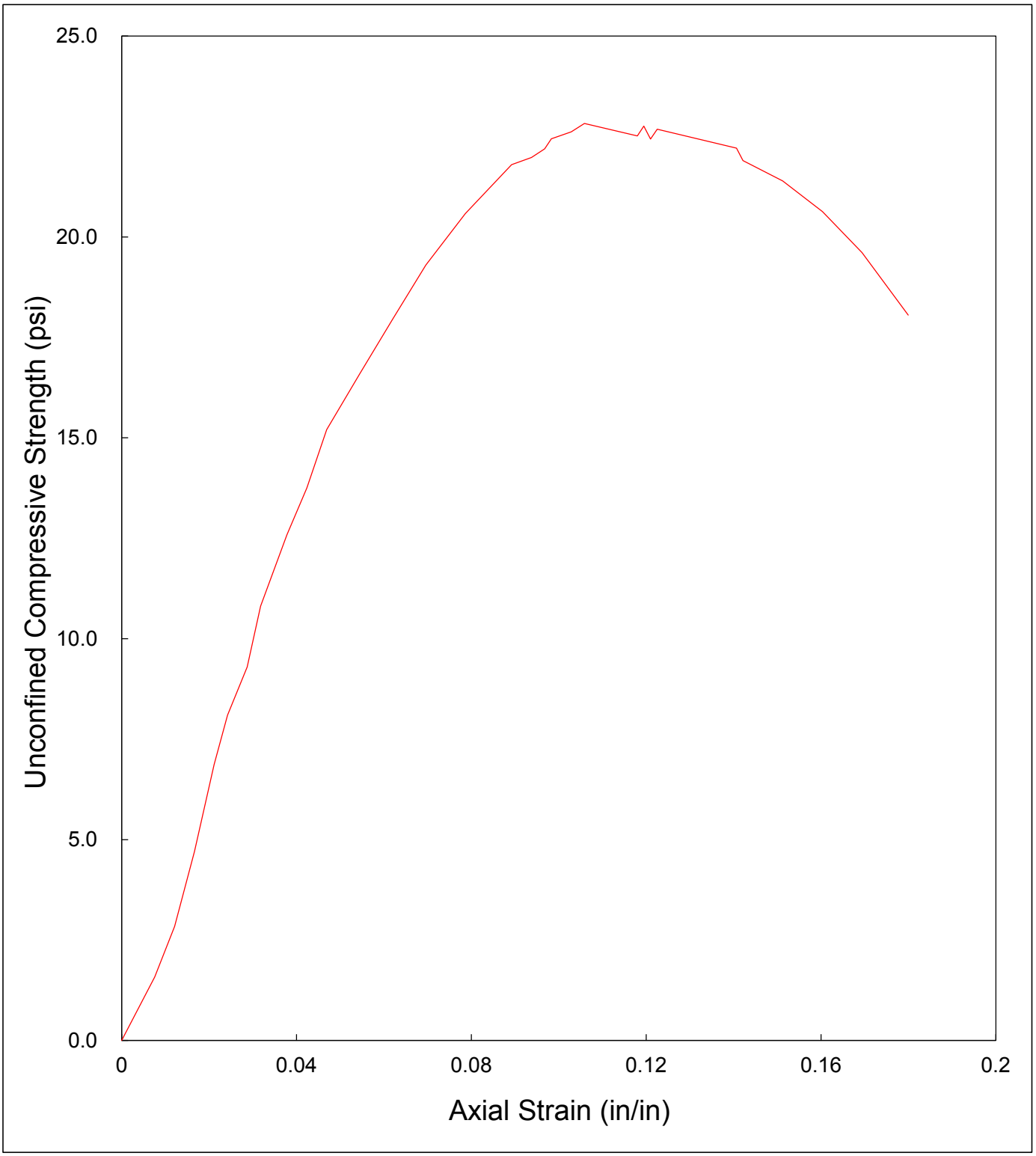
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 2.00 | in. | 1.97 | in. |
| No. 2 | 2.00 | in. | 3.94 | in. |
| No. 3 | 2.00 | in. | 4.01 | in. |
| **Average** | **2.00** | **in.** | **3.31** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***223.28*** | ***g*** |
| Initial Area, Ao | 3.13 | $in^2$ |
| Initial Volume, Vo | 10.36 | $in^3$ |
| Initial Bulk Unit Weight, | 82.1 | $lb/ft^3$ |
| Initial Dry Unit Weight | 65.2 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.50 | in. |
| UCS | 22.8 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.134 | 0.0000 | 0.0 |
| 5 | 0.025 | 0.025 | 3.158 | 0.0076 | 1.6 |
| 9 | 0.040 | 0.040 | 3.172 | 0.0121 | 2.8 |
| 15 | 0.055 | 0.055 | 3.187 | 0.0166 | 4.7 |
| 22 | 0.070 | 0.070 | 3.202 | 0.0212 | 6.9 |
| 26 | 0.080 | 0.080 | 3.211 | 0.0242 | 8.1 |
| 30 | 0.095 | 0.095 | 3.226 | 0.0287 | 9.3 |
| 35 | 0.105 | 0.105 | 3.237 | 0.0318 | 10.8 |
| 41 | 0.125 | 0.125 | 3.257 | 0.0378 | 12.6 |
| 45 | 0.140 | 0.140 | 3.272 | 0.0423 | 13.8 |
| 50 | 0.155 | 0.155 | 3.288 | 0.0469 | 15.2 |
| 55 | 0.180 | 0.180 | 3.314 | 0.0544 | 16.6 |
| 60 | 0.205 | 0.205 | 3.341 | 0.0620 | 18.0 |
| 65 | 0.230 | 0.230 | 3.368 | 0.0696 | 19.3 |
| 70 | 0.260 | 0.260 | 3.401 | 0.0786 | 20.6 |
| 75 | 0.295 | 0.295 | 3.441 | 0.0892 | 21.8 |
| 76 | 0.310 | 0.310 | 3.458 | 0.0938 | 22.0 |
| 77 | 0.320 | 0.320 | 3.470 | 0.0968 | 22.2 |
| 78 | 0.325 | 0.325 | 3.475 | 0.0983 | 22.4 |
| 79 | 0.340 | 0.340 | 3.493 | 0.1028 | 22.6 |
| 80 | 0.350 | 0.350 | 3.505 | 0.1059 | 22.8 |
| 80 | 0.390 | 0.390 | 3.553 | 0.1180 | 22.5 |
| 81 | 0.395 | 0.395 | 3.559 | 0.1195 | 22.8 |
| 80 | 0.400 | 0.400 | 3.565 | 0.1210 | 22.4 |
| 81 | 0.405 | 0.405 | 3.571 | 0.1225 | 22.7 |
| 81 | 0.465 | 0.465 | 3.647 | 0.1407 | 22.2 |
| 80 | 0.470 | 0.470 | 3.653 | 0.1422 | 21.9 |
| 79 | 0.500 | 0.500 | 3.692 | 0.1512 | 21.4 |
| 77 | 0.530 | 0.530 | 3.732 | 0.1603 | 20.6 |
| 74 | 0.560 | 0.560 | 3.773 | 0.1694 | 19.6 |
| 69 | 0.595 | 0.595 | 3.822 | 0.1800 | 18.1 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-017



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-017 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A770_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 26.0 | **%** |
| **BULK UNIT WEIGHT** | 82.1 | lb/ft³ |
| **DRY UNIT WEIGHT** | 65.2 | lb/ft³ |
| **UCS *** | 22.8 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-018 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A771_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 71.93 | g |
| 3. WT WET SOIL + TARE | 118.52 | g |
| 4. WT DRY SOIL + TARE | 105.35 | g |
| 5. WT WATER, Ww | 13.17 | g |
| 6. WT DRY SOIL, Ws | 33.42 | g |
| **7. MOISTURE CONTENT, W** | **39.41** | **%** |

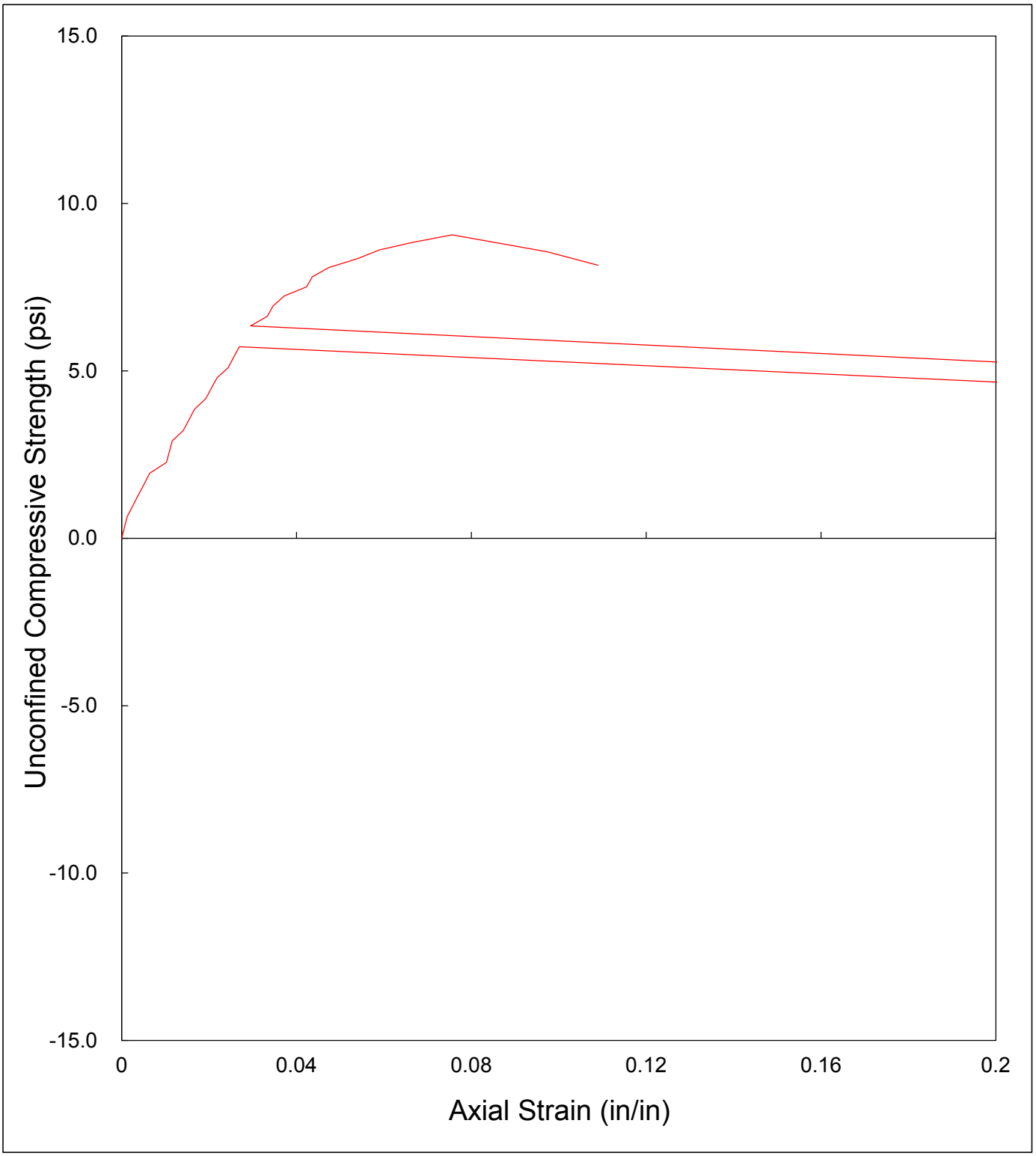
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.99 | in. | 3.85 | in. |
| No. 2 | 1.94 | in. | 3.92 | in. |
| No. 3 | 1.99 | in. | 3.93 | in. |
| **Average** | **1.97** | **in.** | **3.90** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***230.04*** | ***g*** |
| Initial Area, Ao | 3.06 | $in^2$ |
| Initial Volume, Vo | 11.94 | $in^3$ |
| Initial Bulk Unit Weight, | 73.4 | $lb/ft^3$ |
| Initial Dry Unit Weight | 52.7 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.59 | in. |
| UCS | 9.1 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.060 | 0.0000 | 0.0 |
| 2 | 0.005 | 0.005 | 3.064 | 0.0013 | 0.7 |
| 3 | 0.010 | 0.010 | 3.068 | 0.0026 | 1.0 |
| 4 | 0.015 | 0.015 | 3.072 | 0.0038 | 1.3 |
| 5 | 0.020 | 0.020 | 3.076 | 0.0051 | 1.6 |
| 6 | 0.025 | 0.025 | 3.080 | 0.0064 | 1.9 |
| 7 | 0.040 | 0.040 | 3.092 | 0.0103 | 2.3 |
| 9 | 0.045 | 0.045 | 3.096 | 0.0115 | 2.9 |
| 10 | 0.055 | 0.055 | 3.104 | 0.0141 | 3.2 |
| 11 | 0.060 | 0.060 | 3.108 | 0.0154 | 3.5 |
| 12 | 0.065 | 0.065 | 3.112 | 0.0167 | 3.9 |
| 13 | 0.075 | 0.075 | 3.120 | 0.0192 | 4.2 |
| 14 | 0.080 | 0.080 | 3.125 | 0.0205 | 4.5 |
| 15 | 0.085 | 0.085 | 3.129 | 0.0218 | 4.8 |
| 16 | 0.095 | 0.095 | 3.137 | 0.0244 | 5.1 |
| 17 | 0.100 | 0.100 | 3.141 | 0.0256 | 5.4 |
| 18 | 0.105 | 0.105 | 3.145 | 0.0269 | 5.7 |
| 19 | 11.000 | 11.000 | -1.681 | 2.8205 | -11.3 |
| 20 | 0.115 | 0.115 | 3.153 | 0.0295 | 6.3 |
| 21 | 0.130 | 0.130 | 3.166 | 0.0333 | 6.6 |
| 22 | 0.135 | 0.135 | 3.170 | 0.0346 | 6.9 |
| 23 | 0.145 | 0.145 | 3.179 | 0.0372 | 7.2 |
| 24 | 0.165 | 0.165 | 3.196 | 0.0423 | 7.5 |
| 25 | 0.170 | 0.170 | 3.200 | 0.0436 | 7.8 |
| 26 | 0.185 | 0.185 | 3.213 | 0.0474 | 8.1 |
| 27 | 0.210 | 0.210 | 3.235 | 0.0538 | 8.3 |
| 28 | 0.230 | 0.230 | 3.252 | 0.0590 | 8.6 |
| 29 | 0.260 | 0.260 | 3.279 | 0.0667 | 8.8 |
| 30 | 0.295 | 0.295 | 3.311 | 0.0756 | 9.1 |
| 29 | 0.380 | 0.380 | 3.391 | 0.0974 | 8.6 |
| 28 | 0.425 | 0.425 | 3.435 | 0.1090 | 8.2 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-018



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-018 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A771_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 39.4 | **%** |
| **BULK UNIT WEIGHT** | 73.4 | lb/ft³ |
| **DRY UNIT WEIGHT** | 52.7 | lb/ft³ |
| **UCS *** | 9.1 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-019 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A772_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 77.52 | g |
| 3. WT WET SOIL + TARE | 113.98 | g |
| 4. WT DRY SOIL + TARE | 105.12 | g |
| 5. WT WATER, Ww | 8.86 | g |
| 6. WT DRY SOIL, Ws | 27.60 | g |
| **7. MOISTURE CONTENT, W** | **32.10** | **%** |

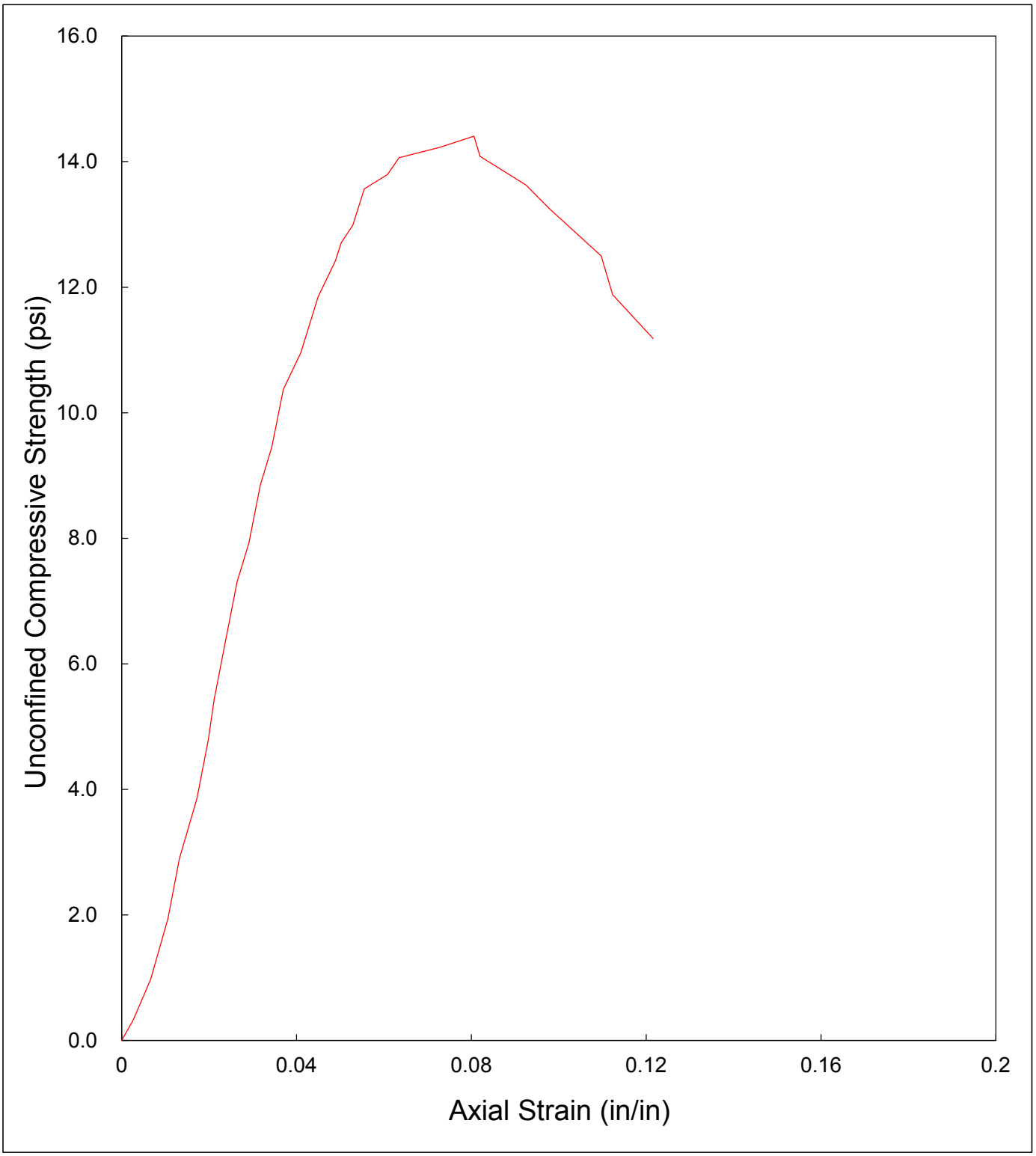
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.97 | in. | 3.83 | in. |
| No. 2 | 1.97 | in. | 3.74 | in. |
| No. 3 | 1.98 | in. | 3.78 | in. |
| **Average** | **1.98** | **in.** | **3.78** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***209.78*** | ***g*** |
| Initial Area, Ao | 3.06 | $in^2$ |
| Initial Volume, Vo | 11.59 | $in^3$ |
| Initial Bulk Unit Weight, | 69.0 | $lb/ft^3$ |
| Initial Dry Unit Weight | 52.2 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.57 | in. |
| UCS | 14.4 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.064 | 0.0000 | 0.0 |
| 1 | 0.010 | 0.010 | 3.072 | 0.0026 | 0.3 |
| 3 | 0.025 | 0.025 | 3.084 | 0.0066 | 1.0 |
| 6 | 0.040 | 0.040 | 3.096 | 0.0106 | 1.9 |
| 9 | 0.050 | 0.050 | 3.105 | 0.0132 | 2.9 |
| 12 | 0.065 | 0.065 | 3.117 | 0.0172 | 3.8 |
| 15 | 0.075 | 0.075 | 3.126 | 0.0198 | 4.8 |
| 17 | 0.080 | 0.080 | 3.130 | 0.0211 | 5.4 |
| 20 | 0.090 | 0.090 | 3.138 | 0.0238 | 6.4 |
| 23 | 0.100 | 0.100 | 3.147 | 0.0264 | 7.3 |
| 25 | 0.110 | 0.110 | 3.155 | 0.0291 | 7.9 |
| 28 | 0.120 | 0.120 | 3.164 | 0.0317 | 8.8 |
| 30 | 0.130 | 0.130 | 3.173 | 0.0344 | 9.5 |
| 33 | 0.140 | 0.140 | 3.181 | 0.0370 | 10.4 |
| 35 | 0.155 | 0.155 | 3.194 | 0.0410 | 11.0 |
| 38 | 0.170 | 0.170 | 3.208 | 0.0449 | 11.8 |
| 40 | 0.185 | 0.185 | 3.221 | 0.0489 | 12.4 |
| 41 | 0.190 | 0.190 | 3.226 | 0.0502 | 12.7 |
| 42 | 0.200 | 0.200 | 3.235 | 0.0529 | 13.0 |
| 43 | 0.205 | 0.205 | 3.239 | 0.0542 | 13.3 |
| 44 | 0.210 | 0.210 | 3.244 | 0.0555 | 13.6 |
| 45 | 0.230 | 0.230 | 3.262 | 0.0608 | 13.8 |
| 46 | 0.240 | 0.240 | 3.271 | 0.0634 | 14.1 |
| 47 | 0.275 | 0.275 | 3.304 | 0.0727 | 14.2 |
| 48 | 0.305 | 0.305 | 3.332 | 0.0806 | 14.4 |
| 47 | 0.310 | 0.310 | 3.337 | 0.0819 | 14.1 |
| 46 | 0.350 | 0.350 | 3.376 | 0.0925 | 13.6 |
| 45 | 0.370 | 0.370 | 3.396 | 0.0978 | 13.3 |
| 43 | 0.415 | 0.415 | 3.441 | 0.1097 | 12.5 |
| 41 | 0.425 | 0.425 | 3.451 | 0.1123 | 11.9 |
| 39 | 0.460 | 0.460 | 3.488 | 0.1216 | 11.2 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-019



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-019 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A772_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 32.1 | **%** |
| **BULK UNIT WEIGHT** | 69.0 | lb/ft³ |
| **DRY UNIT WEIGHT** | 52.2 | lb/ft³ |
| **UCS *** | 14.4 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-020 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A773_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.02 | g |
| 3. WT WET SOIL + TARE | 113.42 | g |
| 4. WT DRY SOIL + TARE | 103.33 | g |
| 5. WT WATER, Ww | 10.09 | g |
| 6. WT DRY SOIL, Ws | 27.31 | g |
| **7. MOISTURE CONTENT, W** | **36.95** | **%** |

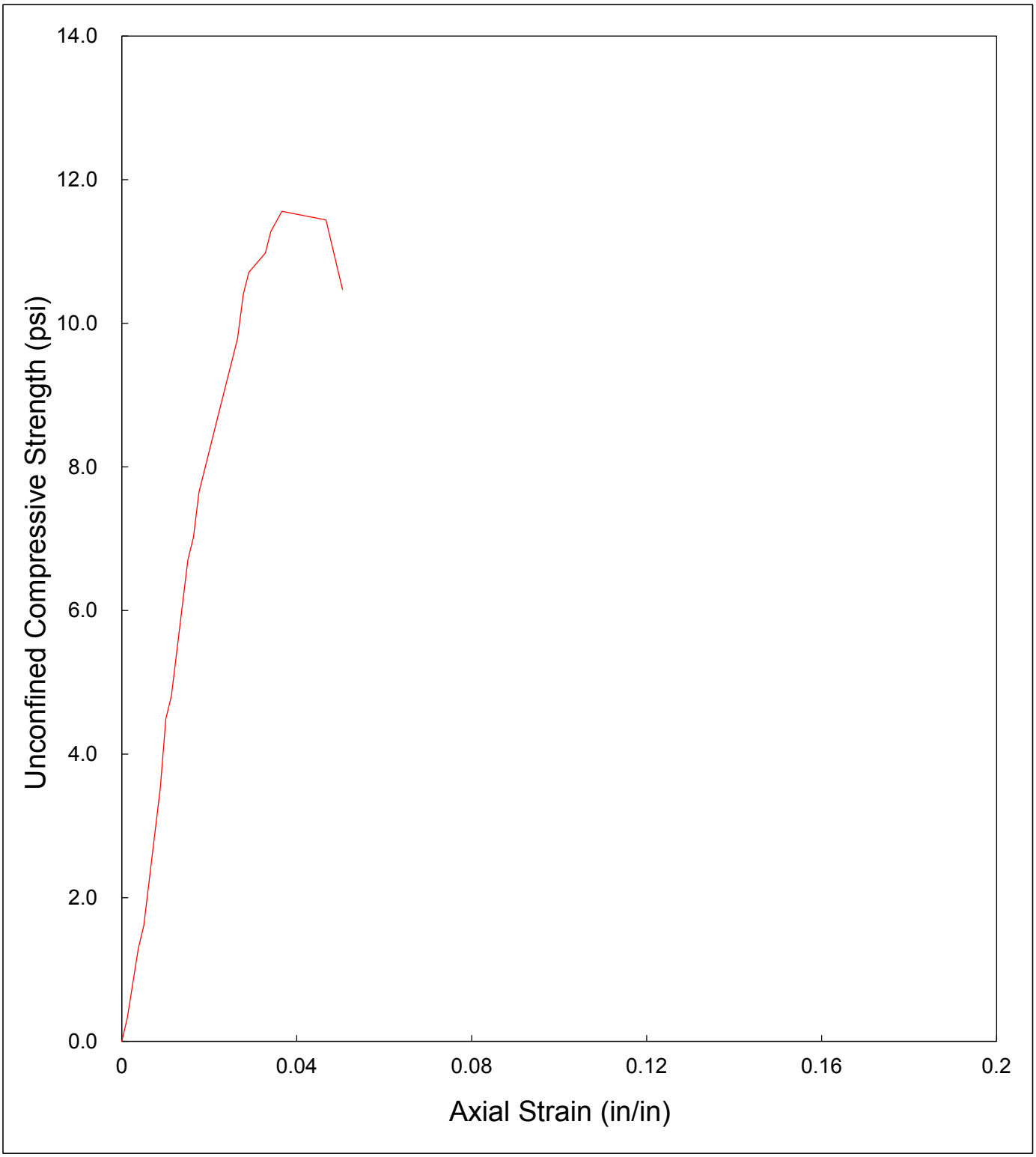
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.97 | in. | 3.99 | in. |
| No. 2 | 1.99 | in. | 3.92 | in. |
| No. 3 | 1.99 | in. | 3.98 | in. |
| **Average** | **1.98** | **in.** | **3.96** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***203.69*** | ***g*** |
| Initial Area, Ao | 3.08 | $in^2$ |
| Initial Volume, Vo | 12.22 | $in^3$ |
| Initial Bulk Unit Weight, | 63.5 | $lb/ft^3$ |
| Initial Dry Unit Weight | 46.4 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.59 | in. |
| UCS | 11.6 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.083 | 0.0000 | 0.0 |
| 1 | 0.005 | 0.005 | 3.087 | 0.0013 | 0.3 |
| 4 | 0.015 | 0.015 | 3.095 | 0.0038 | 1.3 |
| 5 | 0.020 | 0.020 | 3.099 | 0.0050 | 1.6 |
| 7 | 0.025 | 0.025 | 3.103 | 0.0063 | 2.3 |
| 9 | 0.030 | 0.030 | 3.107 | 0.0076 | 2.9 |
| 11 | 0.035 | 0.035 | 3.111 | 0.0088 | 3.5 |
| 14 | 0.040 | 0.040 | 3.115 | 0.0101 | 4.5 |
| 15 | 0.045 | 0.045 | 3.119 | 0.0114 | 4.8 |
| 17 | 0.050 | 0.050 | 3.123 | 0.0126 | 5.4 |
| 19 | 0.055 | 0.055 | 3.127 | 0.0139 | 6.1 |
| 21 | 0.060 | 0.060 | 3.131 | 0.0151 | 6.7 |
| 22 | 0.065 | 0.065 | 3.135 | 0.0164 | 7.0 |
| 24 | 0.070 | 0.070 | 3.139 | 0.0177 | 7.6 |
| 25 | 0.075 | 0.075 | 3.143 | 0.0189 | 8.0 |
| 26 | 0.080 | 0.080 | 3.147 | 0.0202 | 8.3 |
| 27 | 0.085 | 0.085 | 3.151 | 0.0214 | 8.6 |
| 28 | 0.090 | 0.090 | 3.155 | 0.0227 | 8.9 |
| 29 | 0.095 | 0.095 | 3.159 | 0.0240 | 9.2 |
| 30 | 0.100 | 0.100 | 3.163 | 0.0252 | 9.5 |
| 31 | 0.105 | 0.105 | 3.167 | 0.0265 | 9.8 |
| 33 | 0.110 | 0.110 | 3.171 | 0.0278 | 10.4 |
| 34 | 0.115 | 0.115 | 3.175 | 0.0290 | 10.7 |
| 35 | 0.130 | 0.130 | 3.188 | 0.0328 | 11.0 |
| 36 | 0.135 | 0.135 | 3.192 | 0.0341 | 11.3 |
| 37 | 0.145 | 0.145 | 3.200 | 0.0366 | 11.6 |
| 37 | 0.185 | 0.185 | 3.234 | 0.0467 | 11.4 |
| 36 | 0.190 | 0.190 | 3.238 | 0.0479 | 11.1 |
| 35 | 0.195 | 0.195 | 3.243 | 0.0492 | 10.8 |
| 34 | 0.200 | 0.200 | 3.247 | 0.0505 | 10.5 |
| | | | | | |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-020



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-020 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A773_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 36.9 | **%** |
| **BULK UNIT WEIGHT** | 63.5 | lb/ft³ |
| **DRY UNIT WEIGHT** | 46.4 | lb/ft³ |
| **UCS *** | 11.6 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-021 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A774_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.45 | g |
| 3. WT WET SOIL + TARE | 131.06 | g |
| 4. WT DRY SOIL + TARE | 118.42 | g |
| 5. WT WATER, Ww | 12.64 | g |
| 6. WT DRY SOIL, Ws | 41.97 | g |
| **7. MOISTURE CONTENT, W** | **30.12** | **%** |

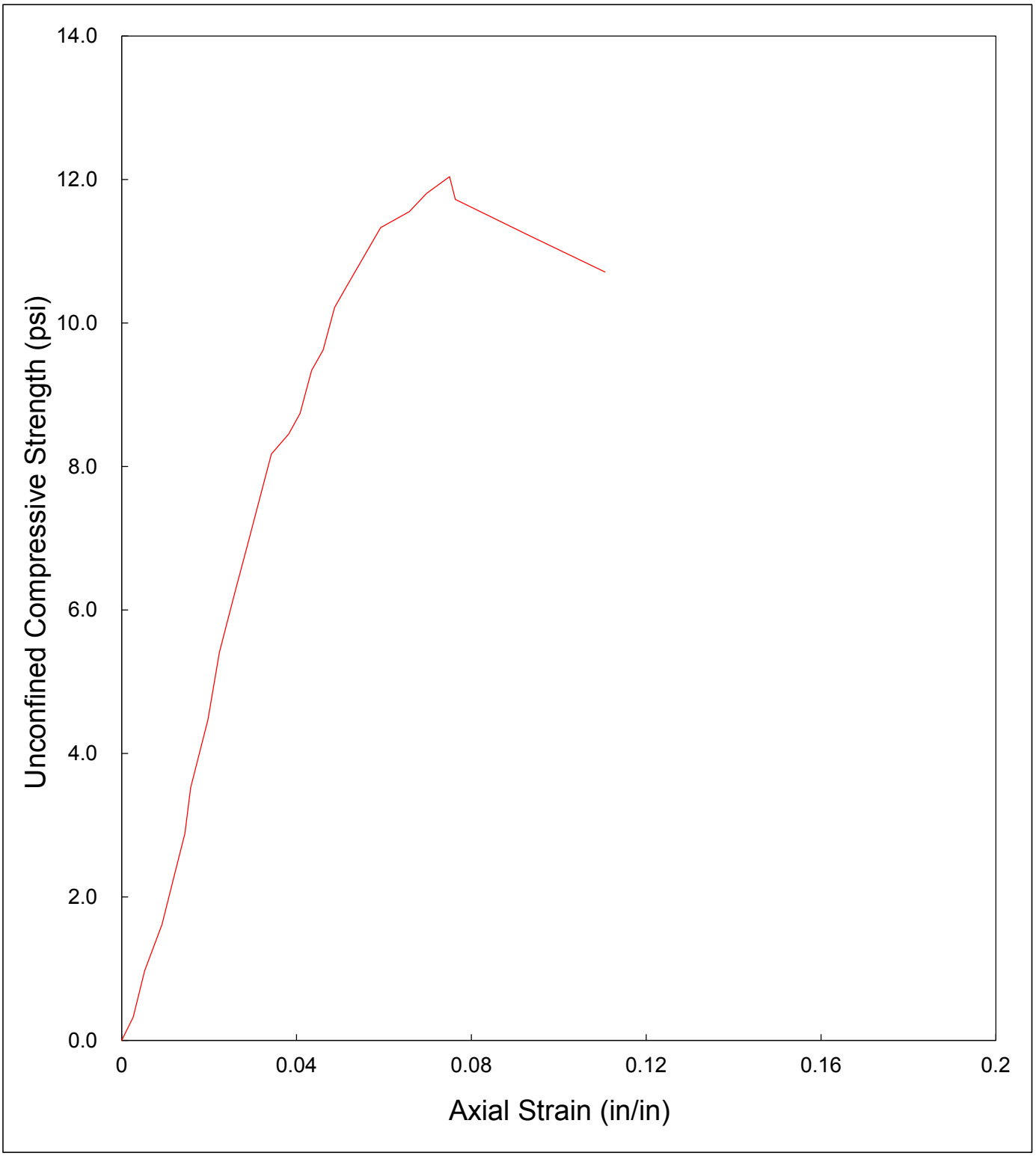
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.96 | in. | 3.77 | in. |
| No. 2 | 1.99 | in. | 3.78 | in. |
| No. 3 | 1.98 | in. | 3.84 | in. |
| **Average** | **1.98** | **in.** | **3.80** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***223.15*** | ***g*** |
| Initial Area, Ao | 3.07 | in² |
| Initial Volume, Vo | 11.67 | in³ |
| Initial Bulk Unit Weight, | 72.8 | lb/ft³ |
| Initial Dry Unit Weight | 56.0 | lb/ft³ |
| 15 % Strain (0.15 Lo) | 0.57 | in. |
| UCS | 12.0 | lb/in² |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA (in²) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH (lb/in²) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.072 | 0.0000 | 0.0 |
| 1 | 0.010 | 0.010 | 3.080 | 0.0026 | 0.3 |
| 3 | 0.020 | 0.020 | 3.089 | 0.0053 | 1.0 |
| 5 | 0.035 | 0.035 | 3.101 | 0.0092 | 1.6 |
| 7 | 0.045 | 0.045 | 3.109 | 0.0118 | 2.3 |
| 9 | 0.055 | 0.055 | 3.117 | 0.0145 | 2.9 |
| 11 | 0.060 | 0.060 | 3.122 | 0.0158 | 3.5 |
| 13 | 0.070 | 0.070 | 3.130 | 0.0184 | 4.2 |
| 14 | 0.075 | 0.075 | 3.134 | 0.0197 | 4.5 |
| 17 | 0.085 | 0.085 | 3.143 | 0.0224 | 5.4 |
| 19 | 0.095 | 0.095 | 3.151 | 0.0250 | 6.0 |
| 20 | 0.100 | 0.100 | 3.155 | 0.0263 | 6.3 |
| 22 | 0.110 | 0.110 | 3.164 | 0.0290 | 7.0 |
| 24 | 0.120 | 0.120 | 3.173 | 0.0316 | 7.6 |
| 26 | 0.130 | 0.130 | 3.181 | 0.0342 | 8.2 |
| 27 | 0.145 | 0.145 | 3.194 | 0.0382 | 8.5 |
| 28 | 0.155 | 0.155 | 3.203 | 0.0408 | 8.7 |
| 29 | 0.160 | 0.160 | 3.207 | 0.0421 | 9.0 |
| 30 | 0.165 | 0.165 | 3.212 | 0.0434 | 9.3 |
| 31 | 0.175 | 0.175 | 3.221 | 0.0461 | 9.6 |
| 33 | 0.185 | 0.185 | 3.230 | 0.0487 | 10.2 |
| 34 | 0.195 | 0.195 | 3.239 | 0.0513 | 10.5 |
| 35 | 0.205 | 0.205 | 3.248 | 0.0540 | 10.8 |
| 36 | 0.215 | 0.215 | 3.257 | 0.0566 | 11.1 |
| 37 | 0.225 | 0.225 | 3.266 | 0.0592 | 11.3 |
| 38 | 0.250 | 0.250 | 3.289 | 0.0658 | 11.6 |
| 39 | 0.265 | 0.265 | 3.303 | 0.0698 | 11.8 |
| 40 | 0.285 | 0.285 | 3.322 | 0.0750 | 12.0 |
| 39 | 0.290 | 0.290 | 3.326 | 0.0763 | 11.7 |
| 38 | 0.355 | 0.355 | 3.389 | 0.0935 | 11.2 |
| 37 | 0.420 | 0.420 | 3.454 | 0.1106 | 10.7 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-021



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-021 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A774_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 30.1 | **%** |
| **BULK UNIT WEIGHT** | 72.8 | lb/ft³ |
| **DRY UNIT WEIGHT** | 56.0 | lb/ft³ |
| **UCS *** | 12.0 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-022 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A775_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 76.60 | g |
| 3. WT WET SOIL + TARE | 118.01 | g |
| 4. WT DRY SOIL + TARE | 109.05 | g |
| 5. WT WATER, Ww | 8.96 | g |
| 6. WT DRY SOIL, Ws | 32.45 | g |
| **7. MOISTURE CONTENT, W** | **27.61** | **%** |

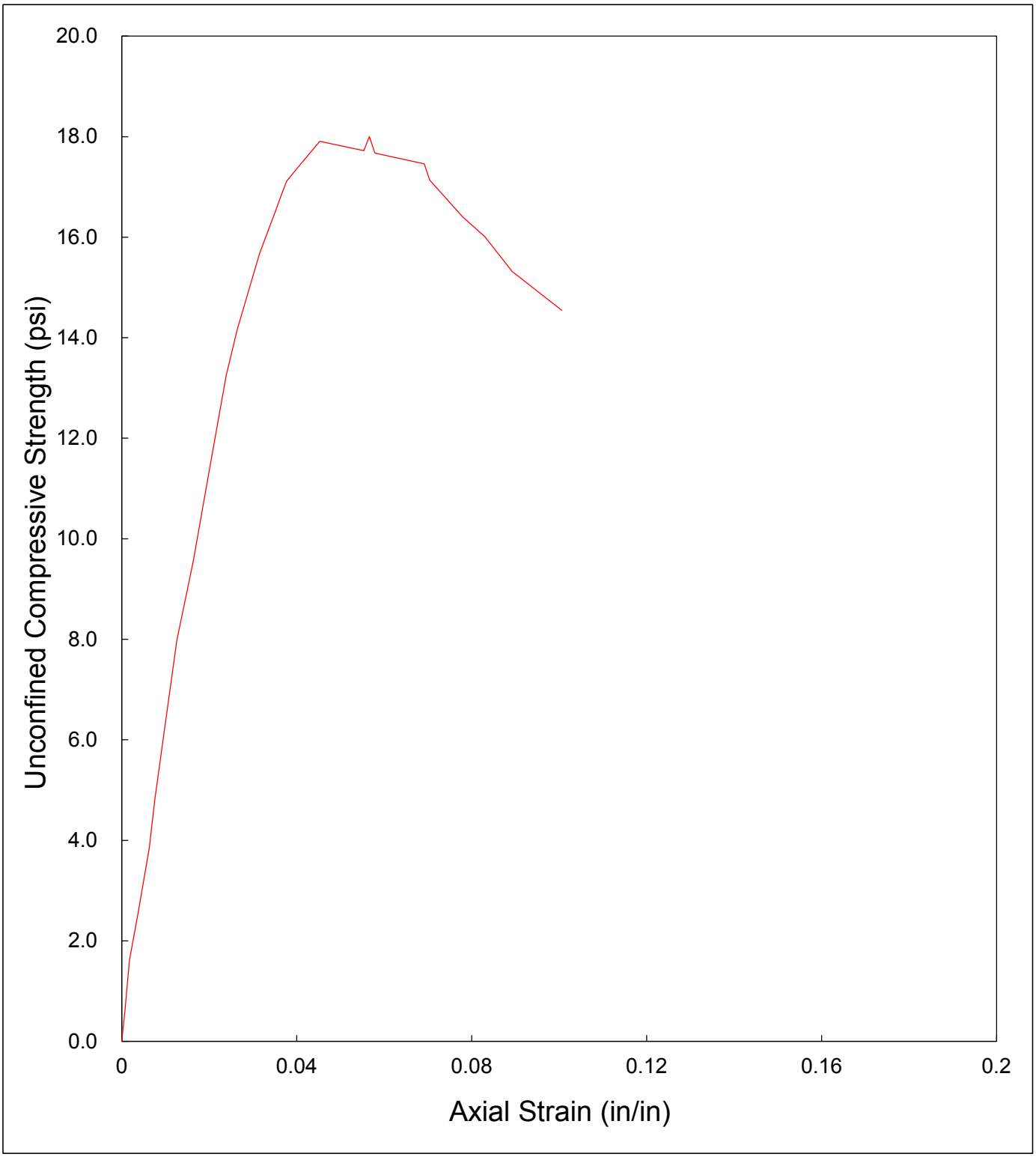
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.98 | in. | 3.98 | in. |
| No. 2 | 2.00 | in. | 3.96 | in. |
| No. 3 | 1.98 | in. | 3.99 | in. |
| **Average** | **1.98** | **in.** | **3.98** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***239.08*** | ***g*** |
| Initial Area, Ao | 3.09 | in² |
| Initial Volume, Vo | 12.30 | in³ |
| Initial Bulk Unit Weight, | 74.1 | lb/ft³ |
| Initial Dry Unit Weight | 58.0 | lb/ft³ |
| 15 % Strain (0.15 Lo) | 0.60 | in. |
| UCS | 18.0 | lb/in² |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA (in²) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH (lb/in²) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.092 | 0.0000 | 0.0 |
| 2 | 0.003 | 0.003 | 3.094 | 0.0008 | 0.6 |
| 5 | 0.007 | 0.007 | 3.098 | 0.0018 | 1.6 |
| 8 | 0.015 | 0.015 | 3.104 | 0.0038 | 2.6 |
| 12 | 0.025 | 0.025 | 3.112 | 0.0063 | 3.9 |
| 15 | 0.030 | 0.030 | 3.116 | 0.0075 | 4.8 |
| 20 | 0.040 | 0.040 | 3.123 | 0.0101 | 6.4 |
| 25 | 0.050 | 0.050 | 3.131 | 0.0126 | 8.0 |
| 30 | 0.065 | 0.065 | 3.143 | 0.0163 | 9.5 |
| 36 | 0.080 | 0.080 | 3.156 | 0.0201 | 11.4 |
| 42 | 0.095 | 0.095 | 3.168 | 0.0239 | 13.3 |
| 45 | 0.105 | 0.105 | 3.176 | 0.0264 | 14.2 |
| 50 | 0.125 | 0.125 | 3.192 | 0.0314 | 15.7 |
| 51 | 0.130 | 0.130 | 3.197 | 0.0327 | 16.0 |
| 52 | 0.135 | 0.135 | 3.201 | 0.0339 | 16.2 |
| 53 | 0.140 | 0.140 | 3.205 | 0.0352 | 16.5 |
| 54 | 0.145 | 0.145 | 3.209 | 0.0365 | 16.8 |
| 55 | 0.150 | 0.150 | 3.213 | 0.0377 | 17.1 |
| 56 | 0.160 | 0.160 | 3.222 | 0.0402 | 17.4 |
| 57 | 0.170 | 0.170 | 3.230 | 0.0428 | 17.6 |
| 58 | 0.180 | 0.180 | 3.239 | 0.0453 | 17.9 |
| 58 | 0.220 | 0.220 | 3.273 | 0.0553 | 17.7 |
| 59 | 0.225 | 0.225 | 3.277 | 0.0566 | 18.0 |
| 58 | 0.230 | 0.230 | 3.282 | 0.0578 | 17.7 |
| 58 | 0.275 | 0.275 | 3.322 | 0.0692 | 17.5 |
| 57 | 0.280 | 0.280 | 3.326 | 0.0704 | 17.1 |
| 56 | 0.295 | 0.295 | 3.340 | 0.0742 | 16.8 |
| 55 | 0.310 | 0.310 | 3.353 | 0.0780 | 16.4 |
| 54 | 0.330 | 0.330 | 3.372 | 0.0830 | 16.0 |
| 52 | 0.355 | 0.355 | 3.395 | 0.0893 | 15.3 |
| 50 | 0.400 | 0.400 | 3.438 | 0.1006 | 14.5 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-022



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-022 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A775_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 27.6 | **%** |
| **BULK UNIT WEIGHT** | 74.1 | lb/ft³ |
| **DRY UNIT WEIGHT** | 58.0 | lb/ft³ |
| **UCS *** | 18.0 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-023 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A776_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 66.11 | g |
| 3. WT WET SOIL + TARE | 119.98 | g |
| 4. WT DRY SOIL + TARE | 111.76 | g |
| 5. WT WATER, Ww | 8.22 | g |
| 6. WT DRY SOIL, Ws | 45.65 | g |
| **7. MOISTURE CONTENT, W** | **18.01** | **%** |

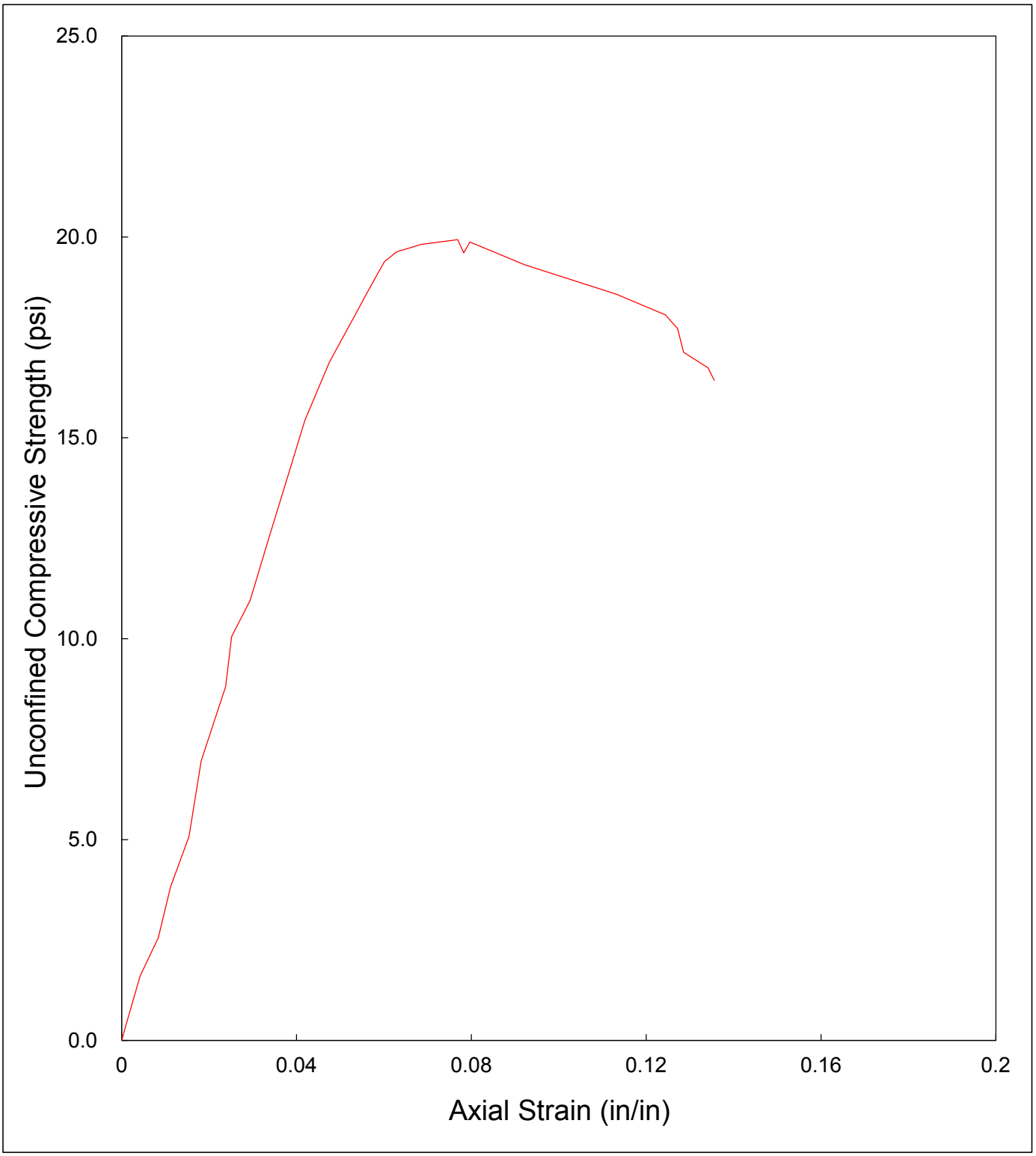
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.99 | in. | 3.61 | in. |
| No. 2 | 1.99 | in. | 3.59 | in. |
| No. 3 | 1.99 | in. | 3.54 | in. |
| **Average** | **1.99** | **in.** | **3.58** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***213.08*** | ***g*** |
| Initial Area, Ao | 3.10 | $in^2$ |
| Initial Volume, Vo | 11.10 | $in^3$ |
| Initial Bulk Unit Weight, | 73.1 | $lb/ft^3$ |
| Initial Dry Unit Weight | 62.0 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.54 | in. |
| UCS | 19.9 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.103 | 0.0000 | 0.0 |
| 1 | 0.003 | 0.003 | 3.106 | 0.0008 | 0.3 |
| 5 | 0.015 | 0.015 | 3.116 | 0.0042 | 1.6 |
| 8 | 0.030 | 0.030 | 3.129 | 0.0084 | 2.6 |
| 12 | 0.040 | 0.040 | 3.138 | 0.0112 | 3.8 |
| 16 | 0.055 | 0.055 | 3.151 | 0.0154 | 5.1 |
| 22 | 0.065 | 0.065 | 3.160 | 0.0182 | 7.0 |
| 28 | 0.085 | 0.085 | 3.178 | 0.0238 | 8.8 |
| 32 | 0.090 | 0.090 | 3.183 | 0.0252 | 10.1 |
| 35 | 0.105 | 0.105 | 3.197 | 0.0293 | 10.9 |
| 40 | 0.120 | 0.120 | 3.211 | 0.0335 | 12.5 |
| 45 | 0.135 | 0.135 | 3.225 | 0.0377 | 14.0 |
| 50 | 0.150 | 0.150 | 3.239 | 0.0419 | 15.4 |
| 55 | 0.170 | 0.170 | 3.258 | 0.0475 | 16.9 |
| 60 | 0.195 | 0.195 | 3.282 | 0.0545 | 18.3 |
| 61 | 0.200 | 0.200 | 3.287 | 0.0559 | 18.6 |
| 63 | 0.210 | 0.210 | 3.296 | 0.0587 | 19.1 |
| 64 | 0.215 | 0.215 | 3.301 | 0.0601 | 19.4 |
| 65 | 0.225 | 0.225 | 3.311 | 0.0629 | 19.6 |
| 66 | 0.245 | 0.245 | 3.331 | 0.0685 | 19.8 |
| 67 | 0.275 | 0.275 | 3.361 | 0.0769 | 19.9 |
| 66 | 0.280 | 0.280 | 3.366 | 0.0783 | 19.6 |
| 67 | 0.285 | 0.285 | 3.372 | 0.0797 | 19.9 |
| 66 | 0.330 | 0.330 | 3.418 | 0.0922 | 19.3 |
| 65 | 0.405 | 0.405 | 3.499 | 0.1132 | 18.6 |
| 64 | 0.445 | 0.445 | 3.544 | 0.1244 | 18.1 |
| 63 | 0.455 | 0.455 | 3.555 | 0.1272 | 17.7 |
| 61 | 0.460 | 0.460 | 3.561 | 0.1286 | 17.1 |
| 60 | 0.480 | 0.480 | 3.584 | 0.1342 | 16.7 |
| 59 | 0.485 | 0.485 | 3.590 | 0.1356 | 16.4 |
| | | | | | |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-023



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-023 | | |
| TESTING DATE: | 4/7/2016 | LOADING RATE: | 0.04 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A776_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 18.0 | **%** |
| **BULK UNIT WEIGHT** | 73.1 | lb/ft³ |
| **DRY UNIT WEIGHT** | 62.0 | lb/ft³ |
| **UCS *** | 19.9 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-028 | | |
| TESTING DATE: | 4/29/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A814_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 2.60 | g |
| 3. WT WET SOIL + TARE | 49.79 | g |
| 4. WT DRY SOIL + TARE | 35.50 | g |
| 5. WT WATER, Ww | 14.29 | g |
| 6. WT DRY SOIL, Ws | 32.90 | g |
| **7. MOISTURE CONTENT, W** | **43.43** | **%** |

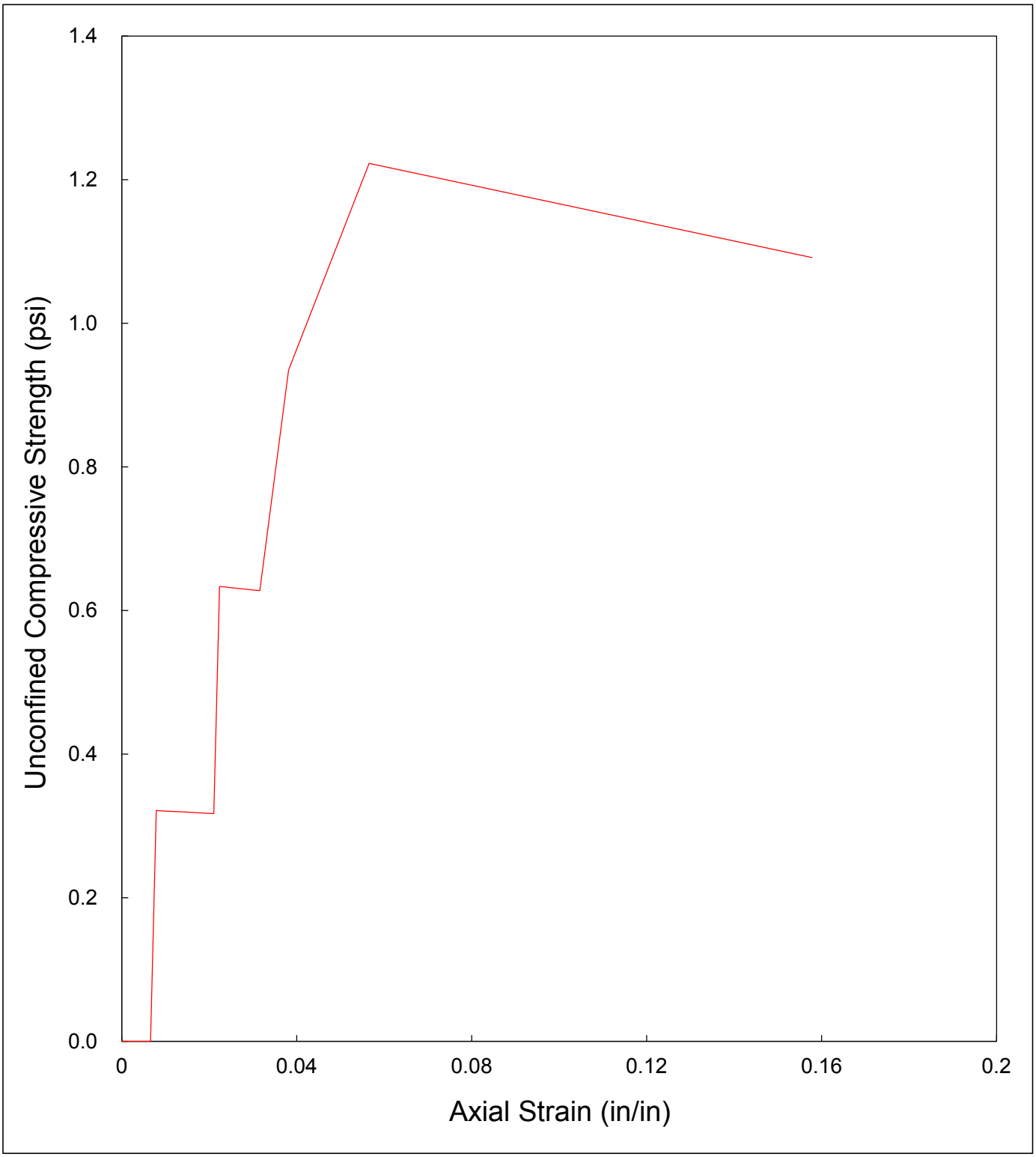
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | *DIAMETER* | | *LENGTH* | |
| No. 1 | 1.98 | in. | 3.80 | in. |
| No. 2 | 1.99 | in. | 3.81 | in. |
| No. 3 | 1.97 | in. | 3.79 | in. |
| **Average** | **1.98** | **in.** | **3.80** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***228.97*** | ***g*** |
| Initial Area, Ao | 3.09 | in² |
| Initial Volume, Vo | 11.73 | in³ |
| Initial Bulk Unit Weight, | 74.3 | lb/ft³ |
| Initial Dry Unit Weight | 51.8 | lb/ft³ |
| 15 % Strain (0.15 Lo) | 0.57 | in. |
| UCS | 1.2 | lb/in² |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA (in²) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH (lb/in²) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.086 | 0.0000 | 0.0 |
| 0 | 0.003 | 0.003 | 3.088 | 0.0008 | 0.0 |
| 0 | 0.005 | 0.005 | 3.090 | 0.0013 | 0.0 |
| 0 | 0.007 | 0.007 | 3.092 | 0.0018 | 0.0 |
| 0 | 0.010 | 0.010 | 3.094 | 0.0026 | 0.0 |
| 0 | 0.015 | 0.015 | 3.098 | 0.0039 | 0.0 |
| 0 | 0.020 | 0.020 | 3.102 | 0.0053 | 0.0 |
| 0 | 0.025 | 0.025 | 3.106 | 0.0066 | 0.0 |
| 1 | 0.030 | 0.030 | 3.110 | 0.0079 | 0.3 |
| 1 | 0.035 | 0.035 | 3.114 | 0.0092 | 0.3 |
| 1 | 0.040 | 0.040 | 3.119 | 0.0105 | 0.3 |
| 1 | 0.045 | 0.045 | 3.123 | 0.0118 | 0.3 |
| 1 | 0.050 | 0.050 | 3.127 | 0.0131 | 0.3 |
| 1 | 0.055 | 0.055 | 3.131 | 0.0145 | 0.3 |
| 1 | 0.060 | 0.060 | 3.135 | 0.0158 | 0.3 |
| 1 | 0.065 | 0.065 | 3.139 | 0.0171 | 0.3 |
| 1 | 0.070 | 0.070 | 3.144 | 0.0184 | 0.3 |
| 1 | 0.075 | 0.075 | 3.148 | 0.0197 | 0.3 |
| 1 | 0.080 | 0.080 | 3.152 | 0.0210 | 0.3 |
| 2 | 0.085 | 0.085 | 3.156 | 0.0224 | 0.6 |
| 2 | 0.090 | 0.090 | 3.161 | 0.0237 | 0.6 |
| 2 | 0.095 | 0.095 | 3.165 | 0.0250 | 0.6 |
| 2 | 0.100 | 0.100 | 3.169 | 0.0263 | 0.6 |
| 2 | 0.105 | 0.105 | 3.173 | 0.0276 | 0.6 |
| 2 | 0.110 | 0.110 | 3.178 | 0.0289 | 0.6 |
| 2 | 0.115 | 0.115 | 3.182 | 0.0302 | 0.6 |
| 2 | 0.120 | 0.120 | 3.186 | 0.0316 | 0.6 |
| 3 | 0.145 | 0.145 | 3.208 | 0.0381 | 0.9 |
| 4 | 0.215 | 0.215 | 3.271 | 0.0565 | 1.2 |
| 4 | 0.600 | 0.600 | 3.664 | 0.1578 | 1.1 |

# UNCONFINED COMPRESSION TESTING

Sample No. EXP-028



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | EXP-028 | | |
| TESTING DATE: | 4/29/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | DMC | TRACKING CODE: | A814_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 43.4 | **%** |
| **BULK UNIT WEIGHT** | 74.3 | lb/ft³ |
| **DRY UNIT WEIGHT** | 51.8 | lb/ft³ |
| **UCS *** | 1.2 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | SI-05-ISS | | |
| TESTING DATE: | 5/5/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | JDM | TRACKING CODE: | A818_US |

| MOISTURE CONTENT (Dry Basis) | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 2.57 | g |
| 3. WT WET SOIL + TARE | 29.15 | g |
| 4. WT DRY SOIL + TARE | 20.09 | g |
| 5. WT WATER, Ww | 9.06 | g |
| 6. WT DRY SOIL, Ws | 17.52 | g |
| **7. MOISTURE CONTENT, W** | **51.71** | **%** |

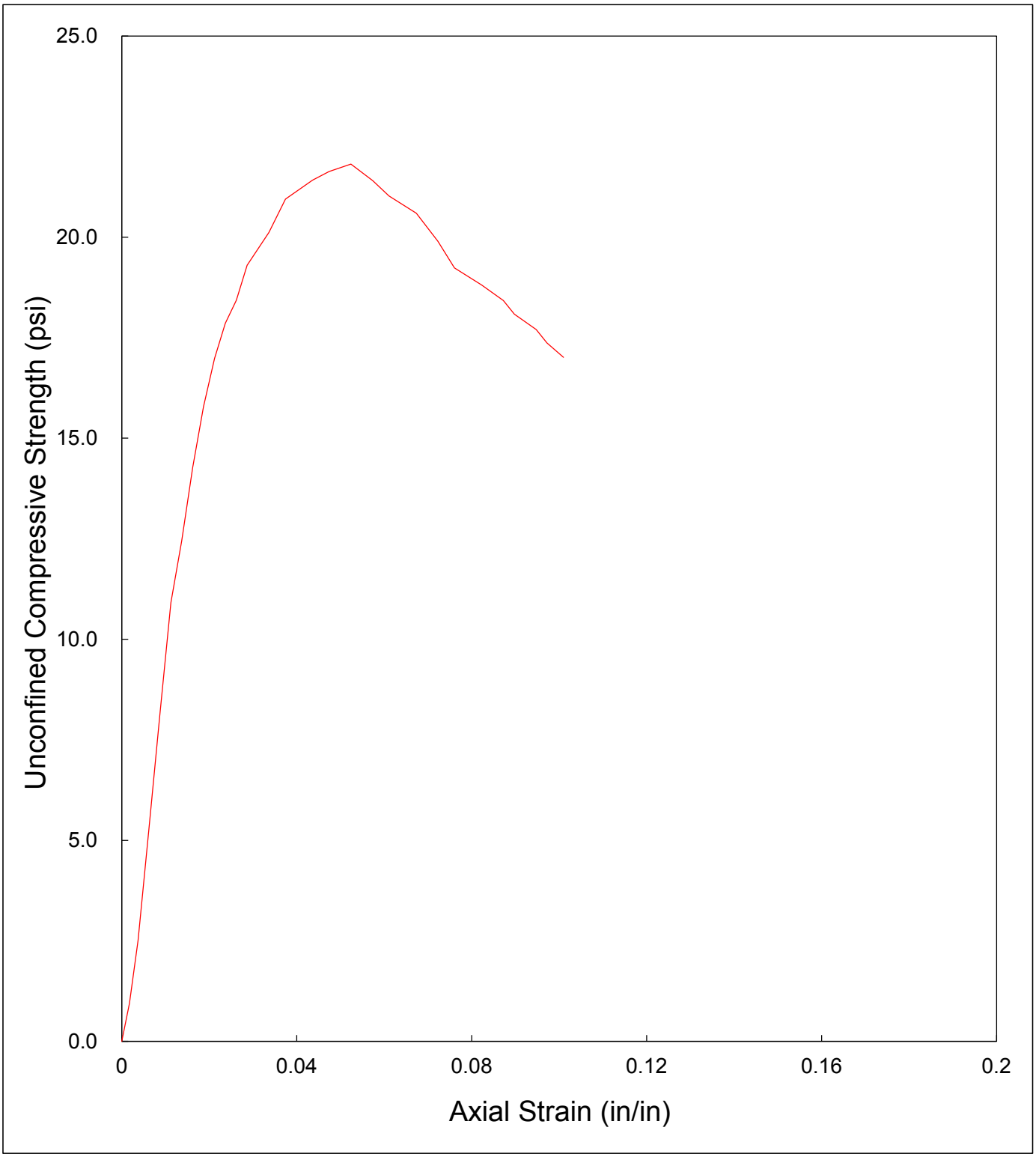
| *SOIL SPECIMEN DIMENSIONS* | | | | |
|---|---|---|---|---|
| | ***DIAMETER*** | | ***LENGTH*** | |
| No. 1 | 2.02 | in. | 4.01 | in. |
| No. 2 | 2.01 | in. | 4.01 | in. |
| No. 3 | 1.99 | in. | 4.02 | in. |
| **Average** | **2.01** | **in.** | **4.01** | **in.** |

| *SPECIMEN CONDITIONS* | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***233.96*** | ***g*** |
| Initial Area, Ao | 3.17 | $in^2$ |
| Initial Volume, Vo | 12.72 | $in^3$ |
| Initial Bulk Unit Weight, | 70.1 | $lb/ft^3$ |
| Initial Dry Unit Weight | 46.2 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.60 | in. |
| UCS | 21.8 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.170 | 0.0000 | 0.0 |
| 3 | 0.007 | 0.007 | 3.176 | 0.0017 | 0.9 |
| 8 | 0.015 | 0.015 | 3.182 | 0.0037 | 2.5 |
| 17 | 0.025 | 0.025 | 3.190 | 0.0062 | 5.3 |
| 26 | 0.035 | 0.035 | 3.198 | 0.0087 | 8.1 |
| 35 | 0.045 | 0.045 | 3.206 | 0.0112 | 10.9 |
| 40 | 0.055 | 0.055 | 3.215 | 0.0137 | 12.4 |
| 46 | 0.065 | 0.065 | 3.223 | 0.0162 | 14.3 |
| 51 | 0.075 | 0.075 | 3.231 | 0.0187 | 15.8 |
| 55 | 0.085 | 0.085 | 3.239 | 0.0212 | 17.0 |
| 58 | 0.095 | 0.095 | 3.247 | 0.0237 | 17.9 |
| 60 | 0.105 | 0.105 | 3.256 | 0.0262 | 18.4 |
| 63 | 0.115 | 0.115 | 3.264 | 0.0287 | 19.3 |
| 66 | 0.135 | 0.135 | 3.281 | 0.0337 | 20.1 |
| 69 | 0.150 | 0.150 | 3.294 | 0.0374 | 20.9 |
| 71 | 0.175 | 0.175 | 3.315 | 0.0436 | 21.4 |
| 72 | 0.190 | 0.190 | 3.328 | 0.0474 | 21.6 |
| 73 | 0.210 | 0.210 | 3.346 | 0.0524 | 21.8 |
| 72 | 0.230 | 0.230 | 3.363 | 0.0573 | 21.4 |
| 71 | 0.245 | 0.245 | 3.377 | 0.0611 | 21.0 |
| 70 | 0.270 | 0.270 | 3.399 | 0.0673 | 20.6 |
| 68 | 0.290 | 0.290 | 3.418 | 0.0723 | 19.9 |
| 66 | 0.305 | 0.305 | 3.431 | 0.0760 | 19.2 |
| 65 | 0.330 | 0.330 | 3.455 | 0.0823 | 18.8 |
| 64 | 0.350 | 0.350 | 3.474 | 0.0873 | 18.4 |
| 63 | 0.360 | 0.360 | 3.483 | 0.0898 | 18.1 |
| 62 | 0.380 | 0.380 | 3.502 | 0.0947 | 17.7 |
| 61 | 0.390 | 0.390 | 3.512 | 0.0972 | 17.4 |
| 60 | 0.405 | 0.405 | 3.527 | 0.1010 | 17.0 |
| | | | | | |
| | | | | | |

# UNCONFINED COMPRESSION TESTING

Sample No. SI-05-ISS



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | SI-05-ISS | | |
| TESTING DATE: | 5/5/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | JDM | TRACKING CODE: | A818_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 51.7 | **%** |
| **BULK UNIT WEIGHT** | 70.1 | $lb/ft^3$ |
| **DRY UNIT WEIGHT** | 46.2 | $lb/ft^3$ |
| **UCS *** | 21.8 | $lb/in^2$ |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# UNCONFINED COMPRESSION TEST

**ASTM D 2166**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | SI-06-ISS (21-Day) | | |
| TESTING DATE: | 5/6/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | JDM | TRACKING CODE: | A819_US |

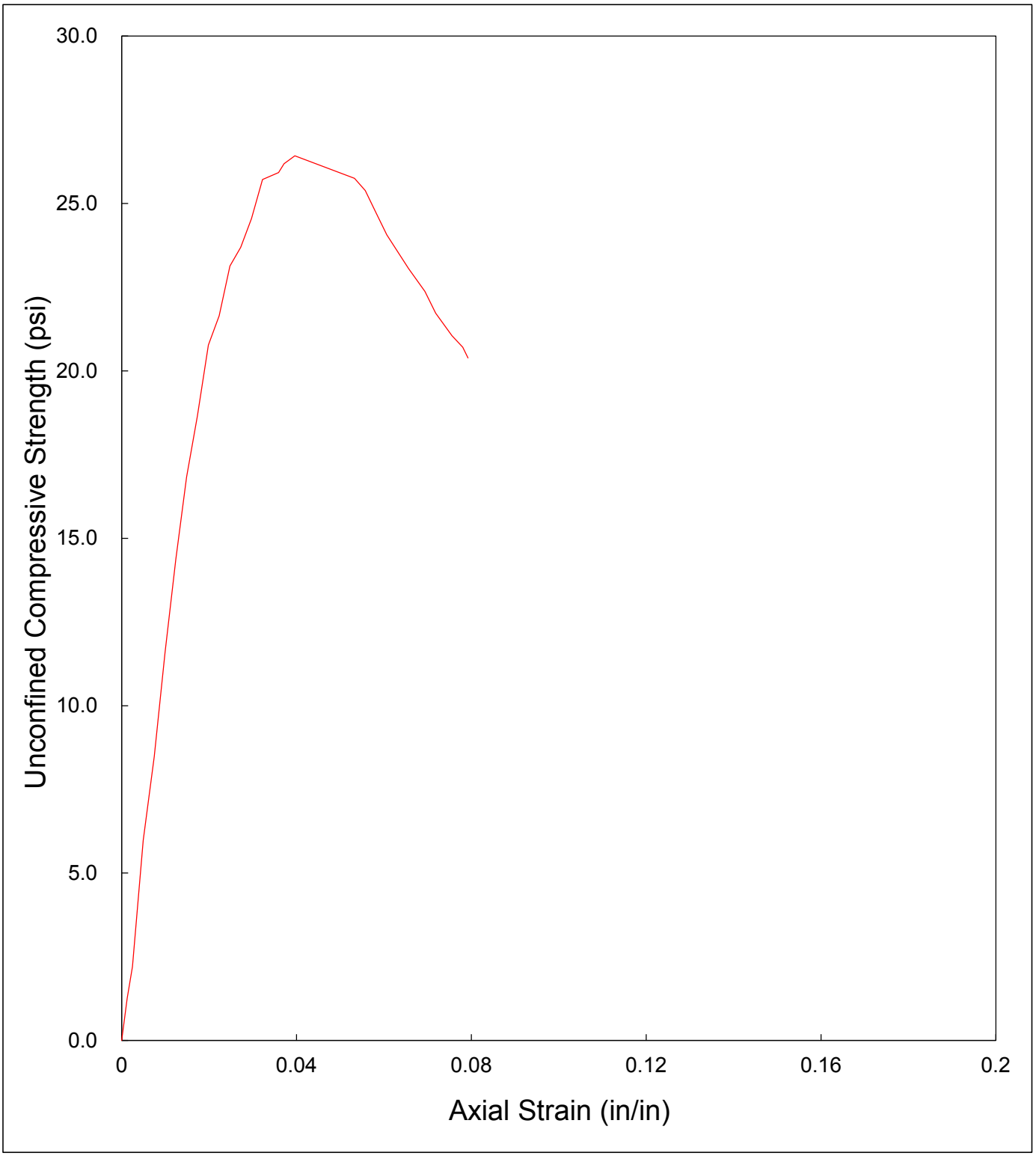
| **MOISTURE CONTENT (Dry Basis)** | | |
|---|---|---|
| 1. MOISTURE TIN NO. | | |
| 2. WT MOISTURE TIN (tare weight) | 63.69 | g |
| 3. WT WET SOIL + TARE | 93.05 | g |
| 4. WT DRY SOIL + TARE | 83.12 | g |
| 5. WT WATER, Ww | 9.93 | g |
| 6. WT DRY SOIL, Ws | 19.43 | g |
| **7. MOISTURE CONTENT, W** | **51.11** | **%** |

| ***SOIL SPECIMEN DIMENSIONS*** | | | | |
|---|---|---|---|---|
| | ***DIAMETER*** | | ***LENGTH*** | |
| No. 1 | 2.02 | in. | 4.04 | in. |
| No. 2 | 2.01 | in. | 4.03 | in. |
| No. 3 | 2.00 | in. | 4.05 | in. |
| **Average** | **2.01** | **in.** | **4.04** | **in.** |

| ***SPECIMEN CONDITIONS*** | | |
|---|---|---|
| ***Initial Specimen WT, Wo*** | ***238.59*** | ***g*** |
| Initial Area, Ao | 3.16 | $in^2$ |
| Initial Volume, Vo | 12.77 | $in^3$ |
| Initial Bulk Unit Weight, | 71.2 | $lb/ft^3$ |
| Initial Dry Unit Weight | 47.1 | $lb/ft^3$ |
| 15 % Strain (0.15 Lo) | 0.61 | in. |
| UCS | 26.4 | $lb/in^2$ |

| COMPRESSIVE LOAD (lbs.) | DIAL GAGE READING (in.) | SPECIMEN DEFORMATION (in.) | CORRECTED AREA ($in^2$) | AXIAL STRAIN (in/in) | UNCONFINED COMPRESSIVE STRENGTH ($lb/in^2$) |
|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 3.162 | 0.0000 | 0.0 |
| 4 | 0.005 | 0.005 | 3.165 | 0.0012 | 1.3 |
| 7 | 0.010 | 0.010 | 3.169 | 0.0025 | 2.2 |
| 19 | 0.020 | 0.020 | 3.177 | 0.0050 | 6.0 |
| 27 | 0.030 | 0.030 | 3.185 | 0.0074 | 8.5 |
| 37 | 0.040 | 0.040 | 3.193 | 0.0099 | 11.6 |
| 46 | 0.050 | 0.050 | 3.201 | 0.0124 | 14.4 |
| 54 | 0.060 | 0.060 | 3.209 | 0.0149 | 16.8 |
| 60 | 0.070 | 0.070 | 3.217 | 0.0173 | 18.6 |
| 67 | 0.080 | 0.080 | 3.225 | 0.0198 | 20.8 |
| 70 | 0.090 | 0.090 | 3.234 | 0.0223 | 21.6 |
| 75 | 0.100 | 0.100 | 3.242 | 0.0248 | 23.1 |
| 77 | 0.110 | 0.110 | 3.250 | 0.0272 | 23.7 |
| 80 | 0.120 | 0.120 | 3.258 | 0.0297 | 24.6 |
| 84 | 0.130 | 0.130 | 3.267 | 0.0322 | 25.7 |
| 85 | 0.145 | 0.145 | 3.279 | 0.0359 | 25.9 |
| 86 | 0.150 | 0.150 | 3.284 | 0.0372 | 26.2 |
| 87 | 0.160 | 0.160 | 3.292 | 0.0396 | 26.4 |
| 86 | 0.215 | 0.215 | 3.339 | 0.0532 | 25.8 |
| 85 | 0.225 | 0.225 | 3.348 | 0.0557 | 25.4 |
| 83 | 0.235 | 0.235 | 3.357 | 0.0582 | 24.7 |
| 81 | 0.245 | 0.245 | 3.366 | 0.0607 | 24.1 |
| 78 | 0.265 | 0.265 | 3.384 | 0.0656 | 23.1 |
| 76 | 0.280 | 0.280 | 3.397 | 0.0693 | 22.4 |
| 74 | 0.290 | 0.290 | 3.406 | 0.0718 | 21.7 |
| 72 | 0.305 | 0.305 | 3.420 | 0.0755 | 21.1 |
| 71 | 0.315 | 0.315 | 3.429 | 0.0780 | 20.7 |
| 70 | 0.320 | 0.320 | 3.434 | 0.0793 | 20.4 |
| | | | | | |
| | | | | | |
| | | | | | |

# UNCONFINED COMPRESSION TESTING
## Sample No. SI-06-ISS (21-Day)



# UNCONFINED COMPRESSION TEST

**ASTM D 2166**
**SUMMARY OF RESULTS**

| | | | |
|---|---|---|---|
| PROJECT: | American Cyanamid Superfund Site | | |
| PROJECT No.: | SH0605 | | |
| SAMPLE No.: | SI-06-ISS (21-Day) | | |
| TESTING DATE: | 5/6/2016 | LOADING RATE: | 0.0400 in./min. |
| TESTED BY: | JDM | TRACKING CODE: | A819_US |

| TESTING PARAMETER AND RESULTS | | |
|---|---|---|
| **MOISTURE CONTENT** | 51.1 | **%** |
| **BULK UNIT WEIGHT** | 71.2 | lb/ft³ |
| **DRY UNIT WEIGHT** | 47.1 | lb/ft³ |
| **UCS *** | 26.4 | lb/in² |

* UCS - UNCONFINED COMPRESSIVE STRENGTH

# MATERIAL pH

**EPA METHOD 9045**
**DATA SHEET**

| | |
|---|---|
| PROJECT: | American Cyanamid Superfund Site |
| PROJECT No.: | SH0605 |
| TESTING DATE: | 3/17/2016 |
| TESTED BY: | JDM |
| TRACKING CODE: | |

| KEMRON SAMPLE No. | | MATERIAL pH |
|---|---|---|
| 1 | EXP-012 | 12.07 |
| 2 | EXP-013 | 12.09 |
| 3 | EXP-014 | 10.99 |
| 4 | EXP-015 | 11.12 |
| 5 | EXP-016 | 11.76 |
| 6 | EXP-017 | 11.79 |
| 7 | EXP-018 | 8.33 |
| 8 | EXP-019 | 5.77 |
| 9 | EXP-020 | 11.85 |
| 10 | EXP-021 | 6.28 |
| 11 | EXP-022 | 6.64 |
| 12 | EXP-023 | 3.85 |
| 13 | EXP-028 | 11.63 |
| 14 | SI-05-90 | 10.38 |
| 15 | SI-06-90 | 10.54 |
| | **AVERAGE:** | 10.21 |

# APPENDIX C

# TREATABILITY STUDY PHOTOGRAPHIC LOG

# American Cyanamid Superfund Site Steam Mixing and Stabilization Treatability Study

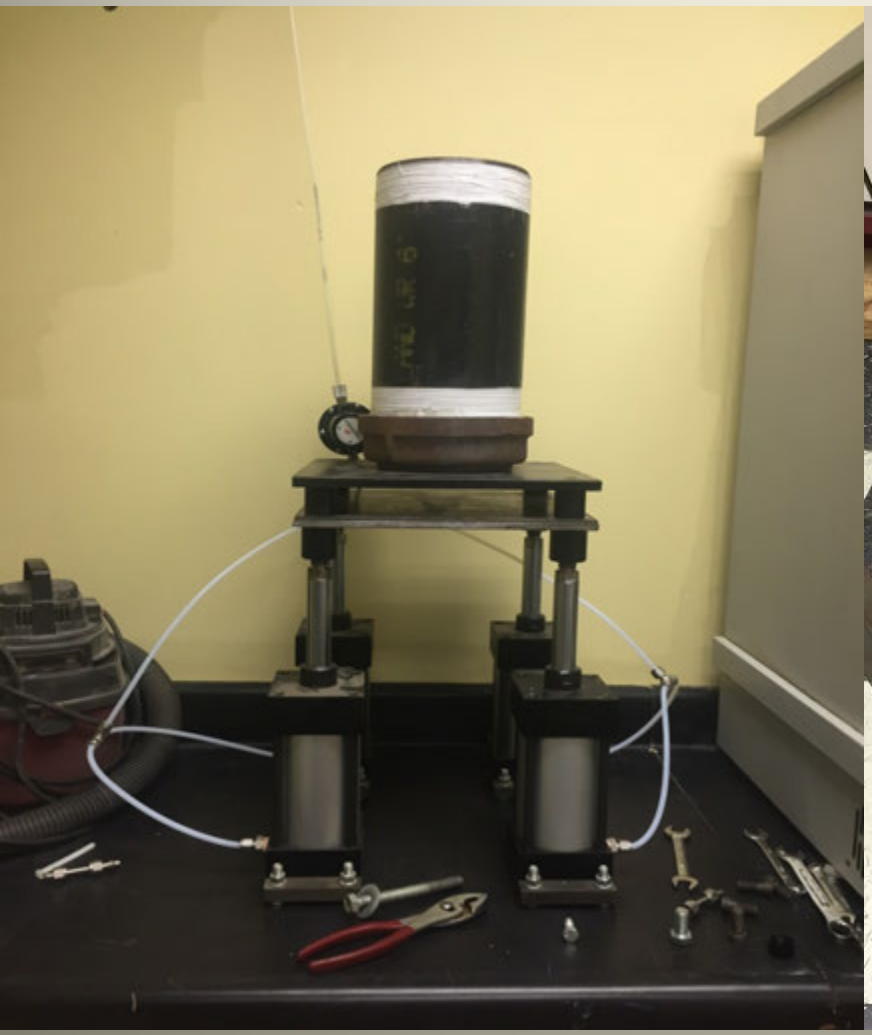
Kemron Project No. SH0605

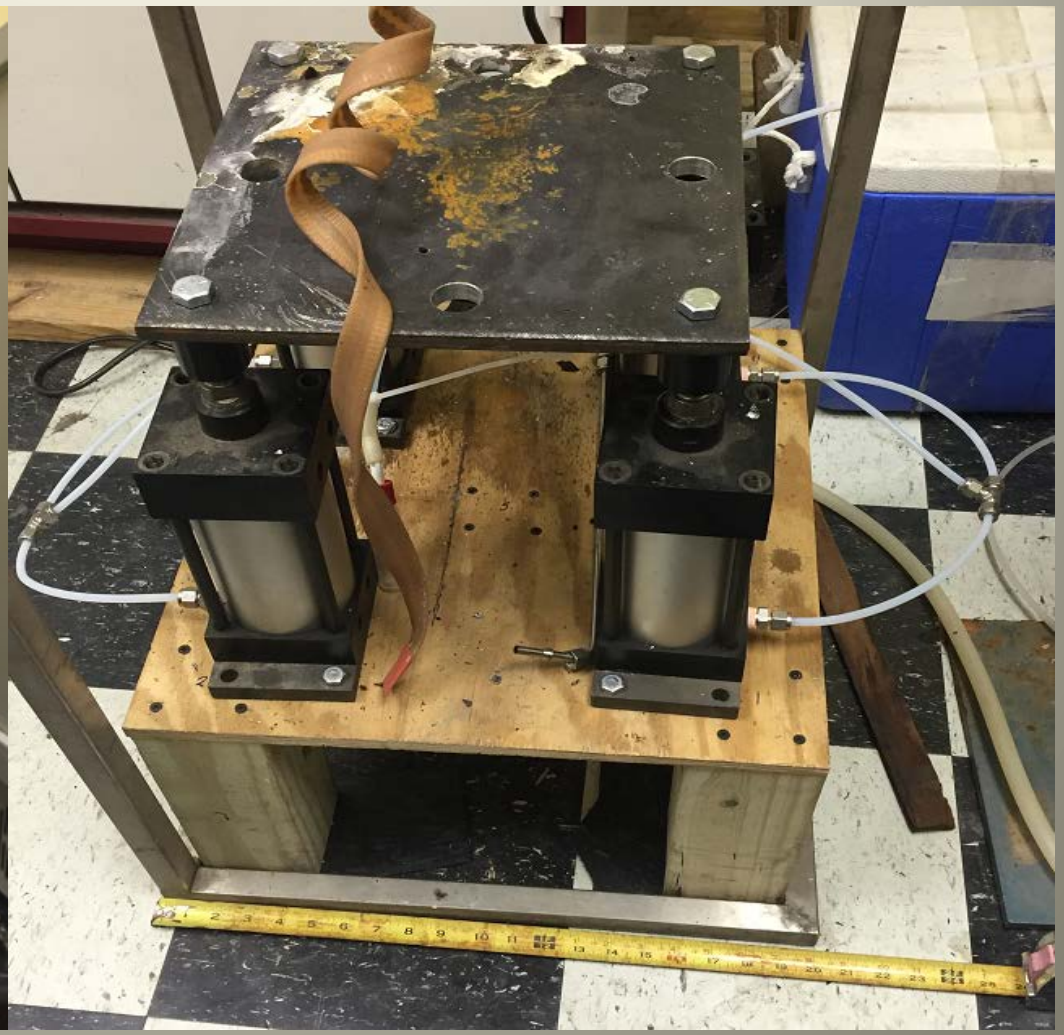
# Early Construction Activities of Mixing System Frame

# Auger Motor Testing

KEMRON needed to test various motors with enough horsepower to rotate within the tarry material  and maintain approximately 6 rotations per minute (rpm)

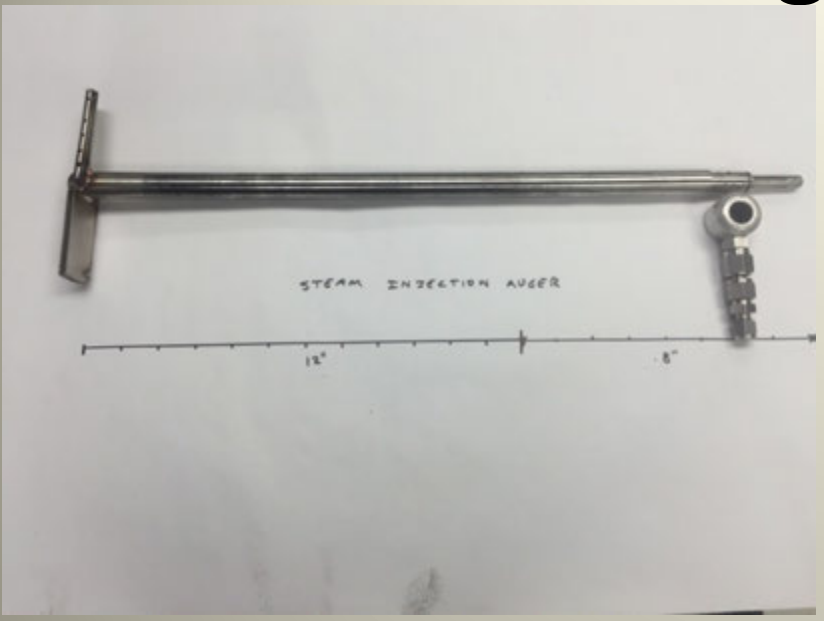
# Hydraulic Lift Testing

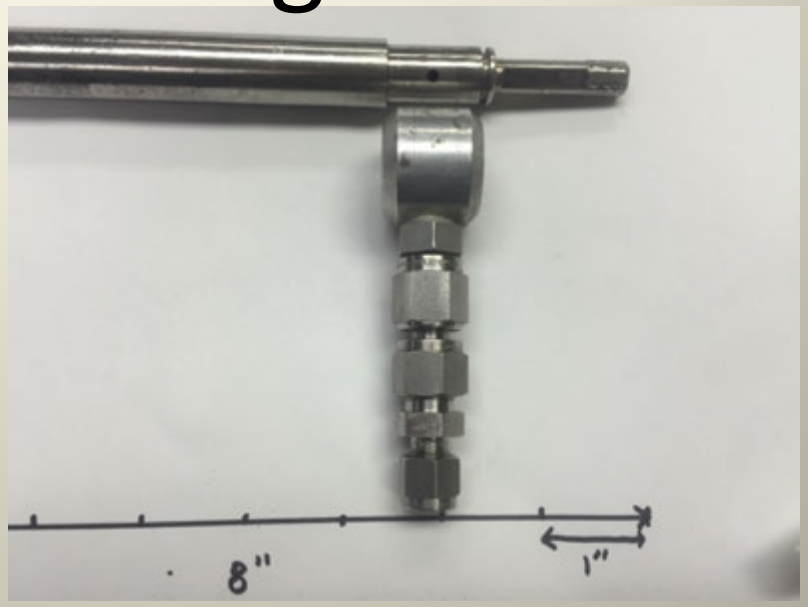


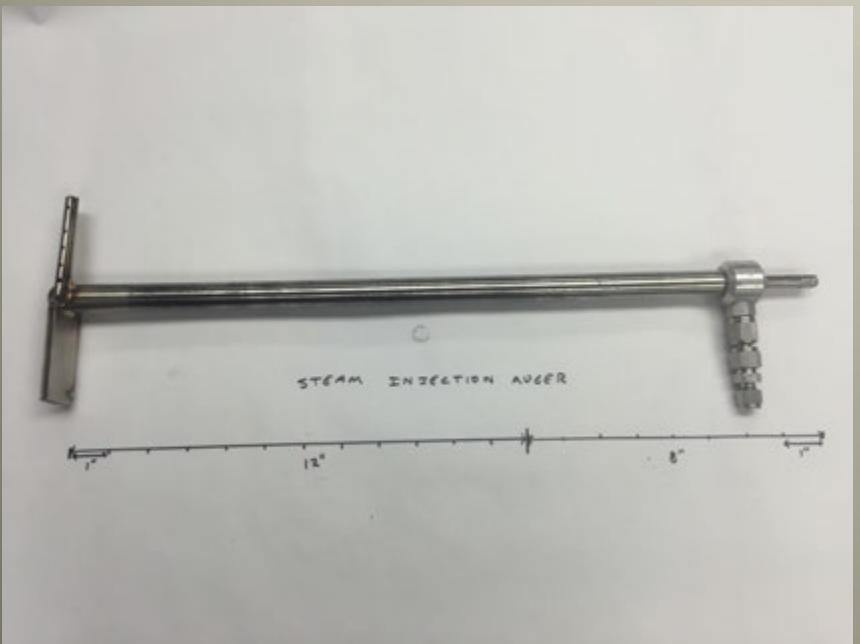


KEMRON needed to develop a hydraulic system capable of equally lifting up to 100 pounds repeatedly during testing

# Auger Design

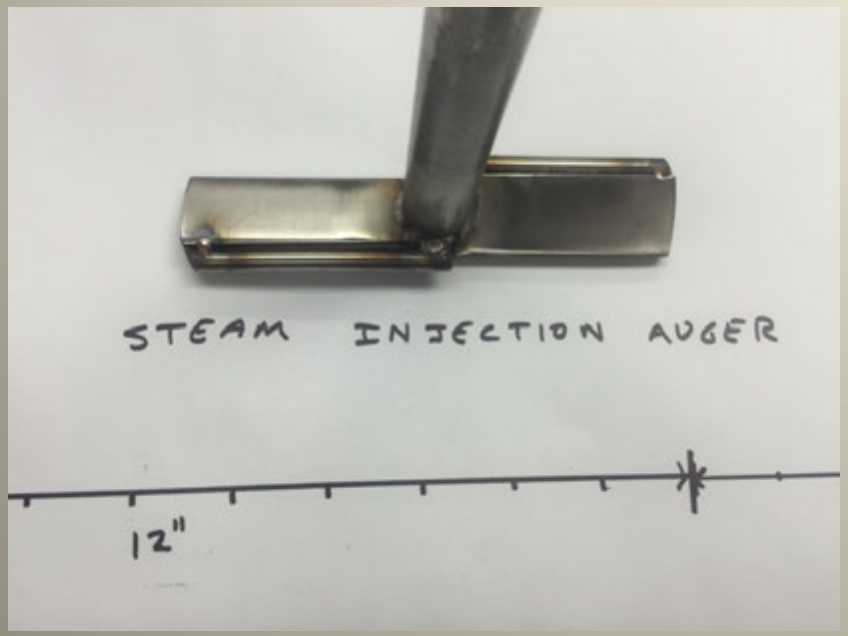


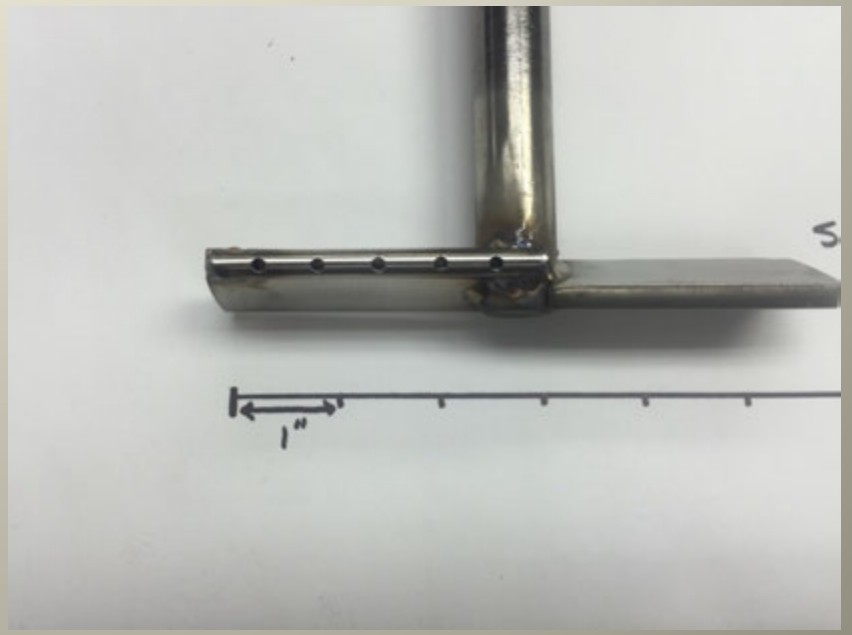




KEMRON modified their initial auger based on discussions with CH2M, current steam auguring technology, and the impoundment material

# Auger Head Design




The final auger head was designed with multiple nozzles along the tail end of the auger fin rotation

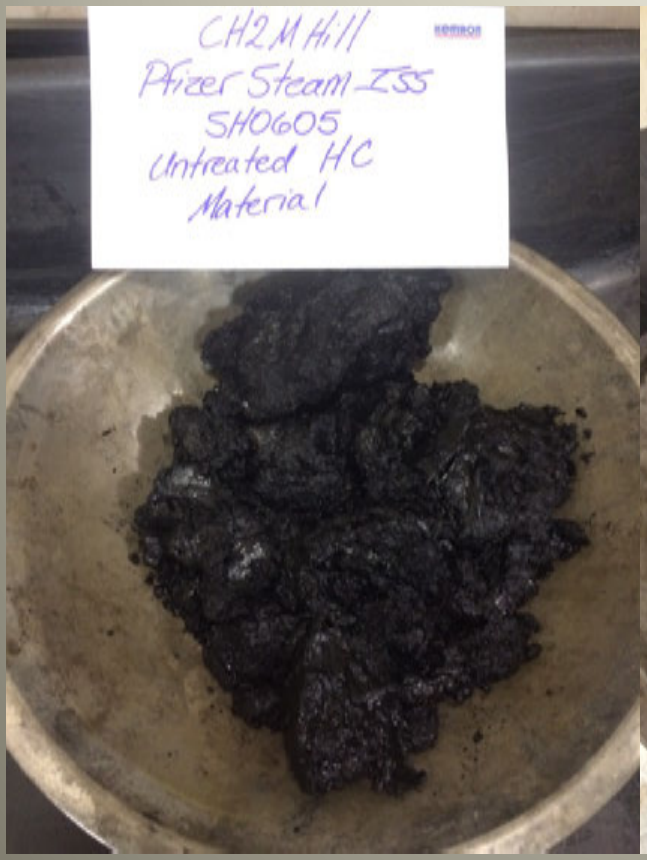
# Construction of Steam Injection and Mixing System

Steam Generation Box inside muffle furnace with modified coiling system to enhance steam injection

Final Steam Injection and Mixing Stand construction

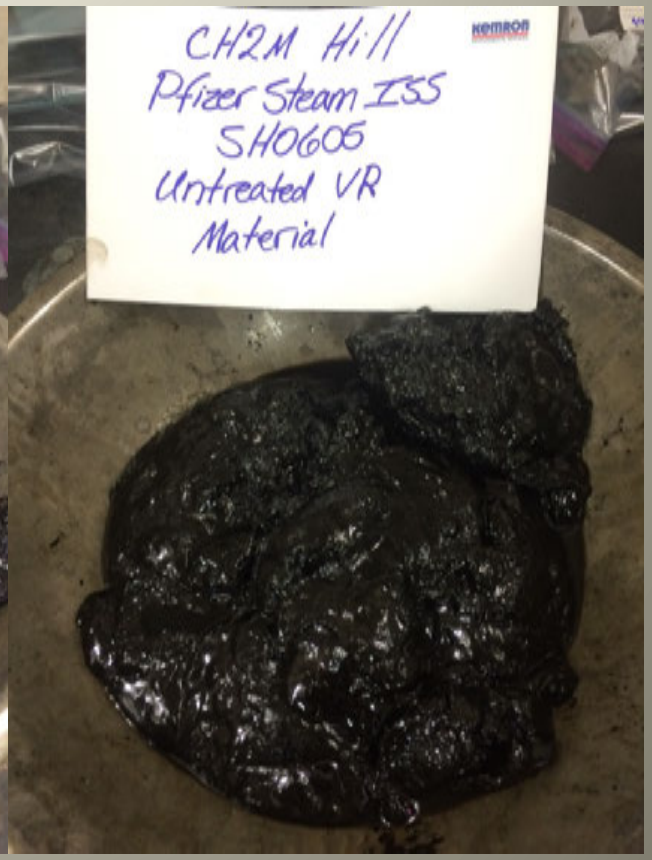
Aligning Reactor and positioning heat tape. Preparing for Trail Run testing. The motor required a railing system to be able to adjust alignment of the auger.

# Impoundment Material Prior to Treatment




HC

50% HC/50%VR




VR

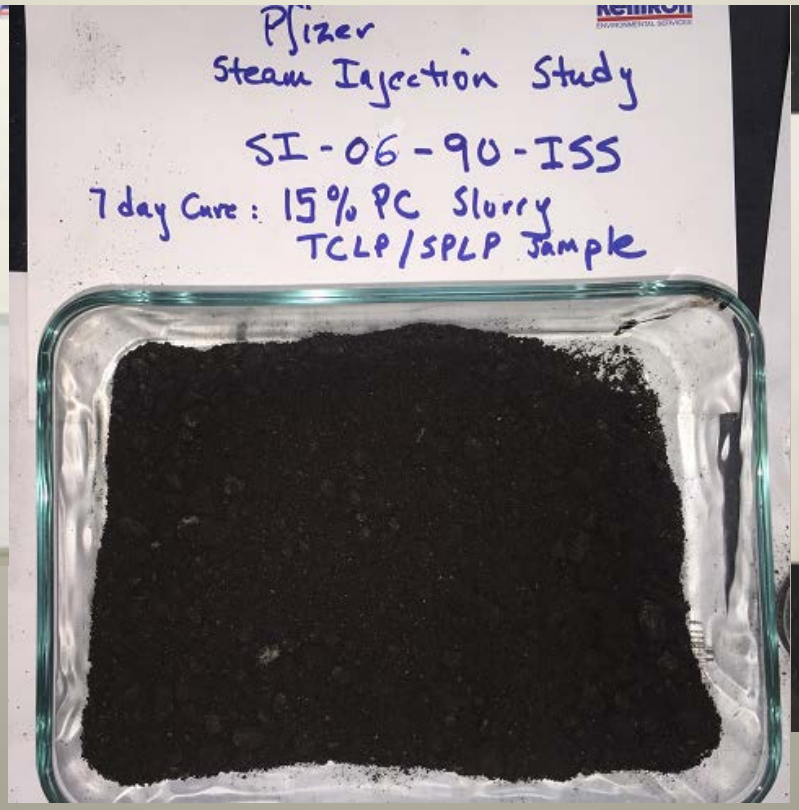
# Final Steam Injection System

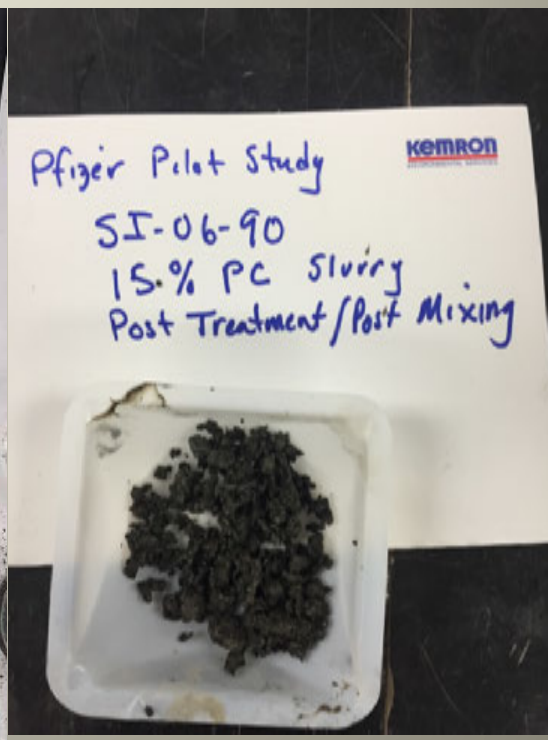
Steam Injection testing in progress. The photograph on the right illustrates soil sampling during testing.

# Air Sampling

During steam injection testing, KEMRON collected discrete air samples with a glass syringe from an air line, injected into Tedlar bags, and tested with an FID

# Stabilized Impoundment Material after 7 days of curing




Stabilized Impoundment Material (50%HC/50%VR) displaced very workable soil like physical properties. The photograph on the far right illustrates the thermally treated impoundment material within minutes after mixing 15% portland cement.

Attachment 2

New Jersey
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01/13/16

**Effective January 1, 2016, SGS has acquired all of the assets of Accutest Laboratories and will continue to operate as SGS-Accutest. SGS-Accutest is part of SGS, the world's leading inspection, verification, testing and certification company.**

Technical Report for

CH2M Hill

OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ 477213

Accutest Job Number: JC12057

Sampling Date: 01/05/16

Report to:

CH2M Hill
1717 Arch Street Suite 4400
Philadelphia, PA 19103
jim.arthur@ch2m.com; Mary.Velasquez@CH2M.com; shane.lowe@ch2m.com
ATTN: Jim Arthur

Total number of pages in report: **31**

NELAP ACCREDITED TNI LABORATORY

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy L. Cole
Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC12057

OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC12057-1 | 01/05/16 | 14:00 | JAN | 01/06/16 | AQ | Water | LEACHATE A -30 DAY |
| JC12057-1R | 01/05/16 | 14:00 | JAN | 01/06/16 | AQ | Water | LEACHATE A -30 DAY |
| JC12057-2 | 01/05/16 | 14:15 | JAN | 01/06/16 | AQ | Water | LEACHATE B -30 DAY |
| JC12057-2R | 01/05/16 | 14:15 | JAN | 01/06/16 | AQ | Water | LEACHATE B -30 DAY |

# Summary of Hits

**Job Number:** JC12057
**Account:** CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 01/05/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC12057-1** | **LEACHATE A -30 DAY** | | | | | |
| Benzene | | 130000 | 500 | 240 | ug/l | SW846 8260C |
| Toluene | | 4990 | 1000 | 160 | ug/l | SW846 8260C |
| **JC12057-1R** | **LEACHATE A -30 DAY** | | | | | |
| Acetophenone | | 3560 | 100 | 14 | ug/l | SW846 8270D |
| **JC12057-2** | **LEACHATE B -30 DAY** | | | | | |
| Benzene | | 27700 | 100 | 47 | ug/l | SW846 8260C |
| Toluene | | 1780 | 200 | 32 | ug/l | SW846 8260C |
| Xylene (total) | | 70.2 J | 200 | 33 | ug/l | SW846 8260C |
| **JC12057-2R** | **LEACHATE B -30 DAY** | | | | | |
| Acetophenone | | 7150 | 400 | 55 | ug/l | SW846 8270D |

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## Sample Results

Report of Analysis

# Report of Analysis





**Client Sample ID:** LEACHATE A -30 DAY
**Lab Sample ID:** JC12057-1 **Date Sampled:** 01/05/16
**Matrix:** AQ - Water **Date Received:** 01/06/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2B138095.D | 1000 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10000 | 3300 | ug/l | |
| 71-43-2 | Benzene | 130000 | 500 | 240 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1000 | 190 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5000 | 200 | ug/l | |
| 108-88-3 | Toluene | 4990 | 1000 | 160 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1000 | 170 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | | 78-117% |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis



**Client Sample ID:** LEACHATE A -30 DAY
**Lab Sample ID:** JC12057-1R
**Matrix:** AQ - Water
**Method:** SW846 8270D SW846 3510C
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Date Sampled:** 01/05/16
**Date Received:** 01/06/16
**Percent Solids:** n/a

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P101844.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |
| Run #2 | P101869.D | 50 | 01/12/16 | LK | 01/11/16 | OP90386 | EP4461 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 3560 [a] | 100 | 14 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 49% | 54% | 14-88% |
| 4165-62-2 | Phenol-d5 | 35% | 54% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 126% | 74% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 77% | 83% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 82% | 93% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 59% | 57% | 10-126% |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B -30 DAY
**Lab Sample ID:** JC12057-2 **Date Sampled:** 01/05/16
**Matrix:** AQ - Water **Date Received:** 01/06/16
**Method:** SW846 8260C **Percent Solids:** n/a
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2B138096.D | 200 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| Run #2 | | | | | | | |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 2000 | 660 | ug/l | |
| 71-43-2 | Benzene | 27700 | 100 | 47 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 200 | 37 | ug/l | |
| 91-20-3 | Naphthalene | ND | 1000 | 40 | ug/l | |
| 108-88-3 | Toluene | 1780 | 200 | 32 | ug/l | |
| 1330-20-7 | Xylene (total) | 70.2 | 200 | 33 | ug/l | J |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | | 73-122% |
| 2037-26-5 | Toluene-D8 | 101% | | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | | 78-117% |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





**Client Sample ID:** LEACHATE B -30 DAY
**Lab Sample ID:** JC12057-2R
**Matrix:** AQ - Water
**Method:** SW846 8270D SW846 3510C
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Date Sampled:** 01/05/16
**Date Received:** 01/06/16
**Percent Solids:** n/a

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | P101843.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |
| Run #2 | P101881.D | 200 | 01/12/16 | LK | 01/11/16 | OP90386 | EP4461 |

| | Initial Volume | Final Volume |
|---|---|---|
| Run #1 | 1000 ml | 1.0 ml |
| Run #2 | 1000 ml | 1.0 ml |

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 7150 [a] | 400 | 55 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 43% | 0% [b] | 14-88% |
| 4165-62-2 | Phenol-d5 | 28% | 0% [b] | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 119% | 0% [b] | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 81% | 0% [b] | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 87% | 0% [b] | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 75% | 0% [b] | 10-126% |

(a) Result is from Run# 2
(b) Outside control limits due to dilution.

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
RL = Reporting Limit B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

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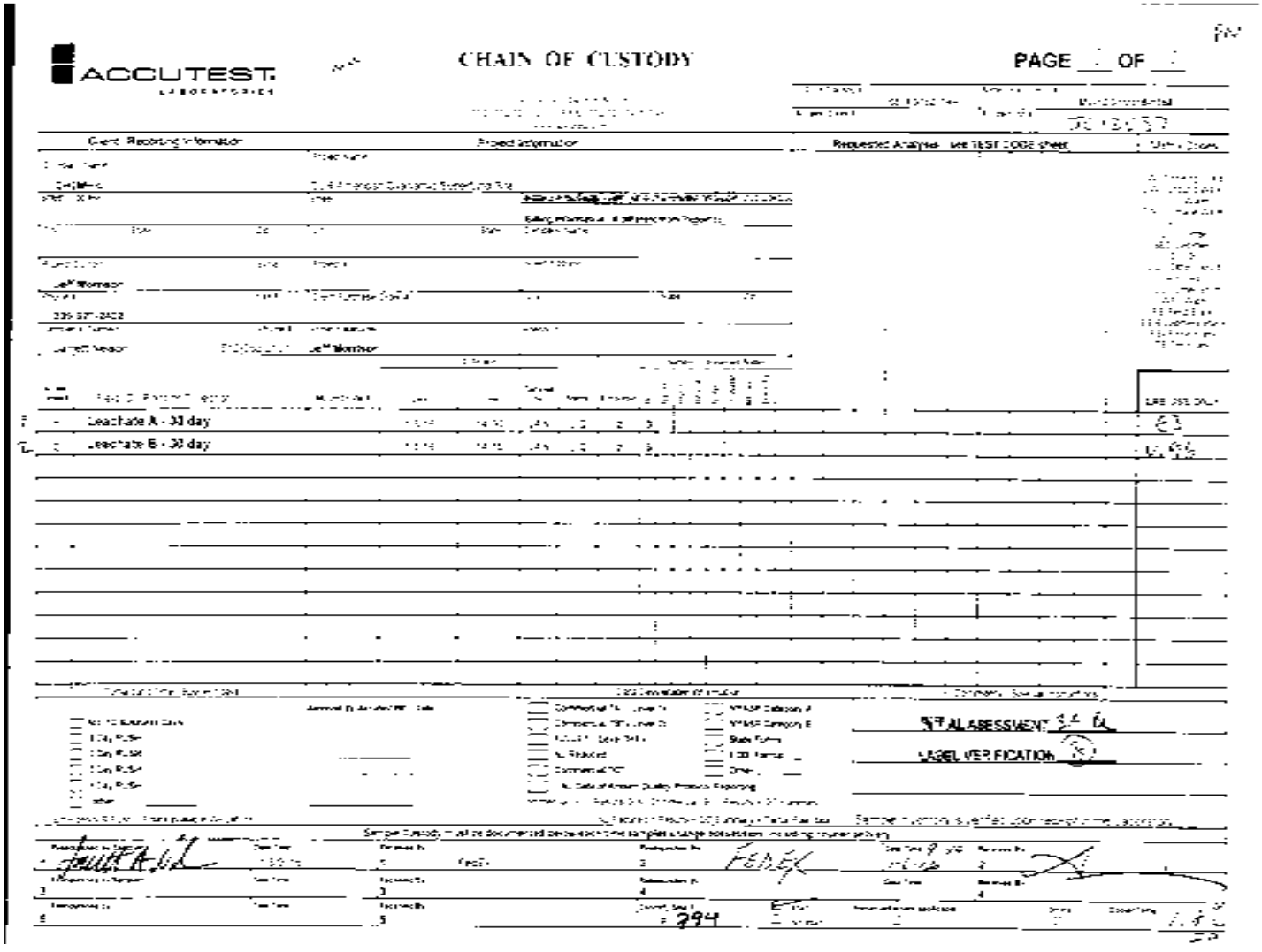
## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



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# CHAIN OF CUSTODY

PAGE 1 OF 1

Client Reporting Information | Project Information | Requested Analysis - see TEST CODE sheet | Matrix Codes

Leachate A - 30 day

Leachate B - 30 day

Sample Custody must be documented below each time samples change possession, including courier delivery.

**JC12057: Chain of Custody**
**Page 1 of 4**

# Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** JC12057 **Client:** CH2MHILL **Project:** OU8 American Cyanamid Superfund Site

**Date / Time Received:** 1/6/2016 9:40:00 AM **Delivery Method:** FedEx **Airbill #'s:** 651491627966

Cooler Temps (Raw Measured) °C: Cooler 1: (1.8);

Cooler Temps (Corrected) °C: Cooler 1: (2.2);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☐ | ☑ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments -1 & -2 No analysis noted on COC. Rec'd 2x 950ml unpreserved amber bottles and 3 HCL Preserved VOC's.

-2 2 of 3 VOC vials rec'd with macrobubbles.

Accutest Laboratories
V:732.329.0200

2235 US Highway 130
F: 732.329.3499

Dayton, New Jersey
www/accutest.com

# Sample Receipt Summary - Problem Resolution

**Accutest Job Number:** JC12057

**Initiator:** ANDREWS

**CSR:** MV

**Response Date:** 1/6/2016

**Response:** V8260ACE
VMS+12DCB
VMS+BENZ
VMS+NAP
VMS+TOLUEN
VMS+XYL

Also needs to be 48 hour t/a, which was not marked on the chain. COMMB Data deliverables.
Per Jeff Morrison

ACCUTEST LABORATORIES

## Job Change Order: JC12057

| | | | |
|---|---|---|---|
| **Requested Date:** | 1/8/2016 | **Received Date:** | 1/6/2016 |
| **Account Name:** | CH2M Hill | **Due Date:** | 1/8/2016 |
| **Project Description:** | OU8 American Cyanamid Superfund Site, 20 Polhe | **Deliverable:** | COMMB |
| **CSR:** | martyw | **TAT (Days):** | 2 |

==========

**Sample #:** JC12057-1, 2

**Dept:**

**TAT:** 2

**Change:**
Relog for B8270ACEPHEN

==========

**Above Changes Per:** Jeff Morrison **Date/Time:** 1/8/2016 5:20:01 PM

To Client: This Change Order is confirmation of the revisions, previously discussed with the Accutest Client Service Representative.



**JC12057: Chain of Custody**
**Page 4 of 4**

New Jersey ACCUTEST LABORATORIES



## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2B6151-MB | 2B138083.D | 1 | 01/07/16 | EH | n/a | n/a | V2B6151 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC12057-1, JC12057-2

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 73-122% |
| 2037-26-5 | Toluene-D8 | 99% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 78-117% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Blank Spike Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2B6151-BS | 2B138086.D | 1 | 01/07/16 | EH | n/a | n/a | V2B6151 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC12057-1, JC12057-2

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 50 | 54.6 | 109 | 47-144 |
| 71-43-2 | Benzene | 50 | 47.0 | 94 | 81-119 |
| 95-50-1 | 1,2-Dichlorobenzene | 50 | 48.3 | 97 | 80-117 |
| 91-20-3 | Naphthalene | 50 | 53.0 | 106 | 66-136 |
| 108-88-3 | Toluene | 50 | 47.3 | 95 | 80-122 |
| 1330-20-7 | Xylene (total) | 150 | 140 | 93 | 82-119 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 73-122% |
| 2037-26-5 | Toluene-D8 | 103% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 78-117% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC11826-6MS | 2B138092.D | 5 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| JC11826-6MSD | 2B138093.D | 5 | 01/07/16 | EH | n/a | n/a | V2B6151 |
| JC11826-6 | 2B138088.D | 5 | 01/07/16 | EH | n/a | n/a | V2B6151 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC12057-1, JC12057-2

| CAS No. | Compound | JC11826-6 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 48.0 | J | 250 | 251 | 81 | 250 | 274 | 90 | 9 | 33-158/19 |
| 71-43-2 | Benzene | 717 | | 250 | 892 | 70 | 250 | 881 | 66 | 1 | 43-138/12 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 236 | 94 | 250 | 235 | 94 | 0 | 71-124/12 |
| 91-20-3 | Naphthalene | ND | | 250 | 286 | 114 | 250 | 280 | 112 | 2 | 57-149/13 |
| 108-88-3 | Toluene | ND | | 250 | 227 | 91 | 250 | 224 | 90 | 1 | 51-136/13 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 689 | 92 | 750 | 682 | 91 | 1 | 46-137/12 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC11826-6 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 100% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 96% | 97% | 101% | 73-122% |
| 2037-26-5 | Toluene-D8 | 100% | 100% | 103% | 84-119% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 100% | 97% | 78-117% |

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V2B6140-BFB
**Lab File ID:** 2B137811.D
**Instrument ID:** GCMS2B
**Injection Date:** 12/29/15
**Injection Time:** 11:49

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 14143 | 16.9 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 38154 | 45.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 83845 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5672 | 6.76 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 78056 | 93.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5811 | 6.93 | (7.44) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 76221 | 90.9 | (97.6) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5049 | 6.02 | (6.62) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V2B6140-IC6140 | 2B137812.D | 12/29/15 | 12:23 | 00:34 | Initial cal 0.2 |
| V2B6140-IC6140 | 2B137813.D | 12/29/15 | 12:52 | 01:03 | Initial cal 0.5 |
| V2B6140-IC6140 | 2B137814.D | 12/29/15 | 13:21 | 01:32 | Initial cal 1 |
| V2B6140-IC6140 | 2B137815.D | 12/29/15 | 13:50 | 02:01 | Initial cal 2 |
| V2B6140-IC6140 | 2B137816.D | 12/29/15 | 14:19 | 02:30 | Initial cal 5 |
| V2B6140-IC6140 | 2B137817.D | 12/29/15 | 14:47 | 02:58 | Initial cal 10 |
| V2B6140-IC6140 | 2B137818.D | 12/29/15 | 15:16 | 03:27 | Initial cal 20 |
| V2B6140-ICC6140 | 2B137819.D | 12/29/15 | 15:45 | 03:56 | Initial cal 50 |
| V2B6140-IC6140 | 2B137820.D | 12/29/15 | 16:13 | 04:24 | Initial cal 100 |
| V2B6140-IC6140 | 2B137821.D | 12/29/15 | 16:42 | 04:53 | Initial cal 200 |
| V2B6140-ICV6140 | 2B137824.D | 12/29/15 | 18:08 | 06:19 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V2B6151-BFB
**Lab File ID:** 2B138080.D
**Instrument ID:** GCMS2B
**Injection Date:** 01/07/16
**Injection Time:** 08:21

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 14274 | 17.3 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 37602 | 45.6 | | Pass |
| 95 | Base peak, 100% relative abundance | 82546 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5635 | 6.83 | | Pass |
| 173 | Less than 2.0% of mass 174 | 257 | 0.31 | (0.33) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 78309 | 94.9 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5898 | 7.15 | (7.53) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 76296 | 92.4 | (97.4) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4974 | 6.03 | (6.52) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V2B6151-CC6140 | 2B138081.D | 01/07/16 | 08:52 | 00:31 | Continuing cal 20 |
| V2B6151-MB | 2B138083.D | 01/07/16 | 09:55 | 01:34 | Method Blank |
| V2B6151-BS | 2B138086.D | 01/07/16 | 11:24 | 03:03 | Blank Spike |
| JC11826-6 | 2B138088.D | 01/07/16 | 12:22 | 04:01 | (used for QC only; not part of job JC12057) |
| ZZZZZZ | 2B138089.D | 01/07/16 | 12:51 | 04:30 | (unrelated sample) |
| ZZZZZZ | 2B138090.D | 01/07/16 | 13:20 | 04:59 | (unrelated sample) |
| ZZZZZZ | 2B138091.D | 01/07/16 | 13:49 | 05:28 | (unrelated sample) |
| JC11826-6MS | 2B138092.D | 01/07/16 | 14:18 | 05:57 | Matrix Spike |
| JC11826-6MSD | 2B138093.D | 01/07/16 | 14:47 | 06:26 | Matrix Spike Duplicate |
| JC12057-1 | 2B138095.D | 01/07/16 | 15:44 | 07:23 | LEACHATE A -30 DAY |
| JC12057-2 | 2B138096.D | 01/07/16 | 16:13 | 07:52 | LEACHATE B -30 DAY |
| ZZZZZZ | 2B138097.D | 01/07/16 | 16:43 | 08:22 | (unrelated sample) |
| ZZZZZZ | 2B138098.D | 01/07/16 | 17:12 | 08:51 | (unrelated sample) |
| ZZZZZZ | 2B138099.D | 01/07/16 | 17:41 | 09:20 | (unrelated sample) |
| ZZZZZZ | 2B138100.D | 01/07/16 | 18:10 | 09:49 | (unrelated sample) |
| ZZZZZZ | 2B138101.D | 01/07/16 | 18:38 | 10:17 | (unrelated sample) |
| ZZZZZZ | 2B138102.D | 01/07/16 | 19:07 | 10:46 | (unrelated sample) |
| ZZZZZZ | 2B138103.D | 01/07/16 | 19:36 | 11:15 | (unrelated sample) |

# Volatile Surrogate Recovery Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** AQ

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC12057-1 | 2B138095.D | 100 | 98 | 101 | 97 |
| JC12057-2 | 2B138096.D | 101 | 98 | 101 | 98 |
| JC11826-6MS | 2B138092.D | 100 | 96 | 100 | 100 |
| JC11826-6MSD | 2B138093.D | 100 | 97 | 100 | 100 |
| V2B6151-BS | 2B138086.D | 104 | 100 | 103 | 99 |
| V2B6151-MB | 2B138083.D | 103 | 101 | 99 | 98 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 76-120% |
| **S2** = 1,2-Dichloroethane-D4 | 73-122% |
| **S3** = Toluene-D8 | 84-119% |
| **S4** = 4-Bromofluorobenzene | 78-117% |

New Jersey ACCUTEST LABORATORIES

## GC/MS Semi-volatiles



### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (DFTPP)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| OP90386-MB1 | P101840.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |

**The QC reported here applies to the following samples:** **Method:** SW846 8270D

JC12057-1R, JC12057-2R

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | ND | 2.0 | 0.28 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 39% | 14-88% |
| 4165-62-2 | Phenol-d5 | 25% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 92% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 65% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 70% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 93% | 10-126% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Semi-Volatile | | 0 | ug/l | |

# Blank Spike Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| OP90386-BS1 | P101841.D | 1 | 01/11/16 | SD | 01/11/16 | OP90386 | EP4460 |

**The QC reported here applies to the following samples:** **Method:** SW846 8270D

JC12057-1R, JC12057-2R

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | 50 | 35.9 | 72 | 52-111 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 52% | 14-88% |
| 4165-62-2 | Phenol-d5 | 35% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 110% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 79% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 85% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 94% | 10-126% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| OP90386-MS | P101849.D | 1 | 01/12/16 | SD | 01/11/16 | OP90386 | EP4460 |
| OP90386-MSD | P101850.D | 1 | 01/12/16 | SD | 01/11/16 | OP90386 | EP4460 |
| JC12253-1 | P101848.D | 1 | 01/12/16 | SD | 01/11/16 | OP90386 | EP4460 |

**The QC reported here applies to the following samples:** **Method:** SW846 8270D

JC12057-1R, JC12057-2R

| CAS No. | Compound | JC12253-1 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 98-86-2 | Acetophenone | ND | | 100 | 67.1 | 67 | 100 | 65.8 | 66 | 2 | 31-141/23 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC12253-1 | Limits |
|---|---|---|---|---|---|
| 367-12-4 | 2-Fluorophenol | 64% | 63% | 41% | 14-88% |
| 4165-62-2 | Phenol-d5 | 57% | 56% | 32% | 10-110% |
| 118-79-6 | 2,4,6-Tribromophenol | 116% | 114% | 101% | 39-149% |
| 4165-60-0 | Nitrobenzene-d5 | 78% | 79% | 66% | 32-128% |
| 321-60-8 | 2-Fluorobiphenyl | 84% | 87% | 77% | 35-119% |
| 1718-51-0 | Terphenyl-d14 | 97% | 95% | 87% | 10-126% |

* = Outside of Control Limits.

# Instrument Performance Check (DFTPP)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** EP4411-DFTPP
**Lab File ID:** P100854.D
**Instrument ID:** GCMSP
**Injection Date:** 12/04/15
**Injection Time:** 20:16

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 51 | 30.0 - 60.0% of mass 198 | 16166 | 30.2 | | Pass |
| 68 | Less than 2.0% of mass 69 | 0 | 0.00 | (0.00) [a] | Pass |
| 69 | Mass 69 relative abundance | 20498 | 38.3 | | Pass |
| 70 | Less than 2.0% of mass 69 | 0 | 0.00 | (0.00) [a] | Pass |
| 127 | 40.0 - 60.0% of mass 198 | 25336 | 47.3 | | Pass |
| 197 | Less than 1.0% of mass 198 | 0 | 0.00 | | Pass |
| 198 | Base peak, 100% relative abundance | 53544 | 100.0 | | Pass |
| 199 | 5.0 - 9.0% of mass 198 | 3567 | 6.66 | | Pass |
| 275 | 10.0 - 30.0% of mass 198 | 9294 | 17.4 | | Pass |
| 365 | 1.0 - 100.0% of mass 198 | 868 | 1.62 | | Pass |
| 441 | Present, but less than mass 443 | 5368 | 10.0 | (76.2) [b] | Pass |
| 442 | 40.0 - 100.0% of mass 198 | 34370 | 64.2 | | Pass |
| 443 | 17.0 - 23.0% of mass 442 | 7045 | 13.2 | (20.5) [c] | Pass |

(a) Value is % of mass 69
(b) Value is % of mass 443
(c) Value is % of mass 442

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| EP4411-IC4411 | P100855.D | 12/04/15 | 20:37 | 00:21 | Initial cal 100 |
| EP4411-IC4411 | P100856.D | 12/04/15 | 21:06 | 00:50 | Initial cal 80 |
| EP4411-ICC4411 | P100857.D | 12/04/15 | 21:35 | 01:19 | Initial cal 50 |
| EP4411-IC4411 | P100858.D | 12/04/15 | 22:05 | 01:49 | Initial cal 25 |
| EP4411-IC4411 | P100859.D | 12/04/15 | 22:34 | 02:18 | Initial cal 10 |
| EP4411-IC4411 | P100860.D | 12/04/15 | 23:03 | 02:47 | Initial cal 5 |
| EP4411-IC4411 | P100861.D | 12/04/15 | 23:33 | 03:17 | Initial cal 2 |
| EP4411-IC4411 | P100862.D | 12/05/15 | 00:02 | 03:46 | Initial cal 1 |

# Instrument Performance Check (DFTPP)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** EP4412-DFTPP
**Lab File ID:** P100865.D
**Instrument ID:** GCMSP
**Injection Date:** 12/07/15
**Injection Time:** 08:47

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 51 | 30.0 - 60.0% of mass 198 | 26011 | 30.4 | | Pass |
| 68 | Less than 2.0% of mass 69 | 0 | 0.00 | (0.00) [a] | Pass |
| 69 | Mass 69 relative abundance | 32120 | 37.5 | | Pass |
| 70 | Less than 2.0% of mass 69 | 0 | 0.00 | (0.00) [a] | Pass |
| 127 | 40.0 - 60.0% of mass 198 | 39957 | 46.6 | | Pass |
| 197 | Less than 1.0% of mass 198 | 0 | 0.00 | | Pass |
| 198 | Base peak, 100% relative abundance | 85698 | 100.0 | | Pass |
| 199 | 5.0 - 9.0% of mass 198 | 5720 | 6.67 | | Pass |
| 275 | 10.0 - 30.0% of mass 198 | 14827 | 17.3 | | Pass |
| 365 | 1.0 - 100.0% of mass 198 | 1242 | 1.45 | | Pass |
| 441 | Present, but less than mass 443 | 7793 | 9.09 | (78.9) [b] | Pass |
| 442 | 40.0 - 100.0% of mass 198 | 49386 | 57.6 | | Pass |
| 443 | 17.0 - 23.0% of mass 442 | 9882 | 11.5 | (20.0) [c] | Pass |

(a) Value is % of mass 69
(b) Value is % of mass 443
(c) Value is % of mass 442

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| EP4412-IC4412 | P100866.D | 12/07/15 | 09:10 | 00:23 | Initial cal 100 |
| EP4412-IC4412 | P100867.D | 12/07/15 | 09:43 | 00:56 | Initial cal 80 |
| EP4412-ICC4412 | P100868.D | 12/07/15 | 10:13 | 01:26 | Initial cal 50 |
| EP4412-IC4412 | P100869.D | 12/07/15 | 10:42 | 01:55 | Initial cal 25 |
| EP4412-IC4412 | P100870.D | 12/07/15 | 11:12 | 02:25 | Initial cal 10 |
| EP4412-IC4412 | P100871.D | 12/07/15 | 11:42 | 02:55 | Initial cal 5 |
| EP4412-IC4412 | P100872.D | 12/07/15 | 12:12 | 03:25 | Initial cal 2 |
| EP4412-IC4412 | P100873.D | 12/07/15 | 12:42 | 03:55 | Initial cal 1 |
| EP4412-ICV4411 | P100874.D | 12/07/15 | 13:12 | 04:25 | Initial cal verification 50 |
| EP4412-ICV4412 | P100874A.D | 12/07/15 | 13:12 | 04:25 | Initial cal verification 50 |
| EP4412-ICV4412 | P100875A.D | 12/07/15 | 13:42 | 04:55 | Initial cal verification 50 |
| EP4412-ICV4411 | P100875.D | 12/07/15 | 13:42 | 04:55 | Initial cal verification 50 |
| EP4412-ICV4411 | P100876.D | 12/07/15 | 14:11 | 05:24 | Initial cal verification 50 |
| EP4412-ICV4411 | P100877.D | 12/07/15 | 14:41 | 05:54 | Initial cal verification 50 |
| EP4412-ICV4411 | P100878.D | 12/07/15 | 15:11 | 06:24 | Initial cal verification 50 |
| EP4412-ICV4412 | P100879.D | 12/07/15 | 15:40 | 06:53 | Initial cal verification 50 |

# Instrument Performance Check (DFTPP)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** EP4460-DFTPP
**Lab File ID:** P101837.D
**Instrument ID:** GCMSP
**Injection Date:** 01/11/16
**Injection Time:** 19:25

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 51 | 30.0 - 60.0% of mass 198 | 20039 | 41.7 | | Pass |
| 68 | Less than 2.0% of mass 69 | 321 | 0.67 | (1.30) [a] | Pass |
| 69 | Mass 69 relative abundance | 24666 | 51.3 | | Pass |
| 70 | Less than 2.0% of mass 69 | 150 | 0.31 | (0.61) [a] | Pass |
| 127 | 40.0 - 60.0% of mass 198 | 24822 | 51.6 | | Pass |
| 197 | Less than 1.0% of mass 198 | 0 | 0.00 | | Pass |
| 198 | Base peak, 100% relative abundance | 48072 | 100.0 | | Pass |
| 199 | 5.0 - 9.0% of mass 198 | 3231 | 6.72 | | Pass |
| 275 | 10.0 - 30.0% of mass 198 | 8283 | 17.2 | | Pass |
| 365 | 1.0 - 100.0% of mass 198 | 591 | 1.23 | | Pass |
| 441 | Present, but less than mass 443 | 3596 | 7.48 | (82.5) [b] | Pass |
| 442 | 40.0 - 100.0% of mass 198 | 21591 | 44.9 | | Pass |
| 443 | 17.0 - 23.0% of mass 442 | 4359 | 9.07 | (20.2) [c] | Pass |

(a) Value is % of mass 69
(b) Value is % of mass 443
(c) Value is % of mass 442

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| EP4460-CC4411 | P101838.D | 01/11/16 | 19:37 | 00:12 | Continuing cal 50 |
| EP4460-CC4412 | P101839.D | 01/11/16 | 20:07 | 00:42 | Continuing cal 50 |
| OP90386-MB1 | P101840.D | 01/11/16 | 21:06 | 01:41 | Method Blank |
| OP90386-BS1 | P101841.D | 01/11/16 | 21:36 | 02:11 | Blank Spike |
| JC12057-2R | P101843.D | 01/11/16 | 22:06 | 02:41 | LEACHATE B -30 DAY |
| JC12057-1R | P101844.D | 01/11/16 | 22:35 | 03:10 | LEACHATE A -30 DAY |
| ZZZZZZ | P101845.D | 01/11/16 | 23:05 | 03:40 | (unrelated sample) |
| ZZZZZZ | P101846.D | 01/11/16 | 23:35 | 04:10 | (unrelated sample) |
| ZZZZZZ | P101847.D | 01/12/16 | 00:04 | 04:39 | (unrelated sample) |
| JC12253-1 | P101848.D | 01/12/16 | 00:34 | 05:09 | (used for QC only; not part of job JC12057) |
| OP90386-MS | P101849.D | 01/12/16 | 01:03 | 05:38 | Matrix Spike |
| OP90386-MSD | P101850.D | 01/12/16 | 01:33 | 06:08 | Matrix Spike Duplicate |
| ZZZZZZ | P101851.D | 01/12/16 | 02:02 | 06:37 | (unrelated sample) |
| ZZZZZZ | P101852.D | 01/12/16 | 02:31 | 07:06 | (unrelated sample) |
| ZZZZZZ | P101853.D | 01/12/16 | 03:01 | 07:36 | (unrelated sample) |
| ZZZZZZ | P101854.D | 01/12/16 | 03:30 | 08:05 | (unrelated sample) |
| ZZZZZZ | P101855.D | 01/12/16 | 03:59 | 08:34 | (unrelated sample) |
| ZZZZZZ | P101856.D | 01/12/16 | 04:29 | 09:04 | (unrelated sample) |
| ZZZZZZ | P101857.D | 01/12/16 | 04:58 | 09:33 | (unrelated sample) |

# Instrument Performance Check (DFTPP)

**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

| | | | |
|---|---|---|---|
| **Sample:** | EP4460-DFTPP | **Injection Date:** | 01/11/16 |
| **Lab File ID:** | P101837.D | **Injection Time:** | 19:25 |
| **Instrument ID:** | GCMSP | | |

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| ZZZZZZ | P101858.D | 01/12/16 | 05:27 | 10:02 | (unrelated sample) |

# Instrument Performance Check (DFTPP)



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** EP4461-DFTPP
**Lab File ID:** P101861.D
**Instrument ID:** GCMSP
**Injection Date:** 01/12/16
**Injection Time:** 09:20

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 51 | 30.0 - 60.0% of mass 198 | 16920 | 41.1 | | Pass |
| 68 | Less than 2.0% of mass 69 | 192 | 0.47 | (0.99) [a] | Pass |
| 69 | Mass 69 relative abundance | 19433 | 47.2 | | Pass |
| 70 | Less than 2.0% of mass 69 | 0 | 0.00 | (0.00) [a] | Pass |
| 127 | 40.0 - 60.0% of mass 198 | 20302 | 49.3 | | Pass |
| 197 | Less than 1.0% of mass 198 | 0 | 0.00 | | Pass |
| 198 | Base peak, 100% relative abundance | 41165 | 100.0 | | Pass |
| 199 | 5.0 - 9.0% of mass 198 | 2892 | 7.03 | | Pass |
| 275 | 10.0 - 30.0% of mass 198 | 7197 | 17.5 | | Pass |
| 365 | 1.0 - 100.0% of mass 198 | 470 | 1.14 | | Pass |
| 441 | Present, but less than mass 443 | 3118 | 7.57 | (87.0) [b] | Pass |
| 442 | 40.0 - 100.0% of mass 198 | 18948 | 46.0 | | Pass |
| 443 | 17.0 - 23.0% of mass 442 | 3583 | 8.70 | (18.9) [c] | Pass |

(a) Value is % of mass 69
(b) Value is % of mass 443
(c) Value is % of mass 442

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| EP4461-CC4411 | P101862.D | 01/12/16 | 09:32 | 00:12 | Continuing cal 25 |
| EP4461-CC4412 | P101863.D | 01/12/16 | 10:04 | 00:44 | Continuing cal 25 |
| EP4461-CC4411 | P101864.D | 01/12/16 | 10:33 | 01:13 | Continuing cal 5 |
| OP90414-MB1 | P101866.D | 01/12/16 | 11:32 | 02:12 | Method Blank |
| OP90414-BS1 | P101867A.D | 01/12/16 | 12:01 | 02:41 | Blank Spike |
| OP90391-MB1 | P101868A.D | 01/12/16 | 12:30 | 03:10 | Method Blank |
| JC12057-1R | P101869.D | 01/12/16 | 13:00 | 03:40 | LEACHATE A -30 DAY |
| OP90414-MS | P101871.D | 01/12/16 | 13:58 | 04:38 | Matrix Spike |
| JC12057-2R | P101881.D | 01/12/16 | 14:27 | 05:07 | LEACHATE B -30 DAY |
| OP90414-MSD | P101872.D | 01/12/16 | 14:57 | 05:37 | Matrix Spike Duplicate |
| JC12312-2 | P101873.D | 01/12/16 | 15:26 | 06:06 | (used for QC only; not part of job JC12057) |
| ZZZZZZ | P101874.D | 01/12/16 | 15:55 | 06:35 | (unrelated sample) |
| ZZZZZZ | P101875.D | 01/12/16 | 16:24 | 07:04 | (unrelated sample) |
| ZZZZZZ | P101876.D | 01/12/16 | 16:54 | 07:34 | (unrelated sample) |
| ZZZZZZ | P101877.D | 01/12/16 | 17:23 | 08:03 | (unrelated sample) |
| ZZZZZZ | P101878.D | 01/12/16 | 17:53 | 08:33 | (unrelated sample) |
| ZZZZZZ | P101879.D | 01/12/16 | 18:22 | 09:02 | (unrelated sample) |
| ZZZZZZ | P101880.D | 01/12/16 | 18:51 | 09:31 | (unrelated sample) |

# Semivolatile Surrogate Recovery Summary



**Job Number:** JC12057
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 American Cyanamid Superfund Site, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8270D **Matrix:** AQ

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 | S5 | S6 |
|---|---|---|---|---|---|---|---|
| JC12057-1R | P101869.D | 54 | 54 | 74 | 83 | 93 | 57 |
| JC12057-1R | P101844.D | 49 | 35 | 126 | 77 | 82 | 59 |
| JC12057-2R | P101881.D | 0* [a] | 0* [a] | 0* [a] | 0* [a] | 0* [a] | 0* [a] |
| JC12057-2R | P101843.D | 43 | 28 | 119 | 81 | 87 | 75 |
| OP90386-BS1 | P101841.D | 52 | 35 | 110 | 79 | 85 | 94 |
| OP90386-MB1 | P101840.D | 39 | 25 | 92 | 65 | 70 | 93 |
| OP90386-MS | P101849.D | 64 | 57 | 116 | 78 | 84 | 97 |
| OP90386-MSD | P101850.D | 63 | 56 | 114 | 79 | 87 | 95 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = 2-Fluorophenol | 14-88% |
| **S2** = Phenol-d5 | 10-110% |
| **S3** = 2,4,6-Tribromophenol | 39-149% |
| **S4** = Nitrobenzene-d5 | 32-128% |
| **S5** = 2-Fluorobiphenyl | 35-119% |
| **S6** = Terphenyl-d14 | 10-126% |

(a) Outside control limits due to dilution.

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Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC16619

Sampling Date: 03/17/16

Report to:

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Total number of pages in report: **51**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC16619

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC16619-1 | 03/17/16 | 17:30 | JM | 03/21/16 | SO | Solid | SI-01-90N-60 |
| JC16619-2 | 03/17/16 | 19:15 | JM | 03/21/16 | SO | Solid | SI-01-90N-POST |
| JC16619-3 | 03/17/16 | 12:37 | JM | 03/21/16 | SO | Solid | SI-02-90-INITIAL |
| JC16619-4 | 03/17/16 | 12:57 | JM | 03/21/16 | SO | Solid | SI-02-90-20 |
| JC16619-5 | 03/17/16 | 13:17 | JM | 03/21/16 | SO | Solid | SI-02-90-40 |
| JC16619-6 | 03/17/16 | 13:37 | JM | 03/21/16 | SO | Solid | SI-02-90-60 |
| JC16619-7 | 03/17/16 | 13:57 | JM | 03/21/16 | SO | Solid | SI-02-90-80 |
| JC16619-8 | 03/17/16 | 14:17 | JM | 03/21/16 | SO | Solid | SI-02-90-100 |
| JC16619-9 | 03/17/16 | 14:37 | JM | 03/21/16 | SO | Solid | SI-02-90-POST |
| JC16619-10 | 03/17/16 | 17:00 | JM | 03/21/16 | SO | Solid | SI-01+ SI-02 BASELINE |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits

**Job Number:** JC16619
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/17/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC16619-1** | **SI-01-90N-60** | | | | | |
| Benzene | | 8460000 | 50000 | 13000 | ug/kg | SW846 8260C |
| Cyclohexane | | 4460 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 855000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 12500 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 71300 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 64000 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 195000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 95600 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 10600 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 2500000 | 500000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 3240000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 716000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | | 206000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | | 922000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC16619-2** | **SI-01-90N-POST** | | | | | |
| Benzene | | 5440000 | 51000 | 14000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 715000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 10200 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 57800 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 48700 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 153000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 100000 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 7290 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 2760000 | 510000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 1960000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | | 525000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | | 156000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | | 682000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC16619-3** | **SI-02-90-INITIAL** | | | | | |
| Benzene | | 9270000 | 51000 | 14000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 8270 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | | 3110 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | | 5390 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 686000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 10200 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 56200 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 58200 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 162000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 103000 | 51000 | 8800 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16619
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/17/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| Methylcyclohexane | 10000 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 1920000 | 51000 | 1900 | ug/kg | SW846 8260C |
| Toluene | 3030000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | 625000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | 176000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | 801000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC16619-4 SI-02-90-20** | | | | | |
| Benzene | 5360000 | 47000 | 13000 | ug/kg | SW846 8260C |
| Carbon disulfide | 3910 J | 19000 | 2200 | ug/kg | SW846 8260C |
| Chlorobenzene | 2220 J | 19000 | 1500 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 519000 | 9400 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 7520 J | 9400 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 41100 | 9400 | 2100 | ug/kg | SW846 8260C |
| Ethylbenzene | 39200 | 9400 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | 115000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | 84900 | 47000 | 8100 | ug/kg | SW846 8260C |
| Methylcyclohexane | 6200 J | 19000 | 2100 | ug/kg | SW846 8260C |
| Naphthalene | 1570000 | 47000 | 1800 | ug/kg | SW846 8260C |
| Toluene | 1870000 | 9400 | 2000 | ug/kg | SW846 8260C |
| m,p-Xylene | 421000 | 9400 | 3300 | ug/kg | SW846 8260C |
| o-Xylene | 119000 | 9400 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | 541000 | 9400 | 2600 | ug/kg | SW846 8260C |
| **JC16619-5 SI-02-90-40** | | | | | |
| Benzene | 4940000 | 50000 | 13000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 560000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 7940 J | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 44900 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 40100 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | 119000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 89900 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | 6710 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 1780000 | 50000 | 1900 | ug/kg | SW846 8260C |
| Toluene | 1830000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | 433000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | 125000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | 558000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC16619-6 SI-02-90-60** | | | | | |
| Benzene | 3620000 | 50000 | 13000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 444000 | 10000 | 1200 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16619
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/17/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| 1,3-Dichlorobenzene | 6570 J | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 36400 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 30500 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | 92300 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 92000 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | 4360 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 1440000 | 50000 | 1900 | ug/kg | SW846 8260C |
| Toluene | 1360000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | 327000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | 96300 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | 423000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC16619-7 SI-02-90-80** | | | | | |
| Benzene | 3270000 | 51000 | 14000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 439000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 5780 J | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 34400 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 28600 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | 86200 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 85900 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | 4460 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 1410000 | 51000 | 1900 | ug/kg | SW846 8260C |
| Toluene | 1280000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | 316000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | 93900 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | 410000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC16619-8 SI-02-90-100** | | | | | |
| Benzene | 3140000 | 50000 | 13000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 524000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 7490 J | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 42400 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 32900 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | 102000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 83800 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | 5170 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 1810000 | 50000 | 1900 | ug/kg | SW846 8260C |
| Toluene | 1370000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | 355000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | 105000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | 460000 | 10000 | 2700 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16619
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/17/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC16619-9** | **SI-02-90-POST** | | | | | |
| Benzene | | 2660000 | 51000 | 14000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 468000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 5730 J | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 35000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 27900 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 83000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 81600 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 4000 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 1560000 | 51000 | 1900 | ug/kg | SW846 8260C |
| Toluene | | 1160000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | | 307000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | | 92200 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | | 399000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC16619-10** | **SI-01+ SI-02 BASELINE** | | | | | |
| Benzene | | 18800000 | 60000 | 16000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 29100 | 19000 | 2200 | ug/kg | SW846 8260C |
| Chlorobenzene | | 5020 J | 19000 | 1500 | ug/kg | SW846 8260C |
| Chloromethane | | 19400 J | 48000 | 2500 | ug/kg | SW846 8260C |
| Cyclohexane | | 14300 J | 19000 | 3000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 850000 | 9600 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 12800 | 9600 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 74700 | 9600 | 2200 | ug/kg | SW846 8260C |
| Ethylbenzene | | 101000 | 9600 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 267000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 118000 | 48000 | 8300 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 24800 | 19000 | 2200 | ug/kg | SW846 8260C |
| Naphthalene | | 1980000 | 480000 | 18000 | ug/kg | SW846 8260C |
| Toluene | | 5580000 | 96000 | 20000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1080000 | 9600 | 3400 | ug/kg | SW846 8260C |
| o-Xylene | | 285000 | 9600 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | | 1370000 | 9600 | 2600 | ug/kg | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-01-90N-60 | | |
| **Lab Sample ID:** | JC16619-1 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233807.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233811.D | 1000 | 03/23/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 8460000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | 4460 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 855000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 12500 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 71300 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 64000 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-01-90N-60 | | |
| **Lab Sample ID:** | JC16619-1 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 195000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 95600 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 10600 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 2500000 [b] | 500000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 3240000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 716000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 206000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 922000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 86% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-01-90N-POST | | |
| **Lab Sample ID:** | JC16619-2 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233808.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233810.D | 1000 | 03/23/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 5440000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 715000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 10200 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 57800 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 48700 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-01-90N-POST | | |
| **Lab Sample ID:** | JC16619-2 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 153000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 100000 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 7290 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 2760000 [b] | 510000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 1960000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 525000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 156000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 682000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 89% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-INITIAL | | |
| **Lab Sample ID:** | JC16619-3 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233815.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233829.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 9270000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 8270 | 20000 | 2300 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 3110 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | 5390 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 686000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 10200 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 56200 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 58200 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-INITIAL | | |
| **Lab Sample ID:** | JC16619-3 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 162000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 103000 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 10000 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 1920000 | 51000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 3030000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 625000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 176000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 801000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 88% | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 84% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-20 | | |
| **Lab Sample ID:** | JC16619-4 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233816.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233830.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.3 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.3 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 94000 | 21000 | ug/kg | |
| 71-43-2 | Benzene | 5360000 [b] | 47000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 47000 | 2900 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 47000 | 2200 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 47000 | 3400 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 94000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 3910 | 19000 | 2200 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 2220 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 47000 | 4500 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 47000 | 2500 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 19000 | 3000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5100 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 1900 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9400 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 519000 | 9400 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 7520 | 9400 | 1500 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 41100 | 9400 | 2100 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 47000 | 3400 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9400 | 7300 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2200 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 39200 | 9400 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 47000 | 4200 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 47000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-20 | | |
| **Lab Sample ID:** | JC16619-4 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 115000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 84900 | 47000 | 8100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 6200 | 19000 | 2100 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9400 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 47000 | 4300 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 47000 | 9300 | ug/kg | |
| 91-20-3 | Naphthalene | 1570000 | 47000 | 1800 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2800 | ug/kg | |
| 108-88-3 | Toluene | 1870000 | 9400 | 2000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 47000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 47000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9400 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 47000 | 2300 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 421000 | 9400 | 3300 | ug/kg | |
| 95-47-6 | o-Xylene | 119000 | 9400 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 541000 | 9400 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 109% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 89% | 86% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-40 | | |
| **Lab Sample ID:** | JC16619-5 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233817.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233831.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 4940000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 560000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 7940 | 10000 | 1600 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 44900 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 40100 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-40 | | |
| **Lab Sample ID:** | JC16619-5 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 119000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 89900 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 6710 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 1780000 | 50000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 1830000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 433000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 125000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 558000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 109% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 84% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-60 | | |
| **Lab Sample ID:** | JC16619-6 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233818.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233832.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 3620000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 444000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 6570 | 10000 | 1600 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 36400 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 30500 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-60 | | |
| **Lab Sample ID:** | JC16619-6 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 92300 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 92000 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 4360 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 1440000 | 50000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 1360000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 327000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 96300 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 423000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 85% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-80 | | |
| **Lab Sample ID:** | JC16619-7 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233819.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233833.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10190 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 3270000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 439000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 5780 | 10000 | 1600 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 34400 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 28600 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-80 | | |
| **Lab Sample ID:** | JC16619-7 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 86200 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 85900 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 4460 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 1410000 | 51000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 1280000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 316000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 93900 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 410000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 88% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 85% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-100 | | |
| **Lab Sample ID:** | JC16619-8 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233820.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| Run #2 | E233846.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 3140000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 524000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 7490 | 10000 | 1600 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 42400 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 32900 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-100 | | |
| **Lab Sample ID:** | JC16619-8 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 102000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 83800 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 5170 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 1810000 | 50000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 1370000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 355000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 105000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 460000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 84% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-POST | | |
| **Lab Sample ID:** | JC16619-9 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233847.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233849.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 2660000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 468000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 5730 | 10000 | 1600 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 35000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 27900 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-02-90-POST | | |
| **Lab Sample ID:** | JC16619-9 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 83000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 81600 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 4000 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 1560000 | 51000 | 1900 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 1160000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 307000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 92200 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 399000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 111% | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis



**Client Sample ID:** SI-01+ SI-02 BASELINE
**Lab Sample ID:** JC16619-10 **Date Sampled:** 03/17/16
**Matrix:** SO - Solid **Date Received:** 03/21/16
**Method:** SW846 8260C **Percent Solids:** n/a [a]
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233848.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233850.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #3 | E233854.D | 1250 | 03/24/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.2 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.2 g | 10.0 ml | 100 ul |
| Run #3 | 5.2 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 96000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 18800000 [b] | 60000 | 16000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 48000 | 3000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 48000 | 2300 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 48000 | 3500 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 96000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 29100 | 19000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 5020 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 48000 | 4600 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | 19400 | 48000 | 2500 | ug/kg | J |
| 110-82-7 | Cyclohexane | 14300 | 19000 | 3000 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5200 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 2000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9600 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 850000 | 9600 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 12800 | 9600 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 74700 | 9600 | 2200 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 48000 | 3500 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9600 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9600 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9600 | 5700 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9600 | 7500 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9600 | 5700 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2300 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 101000 | 9600 | 1600 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis



| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-01+ SI-02 BASELINE | | |
| **Lab Sample ID:** | JC16619-10 | **Date Sampled:** | 03/17/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 03/21/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 76-13-1 | Freon 113 [c] | ND | 48000 | 4300 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 48000 | 13000 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 267000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 118000 | 48000 | 8300 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 24800 | 19000 | 2200 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9600 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 48000 | 4400 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 48000 | 9400 | ug/kg | |
| 91-20-3 | Naphthalene | 1980000 [d] | 480000 | 18000 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2900 | ug/kg | |
| 108-88-3 | Toluene | 5580000 [d] | 96000 | 20000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 48000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 48000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9600 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 48000 | 2400 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 1080000 | 9600 | 3400 | ug/kg | |
| 95-47-6 | o-Xylene | 285000 | 9600 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1370000 | 9600 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 110% | 109% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 104% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 89% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 86% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 3
(c) This compound in BS is outside in house QC limits bias high.
(d) Result is from Run# 2

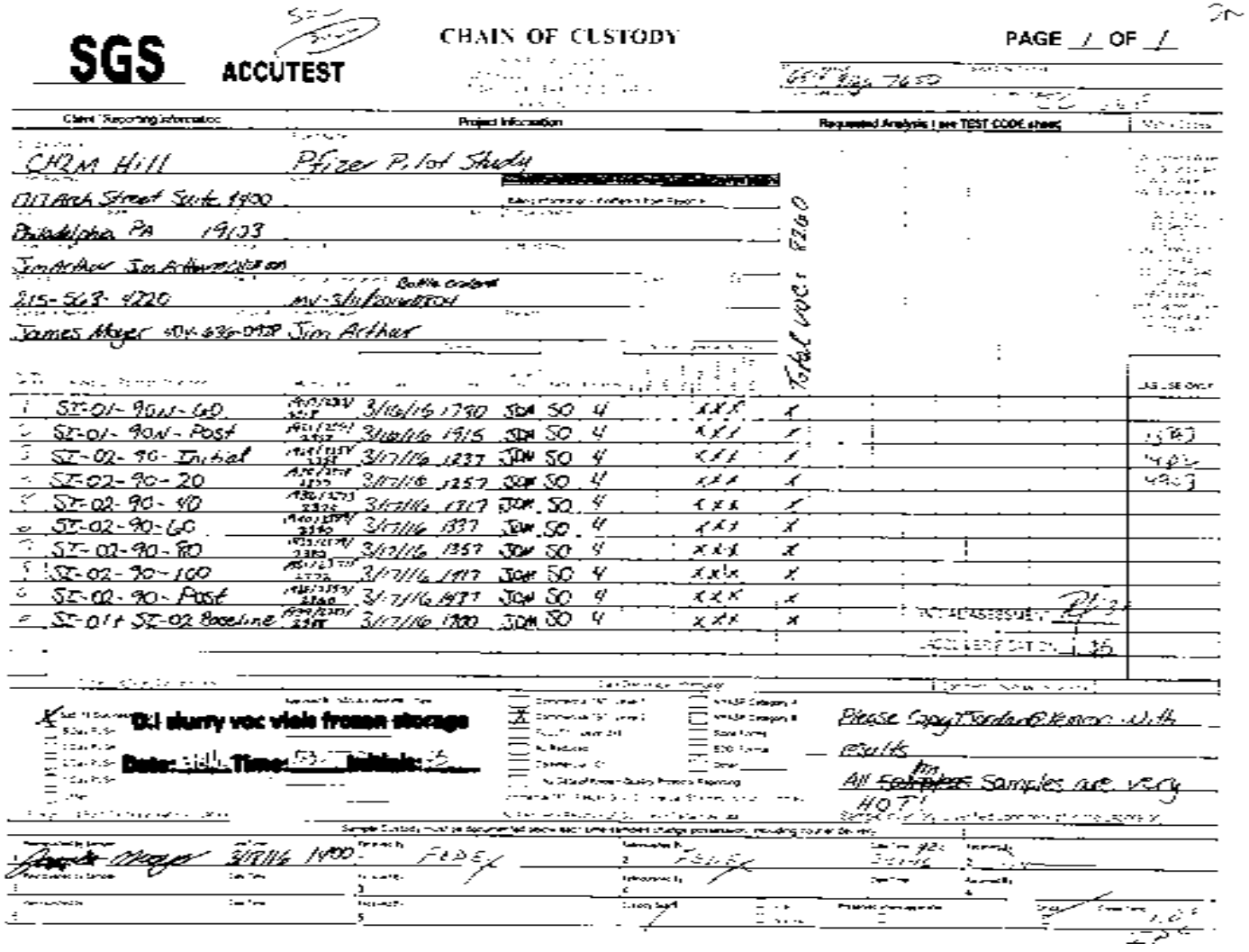
ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



**SGS ACCUTEST**

# CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information | Project Information | Requested Analysis (see TEST CODE sheet)

CH2M Hill — Pfizer Pilot Study

1717 Arch Street Suite 1400

Philadelphia PA 19103

Jim Arthur Jim Arthur@CH2M.com

215-563-4220 — MV-3/11/2016 Bottle ordered

James Mayer 404-636-0938 Jim Arthur

| | | | | | | | | | Total VOCs 8260 | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SI-01-90N-60 | [illegible] | 3/16/16 | 1730 | JDM | SO | 4 | XXX | X | |
| 2 | SI-01-90N-Post | [illegible] | 3/16/16 | 1915 | JDM | SO | 4 | XXX | X | 1580 |
| 3 | SI-02-90-Initial | [illegible] | 3/17/16 | 1237 | JDM | SO | 4 | XXX | X | 1402 |
| 4 | SI-02-90-20 | [illegible] | 3/17/16 | 1257 | JDM | SO | 4 | XXX | X | 4903 |
| 5 | SI-02-90-40 | [illegible] | 3/17/16 | 1317 | JDM | SO | 4 | XXX | X | |
| 6 | SI-02-90-60 | [illegible] | 3/17/16 | 1337 | JDM | SO | 4 | XXX | X | |
| 7 | SI-02-90-80 | [illegible] | 3/17/16 | 1357 | JDM | SO | 4 | XXX | X | |
| 8 | SI-02-90-100 | [illegible] | 3/17/16 | 1417 | JDM | SO | 4 | XXX | X | |
| 9 | SI-02-90-Post | [illegible] | 3/17/16 | 1437 | JDM | SO | 4 | XXX | X | |
| 10 | SI-01+SI-02 Baseline | [illegible] | 3/17/16 | 1700 | JDM | SO | 4 | XXX | X | |

INITIAL ASSESSMENT: [illegible]

ACCOUNTING DATE: 15

X D.I slurry voc vials frozen storage

Date: 3/4 Time: 53 Initials: [illegible]

Please Copy Jordan@Kenon with results

All ~~Samples~~ Samples are very HOT!

Sample Custody must be documented below each time samples change possession, including courier delivery.

James Mayer 3/18/16 1400 — FEDEX — FEDEX — 3/21/16

JC16619: Chain of Custody
Page 1 of 3

# SGS Accutest Sample Receipt Summary

**Job Number:** JC16619 **Client:** CH2MILL **Project:** Pfizer Pilot Study

**Date / Time Received:** 3/21/2016 9:20:00 AM **Delivery Method:** FedEx **Airbill #'s:** 651491667650

Cooler Temps (Raw Measured) °C: Cooler 1: (1.0);

Cooler Temps (Corrected) °C: Cooler 1: (1.4);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☐ | ☐ | ☑ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☐ ☑ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☐ ☑ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

1) -1 thru -10: LL kits rec'd out of HT, sampled 3/16 & 3/17.

2) -3: Time on 60ml jar 12:30 doesn't match coc 12:37, ID and date match.

3) -8 thru -10: Labels on 60ml bottles are washed out, cannot read. They were rec'd in bags with LL kits that were clearly marked with ID/date/time.

4) All samples are tar-like.

## Sample Receipt Summary - Problem Resolution

**Job Number:** JC16619 **Initiator:** daveh

**CSR:** MV **Response Date:** 3/22/2016

**Response:** 1-Sample are expected to be very HIGH in concentration. Lab to run from MEOH vial. DI vials can be frozen but probabaly should not be used.
2- Correct time is 1230- Chain is incorrect.
3-Noted
4-Noted

Per Mary (CH2M) and Tommy (Kemron)

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10190-MB1 | E233803.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10190-MB1 | E233803.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10190-MB2 | E233828.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 72-130% |

# Method Blank Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB1 | E233843.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB1 | E233843.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 82% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Blank Spike Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10190-BS | E233804.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2270 | 91 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2200 | 88 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2880 | 115 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2460 | 98 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2610 | 104 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2390 | 96 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2770 | 111 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2610 | 104 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2530 | 101 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2400 | 96 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2690 | 108 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2690 | 108 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2400 | 96 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2910 | 116 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2330 | 93 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2530 | 101 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2420 | 97 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2290 | 92 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2310 | 92 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2260 | 90 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2570 | 103 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2460 | 98 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2320 | 93 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2530 | 101 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2490 | 100 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2410 | 96 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2180 | 87 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2400 | 96 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2340 | 94 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2260 | 90 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 3840 | 154* [a] | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2240 | 90 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2290 | 92 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2290 | 92 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2600 | 104 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4990 | 100 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10190-BS | E233804.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2320 | 93 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2610 | 104 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2350 | 94 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2420 | 97 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2150 | 86 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2720 | 109 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2410 | 96 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2460 | 98 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2390 | 96 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2990 | 120 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2330 | 93 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2430 | 97 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 3090 | 124 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2700 | 108 | 57-136 |
| | m,p-Xylene | 5000 | 4900 | 98 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2490 | 100 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7390 | 99 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 72-130% |

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-BS | E233844.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2290 | 92 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2190 | 88 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2900 | 116 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2430 | 97 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2590 | 104 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2330 | 93 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2680 | 107 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2610 | 104 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2520 | 101 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2390 | 96 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2710 | 108 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2710 | 108 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2470 | 99 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2830 | 113 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2320 | 93 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2550 | 102 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2470 | 99 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2350 | 94 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2390 | 96 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2310 | 92 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2880 | 115 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2470 | 99 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2330 | 93 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2520 | 101 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2490 | 100 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2370 | 95 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2170 | 87 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2350 | 94 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2340 | 94 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2270 | 91 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 3750 | 150* [a] | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2210 | 88 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2270 | 91 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2320 | 93 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2510 | 100 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4900 | 98 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-BS | E233844.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2270 | 91 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2580 | 103 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2380 | 95 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2410 | 96 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2160 | 86 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2680 | 107 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2390 | 96 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2480 | 99 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2430 | 97 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2960 | 118 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2360 | 94 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2440 | 98 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 3110 | 124 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2780 | 111 | 57-136 |
| | m,p-Xylene | 5000 | 4900 | 98 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2460 | 98 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7360 | 98 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 72-130% |

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-2MS | E233812.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2MSD | E233813.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2 | E233808.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2 | E233810.D | 1000 | 03/23/16 | TDN | n/a | n/a | VE10190 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | JC16619-2 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 510000 | 426000 | 83 | 510000 | 440000 | 86 | 3 | 10-180/33 |
| 71-43-2 | Benzene | 5440000 [b] | | 510000 | 3520000 | -176* [a] | 510000 | 3530000 | -174* [a] | 0 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 510000 | 591000 | 116 | 510000 | 585000 | 115 | 1 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 510000 | 486000 | 95 | 510000 | 491000 | 96 | 1 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 510000 | 513000 | 101 | 510000 | 511000 | 100 | 0 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 510000 | 457000 | 90 | 510000 | 453000 | 89 | 1 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 510000 | 536000 | 105 | 510000 | 571000 | 112 | 6 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 510000 | 535000 | 105 | 510000 | 528000 | 103 | 1 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 510000 | 498000 | 98 | 510000 | 486000 | 95 | 2 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 510000 | 495000 | 97 | 510000 | 496000 | 97 | 0 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 510000 | 527000 | 103 | 510000 | 531000 | 104 | 1 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 510000 | 554000 | 109 | 510000 | 552000 | 108 | 0 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 510000 | 476000 | 93 | 510000 | 465000 | 91 | 2 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 510000 | 592000 | 116 | 510000 | 578000 | 113 | 2 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 510000 | 482000 | 94 | 510000 | 489000 | 96 | 1 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 510000 | 504000 | 99 | 510000 | 514000 | 101 | 2 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 510000 | 488000 | 96 | 510000 | 497000 | 97 | 2 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 715000 | | 510000 | 980000 | 52 | 510000 | 993000 | 54 | 1 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | 10200 | | 510000 | 484000 | 93 | 510000 | 490000 | 94 | 1 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | 57800 | | 510000 | 504000 | 87 | 510000 | 504000 | 87 | 0 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 510000 | 485000 | 95 | 510000 | 472000 | 93 | 3 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 510000 | 509000 | 100 | 510000 | 514000 | 101 | 1 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 510000 | 525000 | 103 | 510000 | 523000 | 103 | 0 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 510000 | 525000 | 103 | 510000 | 521000 | 102 | 1 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 510000 | 511000 | 100 | 510000 | 509000 | 100 | 0 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 510000 | 502000 | 98 | 510000 | 493000 | 97 | 2 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 510000 | 447000 | 88 | 510000 | 456000 | 89 | 2 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 510000 | 479000 | 94 | 510000 | 483000 | 95 | 1 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 510000 | 481000 | 94 | 510000 | 470000 | 92 | 2 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 48700 | | 510000 | 496000 | 88 | 510000 | 503000 | 89 | 1 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 510000 | 786000 | 154* [c] | 510000 | 775000 | 152 | 1 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 510000 | 477000 | 93 | 510000 | 449000 | 88 | 6 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 153000 | | 510000 | 593000 | 86 | 510000 | 610000 | 90 | 3 | 36-145/33 |
| 79-20-9 | Methyl Acetate | 100000 | | 510000 | 550000 | 88 | 510000 | 555000 | 89 | 1 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | 7290 | J | 510000 | 538000 | 104 | 510000 | 533000 | 103 | 1 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 1020000 | 1020000 | 100 | 1020000 | 999000 | 98 | 2 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-2MS | E233812.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2MSD | E233813.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2 | E233808.D | 1 | 03/23/16 | TDN | n/a | n/a | VE10190 |
| JC16619-2 | E233810.D | 1000 | 03/23/16 | TDN | n/a | n/a | VE10190 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-1, JC16619-2, JC16619-3, JC16619-4, JC16619-5, JC16619-6, JC16619-7, JC16619-8

| CAS No. | Compound | JC16619-2 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 510000 | 482000 | 94 | 510000 | 480000 | 94 | 0 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 510000 | 535000 | 105 | 510000 | 540000 | 106 | 1 | 47-133/25 |
| 91-20-3 | Naphthalene | 2760000 | b | 510000 | 2200000 | -45* | a 510000 | 2270000 | -31* | a 3 | 12-160/33 |
| 100-42-5 | Styrene | ND | | 510000 | 488000 | 96 | 510000 | 492000 | 96 | 1 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 510000 | 444000 | 87 | 510000 | 456000 | 89 | 3 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | ND | | 510000 | 547000 | 107 | 510000 | 569000 | 112 | 4 | 34-163/31 |
| 108-88-3 | Toluene | 1960000 | | 510000 | 1940000 | -4* | a 510000 | 1930000 | -6* | a 1 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 510000 | 531000 | 104 | 510000 | 550000 | 108 | 4 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 510000 | 512000 | 100 | 510000 | 522000 | 102 | 2 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 510000 | 605000 | 119 | 510000 | 582000 | 114 | 4 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 510000 | 473000 | 93 | 510000 | 468000 | 92 | 1 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 510000 | 505000 | 99 | 510000 | 512000 | 100 | 1 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 510000 | 587000 | 115 | 510000 | 577000 | 113 | 2 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 510000 | 532000 | 104 | 510000 | 538000 | 105 | 1 | 38-149/29 |
| | m,p-Xylene | 525000 | | 1020000 | 1370000 | 83 | 1020000 | 1380000 | 84 | 1 | 32-148/30 |
| 95-47-6 | o-Xylene | 156000 | | 510000 | 615000 | 90 | 510000 | 623000 | 92 | 1 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 682000 | | 1530000 | 1980000 | 85 | 1530000 | 2000000 | 86 | 1 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC16619-2 | JC16619-2 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 111% | 110% | 108% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 103% | 101% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 92% | 89% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 89% | 86% | 89% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Result is from Run #2.
(c) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-9MS | E233855.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9MSD | E233856.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233847.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233849.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | JC16619-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 510000 | 445000 | 87 | 510000 | 432000 | 85 | 3 | 10-180/33 |
| 71-43-2 | Benzene | 2660000 [b] | | 510000 | 4160000 | 280* [a] | 510000 | 4180000 | 284* [a] | 0 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 510000 | 551000 | 108 | 510000 | 544000 | 107 | 1 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 510000 | 456000 | 89 | 510000 | 453000 | 89 | 1 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 510000 | 487000 | 95 | 510000 | 493000 | 97 | 1 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 510000 | 506000 | 99 | 510000 | 517000 | 101 | 2 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 510000 | 543000 | 106 | 510000 | 532000 | 104 | 2 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 510000 | 501000 | 98 | 510000 | 513000 | 101 | 2 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 510000 | 454000 | 89 | 510000 | 466000 | 91 | 3 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 510000 | 467000 | 92 | 510000 | 466000 | 91 | 0 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 510000 | 583000 | 114 | 510000 | 588000 | 115 | 1 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 510000 | 517000 | 101 | 510000 | 511000 | 100 | 1 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 510000 | 521000 | 102 | 510000 | 541000 | 106 | 4 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 510000 | 549000 | 108 | 510000 | 564000 | 111 | 3 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 510000 | 465000 | 91 | 510000 | 466000 | 91 | 0 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 510000 | 478000 | 94 | 510000 | 482000 | 94 | 1 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 510000 | 463000 | 91 | 510000 | 465000 | 91 | 0 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 468000 | | 510000 | 1080000 | 120 | 510000 | 1070000 | 118 | 1 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | 5730 | J | 510000 | 460000 | 89 | 510000 | 453000 | 88 | 2 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | 35000 | | 510000 | 490000 | 89 | 510000 | 481000 | 87 | 2 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 510000 | 561000 | 110 | 510000 | 584000 | 114 | 4 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 510000 | 486000 | 95 | 510000 | 485000 | 95 | 0 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 510000 | 511000 | 100 | 510000 | 509000 | 100 | 0 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 510000 | 492000 | 96 | 510000 | 488000 | 96 | 1 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 510000 | 481000 | 94 | 510000 | 481000 | 94 | 0 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 510000 | 465000 | 91 | 510000 | 465000 | 91 | 0 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 510000 | 427000 | 84 | 510000 | 422000 | 83 | 1 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 510000 | 456000 | 89 | 510000 | 448000 | 88 | 2 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 510000 | 437000 | 86 | 510000 | 437000 | 86 | 0 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 27900 | | 510000 | 475000 | 88 | 510000 | 480000 | 89 | 1 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 510000 | 700000 | 137 | 510000 | 717000 | 141 | 2 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 510000 | 429000 | 84 | 510000 | 438000 | 86 | 2 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 83000 | | 510000 | 578000 | 97 | 510000 | 570000 | 95 | 1 | 36-145/33 |
| 79-20-9 | Methyl Acetate | 81600 | | 510000 | 566000 | 95 | 510000 | 555000 | 93 | 2 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | 4000 | J | 510000 | 482000 | 94 | 510000 | 497000 | 97 | 3 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 1020000 | 929000 | 91 | 1020000 | 943000 | 92 | 1 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-9MS | E233855.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9MSD | E233856.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233847.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233849.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16619-8, JC16619-9, JC16619-10

| CAS No. | Compound | JC16619-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 510000 | 452000 | 89 | 510000 | 453000 | 89 | 0 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 510000 | 506000 | 99 | 510000 | 504000 | 99 | 0 | 47-133/25 |
| 91-20-3 | Naphthalene | 1560000 | | 510000 | 2720000 | 227* [a] | 510000 | 2760000 | 235* [a] | 1 | 12-160/33 |
| 100-42-5 | Styrene | ND | | 510000 | 469000 | 92 | 510000 | 472000 | 93 | 1 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 510000 | 427000 | 84 | 510000 | 425000 | 83 | 0 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | ND | | 510000 | 523000 | 103 | 510000 | 526000 | 103 | 1 | 34-163/31 |
| 108-88-3 | Toluene | 1160000 | | 510000 | 2080000 | 180* [a] | 510000 | 2070000 | 178* [a] | 0 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 510000 | 508000 | 100 | 510000 | 518000 | 102 | 2 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 510000 | 491000 | 96 | 510000 | 493000 | 97 | 0 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 510000 | 555000 | 109 | 510000 | 563000 | 110 | 1 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 510000 | 444000 | 87 | 510000 | 444000 | 87 | 0 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 510000 | 477000 | 93 | 510000 | 476000 | 93 | 0 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 510000 | 621000 | 122 | 510000 | 641000 | 126 | 3 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 510000 | 587000 | 115 | 510000 | 614000 | 120 | 4 | 38-149/29 |
| | m,p-Xylene | 307000 | | 1020000 | 1350000 | 102 | 1020000 | 1350000 | 102 | 0 | 32-148/30 |
| 95-47-6 | o-Xylene | 92200 | | 510000 | 604000 | 100 | 510000 | 612000 | 102 | 1 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 399000 | | 1530000 | 1960000 | 102 | 1530000 | 1960000 | 102 | 0 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC16619-9 | JC16619-9 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 109% | 111% | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 102% | 105% | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 91% | 89% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 86% | 85% | 87% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Result is from Run #2.

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10121-BFB
**Lab File ID:** E232058.D
**Instrument ID:** GCMSE
**Injection Date:** 01/11/16
**Injection Time:** 09:18



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 9613 | 18.2 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 24837 | 47.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 52890 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3541 | 6.70 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 49576 | 93.7 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3554 | 6.72 | (7.17) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 48312 | 91.3 | (97.5) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3155 | 5.97 | (6.53) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10121-IC10121 | E232059.D | 01/11/16 | 09:52 | 00:34 | Initial cal 0.2 |
| VE10121-IC10121 | E232060.D | 01/11/16 | 10:26 | 01:08 | Initial cal 0.5 |
| VE10121-IC10121 | E232061.D | 01/11/16 | 11:00 | 01:42 | Initial cal 1 |
| VE10121-IC10121 | E232062.D | 01/11/16 | 11:34 | 02:16 | Initial cal 2 |
| VE10121-IC10121 | E232063.D | 01/11/16 | 12:08 | 02:50 | Initial cal 4 |
| VE10121-IC10121 | E232064.D | 01/11/16 | 12:42 | 03:24 | Initial cal 8 |
| VE10121-IC10121 | E232065.D | 01/11/16 | 13:16 | 03:58 | Initial cal 20 |
| VE10121-ICC10121 | E232066.D | 01/11/16 | 13:50 | 04:32 | Initial cal 50 |
| VE10121-IC10121 | E232067.D | 01/11/16 | 14:24 | 05:06 | Initial cal 100 |
| VE10121-IC10121 | E232068.D | 01/11/16 | 14:58 | 05:40 | Initial cal 200 |
| VE10121-ICV10121 | E232071.D | 01/11/16 | 16:40 | 07:22 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10190-BFB
**Lab File ID:** E233800.D
**Instrument ID:** GCMSE
**Injection Date:** 03/23/16
**Injection Time:** 06:54

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 9136 | 17.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 24282 | 45.1 | | Pass |
| 95 | Base peak, 100% relative abundance | 53848 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3582 | 6.65 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 53397 | 99.2 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 4099 | 7.61 | (7.68) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 52320 | 97.2 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3469 | 6.44 | (6.63) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10190-CC10121 | E233801.D | 03/23/16 | 07:28 | 00:34 | Continuing cal 50 |
| ZZZZZZ | E233803B.D | 03/23/16 | 08:37 | 01:43 | (unrelated sample) |
| VE10190-MB1 | E233803.D | 03/23/16 | 08:37 | 01:43 | Method Blank |
| VE10190-BS | E233804.D | 03/23/16 | 09:12 | 02:18 | Blank Spike |
| ZZZZZZ | E233806.D | 03/23/16 | 10:21 | 03:27 | (unrelated sample) |
| JC16619-1 | E233807.D | 03/23/16 | 10:56 | 04:02 | SI-01-90N-60 |
| JC16619-2 | E233808.D | 03/23/16 | 11:31 | 04:37 | SI-01-90N-POST |
| JC16619-2 | E233810.D | 03/23/16 | 12:49 | 05:55 | SI-01-90N-POST |
| JC16619-1 | E233811.D | 03/23/16 | 13:24 | 06:30 | SI-01-90N-60 |
| JC16619-2MS | E233812.D | 03/23/16 | 13:59 | 07:05 | Matrix Spike |
| JC16619-2MSD | E233813.D | 03/23/16 | 14:35 | 07:41 | Matrix Spike Duplicate |
| JC16619-3 | E233815.D | 03/23/16 | 15:45 | 08:51 | SI-02-90-INITIAL |
| JC16619-4 | E233816.D | 03/23/16 | 16:20 | 09:26 | SI-02-90-20 |
| JC16619-5 | E233817.D | 03/23/16 | 16:56 | 10:02 | SI-02-90-40 |
| JC16619-6 | E233818.D | 03/23/16 | 17:32 | 10:38 | SI-02-90-60 |
| JC16619-7 | E233819.D | 03/23/16 | 18:08 | 11:14 | SI-02-90-80 |
| JC16619-8 | E233820.D | 03/23/16 | 18:44 | 11:50 | SI-02-90-100 |

# Instrument Performance Check (BFB)



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10190-BFB2
**Lab File ID:** E233825.D
**Instrument ID:** GCMSE
**Injection Date:** 03/23/16
**Injection Time:** 21:39

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7055 | 16.5 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 19248 | 44.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 42864 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2830 | 6.60 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 41616 | 97.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3396 | 7.92 | (8.16) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41504 | 96.8 | (99.7) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2949 | 6.88 | (7.11) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10190-CC10121 | E233826.D | 03/23/16 | 22:14 | 00:35 | Continuing cal 20 |
| VE10190-MB2 | E233828.D | 03/23/16 | 23:25 | 01:46 | Method Blank |
| JC16619-3 | E233829.D | 03/24/16 | 00:00 | 02:21 | SI-02-90-INITIAL |
| JC16619-4 | E233830.D | 03/24/16 | 00:35 | 02:56 | SI-02-90-20 |
| JC16619-5 | E233831.D | 03/24/16 | 01:09 | 03:30 | SI-02-90-40 |
| JC16619-6 | E233832.D | 03/24/16 | 01:45 | 04:06 | SI-02-90-60 |
| JC16619-7 | E233833.D | 03/24/16 | 02:19 | 04:40 | SI-02-90-80 |

# Instrument Performance Check (BFB)



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10191-BFB
**Lab File ID:** E233840.D
**Instrument ID:** GCMSE
**Injection Date:** 03/24/16
**Injection Time:** 06:30



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 6445 | 17.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 17002 | 44.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 37970 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2551 | 6.72 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 38437 | 101.2 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 2898 | 7.63 | (7.54) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 37674 | 99.2 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2512 | 6.62 | (6.67) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10191-CC10121 | E233841.D | 03/24/16 | 07:06 | 00:36 | Continuing cal 20 |
| VE10191-MB1 | E233843.D | 03/24/16 | 08:16 | 01:46 | Method Blank |
| ZZZZZZ | E233843B.D | 03/24/16 | 08:16 | 01:46 | (unrelated sample) |
| VE10191-BS | E233844.D | 03/24/16 | 08:51 | 02:21 | Blank Spike |
| JC16619-8 | E233846.D | 03/24/16 | 10:01 | 03:31 | SI-02-90-100 |
| JC16619-9 | E233847.D | 03/24/16 | 10:36 | 04:06 | SI-02-90-POST |
| JC16619-10 | E233848.D | 03/24/16 | 11:11 | 04:41 | SI-01+ SI-02 BASELINE |
| JC16619-9 | E233849.D | 03/24/16 | 11:46 | 05:16 | SI-02-90-POST |
| JC16619-10 | E233850.D | 03/24/16 | 12:21 | 05:51 | SI-01+ SI-02 BASELINE |
| JC16619-10 | E233854.D | 03/24/16 | 14:41 | 08:11 | SI-01+ SI-02 BASELINE |
| JC16619-9MS | E233855.D | 03/24/16 | 15:13 | 08:43 | Matrix Spike |
| JC16619-9MSD | E233856.D | 03/24/16 | 15:47 | 09:17 | Matrix Spike Duplicate |
| ZZZZZZ | E233857.D | 03/24/16 | 16:58 | 10:28 | (unrelated sample) |
| ZZZZZZ | E233858.D | 03/24/16 | 17:34 | 11:04 | (unrelated sample) |
| ZZZZZZ | E233859.D | 03/24/16 | 18:08 | 11:38 | (unrelated sample) |

# Volatile Surrogate Recovery Summary



**Job Number:** JC16619
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC16619-1 | E233811.D | 108 | 101 | 91 | 86 |
| JC16619-1 | E233807.D | 109 | 104 | 89 | 85 |
| JC16619-2 | E233810.D | 108 | 101 | 92 | 89 |
| JC16619-2 | E233808.D | 108 | 101 | 89 | 86 |
| JC16619-3 | E233829.D | 110 | 103 | 89 | 84 |
| JC16619-3 | E233815.D | 109 | 102 | 88 | 87 |
| JC16619-4 | E233816.D | 107 | 100 | 90 | 89 |
| JC16619-4 | E233830.D | 109 | 104 | 89 | 86 |
| JC16619-5 | E233817.D | 108 | 100 | 90 | 86 |
| JC16619-5 | E233831.D | 109 | 104 | 91 | 84 |
| JC16619-6 | E233818.D | 109 | 102 | 89 | 87 |
| JC16619-6 | E233832.D | 108 | 103 | 91 | 85 |
| JC16619-7 | E233819.D | 107 | 101 | 88 | 86 |
| JC16619-7 | E233833.D | 107 | 101 | 92 | 85 |
| JC16619-8 | E233846.D | 108 | 104 | 89 | 84 |
| JC16619-8 | E233820.D | 109 | 100 | 90 | 87 |
| JC16619-9 | E233849.D | 107 | 102 | 90 | 87 |
| JC16619-9 | E233847.D | 111 | 105 | 89 | 85 |
| JC16619-10 | E233850.D | 110 | 104 | 89 | 86 |
| JC16619-10 | E233854.D | 109 | 101 | 90 | 87 |
| JC16619-10 | E233848.D | 109 | 105 | 87 | 86 |
| JC16619-2MS | E233812.D | 111 | 104 | 92 | 86 |
| JC16619-2MSD | E233813.D | 110 | 103 | 92 | 89 |
| JC16619-9MS | E233855.D | 110 | 103 | 91 | 86 |
| JC16619-9MSD | E233856.D | 109 | 102 | 91 | 86 |
| VE10190-BS | E233804.D | 110 | 105 | 92 | 86 |
| VE10190-MB1 | E233803.D | 106 | 102 | 91 | 85 |
| VE10190-MB2 | E233828.D | 106 | 100 | 90 | 85 |
| VE10191-BS | E233844.D | 110 | 106 | 91 | 86 |
| VE10191-MB1 | E233843.D | 107 | 103 | 89 | 82 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 70-122% |
| **S2** = 1,2-Dichloroethane-D4 | 68-124% |
| **S3** = Toluene-D8 | 77-125% |
| **S4** = 4-Bromofluorobenzene | 72-130% |

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Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC16773

Sampling Dates: 03/21/16 - 03/22/16

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Total number of pages in report: **50**

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# Sample Summary

CH2M Hill

**Job No:** JC16773

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC16773-1 | 03/21/16 | 12:45 | JDM | 03/23/16 | SO | Soil | SI-03 BASELINE |
| JC16773-2 | 03/22/16 | 09:22 | JDM | 03/23/16 | SO | Soil | SI-03-70-INITIAL |
| JC16773-3 | 03/22/16 | 09:42 | JDM | 03/23/16 | SO | Soil | SI-03-70-20 |
| JC16773-4 | 03/22/16 | 10:02 | JDM | 03/23/16 | SO | Soil | SI-03-70-40 |
| JC16773-5 | 03/22/16 | 10:22 | JDM | 03/23/16 | SO | Soil | SI-03-70-60 |
| JC16773-6 | 03/22/16 | 10:42 | JDM | 03/23/16 | SO | Soil | SI-03-70-80 |
| JC16773-7 | 03/22/16 | 11:02 | JDM | 03/23/16 | SO | Soil | SI-03-70-100 |
| JC16773-8 | 03/22/16 | 11:22 | JDM | 03/23/16 | SO | Soil | SI-03-70-POST |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits

**Job Number:** JC16773
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/21/16 thru 03/22/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC16773-1** | **SI-03 BASELINE** | | | | | |
| Benzene | | 50700000 | 510000 | 140000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 77000 J | 200000 | 23000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1730000 | 100000 | 12000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 27700 J | 100000 | 16000 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 159000 | 100000 | 23000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 239000 | 100000 | 17000 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 546000 | 200000 | 11000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 256000 J | 510000 | 88000 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 51100 J | 200000 | 23000 | ug/kg | SW846 8260C |
| Naphthalene | | 3860000 | 510000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 13600000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 2350000 | 100000 | 36000 | ug/kg | SW846 8260C |
| o-Xylene | | 615000 | 100000 | 28000 | ug/kg | SW846 8260C |
| Xylene (total) | | 2970000 | 100000 | 28000 | ug/kg | SW846 8260C |
| **JC16773-2** | **SI-03-70-INITIAL** | | | | | |
| Benzene | | 22400000 | 490000 | 130000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1410000 | 98000 | 12000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 19900 J | 98000 | 15000 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 124000 | 98000 | 22000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 132000 | 98000 | 16000 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 336000 | 200000 | 10000 | ug/kg | SW846 8260C |
| Naphthalene | | 3470000 | 490000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 6910000 | 98000 | 20000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1360000 | 98000 | 35000 | ug/kg | SW846 8260C |
| o-Xylene | | 358000 | 98000 | 27000 | ug/kg | SW846 8260C |
| Xylene (total) | | 1720000 | 98000 | 27000 | ug/kg | SW846 8260C |
| **JC16773-3** | **SI-03-70-20** | | | | | |
| Benzene | | 27000000 | 630000 | 170000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 32900 | 25000 | 2900 | ug/kg | SW846 8260C |
| Chlorobenzene | | 9900 J | 25000 | 1900 | ug/kg | SW846 8260C |
| Cyclohexane | | 20000 J | 25000 | 4000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1790000 | 13000 | 1500 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 26800 | 13000 | 2000 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 150000 | 13000 | 2800 | ug/kg | SW846 8260C |
| Ethylbenzene | | 177000 | 13000 | 2000 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 454000 | 25000 | 1300 | ug/kg | SW846 8260C |
| Methyl Acetate | | 254000 | 63000 | 11000 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 35200 | 25000 | 2800 | ug/kg | SW846 8260C |
| Naphthalene | | 4490000 | 630000 | 24000 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16773
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/21/16 thru 03/22/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| Toluene | | 9020000 | 130000 | 26000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1770000 | 13000 | 4400 | ug/kg | SW846 8260C |
| o-Xylene | | 496000 | 13000 | 3400 | ug/kg | SW846 8260C |
| Xylene (total) | | 2270000 | 13000 | 3400 | ug/kg | SW846 8260C |
| **JC16773-4** | **SI-03-70-40** | | | | | |
| Benzene | | 24900000 | 530000 | 140000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 29500 | 21000 | 2400 | ug/kg | SW846 8260C |
| Chlorobenzene | | 9480 J | 21000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | | 18700 J | 21000 | 3400 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1810000 | 11000 | 1300 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 28500 | 11000 | 1700 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 157000 | 11000 | 2400 | ug/kg | SW846 8260C |
| Ethylbenzene | | 172000 | 11000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 456000 | 21000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 162000 | 53000 | 9100 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 36300 | 21000 | 2400 | ug/kg | SW846 8260C |
| Naphthalene | | 4760000 | 530000 | 20000 | ug/kg | SW846 8260C |
| Toluene | | 8470000 | 110000 | 22000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1740000 | 11000 | 3700 | ug/kg | SW846 8260C |
| o-Xylene | | 481000 | 11000 | 2900 | ug/kg | SW846 8260C |
| Xylene (total) | | 2220000 | 11000 | 2900 | ug/kg | SW846 8260C |
| **JC16773-5** | **SI-03-70-60** | | | | | |
| Benzene | | 19300000 | 480000 | 130000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 21300 | 19000 | 2200 | ug/kg | SW846 8260C |
| Chlorobenzene | | 7480 J | 19000 | 1500 | ug/kg | SW846 8260C |
| Cyclohexane | | 15800 J | 19000 | 3000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1470000 | 9600 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 22100 | 9600 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 126000 | 9600 | 2200 | ug/kg | SW846 8260C |
| Ethylbenzene | | 139000 | 9600 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 365000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 138000 | 48000 | 8300 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 28800 | 19000 | 2200 | ug/kg | SW846 8260C |
| Naphthalene | | 4130000 | 480000 | 18000 | ug/kg | SW846 8260C |
| Toluene | | 6870000 | 96000 | 20000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1410000 | 9600 | 3400 | ug/kg | SW846 8260C |
| o-Xylene | | 391000 | 9600 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | | 1800000 | 9600 | 2600 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16773
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/21/16 thru 03/22/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC16773-6** | **SI-03-70-80** | | | | | |
| Benzene | | 19200000 | 50000 | 13000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 22400 | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | | 7690 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | | 15800 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1570000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 23600 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 134000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 143000 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 395000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 131000 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 31200 | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 3910000 | 500000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 6660000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1460000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | | 407000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | | 1870000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC16773-7** | **SI-03-70-100** | | | | | |
| Benzene | | 19000000 | 49000 | 13000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 20500 | 20000 | 2200 | ug/kg | SW846 8260C |
| Chlorobenzene | | 7440 J | 20000 | 1500 | ug/kg | SW846 8260C |
| Cyclohexane | | 16500 J | 20000 | 3100 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1520000 | 9800 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 22600 | 9800 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 130000 | 9800 | 2200 | ug/kg | SW846 8260C |
| Ethylbenzene | | 139000 | 9800 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 376000 | 20000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 123000 | 49000 | 8400 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 29500 | 20000 | 2200 | ug/kg | SW846 8260C |
| Naphthalene | | 3890000 | 490000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 6600000 | 98000 | 20000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1430000 | 9800 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | | 396000 | 9800 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | | 1820000 | 9800 | 2700 | ug/kg | SW846 8260C |
| **JC16773-8** | **SI-03-70-POST** | | | | | |
| Benzene | | 17700000 | 51000 | 14000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 20600 | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | | 7160 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | | 13500 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1410000 | 10000 | 1200 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC16773
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 03/21/16 thru 03/22/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| 1,3-Dichlorobenzene | 21500 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 121000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 131000 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | 346000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 147000 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | 25300 | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 3660000 | 510000 | 19000 | ug/kg | SW846 8260C |
| Toluene | 6100000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | 1350000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | 375000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | 1720000 | 10000 | 2800 | ug/kg | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03 BASELINE | | |
| **Lab Sample ID:** | JC16773-1 | **Date Sampled:** | 03/21/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233868.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233908.D | 10000 | 03/25/16 | TDN | n/a | n/a | VE10192 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 100 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 1000000 | 230000 | ug/kg | |
| 71-43-2 | Benzene | 50700000 [b] | 510000 | 140000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 510000 | 32000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 200000 | 16000 | ug/kg | |
| 75-25-2 | Bromoform | ND | 510000 | 24000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 510000 | 37000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 1000000 | 190000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 77000 | 200000 | 23000 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 200000 | 23000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 200000 | 16000 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 510000 | 49000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 200000 | 15000 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 510000 | 27000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 200000 | 32000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 200000 | 56000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 200000 | 21000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 100000 | 13000 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1730000 | 100000 | 12000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 27700 | 100000 | 16000 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 159000 | 100000 | 23000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 510000 | 37000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 100000 | 14000 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 100000 | 14000 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 100000 | 60000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 100000 | 79000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 100000 | 61000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 200000 | 24000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 200000 | 12000 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 200000 | 18000 | ug/kg | |
| 100-41-4 | Ethylbenzene | 239000 | 100000 | 17000 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 510000 | 46000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 510000 | 140000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03 BASELINE | | |
| **Lab Sample ID:** | JC16773-1 | **Date Sampled:** | 03/21/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 546000 | 200000 | 11000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 256000 | 510000 | 88000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | 51100 | 200000 | 23000 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 100000 | 16000 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 510000 | 47000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 510000 | 100000 | ug/kg | |
| 91-20-3 | Naphthalene | 3860000 | 510000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 200000 | 18000 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 200000 | 18000 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 200000 | 31000 | ug/kg | |
| 108-88-3 | Toluene | 13600000 | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 510000 | 18000 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 510000 | 17000 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 200000 | 15000 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 200000 | 15000 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 100000 | 15000 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 510000 | 25000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 200000 | 20000 | ug/kg | |
| | m,p-Xylene | 2350000 | 100000 | 36000 | ug/kg | |
| 95-47-6 | o-Xylene | 615000 | 100000 | 28000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 2970000 | 100000 | 28000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-INITIAL | | |
| **Lab Sample ID:** | JC16773-2 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233869.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233909.D | 10000 | 03/25/16 | TDN | n/a | n/a | VE10192 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.1 g | 10.0 ml | 100 ul |
| Run #2 | 5.1 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 980000 | 220000 | ug/kg | |
| 71-43-2 | Benzene | 22400000 [b] | 490000 | 130000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 490000 | 30000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 200000 | 15000 | ug/kg | |
| 75-25-2 | Bromoform | ND | 490000 | 23000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 490000 | 36000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 980000 | 190000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 200000 | 22000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 200000 | 23000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 200000 | 15000 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 490000 | 47000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 200000 | 15000 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 490000 | 26000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 200000 | 31000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 200000 | 53000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 200000 | 20000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 98000 | 13000 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1410000 | 98000 | 12000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 19900 | 98000 | 15000 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 124000 | 98000 | 22000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 490000 | 35000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 98000 | 14000 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 98000 | 13000 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 98000 | 58000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 98000 | 76000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 98000 | 58000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 200000 | 23000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 200000 | 12000 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 200000 | 17000 | ug/kg | |
| 100-41-4 | Ethylbenzene | 132000 | 98000 | 16000 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 490000 | 44000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 490000 | 130000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-INITIAL | | |
| **Lab Sample ID:** | JC16773-2 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 336000 | 200000 | 10000 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 490000 | 84000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 200000 | 22000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 98000 | 15000 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 490000 | 45000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 490000 | 96000 | ug/kg | |
| 91-20-3 | Naphthalene | 3470000 | 490000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 200000 | 17000 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 200000 | 17000 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 200000 | 30000 | ug/kg | |
| 108-88-3 | Toluene | 6910000 | 98000 | 20000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 490000 | 17000 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 490000 | 17000 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 200000 | 15000 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 200000 | 14000 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 98000 | 14000 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 490000 | 24000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 200000 | 19000 | ug/kg | |
| | m,p-Xylene | 1360000 | 98000 | 35000 | ug/kg | |
| 95-47-6 | o-Xylene | 358000 | 98000 | 27000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1720000 | 98000 | 27000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 88% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-20 | | |
| **Lab Sample ID:** | JC16773-3 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233857.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233870.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #3 | E233893.D | 10000 | 03/25/16 | TDN | n/a | n/a | VE10192 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.0 g | 10.0 ml | 100 ul |
| Run #3 | 4.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 130000 | 28000 | ug/kg | |
| 71-43-2 | Benzene | 27000000 [b] | 630000 | 170000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 63000 | 3900 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 25000 | 2000 | ug/kg | |
| 75-25-2 | Bromoform | ND | 63000 | 3000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 63000 | 4600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 130000 | 24000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 32900 | 25000 | 2900 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 25000 | 2900 | ug/kg | |
| 108-90-7 | Chlorobenzene | 9900 | 25000 | 1900 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 63000 | 6000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 25000 | 1900 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 63000 | 3300 | ug/kg | |
| 110-82-7 | Cyclohexane | 20000 | 25000 | 4000 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 25000 | 6800 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 25000 | 2600 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 13000 | 1600 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1790000 | 13000 | 1500 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 26800 | 13000 | 2000 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 150000 | 13000 | 2800 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 63000 | 4500 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 13000 | 1800 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 13000 | 1700 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 13000 | 7400 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 13000 | 9700 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 13000 | 7400 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 25000 | 3000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 25000 | 1500 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 25000 | 2200 | ug/kg | |
| 100-41-4 | Ethylbenzene | 177000 | 13000 | 2000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-20 | | |
| **Lab Sample ID:** | JC16773-3 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 76-13-1 | Freon 113 [c] | ND | 63000 | 5600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 63000 | 17000 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 454000 | 25000 | 1300 | ug/kg | |
| 79-20-9 | Methyl Acetate | 254000 | 63000 | 11000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 35200 | 25000 | 2800 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 13000 | 1900 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 63000 | 5700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 63000 | 12000 | ug/kg | |
| 91-20-3 | Naphthalene | 4490000 [d] | 630000 | 24000 | ug/kg | |
| 100-42-5 | Styrene | ND | 25000 | 2200 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 25000 | 2200 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 25000 | 3800 | ug/kg | |
| 108-88-3 | Toluene | 9020000 [d] | 130000 | 26000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 63000 | 2200 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 63000 | 2100 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 25000 | 1900 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 25000 | 1800 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 13000 | 1800 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 63000 | 3100 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 25000 | 2500 | ug/kg | |
| | m,p-Xylene | 1770000 | 13000 | 4400 | ug/kg | |
| 95-47-6 | o-Xylene | 496000 | 13000 | 3400 | ug/kg | |
| 1330-20-7 | Xylene (total) | 2270000 | 13000 | 3400 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 111% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 103% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 86% | 91% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 88% | 86% | 88% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 3
(c) This compound in BS is outside in house QC limits bias high.
(d) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-40 | | |
| **Lab Sample ID:** | JC16773-4 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233858.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233871.D | 1000 | 03/25/16 | TDN | n/a | n/a | VE10191 |
| Run #3 | E233910.D | 10000 | 03/25/16 | TDN | n/a | n/a | VE10192 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.7 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.7 g | 10.0 ml | 100 ul |
| Run #3 | 4.7 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 110000 | 24000 | ug/kg | |
| 71-43-2 | Benzene | 24900000 [b] | 530000 | 140000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 53000 | 3300 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 21000 | 1700 | ug/kg | |
| 75-25-2 | Bromoform | ND | 53000 | 2500 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 53000 | 3900 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 110000 | 20000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 29500 | 21000 | 2400 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 21000 | 2400 | ug/kg | |
| 108-90-7 | Chlorobenzene | 9480 | 21000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 53000 | 5100 | ug/kg | |
| 67-66-3 | Chloroform | ND | 21000 | 1600 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 53000 | 2800 | ug/kg | |
| 110-82-7 | Cyclohexane | 18700 | 21000 | 3400 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 21000 | 5800 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 21000 | 2200 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 11000 | 1400 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1810000 | 11000 | 1300 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 28500 | 11000 | 1700 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 157000 | 11000 | 2400 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 53000 | 3800 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 11000 | 1500 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 11000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 11000 | 6300 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 11000 | 8300 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 11000 | 6300 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 21000 | 2500 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 21000 | 1300 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 21000 | 1900 | ug/kg | |
| 100-41-4 | Ethylbenzene | 172000 | 11000 | 1700 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-40 | | |
| **Lab Sample ID:** | JC16773-4 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 76-13-1 | Freon 113 [c] | ND | 53000 | 4800 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 53000 | 14000 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 456000 | 21000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 162000 | 53000 | 9100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 36300 | 21000 | 2400 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 11000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 53000 | 4900 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 53000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 4760000 [d] | 530000 | 20000 | ug/kg | |
| 100-42-5 | Styrene | ND | 21000 | 1900 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 21000 | 1900 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 21000 | 3200 | ug/kg | |
| 108-88-3 | Toluene | 8470000 [d] | 110000 | 22000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 53000 | 1900 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 53000 | 1800 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 21000 | 1600 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 21000 | 1600 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 11000 | 1600 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 53000 | 2600 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 21000 | 2100 | ug/kg | |
| | m,p-Xylene | 1740000 | 11000 | 3700 | ug/kg | |
| 95-47-6 | o-Xylene | 481000 | 11000 | 2900 | ug/kg | |
| 1330-20-7 | Xylene (total) | 2220000 | 11000 | 2900 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 109% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 101% | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 89% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 86% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 3
(c) This compound in BS is outside in house QC limits bias high.
(d) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-60 | | |
| **Lab Sample ID:** | JC16773-5 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233859.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233872.D | 1000 | 03/25/16 | TDN | n/a | n/a | VE10191 |
| Run #3 | E233911.D | 10000 | 03/25/16 | TDN | n/a | n/a | VE10192 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.2 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.2 g | 10.0 ml | 100 ul |
| Run #3 | 5.2 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 96000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 19300000 [b] | 480000 | 130000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 48000 | 3000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 48000 | 2300 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 48000 | 3500 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 96000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 21300 | 19000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 7480 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 48000 | 4600 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 48000 | 2500 | ug/kg | |
| 110-82-7 | Cyclohexane | 15800 | 19000 | 3000 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5200 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 2000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9600 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1470000 | 9600 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 22100 | 9600 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 126000 | 9600 | 2200 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 48000 | 3500 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9600 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9600 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9600 | 5700 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9600 | 7500 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9600 | 5700 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2300 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 139000 | 9600 | 1600 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-60 | | |
| **Lab Sample ID:** | JC16773-5 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 76-13-1 | Freon 113 [c] | ND | 48000 | 4300 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 48000 | 13000 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 365000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 138000 | 48000 | 8300 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 28800 | 19000 | 2200 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9600 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 48000 | 4400 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 48000 | 9400 | ug/kg | |
| 91-20-3 | Naphthalene | 4130000 [d] | 480000 | 18000 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2900 | ug/kg | |
| 108-88-3 | Toluene | 6870000 [d] | 96000 | 20000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 48000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 48000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9600 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 48000 | 2400 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 1410000 | 9600 | 3400 | ug/kg | |
| 95-47-6 | o-Xylene | 391000 | 9600 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1800000 | 9600 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 110% | 111% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 102% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 88% | 88% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 85% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 3
(c) This compound in BS is outside in house QC limits bias high.
(d) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-80 | | |
| **Lab Sample ID:** | JC16773-6 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233912.D | 1 | 03/26/16 | TDN | n/a | n/a | VE10192 |
| Run #2 | E233873.D | 1000 | 03/25/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 19200000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 22400 | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 7690 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | 15800 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1570000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 23600 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 134000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 143000 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-80 | | |
| **Lab Sample ID:** | JC16773-6 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 395000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 131000 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 31200 | 20000 | 2300 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 3910000 [b] | 500000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 6660000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 1460000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 407000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1870000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 87% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-100 | | |
| **Lab Sample ID:** | JC16773-7 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233876.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233874.D | 1000 | 03/25/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.1 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.1 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 98000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 19000000 [b] | 49000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 49000 | 3000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 49000 | 2300 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 49000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 98000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 20500 | 20000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 7440 | 20000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 49000 | 4700 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 49000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | 16500 | 20000 | 3100 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5300 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9800 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1520000 | 9800 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 22600 | 9800 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 130000 | 9800 | 2200 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 49000 | 3500 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9800 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9800 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9800 | 5800 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9800 | 7600 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9800 | 5800 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2300 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 139000 | 9800 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 49000 | 4400 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 49000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-100 | | |
| **Lab Sample ID:** | JC16773-7 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 376000 | 20000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 123000 | 49000 | 8400 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 29500 | 20000 | 2200 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9800 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 49000 | 4500 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 49000 | 9600 | ug/kg | |
| 91-20-3 | Naphthalene | 3890000 [b] | 490000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 6600000 [b] | 98000 | 20000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 49000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 49000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9800 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 49000 | 2400 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 1900 | ug/kg | |
| | m,p-Xylene | 1430000 | 9800 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 396000 | 9800 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1820000 | 9800 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 85% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-POST | | |
| **Lab Sample ID:** | JC16773-8 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E233877.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10191 |
| Run #2 | E233875.D | 1000 | 03/25/16 | TDN | n/a | n/a | VE10191 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 17700000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 20600 | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 7160 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | 13500 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1410000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 21500 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 121000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 131000 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 [c] | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-03-70-POST | | |
| **Lab Sample ID:** | JC16773-8 | **Date Sampled:** | 03/22/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 03/23/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 346000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 147000 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 25300 | 20000 | 2300 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 3660000 [b] | 510000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 6100000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 1350000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 375000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1720000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 111% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 85% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2
(c) This compound in BS is outside in house QC limits bias high.

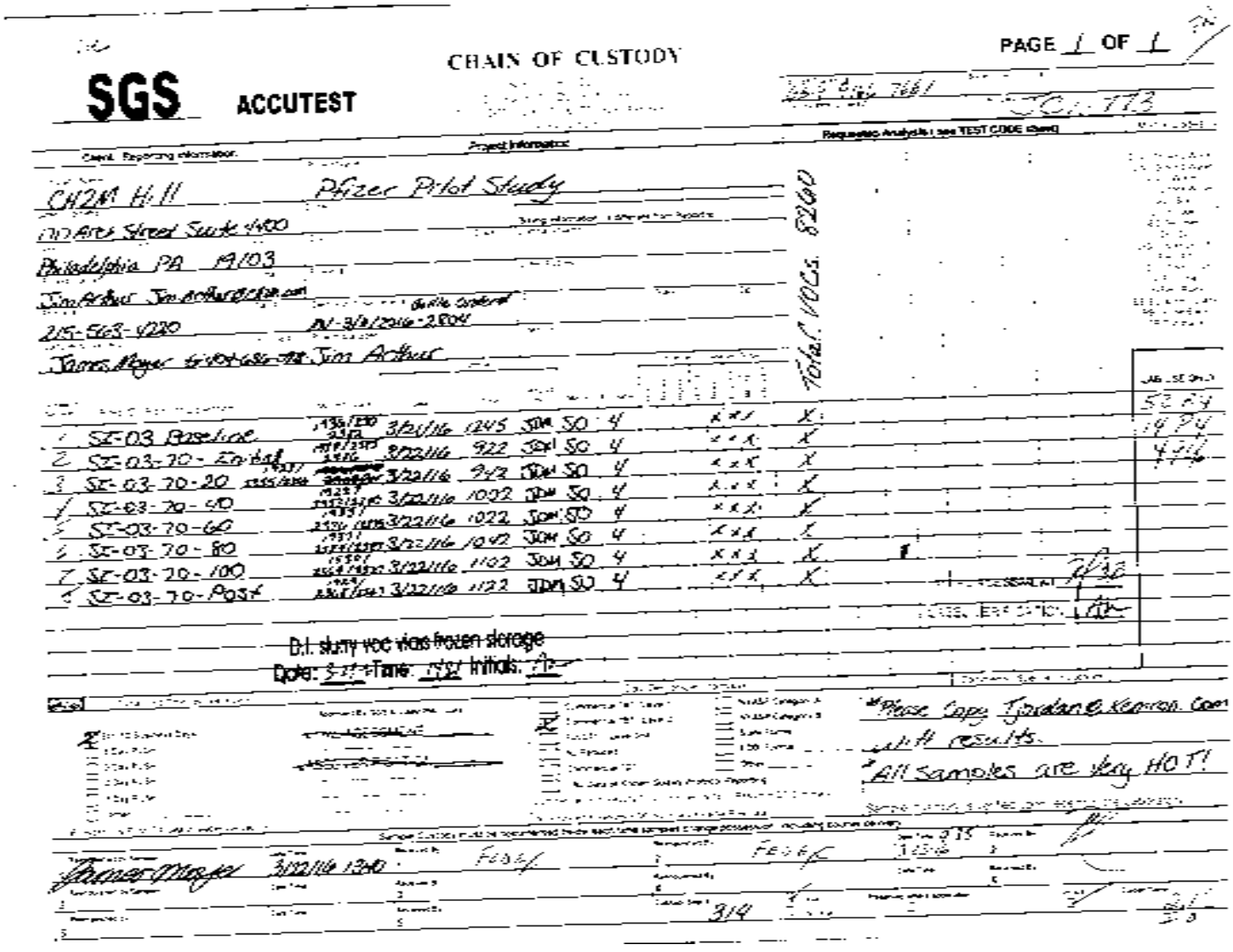
ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

## Misc. Forms

# Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



SGS ACCUTEST

CHAIN OF CUSTODY

PAGE 1 OF 1

JC16773

Client Reporting Information: CH2M Hill
Project Information: Pfizer Pilot Study
Requested Analysis (see TEST CODE sheet): Total VOCs 8260

1700 Arch Street Suite 4400
Philadelphia PA 19103
Jim Arthur Jim.arthur@ch2m.com
215-563-4220
Quote Ordered
AV-3/8/2016-2804
James Moyer 6404-686-78 Jim Arthur

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SI-03 Baseline | 1936/1930 2312 | 3/21/16 | 1245 | JDM | SO | 4 | xxx | X |
| 2 | SI-03-70-Initial | 1938/1939 2316 | 3/22/16 | 922 | JDM | SO | 4 | xxx | X |
| 3 | SI-03-70-20 | 1937/ 2355/2356 | 3/22/16 | 942 | JDM | SO | 4 | xxx | X |
| 4 | SI-03-70-40 | 1927/ 2352/2340 | 3/22/16 | 1002 | JDM | SO | 4 | xxx | X |
| 5 | SI-03-70-60 | 1935/ 2376/2375 | 3/22/16 | 1022 | JDM | SO | 4 | xxx | X |
| 6 | SI-03-70-80 | 1937/ 2354/2357 | 3/22/16 | 1042 | JDM | SO | 4 | xxx | X |
| 7 | SI-03-70-100 | 1930/ 2364/2370 | 3/22/16 | 1102 | JDM | SO | 4 | xxx | X |
| 8 | SI-03-70-Post | 1929/ 2368/2367 | 3/22/16 | 1122 | JDM | SO | 4 | xxx | X |

D.I. slurry voc vials frozen storage
Date: 3-21-16 Time: 1451 Initials: AP

*Please copy Tjordan@kemron.com with results.
*All samples are very HOT!

Sample Custody must be documented below each time samples change possession, including courier delivery.

James Moyer 3/22/16 1340 FedEx FedEx 3/23/16 314

JC16773: Chain of Custody
Page 1 of 3

# SGS Accutest Sample Receipt Summary

**Job Number:** JC16773 **Client:** CH2M HILL **Project:** PFIZER PILOT STUDY

**Date / Time Received:** 3/23/2016 9:35:00 AM **Delivery Method:** FedEx **Airbill #'s:** 6514 9166 7661

Cooler Temps (Raw Measured) °C: Cooler 1: (2.1);

Cooler Temps (Corrected) °C: Cooler 1: (2.5);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☐ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☐ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☐ ☑ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments -1 SLL KIT PROCESSED OUT OF HOLD.

## Sample Receipt Summary - Problem Resolution

**Job Number:** JC16773 **Initiator:** BOBL

**CSR:** Daniel Axelrod **Response Date** 3/24/2016

**Response:** Per client Jim Arthur, accutest sample -1 should be run from MEOH. All samples are dirty. Please proceed as noted.



**JC16773: Chain of Custody**
**Page 3 of 3**

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB1 | E233843.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-3, JC16773-4, JC16773-5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |

# Method Blank Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB1 | E233843.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-3, JC16773-4, JC16773-5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 82% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB2 | E233867.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-MB2 | E233867.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 72-130% |

# Method Blank Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10192-MB1 | E233886.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-3

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 85% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10192-MB2 | E233907.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10192-MB2 | E233907.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 87% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Blank Spike Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-BS | E233844.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2290 | 92 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2190 | 88 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2900 | 116 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2430 | 97 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2590 | 104 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2330 | 93 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2680 | 107 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2610 | 104 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2520 | 101 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2390 | 96 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2710 | 108 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2710 | 108 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2470 | 99 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2830 | 113 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2320 | 93 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2550 | 102 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2470 | 99 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2350 | 94 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2390 | 96 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2310 | 92 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2880 | 115 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2470 | 99 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2330 | 93 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2520 | 101 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2490 | 100 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2370 | 95 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2170 | 87 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2350 | 94 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2340 | 94 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2270 | 91 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 3750 | 150* [a] | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2210 | 88 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2270 | 91 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2320 | 93 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2510 | 100 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4900 | 98 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10191-BS | E233844.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2270 | 91 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2580 | 103 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2380 | 95 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2410 | 96 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2160 | 86 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2680 | 107 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2390 | 96 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2480 | 99 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2430 | 97 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2960 | 118 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2360 | 94 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2440 | 98 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 3110 | 124 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2780 | 111 | 57-136 |
| | m,p-Xylene | 5000 | 4900 | 98 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2460 | 98 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7360 | 98 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 72-130% |

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10192-BS | E233887.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2350 | 94 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2260 | 90 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2890 | 116 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2460 | 98 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2580 | 103 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2570 | 103 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2700 | 108 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2990 | 120 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2650 | 106 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2420 | 97 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2890 | 116 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2720 | 109 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2670 | 107 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 3070 | 123 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2320 | 93 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2520 | 101 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2420 | 97 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2310 | 92 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2340 | 94 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2250 | 90 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2930 | 117 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2560 | 102 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2340 | 94 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2760 | 110 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2540 | 102 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2550 | 102 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2240 | 90 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2400 | 96 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2390 | 96 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2310 | 92 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 4060 | 162* [a] | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2320 | 93 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2310 | 92 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2410 | 96 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2780 | 111 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 5340 | 107 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10192-BS | E233887.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2430 | 97 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2760 | 110 | 71-124 |
| 100-42-5 | Styrene | 2500 | 2420 | 97 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2170 | 87 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2670 | 107 | 70-135 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2510 | 100 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2470 | 99 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 3160 | 126 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2400 | 96 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2520 | 101 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 3250 | 130 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 3010 | 120 | 57-136 |
| | m,p-Xylene | 5000 | 4930 | 99 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2540 | 102 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7470 | 100 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 72-130% |

(a) High percent recoveries and no associated positive reported in the QC batch.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-9MS | E233855.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9MSD | E233856.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233847.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233849.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | JC16619-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 510000 | 445000 | 87 | 510000 | 432000 | 85 | 3 | 10-180/33 |
| 71-43-2 | Benzene | 2660000 [b] | | 510000 | 4160000 | 280* [a] | 510000 | 4180000 | 284* [a] | 0 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 510000 | 551000 | 108 | 510000 | 544000 | 107 | 1 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 510000 | 456000 | 89 | 510000 | 453000 | 89 | 1 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 510000 | 487000 | 95 | 510000 | 493000 | 97 | 1 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 510000 | 506000 | 99 | 510000 | 517000 | 101 | 2 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 510000 | 543000 | 106 | 510000 | 532000 | 104 | 2 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 510000 | 501000 | 98 | 510000 | 513000 | 101 | 2 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 510000 | 454000 | 89 | 510000 | 466000 | 91 | 3 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 510000 | 467000 | 92 | 510000 | 466000 | 91 | 0 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 510000 | 583000 | 114 | 510000 | 588000 | 115 | 1 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 510000 | 517000 | 101 | 510000 | 511000 | 100 | 1 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 510000 | 521000 | 102 | 510000 | 541000 | 106 | 4 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 510000 | 549000 | 108 | 510000 | 564000 | 111 | 3 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 510000 | 465000 | 91 | 510000 | 466000 | 91 | 0 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 510000 | 478000 | 94 | 510000 | 482000 | 94 | 1 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 510000 | 463000 | 91 | 510000 | 465000 | 91 | 0 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 468000 | | 510000 | 1080000 | 120 | 510000 | 1070000 | 118 | 1 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | 5730 | J | 510000 | 460000 | 89 | 510000 | 453000 | 88 | 2 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | 35000 | | 510000 | 490000 | 89 | 510000 | 481000 | 87 | 2 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 510000 | 561000 | 110 | 510000 | 584000 | 114 | 4 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 510000 | 486000 | 95 | 510000 | 485000 | 95 | 0 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 510000 | 511000 | 100 | 510000 | 509000 | 100 | 0 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 510000 | 492000 | 96 | 510000 | 488000 | 96 | 1 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 510000 | 481000 | 94 | 510000 | 481000 | 94 | 0 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 510000 | 465000 | 91 | 510000 | 465000 | 91 | 0 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 510000 | 427000 | 84 | 510000 | 422000 | 83 | 1 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 510000 | 456000 | 89 | 510000 | 448000 | 88 | 2 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 510000 | 437000 | 86 | 510000 | 437000 | 86 | 0 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 27900 | | 510000 | 475000 | 88 | 510000 | 480000 | 89 | 1 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 510000 | 700000 | 137 | 510000 | 717000 | 141 | 2 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 510000 | 429000 | 84 | 510000 | 438000 | 86 | 2 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 83000 | | 510000 | 578000 | 97 | 510000 | 570000 | 95 | 1 | 36-145/33 |
| 79-20-9 | Methyl Acetate | 81600 | | 510000 | 566000 | 95 | 510000 | 555000 | 93 | 2 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | 4000 | J | 510000 | 482000 | 94 | 510000 | 497000 | 97 | 3 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 1020000 | 929000 | 91 | 1020000 | 943000 | 92 | 1 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16619-9MS | E233855.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9MSD | E233856.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233847.D | 1 | 03/24/16 | TDN | n/a | n/a | VE10191 |
| JC16619-9 | E233849.D | 1000 | 03/24/16 | TDN | n/a | n/a | VE10191 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6, JC16773-7, JC16773-8

| CAS No. | Compound | JC16619-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 510000 | 452000 | 89 | 510000 | 453000 | 89 | 0 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 510000 | 506000 | 99 | 510000 | 504000 | 99 | 0 | 47-133/25 |
| 91-20-3 | Naphthalene | 1560000 | | 510000 | 2720000 | 227* [a] | 510000 | 2760000 | 235* [a] | 1 | 12-160/33 |
| 100-42-5 | Styrene | ND | | 510000 | 469000 | 92 | 510000 | 472000 | 93 | 1 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 510000 | 427000 | 84 | 510000 | 425000 | 83 | 0 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | ND | | 510000 | 523000 | 103 | 510000 | 526000 | 103 | 1 | 34-163/31 |
| 108-88-3 | Toluene | 1160000 | | 510000 | 2080000 | 180* [a] | 510000 | 2070000 | 178* [a] | 0 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 510000 | 508000 | 100 | 510000 | 518000 | 102 | 2 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 510000 | 491000 | 96 | 510000 | 493000 | 97 | 0 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 510000 | 555000 | 109 | 510000 | 563000 | 110 | 1 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 510000 | 444000 | 87 | 510000 | 444000 | 87 | 0 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 510000 | 477000 | 93 | 510000 | 476000 | 93 | 0 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 510000 | 621000 | 122 | 510000 | 641000 | 126 | 3 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 510000 | 587000 | 115 | 510000 | 614000 | 120 | 4 | 38-149/29 |
| | m,p-Xylene | 307000 | | 1020000 | 1350000 | 102 | 1020000 | 1350000 | 102 | 0 | 32-148/30 |
| 95-47-6 | o-Xylene | 92200 | | 510000 | 604000 | 100 | 510000 | 612000 | 102 | 1 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 399000 | | 1530000 | 1960000 | 102 | 1530000 | 1960000 | 102 | 0 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC16619-9 | JC16619-9 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 109% | 111% | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 102% | 105% | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 91% | 89% | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 86% | 86% | 85% | 87% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Result is from Run #2.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16818-1MS | E233895.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |
| JC16818-1MSD | E233896.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |
| JC16818-1 [a] | E233889.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | JC16818-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 9940 | 10700 | 108 | 9940 | 10300 | 104 | 4 | 10-180/33 |
| 71-43-2 | Benzene | 832 | | 9940 | 10400 | 96 | 9940 | 10400 | 96 | 0 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 9940 | 11900 | 120 | 9940 | 12200 | 123 | 2 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 9940 | 10100 | 102 | 9940 | 9800 | 99 | 3 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 9940 | 10100 | 102 | 9940 | 10400 | 105 | 3 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 9940 | 7800 | 78 | 9940 | 8600 | 86 | 10 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 9940 | 10600 | 107 | 9940 | 10900 | 110 | 3 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 9940 | 13000 | 131 | 9940 | 12200 | 123 | 6 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 9940 | 10900 | 110 | 9940 | 10600 | 107 | 3 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 9940 | 9830 | 99 | 9940 | 9840 | 99 | 0 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 9940 | 8170 | 82 | 9940 | 8100 | 81 | 1 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 9940 | 11100 | 112 | 9940 | 11200 | 113 | 1 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 9940 | 8730 | 88 | 9940 | 8930 | 90 | 2 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 9940 | 12800 | 129 | 9940 | 12900 | 130 | 1 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 9940 | 8330 | 84 | 9940 | 8420 | 85 | 1 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 9940 | 9500 | 96 | 9940 | 9610 | 97 | 1 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 9940 | 9490 | 95 | 9940 | 9620 | 97 | 1 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 9940 | 8740 | 88 | 9940 | 8720 | 88 | 0 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 9940 | 9260 | 93 | 9940 | 9050 | 91 | 2 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 9940 | 8820 | 89 | 9940 | 8670 | 87 | 2 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 9940 | 10300 | 104 | 9940 | 10500 | 106 | 2 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 9940 | 10900 | 110 | 9940 | 11000 | 111 | 1 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 9940 | 9230 | 93 | 9940 | 9190 | 92 | 0 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 9940 | 12100 | 122 | 9940 | 11600 | 117 | 4 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 9940 | 10400 | 105 | 9940 | 10600 | 107 | 2 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 9940 | 10600 | 107 | 9940 | 10900 | 110 | 3 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 9940 | 9430 | 95 | 9940 | 9330 | 94 | 1 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 9940 | 9840 | 99 | 9940 | 9670 | 97 | 2 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 9940 | 9540 | 96 | 9940 | 9360 | 94 | 2 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 282 | | 9940 | 9950 | 97 | 9940 | 10000 | 98 | 1 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 9940 | 15700 | 158* [b] | 9940 | 15100 | 152 | 4 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 9940 | 10900 | 110 | 9940 | 11900 | 120 | 9 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 35.9 | J | 9940 | 8850 | 89 | 9940 | 8820 | 88 | 0 | 36-145/33 |
| 79-20-9 | Methyl Acetate | ND | | 9940 | 10600 | 107 | 9940 | 10100 | 102 | 5 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | ND | | 9940 | 11500 | 116 | 9940 | 11100 | 112 | 4 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 19900 | 20600 | 104 | 19900 | 20900 | 105 | 1 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC16818-1MS | E233895.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |
| JC16818-1MSD | E233896.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |
| JC16818-1 [a] | E233889.D | 1 | 03/25/16 | TDN | n/a | n/a | VE10192 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC16773-1, JC16773-2, JC16773-3, JC16773-4, JC16773-5, JC16773-6

| CAS No. | Compound | JC16818-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 9940 | 11200 | 113 | 9940 | 11100 | 112 | 1 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 9940 | 12000 | 121 | 9940 | 11600 | 117 | 3 | 47-133/25 |
| 100-42-5 | Styrene | ND | | 9940 | 10200 | 103 | 9940 | 10400 | 105 | 2 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 9940 | 22200 | 223* [c] | 9940 | 21800 | 219* [c] | 2 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | ND | | 9940 | 10500 | 106 | 9940 | 10700 | 108 | 2 | 34-163/31 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 9940 | 6810 | 68 | 9940 | 6520 | 66 | 4 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 9940 | 7920 | 80 | 9940 | 7490 | 75 | 6 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 9940 | 12400 | 125 | 9940 | 12600 | 127 | 2 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 9940 | 9930 | 100 | 9940 | 9490 | 95 | 5 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 9940 | 10200 | 103 | 9940 | 10200 | 103 | 0 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 9940 | 11300 | 114 | 9940 | 11400 | 115 | 1 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 9940 | 10300 | 104 | 9940 | 11000 | 111 | 7 | 38-149/29 |
| | m,p-Xylene | 309 | | 19900 | 21100 | 105 | 19900 | 21200 | 105 | 0 | 32-148/30 |
| 95-47-6 | o-Xylene | 94.9 | J | 9940 | 11000 | 110 | 9940 | 11000 | 110 | 0 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 404 | | 29800 | 32100 | 106 | 29800 | 32200 | 107 | 0 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC16818-1 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 110% | 110% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 97% | 95% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 80% | 78% | 77% | 72-130% |

(a) Dilution required due to matrix interference.
(b) Outside control limits.
(c) Outside control limits due to matrix interference.

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10121-BFB
**Lab File ID:** E232058.D
**Instrument ID:** GCMSE
**Injection Date:** 01/11/16
**Injection Time:** 09:18

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 9613 | 18.2 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 24837 | 47.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 52890 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3541 | 6.70 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 49576 | 93.7 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3554 | 6.72 | (7.17) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 48312 | 91.3 | (97.5) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3155 | 5.97 | (6.53) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10121-IC10121 | E232059.D | 01/11/16 | 09:52 | 00:34 | Initial cal 0.2 |
| VE10121-IC10121 | E232060.D | 01/11/16 | 10:26 | 01:08 | Initial cal 0.5 |
| VE10121-IC10121 | E232061.D | 01/11/16 | 11:00 | 01:42 | Initial cal 1 |
| VE10121-IC10121 | E232062.D | 01/11/16 | 11:34 | 02:16 | Initial cal 2 |
| VE10121-IC10121 | E232063.D | 01/11/16 | 12:08 | 02:50 | Initial cal 4 |
| VE10121-IC10121 | E232064.D | 01/11/16 | 12:42 | 03:24 | Initial cal 8 |
| VE10121-IC10121 | E232065.D | 01/11/16 | 13:16 | 03:58 | Initial cal 20 |
| VE10121-ICC10121 | E232066.D | 01/11/16 | 13:50 | 04:32 | Initial cal 50 |
| VE10121-IC10121 | E232067.D | 01/11/16 | 14:24 | 05:06 | Initial cal 100 |
| VE10121-IC10121 | E232068.D | 01/11/16 | 14:58 | 05:40 | Initial cal 200 |
| VE10121-ICV10121 | E232071.D | 01/11/16 | 16:40 | 07:22 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10191-BFB
**Lab File ID:** E233840.D
**Instrument ID:** GCMSE
**Injection Date:** 03/24/16
**Injection Time:** 06:30



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 6445 | 17.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 17002 | 44.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 37970 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2551 | 6.72 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 38437 | 101.2 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 2898 | 7.63 | (7.54) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 37674 | 99.2 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2512 | 6.62 | (6.67) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10191-CC10121 | E233841.D | 03/24/16 | 07:06 | 00:36 | Continuing cal 20 |
| VE10191-MB1 | E233843.D | 03/24/16 | 08:16 | 01:46 | Method Blank |
| ZZZZZZ | E233843B.D | 03/24/16 | 08:16 | 01:46 | (unrelated sample) |
| VE10191-BS | E233844.D | 03/24/16 | 08:51 | 02:21 | Blank Spike |
| ZZZZZZ | E233846.D | 03/24/16 | 10:01 | 03:31 | (unrelated sample) |
| JC16619-9 | E233847.D | 03/24/16 | 10:36 | 04:06 | (used for QC only; not part of job JC16773) |
| ZZZZZZ | E233848.D | 03/24/16 | 11:11 | 04:41 | (unrelated sample) |
| JC16619-9 | E233849.D | 03/24/16 | 11:46 | 05:16 | (used for QC only; not part of job JC16773) |
| ZZZZZZ | E233850.D | 03/24/16 | 12:21 | 05:51 | (unrelated sample) |
| ZZZZZZ | E233854.D | 03/24/16 | 14:41 | 08:11 | (unrelated sample) |
| JC16619-9MS | E233855.D | 03/24/16 | 15:13 | 08:43 | Matrix Spike |
| JC16619-9MSD | E233856.D | 03/24/16 | 15:47 | 09:17 | Matrix Spike Duplicate |
| JC16773-3 | E233857.D | 03/24/16 | 16:58 | 10:28 | SI-03-70-20 |
| JC16773-4 | E233858.D | 03/24/16 | 17:34 | 11:04 | SI-03-70-40 |
| JC16773-5 | E233859.D | 03/24/16 | 18:08 | 11:38 | SI-03-70-60 |

# Instrument Performance Check (BFB)



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10191-BFB2
**Lab File ID:** E233864.D
**Instrument ID:** GCMSE
**Injection Date:** 03/24/16
**Injection Time:** 20:27

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7539 | 16.9 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 19922 | 44.7 | | Pass |
| 95 | Base peak, 100% relative abundance | 44541 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3062 | 6.87 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 43469 | 97.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3297 | 7.40 | (7.58) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41968 | 94.2 | (96.5) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2836 | 6.37 | (6.76) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10191-CC10121 | E233865.D | 03/24/16 | 21:02 | 00:35 | Continuing cal 50 |
| VE10191-MB2 | E233867.D | 03/24/16 | 22:11 | 01:44 | Method Blank |
| JC16773-1 | E233868.D | 03/24/16 | 22:45 | 02:18 | SI-03 BASELINE |
| JC16773-2 | E233869.D | 03/24/16 | 23:19 | 02:52 | SI-03-70-INITIAL |
| JC16773-3 | E233870.D | 03/24/16 | 23:54 | 03:27 | SI-03-70-20 |
| JC16773-4 | E233871.D | 03/25/16 | 00:28 | 04:01 | SI-03-70-40 |
| JC16773-5 | E233872.D | 03/25/16 | 01:03 | 04:36 | SI-03-70-60 |
| JC16773-6 | E233873.D | 03/25/16 | 01:38 | 05:11 | SI-03-70-80 |
| JC16773-7 | E233874.D | 03/25/16 | 02:13 | 05:46 | SI-03-70-100 |
| JC16773-8 | E233875.D | 03/25/16 | 02:48 | 06:21 | SI-03-70-POST |
| JC16773-7 | E233876.D | 03/25/16 | 03:23 | 06:56 | SI-03-70-100 |
| JC16773-8 | E233877.D | 03/25/16 | 03:58 | 07:31 | SI-03-70-POST |

# Instrument Performance Check (BFB)



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10192-BFB
**Lab File ID:** E233881.D
**Instrument ID:** GCMSE
**Injection Date:** 03/25/16
**Injection Time:** 06:16



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 6947 | 16.2 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 18906 | 44.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 42941 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2827 | 6.58 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 43312 | 100.9 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3332 | 7.76 | (7.69) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 42008 | 97.8 | (97.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2806 | 6.53 | (6.68) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10192-CC10121 | E233884.D | 03/25/16 | 08:30 | 02:14 | Continuing cal 20 |
| VE10192-MB1 | E233886.D | 03/25/16 | 09:39 | 03:23 | Method Blank |
| ZZZZZZ | E233886B.D | 03/25/16 | 09:39 | 03:23 | (unrelated sample) |
| VE10192-BS | E233887.D | 03/25/16 | 10:13 | 03:57 | Blank Spike |
| JC16818-1 | E233889.D | 03/25/16 | 11:24 | 05:08 | (used for QC only; not part of job JC16773) |
| ZZZZZZ | E233890.D | 03/25/16 | 11:58 | 05:42 | (unrelated sample) |
| JC16773-3 | E233893.D | 03/25/16 | 13:08 | 06:52 | SI-03-70-20 |
| ZZZZZZ | E233894.D | 03/25/16 | 13:43 | 07:27 | (unrelated sample) |
| JC16818-1MS | E233895.D | 03/25/16 | 14:18 | 08:02 | Matrix Spike |
| JC16818-1MSD | E233896.D | 03/25/16 | 14:54 | 08:38 | Matrix Spike Duplicate |
| ZZZZZZ | E233898.D | 03/25/16 | 16:04 | 09:48 | (unrelated sample) |
| ZZZZZZ | E233900.D | 03/25/16 | 17:15 | 10:59 | (unrelated sample) |
| ZZZZZZ | E233901.D | 03/25/16 | 17:50 | 11:34 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10192-BFB2
**Lab File ID:** E233904.D
**Instrument ID:** GCMSE
**Injection Date:** 03/25/16
**Injection Time:** 19:37

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7994 | 17.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 20613 | 43.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 47058 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3078 | 6.54 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 46122 | 98.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3428 | 7.28 | (7.43) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 44157 | 93.8 | (95.7) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2857 | 6.07 | (6.47) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10192-CC10121 | E233905.D | 03/25/16 | 20:12 | 00:35 | Continuing cal 50 |
| VE10192-MB2 | E233907.D | 03/25/16 | 21:23 | 01:46 | Method Blank |
| JC16773-1 | E233908.D | 03/25/16 | 21:58 | 02:21 | SI-03 BASELINE |
| JC16773-2 | E233909.D | 03/25/16 | 22:33 | 02:56 | SI-03-70-INITIAL |
| JC16773-4 | E233910.D | 03/25/16 | 23:08 | 03:31 | SI-03-70-40 |
| JC16773-5 | E233911.D | 03/25/16 | 23:43 | 04:06 | SI-03-70-60 |
| JC16773-6 | E233912.D | 03/26/16 | 00:17 | 04:40 | SI-03-70-80 |

# Volatile Surrogate Recovery Summary



**Job Number:** JC16773
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC16773-1 | E233868.D | 109 | 103 | 90 | 86 |
| JC16773-1 | E233908.D | 110 | 103 | 90 | 87 |
| JC16773-2 | E233909.D | 110 | 102 | 91 | 87 |
| JC16773-2 | E233869.D | 109 | 102 | 91 | 88 |
| JC16773-3 | E233870.D | 111 | 103 | 91 | 86 |
| JC16773-3 | E233893.D | 110 | 100 | 92 | 88 |
| JC16773-3 | E233857.D | 109 | 104 | 86 | 88 |
| JC16773-4 | E233910.D | 108 | 102 | 92 | 87 |
| JC16773-4 | E233871.D | 109 | 101 | 89 | 86 |
| JC16773-4 | E233858.D | 108 | 101 | 87 | 87 |
| JC16773-5 | E233911.D | 111 | 104 | 91 | 87 |
| JC16773-5 | E233872.D | 110 | 102 | 88 | 85 |
| JC16773-5 | E233859.D | 110 | 102 | 88 | 87 |
| JC16773-6 | E233912.D | 110 | 104 | 89 | 87 |
| JC16773-6 | E233873.D | 110 | 103 | 90 | 87 |
| JC16773-7 | E233876.D | 109 | 104 | 87 | 85 |
| JC16773-7 | E233874.D | 108 | 101 | 90 | 85 |
| JC16773-8 | E233877.D | 111 | 103 | 87 | 85 |
| JC16773-8 | E233875.D | 110 | 103 | 91 | 85 |
| JC16619-9MS | E233855.D | 110 | 103 | 91 | 86 |
| JC16619-9MSD | E233856.D | 109 | 102 | 91 | 86 |
| JC16818-1MS | E233895.D | 108 | 100 | 97 | 80 |
| JC16818-1MSD | E233896.D | 110 | 100 | 95 | 78 |
| VE10191-BS | E233844.D | 110 | 106 | 91 | 86 |
| VE10191-MB1 | E233843.D | 107 | 103 | 89 | 82 |
| VE10191-MB2 | E233867.D | 107 | 101 | 91 | 86 |
| VE10192-BS | E233887.D | 108 | 103 | 93 | 86 |
| VE10192-MB1 | E233886.D | 107 | 102 | 89 | 85 |
| VE10192-MB2 | E233907.D | 109 | 101 | 91 | 87 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 70-122% |
| **S2** = 1,2-Dichloroethane-D4 | 68-124% |
| **S3** = Toluene-D8 | 77-125% |
| **S4** = 4-Bromofluorobenzene | 72-130% |

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*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC17894

Sampling Date: 04/06/16

Report to:

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Total number of pages in report: **46**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC17894

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC17894-1 | 04/06/16 | 08:30 | JM | 04/08/16 | SO | Soil | SI-04 BASELINE |
| JC17894-2 | 04/06/16 | 15:08 | JM | 04/08/16 | SO | Soil | SI-04-90VR-INITIAL |
| JC17894-3 | 04/06/16 | 15:33 | JM | 04/08/16 | SO | Soil | SI-04-90VR-20 |
| JC17894-4 | 04/06/16 | 15:53 | JM | 04/08/16 | SO | Soil | SI-04-90VR-40 |
| JC17894-5 | 04/06/16 | 16:13 | JM | 04/08/16 | SO | Soil | SI-04-90VR-60 |
| JC17894-6 | 04/06/16 | 16:33 | JM | 04/08/16 | SO | Soil | SI-04-90VR-80 |
| JC17894-7 | 04/06/16 | 16:53 | JM | 04/08/16 | SO | Soil | SI-04-90VR-100 |
| JC17894-8 | 04/06/16 | 17:13 | JM | 04/08/16 | SO | Soil | SI-04-90VR-POST |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits

**Job Number:** JC17894
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/06/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC17894-1** | **SI-04 BASELINE** | | | | | |
| Benzene | | 72100000 | 260000 | 69000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 102000 | 21000 | 2400 | ug/kg | SW846 8260C |
| Chlorobenzene | | 21600 | 21000 | 1600 | ug/kg | SW846 8260C |
| Chloromethane | | 11100 J | 52000 | 2700 | ug/kg | SW846 8260C |
| Cyclohexane | | 29100 | 21000 | 3300 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 3480000 | 520000 | 64000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 54100 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 310000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 325000 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 748000 | 21000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 227000 | 52000 | 9000 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 62800 | 21000 | 2400 | ug/kg | SW846 8260C |
| Naphthalene | | 7730000 | 2600000 | 98000 | ug/kg | SW846 8260C |
| Tetrachloroethene | | 9190 J | 21000 | 3100 | ug/kg | SW846 8260C |
| Toluene | | 16800000 | 520000 | 110000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 8890 J | 52000 | 1800 | ug/kg | SW846 8260C |
| m,p-Xylene | | 3090000 | 10000 | 3700 | ug/kg | SW846 8260C |
| o-Xylene | | 856000 | 10000 | 2900 | ug/kg | SW846 8260C |
| Xylene (total) | | 3940000 | 10000 | 2900 | ug/kg | SW846 8260C |
| **JC17894-2** | **SI-04-90VR-INITIAL** | | | | | |
| Benzene | | 2110000 | 50000 | 13000 | ug/kg | SW846 8260C |
| Chlorobenzene | | 3600 J | 20000 | 1600 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1700000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 23100 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 138000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 45200 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 157000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 63700 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 4680 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 5330000 | 500000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 1140000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | | 485000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | | 163000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | | 648000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC17894-3** | **SI-04-90VR-20** | | | | | |
| Benzene | | 2320000 | 47000 | 13000 | ug/kg | SW846 8260C |
| Chlorobenzene | | 2880 J | 19000 | 1500 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1460000 | 9400 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 20500 | 9400 | 1500 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC17894
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/06/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| 1,4-Dichlorobenzene | | 122000 | 9400 | 2100 | ug/kg | SW846 8260C |
| Ethylbenzene | | 41900 | 9400 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 135000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 54300 | 47000 | 8100 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 4080 J | 19000 | 2100 | ug/kg | SW846 8260C |
| Naphthalene | | 4990000 | 470000 | 18000 | ug/kg | SW846 8260C |
| Toluene | | 1060000 | 9400 | 2000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 440000 | 9400 | 3300 | ug/kg | SW846 8260C |
| o-Xylene | | 146000 | 9400 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | | 586000 | 9400 | 2600 | ug/kg | SW846 8260C |
| **JC17894-4** | **SI-04-90VR-40** | | | | | |
| Benzene | | 1560000 | 4700 | 1300 | ug/kg | SW846 8260C |
| Chlorobenzene | | 2730 J | 19000 | 1500 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1500000 | 9400 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 19700 | 9400 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 120000 | 9400 | 2100 | ug/kg | SW846 8260C |
| Ethylbenzene | | 38400 | 9400 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 131000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 55500 | 47000 | 8100 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 3030 J | 19000 | 2100 | ug/kg | SW846 8260C |
| Naphthalene | | 5240000 | 470000 | 18000 | ug/kg | SW846 8260C |
| Toluene | | 883000 | 9400 | 2000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 402000 | 9400 | 3300 | ug/kg | SW846 8260C |
| o-Xylene | | 137000 | 9400 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | | 539000 | 9400 | 2600 | ug/kg | SW846 8260C |
| **JC17894-5** | **SI-04-90VR-60** | | | | | |
| Benzene | | 1190000 | 4500 | 1200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1260000 | 8900 | 1100 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 16800 | 8900 | 1400 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 102000 | 8900 | 2000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 30000 | 8900 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 110000 | 18000 | 950 | ug/kg | SW846 8260C |
| Methyl Acetate | | 48100 | 45000 | 7700 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 2580 J | 18000 | 2000 | ug/kg | SW846 8260C |
| Naphthalene | | 4730000 | 450000 | 17000 | ug/kg | SW846 8260C |
| Toluene | | 690000 | 8900 | 1900 | ug/kg | SW846 8260C |
| m,p-Xylene | | 319000 | 8900 | 3100 | ug/kg | SW846 8260C |
| o-Xylene | | 110000 | 8900 | 2400 | ug/kg | SW846 8260C |
| Xylene (total) | | 429000 | 8900 | 2400 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC17894
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/06/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC17894-6** | **SI-04-90VR-80** | | | | | |
| Benzene | | 1240000 | 5100 | 1400 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1380000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 18000 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 112000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | | 30200 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 116000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 52700 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 2420 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | | 5410000 | 510000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 711000 | 10000 | 2100 | ug/kg | SW846 8260C |
| m,p-Xylene | | 327000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | | 114000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | | 440000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC17894-7** | **SI-04-90VR-100** | | | | | |
| Benzene | | 1010000 | 4900 | 1300 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1350000 | 9800 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 17400 | 9800 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 105000 | 9800 | 2200 | ug/kg | SW846 8260C |
| Ethylbenzene | | 28100 | 9800 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 107000 | 20000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 54200 | 49000 | 8400 | ug/kg | SW846 8260C |
| Naphthalene | | 5620000 | 490000 | 19000 | ug/kg | SW846 8260C |
| Toluene | | 626000 | 9800 | 2000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 298000 | 9800 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | | 107000 | 9800 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | | 406000 | 9800 | 2700 | ug/kg | SW846 8260C |
| **JC17894-8** | **SI-04-90VR-POST** | | | | | |
| Benzene | | 746000 | 3700 | 980 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1070000 | 7400 | 900 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 14100 | 7400 | 1200 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 83600 | 7400 | 1700 | ug/kg | SW846 8260C |
| Ethylbenzene | | 22100 | 7400 | 1200 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 83300 | 15000 | 780 | ug/kg | SW846 8260C |
| Methyl Acetate | | 44400 | 37000 | 6300 | ug/kg | SW846 8260C |
| Naphthalene | | 4440000 | 370000 | 14000 | ug/kg | SW846 8260C |
| Tetrachloroethene | | 4340 J | 15000 | 2200 | ug/kg | SW846 8260C |
| Toluene | | 473000 | 7400 | 1500 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 4630 J | 37000 | 1200 | ug/kg | SW846 8260C |
| m,p-Xylene | | 236000 | 7400 | 2600 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC17894
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/06/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| o-Xylene | | 83400 | 7400 | 2000 | ug/kg | SW846 8260C |
| Xylene (total) | | 319000 | 7400 | 2000 | ug/kg | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04 BASELINE | | |
| **Lab Sample ID:** | JC17894-1 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234391.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234426.D | 5000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.8 g | 10.0 ml | 100 ul |
| Run #2 | 4.8 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 72100000 [b] | 260000 | 69000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 52000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 21000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 52000 | 2500 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 52000 | 3800 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 20000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 102000 | 21000 | 2400 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 21000 | 2400 | ug/kg | |
| 108-90-7 | Chlorobenzene | 21600 | 21000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 52000 | 5000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 21000 | 1600 | ug/kg | |
| 74-87-3 | Chloromethane | 11100 | 52000 | 2700 | ug/kg | J |
| 110-82-7 | Cyclohexane | 29100 | 21000 | 3300 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 21000 | 5700 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 21000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1400 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 3480000 [b] | 520000 | 64000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 54100 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 310000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 52000 | 3800 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1500 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6200 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 8100 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6200 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 21000 | 2500 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 21000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 21000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 325000 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 52000 | 4700 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 52000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04 BASELINE | | |
| **Lab Sample ID:** | JC17894-1 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 748000 | 21000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 227000 | 52000 | 9000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 62800 | 21000 | 2400 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 52000 | 4800 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 52000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 7730000 [b] | 2600000 | 98000 | ug/kg | |
| 100-42-5 | Styrene | ND | 21000 | 1900 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 21000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | 9190 | 21000 | 3100 | ug/kg | J |
| 108-88-3 | Toluene | 16800000 [b] | 520000 | 110000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 52000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 8890 | 52000 | 1800 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 21000 | 1600 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 21000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 52000 | 2600 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 21000 | 2100 | ug/kg | |
| | m,p-Xylene | 3090000 | 10000 | 3700 | ug/kg | |
| 95-47-6 | o-Xylene | 856000 | 10000 | 2900 | ug/kg | |
| 1330-20-7 | Xylene (total) | 3940000 | 10000 | 2900 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 100% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-INITIAL | | |
| **Lab Sample ID:** | JC17894-2 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234386.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234419.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 100 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 2110000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 3600 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1700000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 23100 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 138000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 45200 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-INITIAL | | |
| **Lab Sample ID:** | JC17894-2 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 157000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 63700 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 4680 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 5330000 [b] | 500000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 1140000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 485000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 163000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 648000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-20 | | |
| **Lab Sample ID:** | JC17894-3 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234387.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234420.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.3 g | 10.0 ml | 100 ul |
| Run #2 | 5.3 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 94000 | 21000 | ug/kg | |
| 71-43-2 | Benzene | 2320000 [b] | 47000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 47000 | 2900 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 47000 | 2200 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 47000 | 3400 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 94000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 19000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 2880 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 47000 | 4500 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 47000 | 2500 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 19000 | 3000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5100 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 1900 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9400 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1460000 | 9400 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 20500 | 9400 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 122000 | 9400 | 2100 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 47000 | 3400 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9400 | 7300 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2200 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 41900 | 9400 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 47000 | 4200 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 47000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-20 | | |
| **Lab Sample ID:** | JC17894-3 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 135000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 54300 | 47000 | 8100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 4080 | 19000 | 2100 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9400 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 47000 | 4300 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 47000 | 9300 | ug/kg | |
| 91-20-3 | Naphthalene | 4990000 [b] | 470000 | 18000 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2800 | ug/kg | |
| 108-88-3 | Toluene | 1060000 | 9400 | 2000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 47000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 47000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9400 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 47000 | 2300 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 440000 | 9400 | 3300 | ug/kg | |
| 95-47-6 | o-Xylene | 146000 | 9400 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 586000 | 9400 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 96% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-40 | | |
| **Lab Sample ID:** | JC17894-4 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234388.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234421.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.3 g | 10.0 ml | 100 ul |
| Run #2 | 5.3 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 94000 | 21000 | ug/kg | |
| 71-43-2 | Benzene | 1560000 | 4700 | 1300 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 47000 | 2900 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 47000 | 2200 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 47000 | 3400 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 94000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 19000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 2730 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 47000 | 4500 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 47000 | 2500 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 19000 | 3000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5100 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 1900 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9400 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1500000 | 9400 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 19700 | 9400 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 120000 | 9400 | 2100 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 47000 | 3400 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9400 | 7300 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2200 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 38400 | 9400 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 47000 | 4200 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 47000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-40 | | |
| **Lab Sample ID:** | JC17894-4 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 131000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 55500 | 47000 | 8100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 3030 | 19000 | 2100 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9400 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 47000 | 4300 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 47000 | 9300 | ug/kg | |
| 91-20-3 | Naphthalene | 5240000 [b] | 470000 | 18000 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2800 | ug/kg | |
| 108-88-3 | Toluene | 883000 | 9400 | 2000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 47000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 47000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9400 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 47000 | 2300 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 402000 | 9400 | 3300 | ug/kg | |
| 95-47-6 | o-Xylene | 137000 | 9400 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 539000 | 9400 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 101% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-60 | | |
| **Lab Sample ID:** | JC17894-5 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234389.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234422.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.6 g | 10.0 ml | 100 ul |
| Run #2 | 5.6 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 89000 | 20000 | ug/kg | |
| 71-43-2 | Benzene | 1190000 | 4500 | 1200 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 45000 | 2800 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 18000 | 1400 | ug/kg | |
| 75-25-2 | Bromoform | ND | 45000 | 2100 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 45000 | 3200 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 89000 | 17000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 18000 | 2000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 18000 | 2100 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 18000 | 1400 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 45000 | 4300 | ug/kg | |
| 67-66-3 | Chloroform | ND | 18000 | 1300 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 45000 | 2300 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 18000 | 2800 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 18000 | 4900 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 18000 | 1800 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 8900 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1260000 | 8900 | 1100 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 16800 | 8900 | 1400 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 102000 | 8900 | 2000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 45000 | 3200 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 8900 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 8900 | 1200 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 8900 | 5300 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 8900 | 7000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 8900 | 5300 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 18000 | 2100 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 18000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 18000 | 1600 | ug/kg | |
| 100-41-4 | Ethylbenzene | 30000 | 8900 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 45000 | 4000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 45000 | 12000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-60 | | |
| **Lab Sample ID:** | JC17894-5 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 110000 | 18000 | 950 | ug/kg | |
| 79-20-9 | Methyl Acetate | 48100 | 45000 | 7700 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 2580 | 18000 | 2000 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 8900 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 45000 | 4100 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 45000 | 8800 | ug/kg | |
| 91-20-3 | Naphthalene | 4730000 [b] | 450000 | 17000 | ug/kg | |
| 100-42-5 | Styrene | ND | 18000 | 1600 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 18000 | 1600 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 18000 | 2700 | ug/kg | |
| 108-88-3 | Toluene | 690000 | 8900 | 1900 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 45000 | 1600 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 45000 | 1500 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 18000 | 1300 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 18000 | 1300 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 8900 | 1300 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 45000 | 2200 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 18000 | 1800 | ug/kg | |
| | m,p-Xylene | 319000 | 8900 | 3100 | ug/kg | |
| 95-47-6 | o-Xylene | 110000 | 8900 | 2400 | ug/kg | |
| 1330-20-7 | Xylene (total) | 429000 | 8900 | 2400 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 101% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-80 | | |
| **Lab Sample ID:** | JC17894-6 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234390.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| Run #2 | E234423.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 100 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 1240000 | 5100 | 1400 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2300 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3200 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1380000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 18000 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 112000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 30200 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-80 | | |
| **Lab Sample ID:** | JC17894-6 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 116000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 52700 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 2420 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 5410000 [b] | 510000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 711000 | 10000 | 2100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 327000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 114000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 440000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 103% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 97% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 98% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-100 | | |
| **Lab Sample ID:** | JC17894-7 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234427.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| Run #2 | E234424.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.1 g | 10.0 ml | 100 ul |
| Run #2 | 5.1 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 98000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 1010000 | 4900 | 1300 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 49000 | 3000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 49000 | 2300 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 49000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 98000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 20000 | 2200 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 20000 | 1500 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 49000 | 4700 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 49000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 20000 | 3100 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5300 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9800 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1350000 | 9800 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 17400 | 9800 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 105000 | 9800 | 2200 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 49000 | 3500 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9800 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9800 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9800 | 5800 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9800 | 7600 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9800 | 5800 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2300 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 28100 | 9800 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 49000 | 4400 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 49000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-100 | | |
| **Lab Sample ID:** | JC17894-7 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 107000 | 20000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 54200 | 49000 | 8400 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 20000 | 2200 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9800 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 49000 | 4500 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 49000 | 9600 | ug/kg | |
| 91-20-3 | Naphthalene | 5620000 [b] | 490000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 626000 | 9800 | 2000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 49000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 49000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9800 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 49000 | 2400 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 1900 | ug/kg | |
| | m,p-Xylene | 298000 | 9800 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 107000 | 9800 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 406000 | 9800 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 103% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-POST | | |
| **Lab Sample ID:** | JC17894-8 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234428.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| Run #2 | E234425.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 6.8 g | 10.0 ml | 100 ul |
| Run #2 | 6.8 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 74000 | 16000 | ug/kg | |
| 71-43-2 | Benzene | 746000 | 3700 | 980 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 37000 | 2300 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 15000 | 1100 | ug/kg | |
| 75-25-2 | Bromoform | ND | 37000 | 1700 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 37000 | 2700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 74000 | 14000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 15000 | 1700 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 15000 | 1700 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 15000 | 1100 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 37000 | 3500 | ug/kg | |
| 67-66-3 | Chloroform | ND | 15000 | 1100 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 37000 | 1900 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 15000 | 2300 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 15000 | 4000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 15000 | 1500 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 7400 | 960 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1070000 | 7400 | 900 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 14100 | 7400 | 1200 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 83600 | 7400 | 1700 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 37000 | 2700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 7400 | 1000 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 7400 | 990 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 7400 | 4400 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 7400 | 5700 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 7400 | 4400 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 15000 | 1700 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 15000 | 870 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 15000 | 1300 | ug/kg | |
| 100-41-4 | Ethylbenzene | 22100 | 7400 | 1200 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 37000 | 3300 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 37000 | 9900 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-04-90VR-POST | | |
| **Lab Sample ID:** | JC17894-8 | **Date Sampled:** | 04/06/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/08/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 83300 | 15000 | 780 | ug/kg | |
| 79-20-9 | Methyl Acetate | 44400 | 37000 | 6300 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 15000 | 1700 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 7400 | 1100 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 37000 | 3400 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 37000 | 7200 | ug/kg | |
| 91-20-3 | Naphthalene | 4440000 [b] | 370000 | 14000 | ug/kg | |
| 100-42-5 | Styrene | ND | 15000 | 1300 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 15000 | 1300 | ug/kg | |
| 127-18-4 | Tetrachloroethene | 4340 | 15000 | 2200 | ug/kg | J |
| 108-88-3 | Toluene | 473000 | 7400 | 1500 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 37000 | 1300 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4630 | 37000 | 1200 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 15000 | 1100 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 15000 | 1100 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 7400 | 1100 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 37000 | 1800 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 15000 | 1400 | ug/kg | |
| | m,p-Xylene | 236000 | 7400 | 2600 | ug/kg | |
| 95-47-6 | o-Xylene | 83400 | 7400 | 2000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 319000 | 7400 | 2000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 101% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 98% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

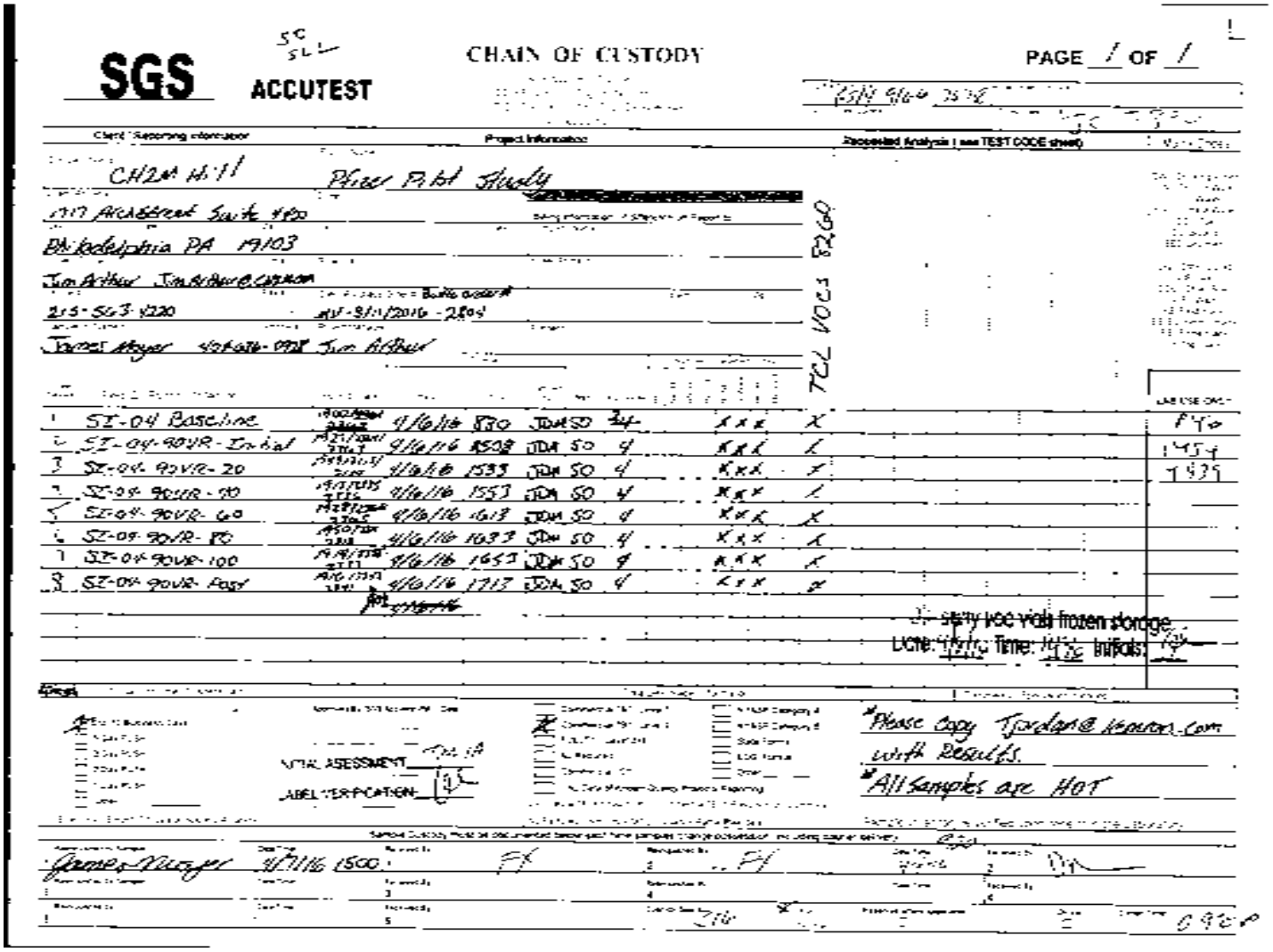
ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody





SGS ACCUTEST

SC
SLL

# CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information | Project Information | Requested Analysis (see TEST CODE sheet)

CH2M Hill — Pfizer Pilot Study

1717 Arch Street Suite 4400
Philadelphia PA 19103

Jim Arthur Jim.Arthur@CH2M.com
215-563-4220 — Bottle order # MV-3/11/2016-2804

James Mayer 404-636-0928 Jim Arthur

TCL VOCs 8260

| | | | | | | | | | | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | SI-04 Baseline | [illegible] | 4/6/16 | 830 | JDM | 50 | 4 | X X X | X | 1440 |
| 2 | SI-04-90VR-Initial | [illegible] | 4/6/16 | 1508 | JDM | 50 | 4 | X X X | X | 1454 |
| 3 | SI-04-90VR-20 | [illegible] | 4/6/16 | 1533 | JDM | 50 | 4 | X X X | X | 1439 |
| 4 | SI-04-90VR-40 | [illegible] | 4/6/16 | 1553 | JDM | 50 | 4 | X X X | X | |
| 5 | SI-04-90VR-60 | [illegible] | 4/6/16 | 1613 | JDM | 50 | 4 | X X X | X | |
| 6 | SI-04-90VR-80 | [illegible] | 4/6/16 | 1633 | JDM | 50 | 4 | X X X | X | |
| 7 | SI-04-90VR-100 | [illegible] | 4/6/16 | 1653 | JDM | 50 | 4 | X X X | X | |
| 8 | SI-04-90VR-Post | [illegible] | 4/6/16 | 1713 | JDM | 50 | 4 | X X X | X | |

Sorry voc vials frozen storage.
Date: [illegible] Time: [illegible] Initials: [illegible]

NOTAL ASSESSMENT [illegible]
LABEL VERIFICATION [illegible]

*Please copy Tjordan@kemron.com with Results.
*All Samples are HOT

Sample Custody must be documented below each time samples change possession, including courier delivery.

James Mayer 4/7/16 1500 — FX — FX — [illegible] — [illegible]

0900

JC17894: Chain of Custody
Page 1 of 3

**Job Number:** JC17894 **Client:** CH2M Hill **Project:** Pfizer Pilot Study

**Date / Time Received:** 4/8/2016 9:30:00 AM **Delivery Method:** FedEx **Airbill #'s:** 651491667672

Cooler Temps (Raw Measured) °C: Cooler 1: (0.9);

Cooler Temps (Corrected) °C: Cooler 1: (1.3);

| Cooler Security | Y | N | | Y | N |
|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | ☐ | 3. COC Present: | ☑ | ☐ |
| 2. Custody Seals Intact: | ☑ | ☐ | 4. Smpl Dates/Time OK | ☑ | ☐ |

| Cooler Temperature | Y | N |
|---|---|---|
| 1. Temp criteria achieved: | ☑ | ☐ |
| 2. Cooler temp verification: | IR Gun | |
| 3. Cooler media: | Ice (Bag) | |
| 4. No. Coolers: | 1 | |

| Quality Control _Preservation | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☑ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☑ | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | ☐ | |
| 4. VOCs headspace free: | ☑ | ☐ | ☐ |

| Sample Integrity - Documentation | Y | N |
|---|---|---|
| 1. Sample labels present on bottles: | ☑ | ☐ |
| 2. Container labeling complete: | ☑ | ☐ |
| 3. Sample container label / COC agree: | ☑ | ☐ |

| Sample Integrity - Condition | Y | N |
|---|---|---|
| 1. Sample recvd within HT: | ☑ | ☐ |
| 2. All containers accounted for: | ☑ | ☐ |
| 3. Condition of sample: | Intact | |

| Sample Integrity - Instructions | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | ☐ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

1) -1: Did not receive DI vials.

2) Client notes that "All samples are HOT".

## Problem Resolution



**Accutest Job Number:** JC17894

**CSR:** _____ **Response Date:** 4/8/2016

**Response:** Proceed with analysis



**JC17894: Chain of Custody**
**Page 3 of 3**

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10208-MB1 | E234377.D | 1 | 04/13/16 | TDN | n/a | n/a | VE10208 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10208-MB1 | E234377.D | 1 | 04/13/16 | TDN | n/a | n/a | VE10208 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 96% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10209-MB1 | E234416.D | 1 | 04/14/16 | TDN | n/a | n/a | VE10209 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10209-MB1 | E234416.D | 1 | 04/14/16 | TDN | n/a | n/a | VE10209 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Blank Spike Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10208-BS | E234378.D | 1 | 04/13/16 | TDN | n/a | n/a | VE10208 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2000 | 80 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2560 | 102 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2540 | 102 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2470 | 99 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2650 | 106 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2370 | 95 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2540 | 102 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2440 | 98 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2660 | 106 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2620 | 105 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2520 | 101 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2680 | 107 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2630 | 105 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2390 | 96 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2540 | 102 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2610 | 104 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2640 | 106 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2620 | 105 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2560 | 102 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2630 | 105 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2800 | 112 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2600 | 104 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2650 | 106 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2570 | 103 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2510 | 100 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2560 | 102 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2530 | 101 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2500 | 100 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2390 | 96 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2580 | 103 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2480 | 99 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2280 | 91 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2550 | 102 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2210 | 88 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2500 | 100 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 5050 | 101 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10208-BS | E234378.D | 1 | 04/13/16 | TDN | n/a | n/a | VE10208 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2480 | 99 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2510 | 100 | 71-124 |
| 100-42-5 | Styrene | 2500 | 2650 | 106 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2400 | 96 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2740 | 110 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2460 | 98 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2740 | 110 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2740 | 110 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2680 | 107 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2350 | 94 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2630 | 105 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 2720 | 109 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2690 | 108 | 57-136 |
| | m,p-Xylene | 5000 | 5360 | 107 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2800 | 112 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 8160 | 109 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 96% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10209-BS | E234417.D | 1 | 04/14/16 | TDN | n/a | n/a | VE10209 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2580 | 103 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2390 | 96 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2430 | 97 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2340 | 94 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2500 | 100 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2430 | 97 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 3250 | 130 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2500 | 100 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2510 | 100 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2420 | 97 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2550 | 102 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2500 | 100 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2690 | 108 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2430 | 97 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2440 | 98 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2430 | 97 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2470 | 99 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2450 | 98 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2390 | 96 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2410 | 96 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2810 | 112 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2460 | 98 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2490 | 100 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2590 | 104 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2370 | 95 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2440 | 98 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2380 | 95 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2350 | 94 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2260 | 90 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2360 | 94 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2610 | 104 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2940 | 118 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2420 | 97 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2130 | 85 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2400 | 96 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4960 | 99 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10209-BS | E234417.D | 1 | 04/14/16 | TDN | n/a | n/a | VE10209 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 3100 | 124 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2520 | 101 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2600 | 104 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2410 | 96 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2310 | 92 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2550 | 102 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2290 | 92 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2620 | 105 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2610 | 104 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2550 | 102 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2210 | 88 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2430 | 97 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 2720 | 109 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2710 | 108 | 57-136 |
| | m,p-Xylene | 5000 | 4940 | 99 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2580 | 103 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7520 | 100 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17894-1MS | E234392.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| JC17894-1MSD | E234393.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| JC17894-1 | E234391.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | JC17894-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 521000 | 467000 | 90 | 521000 | 477000 | 92 | 2 | 10-180/33 |
| 71-43-2 | Benzene | 41600000 | E | 521000 | 40900000 | -134* [a] | 521000 | 41500000 | -19* [a] | 1 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 521000 | 561000 | 108 | 521000 | 559000 | 107 | 0 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 521000 | 506000 | 97 | 521000 | 501000 | 96 | 1 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 521000 | 553000 | 106 | 521000 | 546000 | 105 | 1 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 521000 | 506000 | 97 | 521000 | 497000 | 95 | 2 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 521000 | 552000 | 106 | 521000 | 527000 | 101 | 5 | 26-164/30 |
| 75-15-0 | Carbon disulfide | 102000 | | 521000 | 636000 | 103 | 521000 | 628000 | 101 | 1 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 521000 | 531000 | 102 | 521000 | 530000 | 102 | 0 | 43-152/31 |
| 108-90-7 | Chlorobenzene | 21600 | | 521000 | 588000 | 109 | 521000 | 573000 | 106 | 3 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 521000 | 541000 | 104 | 521000 | 537000 | 103 | 1 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 521000 | 599000 | 115 | 521000 | 588000 | 113 | 2 | 52-134/27 |
| 74-87-3 | Chloromethane | 11100 | J | 521000 | 528000 | 99 | 521000 | 519000 | 98 | 2 | 41-142/28 |
| 110-82-7 | Cyclohexane | 29100 | | 521000 | 565000 | 103 | 521000 | 556000 | 101 | 2 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 521000 | 590000 | 113 | 521000 | 585000 | 112 | 1 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 521000 | 557000 | 107 | 521000 | 549000 | 105 | 1 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 521000 | 556000 | 107 | 521000 | 543000 | 104 | 2 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 3320000 | E | 521000 | 3820000 | 96 | 521000 | 3750000 | 83 | 2 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | 54100 | | 521000 | 614000 | 108 | 521000 | 599000 | 105 | 2 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | 310000 | | 521000 | 865000 | 107 | 521000 | 848000 | 103 | 2 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 521000 | 577000 | 111 | 521000 | 564000 | 108 | 2 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 521000 | 595000 | 114 | 521000 | 581000 | 112 | 2 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 521000 | 1720000 | 330* [b] | 521000 | 1710000 | 328* [b] | 1 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 521000 | 572000 | 110 | 521000 | 556000 | 107 | 3 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 521000 | 555000 | 107 | 521000 | 563000 | 108 | 1 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 521000 | 567000 | 109 | 521000 | 560000 | 108 | 1 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 521000 | 525000 | 101 | 521000 | 520000 | 100 | 1 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 521000 | 507000 | 97 | 521000 | 492000 | 94 | 3 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 521000 | 483000 | 93 | 521000 | 470000 | 90 | 3 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 325000 | | 521000 | 858000 | 102 | 521000 | 842000 | 99 | 2 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 521000 | 531000 | 102 | 521000 | 516000 | 99 | 3 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 521000 | 462000 | 89 | 521000 | 479000 | 92 | 4 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 748000 | | 521000 | 1310000 | 108 | 521000 | 1280000 | 102 | 2 | 36-145/33 |
| 79-20-9 | Methyl Acetate | 227000 | | 521000 | 677000 | 86 | 521000 | 679000 | 87 | 0 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | 62800 | | 521000 | 562000 | 96 | 521000 | 554000 | 94 | 1 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 1040000 | 1060000 | 102 | 1040000 | 1060000 | 102 | 0 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17894-1MS | E234392.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| JC17894-1MSD | E234393.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |
| JC17894-1 | E234391.D | 100 | 04/13/16 | TDN | n/a | n/a | VE10208 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6

| CAS No. | Compound | JC17894-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 521000 | 515000 | 99 | 521000 | 523000 | 100 | 2 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 521000 | 552000 | 106 | 521000 | 552000 | 106 | 0 | 47-133/25 |
| 100-42-5 | Styrene | ND | | 521000 | 571000 | 110 | 521000 | 564000 | 108 | 1 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 521000 | 531000 | 102 | 521000 | 519000 | 100 | 2 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | 9190 | J | 521000 | 650000 | 123 | 521000 | 634000 | 120 | 2 | 34-163/31 |
| 108-88-3 | Toluene | 14100000 | E | 521000 | 14200000 | 19* [a] | 521000 | 14000000 | -19* [a] | 1 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 521000 | 623000 | 120 | 521000 | 623000 | 120 | 0 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 8890 | J | 521000 | 638000 | 121 | 521000 | 634000 | 120 | 1 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 521000 | 588000 | 113 | 521000 | 579000 | 111 | 2 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 521000 | 480000 | 92 | 521000 | 466000 | 89 | 3 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 521000 | 556000 | 107 | 521000 | 537000 | 103 | 3 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 521000 | 583000 | 112 | 521000 | 570000 | 109 | 2 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 521000 | 577000 | 111 | 521000 | 570000 | 109 | 1 | 38-149/29 |
| | m,p-Xylene | 3090000 | | 1040000 | 4050000 | 92 | 1040000 | 3990000 | 86 | 1 | 32-148/30 |
| 95-47-6 | o-Xylene | 856000 | | 521000 | 1440000 | 112 | 521000 | 1410000 | 106 | 2 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 3940000 | | 1560000 | 5490000 | 99 | 1560000 | 5390000 | 93 | 2 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC17894-1 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 105% | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 97% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 92% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 97% | 97% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Outside control limits due to matrix interference.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17894-8MS | E234429.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8MSD | E234430.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8 | E234428.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8 | E234425.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | JC17894-8 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 368000 | 320000 | 87 | 368000 | 333000 | 91 | 4 | 10-180/33 |
| 71-43-2 | Benzene | 746000 | | 368000 | 1140000 | 107 | 368000 | 1160000 | 113 | 2 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 368000 | 408000 | 111 | 368000 | 417000 | 113 | 2 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 368000 | 390000 | 106 | 368000 | 407000 | 111 | 4 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 368000 | 419000 | 114 | 368000 | 427000 | 116 | 2 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 368000 | 346000 | 94 | 368000 | 342000 | 93 | 1 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 368000 | 397000 | 108 | 368000 | 404000 | 110 | 2 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 368000 | 440000 | 120 | 368000 | 433000 | 118 | 2 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 368000 | 436000 | 119 | 368000 | 434000 | 118 | 0 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 368000 | 417000 | 113 | 368000 | 426000 | 116 | 2 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 368000 | 365000 | 99 | 368000 | 365000 | 99 | 0 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 368000 | 423000 | 115 | 368000 | 431000 | 117 | 2 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 368000 | 374000 | 102 | 368000 | 376000 | 102 | 1 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 368000 | 436000 | 119 | 368000 | 425000 | 116 | 3 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 368000 | 426000 | 116 | 368000 | 432000 | 118 | 1 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 368000 | 418000 | 114 | 368000 | 424000 | 115 | 1 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 368000 | 419000 | 114 | 368000 | 426000 | 116 | 2 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 1070000 | | 368000 | 1470000 | 109 | 368000 | 1510000 | 120 | 3 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | 14100 | | 368000 | 413000 | 109 | 368000 | 422000 | 111 | 2 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | 83600 | | 368000 | 490000 | 111 | 368000 | 501000 | 114 | 2 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 368000 | 405000 | 110 | 368000 | 394000 | 107 | 3 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 368000 | 425000 | 116 | 368000 | 433000 | 118 | 2 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 368000 | 426000 | 116 | 368000 | 437000 | 119 | 3 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 368000 | 452000 | 123 | 368000 | 441000 | 120 | 2 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 368000 | 397000 | 108 | 368000 | 407000 | 111 | 2 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 368000 | 428000 | 116 | 368000 | 426000 | 116 | 0 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 368000 | 400000 | 109 | 368000 | 416000 | 113 | 4 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 368000 | 394000 | 107 | 368000 | 408000 | 111 | 3 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 368000 | 379000 | 103 | 368000 | 392000 | 107 | 3 | 36-148/27 |
| 100-41-4 | Ethylbenzene | 22100 | | 368000 | 431000 | 111 | 368000 | 432000 | 111 | 0 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 368000 | 446000 | 121 | 368000 | 432000 | 118 | 3 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 368000 | 377000 | 103 | 368000 | 385000 | 105 | 2 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | 83300 | | 368000 | 494000 | 112 | 368000 | 517000 | 118 | 5 | 36-145/33 |
| 79-20-9 | Methyl Acetate | 44400 | | 368000 | 382000 | 92 | 368000 | 393000 | 95 | 3 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | ND | | 368000 | 411000 | 112 | 368000 | 412000 | 112 | 0 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 735000 | 808000 | 110 | 735000 | 806000 | 110 | 0 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17894-8MS | E234429.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8MSD | E234430.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8 | E234428.D | 100 | 04/14/16 | TDN | n/a | n/a | VE10209 |
| JC17894-8 | E234425.D | 1000 | 04/14/16 | TDN | n/a | n/a | VE10209 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC17894-1, JC17894-2, JC17894-3, JC17894-4, JC17894-5, JC17894-6, JC17894-7, JC17894-8

| CAS No. | Compound | JC17894-8 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 368000 | 408000 | 111 | 368000 | 416000 | 113 | 2 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 368000 | 425000 | 116 | 368000 | 425000 | 116 | 0 | 47-133/25 |
| 91-20-3 | Naphthalene | 4440000 [a] | | 368000 | 4600000 | 65 | 368000 | 4780000 | 114 | 4 | 12-160/33 |
| 100-42-5 | Styrene | ND | | 368000 | 421000 | 115 | 368000 | 417000 | 113 | 1 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 368000 | 381000 | 104 | 368000 | 402000 | 109 | 5 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | 4340 | J | 368000 | 441000 | 119 | 368000 | 444000 | 120 | 1 | 34-163/31 |
| 108-88-3 | Toluene | 473000 | | 368000 | 867000 | 107 | 368000 | 897000 | 115 | 3 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 368000 | 458000 | 125 | 368000 | 479000 | 130 | 4 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4630 | J | 368000 | 459000 | 124 | 368000 | 475000 | 128 | 3 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 368000 | 447000 | 122 | 368000 | 438000 | 119 | 2 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 368000 | 368000 | 100 | 368000 | 379000 | 103 | 3 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 368000 | 422000 | 115 | 368000 | 431000 | 117 | 2 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 368000 | 397000 | 108 | 368000 | 387000 | 105 | 3 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 368000 | 392000 | 107 | 368000 | 387000 | 105 | 1 | 38-149/29 |
| | m,p-Xylene | 236000 | | 735000 | 1080000 | 115 | 735000 | 1090000 | 116 | 1 | 32-148/30 |
| 95-47-6 | o-Xylene | 83400 | | 368000 | 530000 | 121 | 368000 | 531000 | 122 | 0 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 319000 | | 1100000 | 1610000 | 117 | 1100000 | 1620000 | 118 | 1 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC17894-8 | JC17894-8 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 102% | 102% | 101% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 99% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 95% | 94% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 99% | 98% | 98% | 72-130% |

(a) Result is from Run #2.

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10206-BFB
**Lab File ID:** E234316.D
**Instrument ID:** GCMSE
**Injection Date:** 04/11/16
**Injection Time:** 20:55

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8171 | 18.1 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 21194 | 46.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 45186 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3045 | 6.74 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 41941 | 92.8 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3226 | 7.14 | (7.69) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41088 | 90.9 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2750 | 6.09 | (6.69) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10206-IC10206 | E234317.D | 04/11/16 | 21:30 | 00:35 | Initial cal 0.2 |
| VE10206-IC10206 | E234318.D | 04/11/16 | 22:05 | 01:10 | Initial cal 0.5 |
| VE10206-IC10206 | E234319.D | 04/11/16 | 22:39 | 01:44 | Initial cal 1 |
| VE10206-IC10206 | E234320.D | 04/11/16 | 23:13 | 02:18 | Initial cal 2 |
| VE10206-IC10206 | E234321.D | 04/11/16 | 23:48 | 02:53 | Initial cal 4 |
| VE10206-IC10206 | E234322.D | 04/12/16 | 00:22 | 03:27 | Initial cal 8 |
| VE10206-IC10206 | E234323.D | 04/12/16 | 00:57 | 04:02 | Initial cal 20 |
| VE10206-ICC10206 | E234324.D | 04/12/16 | 01:31 | 04:36 | Initial cal 50 |
| VE10206-IC10206 | E234325.D | 04/12/16 | 02:05 | 05:10 | Initial cal 100 |
| VE10206-IC10206 | E234326.D | 04/12/16 | 02:40 | 05:45 | Initial cal 200 |

# Instrument Performance Check (BFB)



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10206-BFB2
**Lab File ID:** E234331.D
**Instrument ID:** GCMSE
**Injection Date:** 04/12/16
**Injection Time:** 08:24

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7980 | 17.8 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 20882 | 46.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 44882 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2884 | 6.43 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 43069 | 96.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3341 | 7.44 | (7.76) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41770 | 93.1 | (97.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2658 | 5.92 | (6.36) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10206-ICV10206 | E234332.D | 04/12/16 | 08:59 | 00:35 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10208-BFB
**Lab File ID:** E234373.D
**Instrument ID:** GCMSE
**Injection Date:** 04/13/16
**Injection Time:** 08:03



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8301 | 17.6 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 22389 | 47.6 | | Pass |
| 95 | Base peak, 100% relative abundance | 47045 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3199 | 6.80 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 45504 | 96.7 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3464 | 7.36 | (7.61) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 44338 | 94.2 | (97.4) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2905 | 6.17 | (6.55) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10208-CC10206 | E234374.D | 04/13/16 | 08:36 | 00:33 | Continuing cal 20 |
| VE10208-CC10206 | E234375.D | 04/13/16 | 09:10 | 01:07 | Continuing cal 20 |
| VE10208-MB1 | E234377.D | 04/13/16 | 10:18 | 02:15 | Method Blank |
| ZZZZZZ | E234377A.D | 04/13/16 | 10:18 | 02:15 | (unrelated sample) |
| VE10208-BS | E234378.D | 04/13/16 | 10:52 | 02:49 | Blank Spike |
| ZZZZZZ | E234379.D | 04/13/16 | 11:26 | 03:23 | (unrelated sample) |
| ZZZZZZ | E234380.D | 04/13/16 | 12:00 | 03:57 | (unrelated sample) |
| ZZZZZZ | E234381.D | 04/13/16 | 12:34 | 04:31 | (unrelated sample) |
| ZZZZZZ | E234382.D | 04/13/16 | 13:08 | 05:05 | (unrelated sample) |
| ZZZZZZ | E234383.D | 04/13/16 | 13:42 | 05:39 | (unrelated sample) |
| ZZZZZZ | E234384.D | 04/13/16 | 14:16 | 06:13 | (unrelated sample) |
| JC17894-2 | E234386.D | 04/13/16 | 15:24 | 07:21 | SI-04-90VR-INITIAL |
| JC17894-3 | E234387.D | 04/13/16 | 15:58 | 07:55 | SI-04-90VR-20 |
| JC17894-4 | E234388.D | 04/13/16 | 16:33 | 08:30 | SI-04-90VR-40 |
| JC17894-5 | E234389.D | 04/13/16 | 17:07 | 09:04 | SI-04-90VR-60 |
| JC17894-6 | E234390.D | 04/13/16 | 17:42 | 09:39 | SI-04-90VR-80 |
| JC17894-1 | E234391.D | 04/13/16 | 18:16 | 10:13 | SI-04 BASELINE |
| JC17894-1MS | E234392.D | 04/13/16 | 18:50 | 10:47 | Matrix Spike |
| JC17894-1MSD | E234393.D | 04/13/16 | 19:25 | 11:22 | Matrix Spike Duplicate |

# Instrument Performance Check (BFB)



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10209-BFB
**Lab File ID:** E234412.D
**Instrument ID:** GCMSE
**Injection Date:** 04/14/16
**Injection Time:** 06:08

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7679 | 18.1 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 20176 | 47.6 | | Pass |
| 95 | Base peak, 100% relative abundance | 42392 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2870 | 6.77 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 41659 | 98.3 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3310 | 7.81 | (7.95) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 40488 | 95.5 | (97.2) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2794 | 6.59 | (6.90) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10209-CC10206 | E234414.D | 04/14/16 | 07:21 | 01:13 | Continuing cal 50 |
| ZZZZZZ | E234416A.D | 04/14/16 | 08:29 | 02:21 | (unrelated sample) |
| VE10209-MB1 | E234416.D | 04/14/16 | 08:29 | 02:21 | Method Blank |
| VE10209-BS | E234417.D | 04/14/16 | 09:03 | 02:55 | Blank Spike |
| JC17894-2 | E234419.D | 04/14/16 | 10:11 | 04:03 | SI-04-90VR-INITIAL |
| JC17894-3 | E234420.D | 04/14/16 | 10:46 | 04:38 | SI-04-90VR-20 |
| JC17894-4 | E234421.D | 04/14/16 | 11:20 | 05:12 | SI-04-90VR-40 |
| JC17894-5 | E234422.D | 04/14/16 | 11:54 | 05:46 | SI-04-90VR-60 |
| JC17894-6 | E234423.D | 04/14/16 | 12:28 | 06:20 | SI-04-90VR-80 |
| JC17894-7 | E234424.D | 04/14/16 | 13:03 | 06:55 | SI-04-90VR-100 |
| JC17894-8 | E234425.D | 04/14/16 | 13:37 | 07:29 | SI-04-90VR-POST |
| JC17894-1 | E234426.D | 04/14/16 | 14:11 | 08:03 | SI-04 BASELINE |
| JC17894-7 | E234427.D | 04/14/16 | 14:45 | 08:37 | SI-04-90VR-100 |
| JC17894-8 | E234428.D | 04/14/16 | 15:19 | 09:11 | SI-04-90VR-POST |
| JC17894-8MS | E234429.D | 04/14/16 | 15:54 | 09:46 | Matrix Spike |
| JC17894-8MSD | E234430.D | 04/14/16 | 16:28 | 10:20 | Matrix Spike Duplicate |

# Volatile Surrogate Recovery Summary



**Job Number:** JC17894
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC17894-1 | E234426.D | 100 | 100 | 94 | 99 |
| JC17894-1 | E234391.D | 104 | 100 | 91 | 97 |
| JC17894-2 | E234419.D | 102 | 100 | 94 | 99 |
| JC17894-2 | E234386.D | 103 | 101 | 93 | 97 |
| JC17894-3 | E234420.D | 102 | 101 | 93 | 96 |
| JC17894-3 | E234387.D | 102 | 100 | 92 | 100 |
| JC17894-4 | E234421.D | 101 | 100 | 94 | 99 |
| JC17894-4 | E234388.D | 102 | 100 | 94 | 99 |
| JC17894-5 | E234422.D | 101 | 99 | 95 | 99 |
| JC17894-5 | E234389.D | 102 | 98 | 95 | 98 |
| JC17894-6 | E234423.D | 103 | 100 | 94 | 98 |
| JC17894-6 | E234390.D | 101 | 97 | 94 | 98 |
| JC17894-7 | E234427.D | 102 | 98 | 95 | 99 |
| JC17894-7 | E234424.D | 103 | 101 | 94 | 99 |
| JC17894-8 | E234428.D | 102 | 99 | 94 | 98 |
| JC17894-8 | E234425.D | 101 | 100 | 95 | 98 |
| JC17894-1MS | E234392.D | 104 | 98 | 93 | 98 |
| JC17894-1MSD | E234393.D | 105 | 97 | 92 | 97 |
| JC17894-8MS | E234429.D | 102 | 100 | 95 | 98 |
| JC17894-8MSD | E234430.D | 102 | 100 | 95 | 99 |
| VE10208-BS | E234378.D | 102 | 102 | 95 | 96 |
| VE10208-MB1 | E234377.D | 101 | 99 | 94 | 96 |
| VE10209-BS | E234417.D | 103 | 101 | 95 | 100 |
| VE10209-MB1 | E234416.D | 102 | 100 | 94 | 99 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 70-122% |
| **S2** = 1,2-Dichloroethane-D4 | 68-124% |
| **S3** = Toluene-D8 | 77-125% |
| **S4** = 4-Bromofluorobenzene | 72-130% |

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Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

477213

SGS Accutest Job Number: JC18297

Sampling Date: 04/13/16

Report to:

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Total number of pages in report: **83**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC18297

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
Project No: 477213

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC18297-1 | 04/13/16 | 10:30 | JDM | 04/14/16 | SO | Soil | SI-05+ SI-06 BASELINE(A) |
| JC18297-2 | 04/13/16 | 10:32 | JDM | 04/14/16 | SO | Soil | SI-05+ SI-06 BASELINE(B) |
| JC18297-3 | 04/13/16 | 10:33 | JDM | 04/14/16 | SO | Soil | SI-05+ SI-06 BASELINE(C) |
| JC18297-4 | 04/13/16 | 14:00 | JDM | 04/14/16 | SO | Soil | SI-05-90-INITIAL |
| JC18297-5 | 04/13/16 | 14:20 | JDM | 04/14/16 | SO | Soil | SI-05-90-20 |
| JC18297-6 | 04/13/16 | 14:40 | JDM | 04/14/16 | SO | Soil | SI-05-90-40 |
| JC18297-7 | 04/13/16 | 15:00 | JDM | 04/14/16 | SO | Soil | SI-05-90-60 |
| JC18297-8 | 04/13/16 | 15:20 | JDM | 04/14/16 | SO | Soil | SI-05-90-80 |
| JC18297-9 | 04/13/16 | 15:40 | JDM | 04/14/16 | SO | Soil | SI-05-90-100 |
| JC18297-10 | 04/13/16 | 16:00 | JDM | 04/14/16 | SO | Soil | SI-05-90-POST |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits

**Job Number:** JC18297
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/13/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18297-1** | **SI-05+ SI-06 BASELINE(A)** | | | | | |
| Acetone | | 42000 | 10000 | 2200 | ug/kg | SW846 8260C |
| Benzene | | 67200000 | 1000000 | 270000 | ug/kg | SW846 8260C |
| 2-Butanone (MEK) | | 10200 | 10000 | 1900 | ug/kg | SW846 8260C |
| Carbon disulfide | | 105000 | 2000 | 230 | ug/kg | SW846 8260C |
| Chlorobenzene | | 15000 | 2000 | 160 | ug/kg | SW846 8260C |
| Chloroethane | | 3190 J | 5000 | 480 | ug/kg | SW846 8260C |
| Chloroform | | 568 J | 2000 | 150 | ug/kg | SW846 8260C |
| Chloromethane | | 47200 | 5000 | 260 | ug/kg | SW846 8260C |
| Cyclohexane | | 22800 | 2000 | 320 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 2250000 | 20000 | 2400 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 35300 | 1000 | 160 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 202000 | 20000 | 4500 | ug/kg | SW846 8260C |
| Ethylbenzene | | 302000 | 20000 | 3300 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 746000 | 40000 | 2100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 305000 | 100000 | 17000 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 59100 | 2000 | 230 | ug/kg | SW846 8260C |
| Methyl Tert Butyl Ether | | 299 J | 1000 | 150 | ug/kg | SW846 8260C |
| Naphthalene | | 5230000 | 1000000 | 38000 | ug/kg | SW846 8260C |
| Tetrachloroethene | | 1130 J | 2000 | 300 | ug/kg | SW846 8260C |
| Toluene | | 15600000 | 200000 | 42000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 4330 J | 5000 | 170 | ug/kg | SW846 8260C |
| 1,1,1-Trichloroethane | | 266 J | 2000 | 150 | ug/kg | SW846 8260C |
| m,p-Xylene | | 2820000 | 20000 | 7000 | ug/kg | SW846 8260C |
| o-Xylene | | 724000 | 20000 | 5500 | ug/kg | SW846 8260C |
| Xylene (total) | | 3540000 | 20000 | 5500 | ug/kg | SW846 8260C |
| **JC18297-2** | **SI-05+ SI-06 BASELINE(B)** | | | | | |
| Acetone | | 47700 | 9600 | 2200 | ug/kg | SW846 8260C |
| Benzene | | 56300000 | 960000 | 260000 | ug/kg | SW846 8260C |
| 2-Butanone (MEK) | | 8920 J | 9600 | 1800 | ug/kg | SW846 8260C |
| Carbon disulfide | | 87900 | 1900 | 220 | ug/kg | SW846 8260C |
| Chlorobenzene | | 13900 | 1900 | 150 | ug/kg | SW846 8260C |
| Chloroethane | | 2410 J | 4800 | 460 | ug/kg | SW846 8260C |
| Chloroform | | 467 J | 1900 | 140 | ug/kg | SW846 8260C |
| Chloromethane | | 34600 | 4800 | 250 | ug/kg | SW846 8260C |
| Cyclohexane | | 18200 | 1900 | 300 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 2110000 | 19000 | 2300 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 31200 | 960 | 150 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 176000 | 960 | 220 | ug/kg | SW846 8260C |
| Ethylbenzene | | 260000 | 19000 | 3100 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 632000 | 38000 | 2000 | ug/kg | SW846 8260C |
| Methyl Acetate | | 358000 | 96000 | 17000 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18297
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/13/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| Methylcyclohexane | 44800 | 1900 | 220 | ug/kg | SW846 8260C |
| Methyl Tert Butyl Ether | 433 J | 960 | 150 | ug/kg | SW846 8260C |
| Naphthalene | 4750000 | 960000 | 36000 | ug/kg | SW846 8260C |
| Tetrachloroethene | 312 J | 1900 | 290 | ug/kg | SW846 8260C |
| Toluene | 13500000 | 190000 | 40000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | 3730 J | 4800 | 160 | ug/kg | SW846 8260C |
| 1,1,1-Trichloroethane | 263 J | 1900 | 140 | ug/kg | SW846 8260C |
| m,p-Xylene | 2440000 | 19000 | 6800 | ug/kg | SW846 8260C |
| o-Xylene | 625000 | 19000 | 5300 | ug/kg | SW846 8260C |
| Xylene (total) | 3060000 | 19000 | 5300 | ug/kg | SW846 8260C |
| **JC18297-3 SI-05+ SI-06 BASELINE(C)** | | | | | |
| Acetone | 23900 | 10000 | 2200 | ug/kg | SW846 8260C |
| Benzene | 47800000 | 1000000 | 270000 | ug/kg | SW846 8260C |
| 2-Butanone (MEK) | 5660 J | 10000 | 1900 | ug/kg | SW846 8260C |
| Carbon disulfide | 76000 | 2000 | 230 | ug/kg | SW846 8260C |
| Chlorobenzene | 16100 | 2000 | 160 | ug/kg | SW846 8260C |
| Chloroethane | 1430 J | 5000 | 480 | ug/kg | SW846 8260C |
| Chloroform | 449 J | 2000 | 150 | ug/kg | SW846 8260C |
| Chloromethane | 14800 | 5000 | 260 | ug/kg | SW846 8260C |
| Cyclohexane | 17900 | 2000 | 320 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 2590000 | 200000 | 24000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 41700 | 1000 | 160 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 233000 | 200000 | 45000 | ug/kg | SW846 8260C |
| Ethylbenzene | 237000 | 200000 | 33000 | ug/kg | SW846 8260C |
| Isopropylbenzene | 544000 | 400000 | 21000 | ug/kg | SW846 8260C |
| Methyl Acetate | 197000 | 5000 | 860 | ug/kg | SW846 8260C |
| Methylcyclohexane | 46400 | 2000 | 230 | ug/kg | SW846 8260C |
| Naphthalene | 6940000 | 1000000 | 38000 | ug/kg | SW846 8260C |
| Tetrachloroethene | 372 J | 2000 | 300 | ug/kg | SW846 8260C |
| Toluene | 11600000 | 200000 | 42000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | 5010 | 5000 | 170 | ug/kg | SW846 8260C |
| 1,1,1-Trichloroethane | 469 J | 2000 | 150 | ug/kg | SW846 8260C |
| m,p-Xylene | 2190000 | 200000 | 70000 | ug/kg | SW846 8260C |
| o-Xylene | 581000 | 200000 | 55000 | ug/kg | SW846 8260C |
| Xylene (total) | 2770000 | 200000 | 55000 | ug/kg | SW846 8260C |
| **JC18297-4 SI-05-90-INITIAL** | | | | | |
| Acetone | 5530 J | 9800 | 2200 | ug/kg | SW846 8260C |
| Benzene | 11200000 | 98000 | 26000 | ug/kg | SW846 8260C |
| Carbon disulfide | 5940 | 2000 | 220 | ug/kg | SW846 8260C |
| Chlorobenzene | 5570 | 2000 | 150 | ug/kg | SW846 8260C |
| Chloromethane | 568 J | 4900 | 260 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18297
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/13/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| Cyclohexane | 5620 | 2000 | 310 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1590000 | 49000 | 6000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 21700 | 980 | 150 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 127000 | 980 | 220 | ug/kg | SW846 8260C |
| Ethylbenzene | 99700 | 980 | 160 | ug/kg | SW846 8260C |
| Isopropylbenzene | 280000 | 4900 | 260 | ug/kg | SW846 8260C |
| Methyl Acetate | 223000 | 12000 | 2100 | ug/kg | SW846 8260C |
| Methylcyclohexane | 15000 | 2000 | 220 | ug/kg | SW846 8260C |
| Naphthalene | 4870000 | 250000 | 9300 | ug/kg | SW846 8260C |
| Toluene | 3690000 | 49000 | 10000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | 3860 J | 4900 | 170 | ug/kg | SW846 8260C |
| m,p-Xylene | 912000 | 2500 | 860 | ug/kg | SW846 8260C |
| o-Xylene | 286000 | 2500 | 670 | ug/kg | SW846 8260C |
| Xylene (total) | 1200000 | 2500 | 670 | ug/kg | SW846 8260C |
| **JC18297-5 SI-05-90-20** | | | | | |
| Benzene | 8940000 | 100000 | 27000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1560000 | 51000 | 6200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 22100 J | 51000 | 8000 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 122000 | 51000 | 11000 | ug/kg | SW846 8260C |
| Ethylbenzene | 93600 | 51000 | 8300 | ug/kg | SW846 8260C |
| Isopropylbenzene | 271000 | 100000 | 5400 | ug/kg | SW846 8260C |
| Methylcyclohexane | 13100 J | 100000 | 12000 | ug/kg | SW846 8260C |
| Naphthalene | 5030000 | 260000 | 9600 | ug/kg | SW846 8260C |
| Toluene | 3680000 | 51000 | 11000 | ug/kg | SW846 8260C |
| m,p-Xylene | 896000 | 51000 | 18000 | ug/kg | SW846 8260C |
| o-Xylene | 265000 | 51000 | 14000 | ug/kg | SW846 8260C |
| Xylene (total) | 1160000 | 51000 | 14000 | ug/kg | SW846 8260C |
| **JC18297-6 SI-05-90-40** | | | | | |
| Benzene | 9150000 | 25000 | 6500 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1490000 | 49000 | 6000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 20000 J | 49000 | 7700 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 114000 | 49000 | 11000 | ug/kg | SW846 8260C |
| Ethylbenzene | 83800 | 49000 | 8000 | ug/kg | SW846 8260C |
| Isopropylbenzene | 261000 | 98000 | 5200 | ug/kg | SW846 8260C |
| Methyl Acetate | 187000 J | 250000 | 42000 | ug/kg | SW846 8260C |
| Methylcyclohexane | 12000 J | 98000 | 11000 | ug/kg | SW846 8260C |
| Naphthalene | 4850000 | 250000 | 9300 | ug/kg | SW846 8260C |
| Toluene | 3230000 | 49000 | 10000 | ug/kg | SW846 8260C |
| m,p-Xylene | 803000 | 49000 | 17000 | ug/kg | SW846 8260C |
| o-Xylene | 242000 | 49000 | 13000 | ug/kg | SW846 8260C |
| Xylene (total) | 1050000 | 49000 | 13000 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18297
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/13/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18297-7** | **SI-05-90-60** | | | | | |
| Benzene | | 7880000 | 22000 | 5800 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1170000 | 44000 | 5400 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 16500 J | 44000 | 6900 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 89500 | 44000 | 9900 | ug/kg | SW846 8260C |
| Ethylbenzene | | 68600 | 44000 | 7100 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 204000 | 88000 | 4600 | ug/kg | SW846 8260C |
| Methyl Acetate | | 187000 J | 220000 | 38000 | ug/kg | SW846 8260C |
| Naphthalene | | 3830000 | 220000 | 8300 | ug/kg | SW846 8260C |
| Toluene | | 2700000 | 44000 | 9100 | ug/kg | SW846 8260C |
| m,p-Xylene | | 648000 | 44000 | 15000 | ug/kg | SW846 8260C |
| o-Xylene | | 189000 | 44000 | 12000 | ug/kg | SW846 8260C |
| Xylene (total) | | 838000 | 44000 | 12000 | ug/kg | SW846 8260C |
| **JC18297-8** | **SI-05-90-80** | | | | | |
| Benzene | | 8030000 | 25000 | 6700 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1390000 | 50000 | 6100 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 17900 J | 50000 | 7900 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 103000 | 50000 | 11000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 74500 | 50000 | 8200 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 230000 | 100000 | 5300 | ug/kg | SW846 8260C |
| Methyl Acetate | | 162000 J | 250000 | 43000 | ug/kg | SW846 8260C |
| Naphthalene | | 4660000 | 250000 | 9500 | ug/kg | SW846 8260C |
| Toluene | | 2780000 | 50000 | 10000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 712000 | 50000 | 18000 | ug/kg | SW846 8260C |
| o-Xylene | | 218000 | 50000 | 14000 | ug/kg | SW846 8260C |
| Xylene (total) | | 931000 | 50000 | 14000 | ug/kg | SW846 8260C |
| **JC18297-9** | **SI-05-90-100** | | | | | |
| Benzene | | 6580000 | 23000 | 6200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1190000 | 46000 | 5600 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 16200 J | 46000 | 7300 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 91500 | 46000 | 10000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 63600 | 46000 | 7500 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 200000 | 93000 | 4900 | ug/kg | SW846 8260C |
| Methyl Acetate | | 174000 J | 230000 | 40000 | ug/kg | SW846 8260C |
| Naphthalene | | 4230000 | 230000 | 8800 | ug/kg | SW846 8260C |
| Toluene | | 2300000 | 46000 | 9600 | ug/kg | SW846 8260C |
| m,p-Xylene | | 602000 | 46000 | 16000 | ug/kg | SW846 8260C |
| o-Xylene | | 184000 | 46000 | 13000 | ug/kg | SW846 8260C |
| Xylene (total) | | 786000 | 46000 | 13000 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18297
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/13/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18297-10** | **SI-05-90-POST** | | | | | |
| Benzene | | 5310000 | 24000 | 6400 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1130000 | 48000 | 5900 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 14500 J | 48000 | 7500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 85900 | 48000 | 11000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 56000 | 48000 | 7800 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 178000 | 96000 | 5100 | ug/kg | SW846 8260C |
| Methyl Acetate | | 152000 J | 240000 | 41000 | ug/kg | SW846 8260C |
| Naphthalene | | 4070000 | 240000 | 9100 | ug/kg | SW846 8260C |
| Toluene | | 1950000 | 48000 | 10000 | ug/kg | SW846 8260C |
| m,p-Xylene | | 529000 | 48000 | 17000 | ug/kg | SW846 8260C |
| o-Xylene | | 166000 | 48000 | 13000 | ug/kg | SW846 8260C |
| Xylene (total) | | 695000 | 48000 | 13000 | ug/kg | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(A) | | |
| **Lab Sample ID:** | JC18297-1 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239619.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |
| Run #2 | D239685.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| Run #3 | D239806.D | 20 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #4 | D239867.D | 200 | 04/26/16 | AJ | n/a | n/a | VD9767 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 10.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 0.50 ul |
| Run #3 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #4 | 5.0 g | 10.0 ml | 1.0 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 42000 | 10000 | 2200 | ug/kg | |
| 71-43-2 | Benzene | 67200000 [b] | 1000000 | 270000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 5000 | 310 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 2000 | 160 | ug/kg | |
| 75-25-2 | Bromoform | ND | 5000 | 240 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 5000 | 360 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | 10200 | 10000 | 1900 | ug/kg | |
| 75-15-0 | Carbon disulfide | 105000 | 2000 | 230 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 2000 | 230 | ug/kg | |
| 108-90-7 | Chlorobenzene | 15000 | 2000 | 160 | ug/kg | |
| 75-00-3 | Chloroethane | 3190 | 5000 | 480 | ug/kg | J |
| 67-66-3 | Chloroform | 568 | 2000 | 150 | ug/kg | J |
| 74-87-3 | Chloromethane | 47200 | 5000 | 260 | ug/kg | |
| 110-82-7 | Cyclohexane | 22800 | 2000 | 320 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2000 | 540 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 2000 | 210 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1000 | 130 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 2250000 [c] | 20000 | 2400 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 35300 | 1000 | 160 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 202000 [c] | 20000 | 4500 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 5000 | 360 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1000 | 140 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1000 | 130 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1000 | 590 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1000 | 780 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1000 | 590 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 2000 | 240 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 2000 | 120 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(A) | | |
| **Lab Sample ID:** | JC18297-1 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 2000 | 180 | ug/kg | |
| 100-41-4 | Ethylbenzene | 302000 [c] | 20000 | 3300 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 5000 | 450 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 5000 | 1300 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 746000 [c] | 40000 | 2100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 305000 [c] | 100000 | 17000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 59100 | 2000 | 230 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | 299 | 1000 | 150 | ug/kg | J |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5000 | 460 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 5000 | 980 | ug/kg | |
| 91-20-3 | Naphthalene | 5230000 [d] | 1000000 | 38000 | ug/kg | |
| 100-42-5 | Styrene | ND | 2000 | 180 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 2000 | 180 | ug/kg | |
| 127-18-4 | Tetrachloroethene | 1130 | 2000 | 300 | ug/kg | J |
| 108-88-3 | Toluene | 15600000 [d] | 200000 | 42000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 5000 | 180 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4330 | 5000 | 170 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | 266 | 2000 | 150 | ug/kg | J |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 2000 | 150 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 1000 | 150 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 5000 | 250 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 2000 | 200 | ug/kg | |
| | m,p-Xylene | 2820000 [c] | 20000 | 7000 | ug/kg | |
| 95-47-6 | o-Xylene | 724000 [c] | 20000 | 5500 | ug/kg | |
| 1330-20-7 | Xylene (total) | 3540000 [c] | 20000 | 5500 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 107% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 50% | 103% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 85% | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 102% | 102% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 4
(c) Result is from Run# 2
(d) Result is from Run# 3

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(B) | | |
| **Lab Sample ID:** | JC18297-2 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239622.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |
| Run #2 | D239686.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| Run #3 | D239807.D | 20 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #4 | D239881.D | 200 | 04/26/16 | AJ | n/a | n/a | VD9768 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.2 g | 10.0 ml | 10.0 ul |
| Run #2 | 5.2 g | 10.0 ml | 0.50 ul |
| Run #3 | 5.2 g | 10.0 ml | 1.0 ul |
| Run #4 | 5.2 g | 10.0 ml | 1.0 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 47700 | 9600 | 2200 | ug/kg | |
| 71-43-2 | Benzene | 56300000 [b] | 960000 | 260000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 4800 | 300 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 1900 | 150 | ug/kg | |
| 75-25-2 | Bromoform | ND | 4800 | 230 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 4800 | 350 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | 8920 | 9600 | 1800 | ug/kg | J |
| 75-15-0 | Carbon disulfide | 87900 | 1900 | 220 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 1900 | 220 | ug/kg | |
| 108-90-7 | Chlorobenzene | 13900 | 1900 | 150 | ug/kg | |
| 75-00-3 | Chloroethane | 2410 | 4800 | 460 | ug/kg | J |
| 67-66-3 | Chloroform | 467 | 1900 | 140 | ug/kg | J |
| 74-87-3 | Chloromethane | 34600 | 4800 | 250 | ug/kg | |
| 110-82-7 | Cyclohexane | 18200 | 1900 | 300 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 1900 | 520 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 1900 | 200 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 960 | 130 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 2110000 [c] | 19000 | 2300 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 31200 | 960 | 150 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 176000 | 960 | 220 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 4800 | 350 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 960 | 140 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 960 | 130 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 960 | 570 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 960 | 750 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 960 | 570 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1900 | 230 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1900 | 110 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(B) | | |
| **Lab Sample ID:** | JC18297-2 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1900 | 170 | ug/kg | |
| 100-41-4 | Ethylbenzene | 260000 [c] | 19000 | 3100 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 4800 | 430 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 4800 | 1300 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 632000 [c] | 38000 | 2000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 358000 [c] | 96000 | 17000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 44800 | 1900 | 220 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | 433 | 960 | 150 | ug/kg | J |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 4800 | 440 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 4800 | 940 | ug/kg | |
| 91-20-3 | Naphthalene | 4750000 [d] | 960000 | 36000 | ug/kg | |
| 100-42-5 | Styrene | ND | 1900 | 170 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1900 | 170 | ug/kg | |
| 127-18-4 | Tetrachloroethene | 312 | 1900 | 290 | ug/kg | J |
| 108-88-3 | Toluene | 13500000 [d] | 190000 | 40000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 4800 | 170 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 3730 | 4800 | 160 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | 263 | 1900 | 140 | ug/kg | J |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1900 | 140 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 960 | 140 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 4800 | 240 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 1900 | 190 | ug/kg | |
| | m,p-Xylene | 2440000 [c] | 19000 | 6800 | ug/kg | |
| 95-47-6 | o-Xylene | 625000 [c] | 19000 | 5300 | ug/kg | |
| 1330-20-7 | Xylene (total) | 3060000 [c] | 19000 | 5300 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 106% | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 48% | 103% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 86% | 85% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 102% | 101% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 4
(c) Result is from Run# 2
(d) Result is from Run# 3

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(C) | | |
| **Lab Sample ID:** | JC18297-3 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239623.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |
| Run #2 | D239687.D | 20 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| Run #3 | D239736.D | 200 | 04/21/16 | AJ | n/a | n/a | VD9765 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 10.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #3 | 5.0 g | 10.0 ml | 1.0 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 23900 | 10000 | 2200 | ug/kg | |
| 71-43-2 | Benzene | 47800000 [b] | 1000000 | 270000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 5000 | 310 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 2000 | 160 | ug/kg | |
| 75-25-2 | Bromoform | ND | 5000 | 240 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 5000 | 360 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | 5660 | 10000 | 1900 | ug/kg | J |
| 75-15-0 | Carbon disulfide | 76000 | 2000 | 230 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 2000 | 230 | ug/kg | |
| 108-90-7 | Chlorobenzene | 16100 | 2000 | 160 | ug/kg | |
| 75-00-3 | Chloroethane | 1430 | 5000 | 480 | ug/kg | J |
| 67-66-3 | Chloroform | 449 | 2000 | 150 | ug/kg | J |
| 74-87-3 | Chloromethane | 14800 | 5000 | 260 | ug/kg | |
| 110-82-7 | Cyclohexane | 17900 | 2000 | 320 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2000 | 540 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 2000 | 210 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1000 | 130 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 2590000 [c] | 200000 | 24000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 41700 | 1000 | 160 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 233000 [c] | 200000 | 45000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 5000 | 360 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1000 | 140 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1000 | 130 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1000 | 590 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1000 | 780 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1000 | 590 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 2000 | 240 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 2000 | 120 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 2000 | 180 | ug/kg | |
| 100-41-4 | Ethylbenzene | 237000 [c] | 200000 | 33000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05+ SI-06 BASELINE(C) | | |
| **Lab Sample ID:** | JC18297-3 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 76-13-1 | Freon 113 | ND | 5000 | 450 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 5000 | 1300 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 544000 [c] | 400000 | 21000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 197000 | 5000 | 860 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 46400 | 2000 | 230 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1000 | 150 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5000 | 460 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 5000 | 980 | ug/kg | |
| 91-20-3 | Naphthalene | 6940000 [c] | 1000000 | 38000 | ug/kg | |
| 100-42-5 | Styrene | ND | 2000 | 180 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 2000 | 180 | ug/kg | |
| 127-18-4 | Tetrachloroethene | 372 | 2000 | 300 | ug/kg | J |
| 108-88-3 | Toluene | 11600000 [c] | 200000 | 42000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 5000 | 180 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 5010 | 5000 | 170 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | 469 | 2000 | 150 | ug/kg | J |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 2000 | 150 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 1000 | 150 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 5000 | 250 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 2000 | 200 | ug/kg | |
| | m,p-Xylene | 2190000 [c] | 200000 | 70000 | ug/kg | |
| 95-47-6 | o-Xylene | 581000 [c] | 200000 | 55000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 2770000 [c] | 200000 | 55000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 103% | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 53% | 97% | 98% | 68-124% |
| 2037-26-5 | Toluene-D8 | 87% | 92% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 103% | 102% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 3
(c) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-INITIAL | | |
| **Lab Sample ID:** | JC18297-4 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239624.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |
| Run #2 | D239850.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |
| Run #3 | D239772.D | 5 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| Run #4 | D239688.D | 20 | 04/20/16 | AJ | n/a | n/a | VD9763 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.1 g | 10.0 ml | 10.0 ul |
| Run #2 | 5.1 g | 10.0 ml | 4.0 ul |
| Run #3 | 5.1 g | 10.0 ml | 1.0 ul |
| Run #4 | 5.1 g | 10.0 ml | 1.0 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 5530 | 9800 | 2200 | ug/kg | J |
| 71-43-2 | Benzene | 11200000 [b] | 98000 | 26000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 4900 | 300 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 2000 | 150 | ug/kg | |
| 75-25-2 | Bromoform | ND | 4900 | 230 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 4900 | 360 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 9800 | 1900 | ug/kg | |
| 75-15-0 | Carbon disulfide | 5940 | 2000 | 220 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 2000 | 230 | ug/kg | |
| 108-90-7 | Chlorobenzene | 5570 | 2000 | 150 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 4900 | 470 | ug/kg | |
| 67-66-3 | Chloroform | ND | 2000 | 150 | ug/kg | |
| 74-87-3 | Chloromethane | 568 | 4900 | 260 | ug/kg | J |
| 110-82-7 | Cyclohexane | 5620 | 2000 | 310 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2000 | 530 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 2000 | 200 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 980 | 130 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1590000 [c] | 49000 | 6000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 21700 | 980 | 150 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 127000 | 980 | 220 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 4900 | 350 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 980 | 140 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 980 | 130 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 980 | 580 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 980 | 760 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 980 | 580 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 2000 | 230 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 2000 | 120 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-INITIAL | | |
| **Lab Sample ID:** | JC18297-4 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 2000 | 170 | ug/kg | |
| 100-41-4 | Ethylbenzene | 99700 | 980 | 160 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 4900 | 440 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 4900 | 1300 | ug/kg | |
| 98-82-8 | Isopropylbenzene | 280000 [d] | 4900 | 260 | ug/kg | |
| 79-20-9 | Methyl Acetate | 223000 [d] | 12000 | 2100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 15000 | 2000 | 220 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 980 | 150 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 4900 | 450 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 4900 | 960 | ug/kg | |
| 91-20-3 | Naphthalene | 4870000 [c] | 250000 | 9300 | ug/kg | |
| 100-42-5 | Styrene | ND | 2000 | 170 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 2000 | 170 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 2000 | 300 | ug/kg | |
| 108-88-3 | Toluene | 3690000 [c] | 49000 | 10000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 4900 | 170 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 3860 | 4900 | 170 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 2000 | 150 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 2000 | 140 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 980 | 140 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 4900 | 240 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 2000 | 190 | ug/kg | |
| | m,p-Xylene | 912000 [d] | 2500 | 860 | ug/kg | |
| 95-47-6 | o-Xylene | 286000 [d] | 2500 | 670 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1200000 [d] | 2500 | 670 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 105% | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 90% | 96% | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 86% | 86% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 96% | 102% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 4
(c) Result is from Run# 3
(d) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-20 | | |
| **Lab Sample ID:** | JC18297-5 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239773.D | 5 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | D239689.D | 20 | 04/20/16 | AJ | n/a | n/a | VD9763 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 1.0 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 510000 | 110000 | ug/kg | |
| 71-43-2 | Benzene | 8940000 [b] | 100000 | 27000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 260000 | 16000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100000 | 8000 | ug/kg | |
| 75-25-2 | Bromoform | ND | 260000 | 12000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 260000 | 19000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 510000 | 97000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100000 | 12000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100000 | 12000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100000 | 7900 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 260000 | 25000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100000 | 7600 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 260000 | 13000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100000 | 16000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100000 | 28000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100000 | 10000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 51000 | 6700 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1560000 | 51000 | 6200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 22100 | 51000 | 8000 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 122000 | 51000 | 11000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 260000 | 18000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 51000 | 7200 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 51000 | 6800 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 51000 | 30000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 51000 | 40000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 51000 | 30000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100000 | 12000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100000 | 6000 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100000 | 9000 | ug/kg | |
| 100-41-4 | Ethylbenzene | 93600 | 51000 | 8300 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 260000 | 23000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 260000 | 68000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-20 | | |
| **Lab Sample ID:** | JC18297-5 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 271000 | 100000 | 5400 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 260000 | 44000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 13100 | 100000 | 12000 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 51000 | 7800 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 260000 | 23000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 260000 | 50000 | ug/kg | |
| 91-20-3 | Naphthalene | 5030000 | 260000 | 9600 | ug/kg | |
| 100-42-5 | Styrene | ND | 100000 | 9100 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100000 | 8900 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100000 | 15000 | ug/kg | |
| 108-88-3 | Toluene | 3680000 | 51000 | 11000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 260000 | 9000 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 260000 | 8600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100000 | 7600 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100000 | 7500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 51000 | 7500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 260000 | 13000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100000 | 10000 | ug/kg | |
| | m,p-Xylene | 896000 | 51000 | 18000 | ug/kg | |
| 95-47-6 | o-Xylene | 265000 | 51000 | 14000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1160000 | 51000 | 14000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 106% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-40 | | |
| **Lab Sample ID:** | JC18297-6 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239804.D | 5 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | | | | | | | |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.1 g | 10.0 ml | 1.0 ul |
| Run #2 | | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 490000 | 110000 | ug/kg | |
| 71-43-2 | Benzene | 9150000 | 25000 | 6500 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250000 | 15000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 98000 | 7600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250000 | 12000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250000 | 18000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 490000 | 94000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 98000 | 11000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 98000 | 11000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 98000 | 7600 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250000 | 24000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 98000 | 7300 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250000 | 13000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 98000 | 15000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 98000 | 27000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 98000 | 10000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 49000 | 6400 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1490000 | 49000 | 6000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 20000 | 49000 | 7700 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 114000 | 49000 | 11000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250000 | 18000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 49000 | 6900 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 49000 | 6600 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 49000 | 29000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 49000 | 38000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 49000 | 29000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 98000 | 12000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 98000 | 5800 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 98000 | 8700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 83800 | 49000 | 8000 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250000 | 22000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250000 | 66000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-40 | | |
| **Lab Sample ID:** | JC18297-6 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 261000 | 98000 | 5200 | ug/kg | |
| 79-20-9 | Methyl Acetate | 187000 | 250000 | 42000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | 12000 | 98000 | 11000 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 49000 | 7500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250000 | 22000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250000 | 48000 | ug/kg | |
| 91-20-3 | Naphthalene | 4850000 | 250000 | 9300 | ug/kg | |
| 100-42-5 | Styrene | ND | 98000 | 8700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 98000 | 8600 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 98000 | 15000 | ug/kg | |
| 108-88-3 | Toluene | 3230000 | 49000 | 10000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250000 | 8600 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250000 | 8300 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 98000 | 7300 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 98000 | 7200 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 49000 | 7200 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250000 | 12000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 98000 | 9700 | ug/kg | |
| | m,p-Xylene | 803000 | 49000 | 17000 | ug/kg | |
| 95-47-6 | o-Xylene | 242000 | 49000 | 13000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1050000 | 49000 | 13000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | | 72-130% |

(a) All results reported on a wet weight basis.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-60 | | |
| **Lab Sample ID:** | JC18297-7 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239805.D | 5 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | | | | | | | |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.7 g | 10.0 ml | 1.0 ul |
| Run #2 | | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 440000 | 98000 | ug/kg | |
| 71-43-2 | Benzene | 7880000 | 22000 | 5800 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 220000 | 14000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 88000 | 6800 | ug/kg | |
| 75-25-2 | Bromoform | ND | 220000 | 10000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 220000 | 16000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 440000 | 84000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 88000 | 10000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 88000 | 10000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 88000 | 6800 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 220000 | 21000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 88000 | 6500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 220000 | 11000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 88000 | 14000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 88000 | 24000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 88000 | 9000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 44000 | 5700 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1170000 | 44000 | 5400 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 16500 | 44000 | 6900 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 89500 | 44000 | 9900 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 220000 | 16000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 44000 | 6200 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 44000 | 5900 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 44000 | 26000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 44000 | 34000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 44000 | 26000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 88000 | 10000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 88000 | 5200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 88000 | 7800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 68600 | 44000 | 7100 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 220000 | 20000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 220000 | 59000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-60 | | |
| **Lab Sample ID:** | JC18297-7 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 204000 | 88000 | 4600 | ug/kg | |
| 79-20-9 | Methyl Acetate | 187000 | 220000 | 38000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | ND | 88000 | 10000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 44000 | 6700 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 220000 | 20000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 220000 | 43000 | ug/kg | |
| 91-20-3 | Naphthalene | 3830000 | 220000 | 8300 | ug/kg | |
| 100-42-5 | Styrene | ND | 88000 | 7800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 88000 | 7700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 88000 | 13000 | ug/kg | |
| 108-88-3 | Toluene | 2700000 | 44000 | 9100 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 220000 | 7700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 220000 | 7400 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 88000 | 6500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 88000 | 6400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 44000 | 6400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 220000 | 11000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 88000 | 8600 | ug/kg | |
| | m,p-Xylene | 648000 | 44000 | 15000 | ug/kg | |
| 95-47-6 | o-Xylene | 189000 | 44000 | 12000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 838000 | 44000 | 12000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | | 72-130% |

(a) All results reported on a wet weight basis.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-80 | | |
| **Lab Sample ID:** | JC18297-8 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239808.D | 5 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | | | | | | | |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500000 | 110000 | ug/kg | |
| 71-43-2 | Benzene | 8030000 | 25000 | 6700 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250000 | 15000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100000 | 7800 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250000 | 12000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250000 | 18000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500000 | 96000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100000 | 11000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100000 | 12000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100000 | 7800 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250000 | 24000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100000 | 7500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250000 | 13000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100000 | 16000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100000 | 27000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100000 | 10000 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50000 | 6600 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1390000 | 50000 | 6100 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 17900 | 50000 | 7900 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 103000 | 50000 | 11000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250000 | 18000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50000 | 7100 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50000 | 6700 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50000 | 30000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50000 | 39000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50000 | 30000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100000 | 12000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100000 | 5900 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100000 | 8900 | ug/kg | |
| 100-41-4 | Ethylbenzene | 74500 | 50000 | 8200 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250000 | 22000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250000 | 67000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-80 | | |
| **Lab Sample ID:** | JC18297-8 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 230000 | 100000 | 5300 | ug/kg | |
| 79-20-9 | Methyl Acetate | 162000 | 250000 | 43000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | ND | 100000 | 11000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50000 | 7700 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250000 | 23000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250000 | 49000 | ug/kg | |
| 91-20-3 | Naphthalene | 4660000 | 250000 | 9500 | ug/kg | |
| 100-42-5 | Styrene | ND | 100000 | 8900 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100000 | 8800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100000 | 15000 | ug/kg | |
| 108-88-3 | Toluene | 2780000 | 50000 | 10000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250000 | 8800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250000 | 8500 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100000 | 7500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100000 | 7400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50000 | 7400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250000 | 12000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100000 | 9900 | ug/kg | |
| | m,p-Xylene | 712000 | 50000 | 18000 | ug/kg | |
| 95-47-6 | o-Xylene | 218000 | 50000 | 14000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 931000 | 50000 | 14000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | | 72-130% |

(a) All results reported on a wet weight basis.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-100 | | |
| **Lab Sample ID:** | JC18297-9 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239809.D | 5 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | | | | | | | |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.4 g | 10.0 ml | 1.0 ul |
| Run #2 | | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 460000 | 100000 | ug/kg | |
| 71-43-2 | Benzene | 6580000 | 23000 | 6200 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 230000 | 14000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 93000 | 7200 | ug/kg | |
| 75-25-2 | Bromoform | ND | 230000 | 11000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 230000 | 17000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 460000 | 88000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 93000 | 11000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 93000 | 11000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 93000 | 7200 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 230000 | 22000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 93000 | 6900 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 230000 | 12000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 93000 | 15000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 93000 | 25000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 93000 | 9500 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 46000 | 6100 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1190000 | 46000 | 5600 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 16200 | 46000 | 7300 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 91500 | 46000 | 10000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 230000 | 17000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 46000 | 6500 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 46000 | 6200 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 46000 | 27000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 46000 | 36000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 46000 | 28000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 93000 | 11000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 93000 | 5500 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 93000 | 8200 | ug/kg | |
| 100-41-4 | Ethylbenzene | 63600 | 46000 | 7500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 230000 | 21000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 230000 | 62000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-100 | | |
| **Lab Sample ID:** | JC18297-9 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 200000 | 93000 | 4900 | ug/kg | |
| 79-20-9 | Methyl Acetate | 174000 | 230000 | 40000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | ND | 93000 | 11000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 46000 | 7100 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 230000 | 21000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 230000 | 45000 | ug/kg | |
| 91-20-3 | Naphthalene | 4230000 | 230000 | 8800 | ug/kg | |
| 100-42-5 | Styrene | ND | 93000 | 8200 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 93000 | 8100 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 93000 | 14000 | ug/kg | |
| 108-88-3 | Toluene | 2300000 | 46000 | 9600 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 230000 | 8100 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 230000 | 7800 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 93000 | 6900 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 93000 | 6800 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 46000 | 6800 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 230000 | 12000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 93000 | 9100 | ug/kg | |
| | m,p-Xylene | 602000 | 46000 | 16000 | ug/kg | |
| 95-47-6 | o-Xylene | 184000 | 46000 | 13000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 786000 | 46000 | 13000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | | 72-130% |

(a) All results reported on a wet weight basis.

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis



| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-POST | | |
| **Lab Sample ID:** | JC18297-10 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | D239810.D | 5 | 04/23/16 | AJ | n/a | n/a | VD9766 |
| Run #2 | | | | | | | |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.2 g | 10.0 ml | 1.0 ul |
| Run #2 | | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 480000 | 110000 | ug/kg | |
| 71-43-2 | Benzene | 5310000 | 24000 | 6400 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 240000 | 15000 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 96000 | 7500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 240000 | 11000 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 240000 | 17000 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 480000 | 92000 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 96000 | 11000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 96000 | 11000 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 96000 | 7500 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 240000 | 23000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 96000 | 7200 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 240000 | 13000 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 96000 | 15000 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 96000 | 26000 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 96000 | 9900 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 48000 | 6300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1130000 | 48000 | 5900 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 14500 | 48000 | 7500 | ug/kg | J |
| 106-46-7 | 1,4-Dichlorobenzene | 85900 | 48000 | 11000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 240000 | 17000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 48000 | 6800 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 48000 | 6400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 48000 | 28000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 48000 | 37000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 48000 | 29000 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 96000 | 11000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 96000 | 5700 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 96000 | 8500 | ug/kg | |
| 100-41-4 | Ethylbenzene | 56000 | 48000 | 7800 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 240000 | 22000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 240000 | 64000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis



| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-POST | | |
| **Lab Sample ID:** | JC18297-10 | **Date Sampled:** | 04/13/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/14/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 178000 | 96000 | 5100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 152000 | 240000 | 41000 | ug/kg | J |
| 108-87-2 | Methylcyclohexane | ND | 96000 | 11000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 48000 | 7400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 240000 | 22000 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 240000 | 47000 | ug/kg | |
| 91-20-3 | Naphthalene | 4070000 | 240000 | 9100 | ug/kg | |
| 100-42-5 | Styrene | ND | 96000 | 8600 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 96000 | 8400 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 96000 | 14000 | ug/kg | |
| 108-88-3 | Toluene | 1950000 | 48000 | 10000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 240000 | 8500 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 240000 | 8100 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 96000 | 7200 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 96000 | 7100 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 48000 | 7100 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 240000 | 12000 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 96000 | 9500 | ug/kg | |
| | m,p-Xylene | 529000 | 48000 | 17000 | ug/kg | |
| 95-47-6 | o-Xylene | 166000 | 48000 | 13000 | ug/kg | |
| 1330-20-7 | Xylene (total) | 695000 | 48000 | 13000 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | | 72-130% |

(a) All results reported on a wet weight basis.

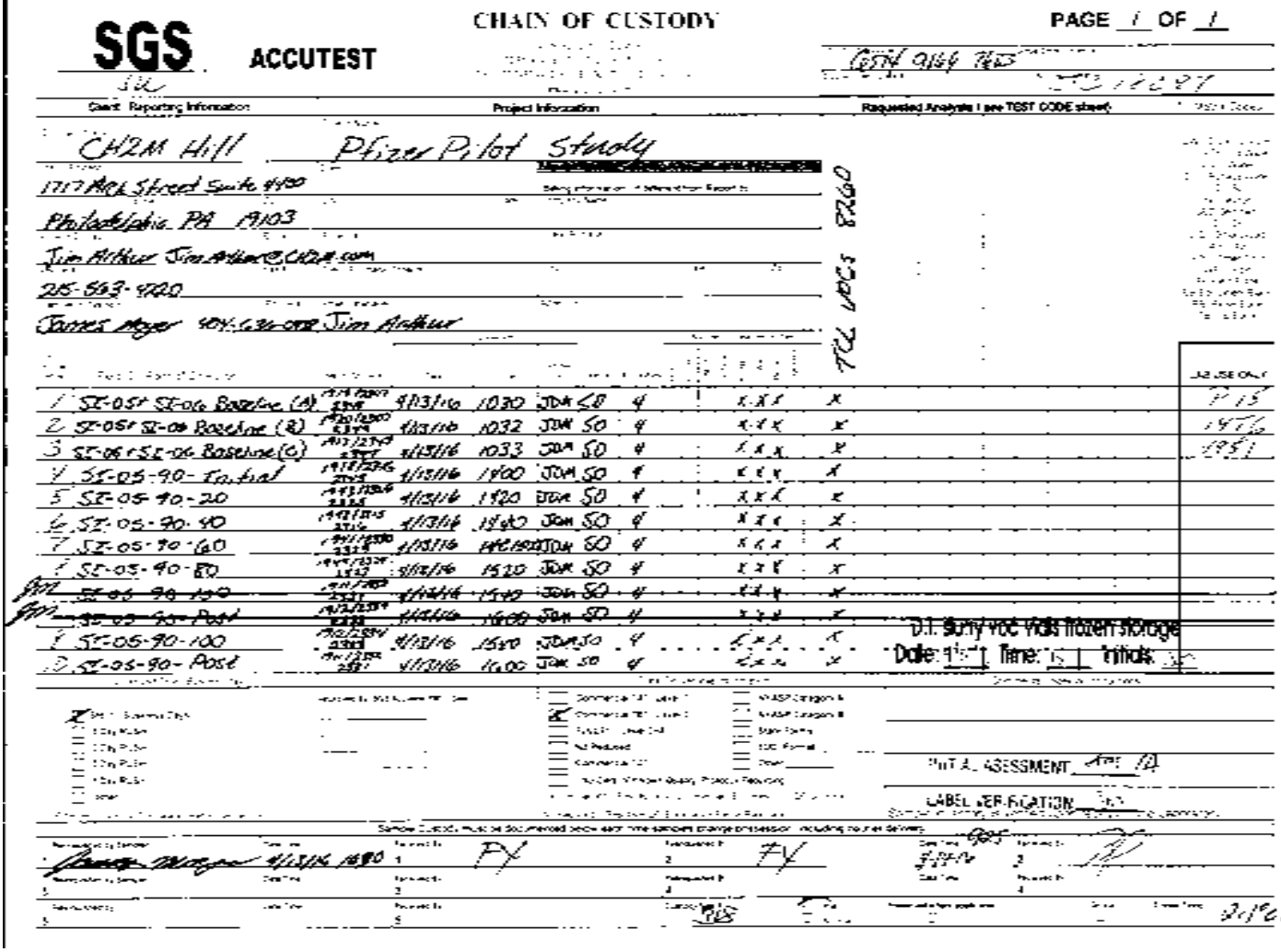
ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

## Misc. Forms

# Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



SGS ACCUTEST

CHAIN OF CUSTODY

PAGE 1 OF 1

Client / Reporting Information

CH2M Hill

1717 Arch Street Suite 4400

Philadelphia PA 19103

Jim Arthur Jim.Arthur@CH2M.com

215-563-4220

James Meyer 484-632-0018 Jim Arthur

Project Information

Pfizer Pilot Study

Requested Analysis (see TEST CODE sheet)

TCL VOCs 8260

| | Sample ID | Date | Time | Sampled By | # of bottles | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | SZ-05f SZ-06 Baseline (A) | 4/13/16 | 1030 | JDM | 50 | 4 | X X X | X |
| 2 | SZ-05f SZ-06 Baseline (B) | 4/13/16 | 1032 | JDM | 50 | 4 | X X X | X |
| 3 | SZ-06 f SZ-06 Baseline (C) | 4/13/16 | 1033 | JDM | 50 | 4 | X X X | X |
| 4 | SZ-05-90-Initial | 4/13/16 | 1400 | JDM | 50 | 4 | X X X | X |
| 5 | SZ-05-90-20 | 4/13/16 | 1420 | JDM | 50 | 4 | X X X | X |
| 6 | SZ-05-90-40 | 4/13/16 | 1440 | JDM | 50 | 4 | X X X | X |
| 7 | SZ-05-90-60 | 4/13/16 | 1500 | JDM | 50 | 4 | X X X | X |
| 8 | SZ-05-90-80 | 4/13/16 | 1520 | JDM | 50 | 4 | X X X | X |
| 9 | SZ-05-90-100 | 4/13/16 | 1540 | JDM | 50 | 4 | X X X | X |
| 10 | SZ-05-90-Post | 4/13/16 | 1600 | JDM | 50 | 4 | X X X | X |

Lab use only

P15

1476

1951

D.I. Sunny VOC vials frozen storage

Date: 4/14 Time: 15 Initials: JM

INITIAL ASSESSMENT: APR 14

LABEL VERIFICATION:

Relinquished by Sampler: James Meyer 4/13/16 1600

Received By: FX

Relinquished By: FX

Received By: FED EX

Cooler Temp: 2.1°C

# SGS Accutest Sample Receipt Summary

**Job Number:** JC18297 **Client:** _____ **Project:** _____

**Date / Time Received:** 4/14/2016 9:25:00 AM **Delivery Method:** _____ **Airbill #'s:** _____

Cooler Temps (Raw Measured) °C: Cooler 1: (2.1);

Cooler Temps (Corrected) °C: Cooler 1: (2.5);

| Cooler Security | Y | or | N | | Y | or | N |
|---|---|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | | ☐ | 3. COC Present: | ☑ | | ☐ |
| 2. Custody Seals Intact: | ☑ | | ☐ | 4. Smpl Dates/Time OK | ☑ | | ☐ |

| Cooler Temperature | Y | or | N |
|---|---|---|---|
| 1. Temp criteria achieved: | ☑ | | ☐ |
| 2. Cooler temp verification: | IR Gun | | |
| 3. Cooler media: | Ice (Bag) | | |
| 4. No. Coolers: | 1 | | |

| Quality Control Preservation | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | | ☐ | ☑ |
| 2. Trip Blank listed on COC: | ☐ | | ☐ | ☑ |
| 3. Samples preserved properly: | ☑ | | ☐ | |
| 4. VOCs headspace free: | ☐ | | ☐ | ☑ |

| Sample Integrity - Documentation | Y | or | N |
|---|---|---|---|
| 1. Sample labels present on bottles: | ☑ | | ☐ |
| 2. Container labeling complete: | ☑ | | ☐ |
| 3. Sample container label / COC agree: | ☑ | | ☐ |

| Sample Integrity - Condition | Y | or | N |
|---|---|---|---|
| 1. Sample recvd within HT: | ☑ | | ☐ |
| 2. All containers accounted for: | ☑ | | ☐ |
| 3. Condition of sample: | Intact | | |

| Sample Integrity - Instructions | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | | ☐ | |
| 4. Compositing instructions clear: | ☐ | | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | | ☐ | ☑ |

Comments

**JC18297: Chain of Custody**
**Page 2 of 2**

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-MB | D239613.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-MB | D239613.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 111% | 68-124% |
| 2037-26-5 | Toluene-D8 | 96% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9763-MB | D239678.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4, JC18297-5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9765-MB | D239730.D | 1 | 04/21/16 | AJ | n/a | n/a | VD9765 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-3

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB | D239767.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-4, JC18297-5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB | D239767.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-4, JC18297-5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB3 | D239799.D | 1 | 04/23/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB3 | D239799.D | 1 | 04/23/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9767-MB | D239837.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-4

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9767-MB2 | D239861.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 96% | 68-124% |
| 2037-26-5 | Toluene-D8 | 89% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 72-130% |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9768-MB | D239875.D | 1 | 04/26/16 | AJ | n/a | n/a | VD9768 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-2

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-MB2 | D239659.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18295-9MS, JC18295-9MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-MB2 | D239659.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18295-9MS, JC18295-9MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9765-MB2 | D239750.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9765 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18400-16MS, JC18400-16MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 91% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9765-MB2 | D239762.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9765 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18400-16MS, JC18400-16MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 90% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB2 | D239786.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18422-2MS, JC18422-2MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-MB2 | D239786.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18422-2MS, JC18422-2MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-130% |

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-BS | D239614.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 3370 | 135 | 30-150 |
| 74-97-5 | Bromochloromethane | 2500 | 2750 | 110 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2770 | 111 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2840 | 114 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2420 | 97 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 3020 | 121 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2760 | 110 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2880 | 115 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2750 | 110 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2430 | 97 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2960 | 118 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2150 | 86 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2790 | 112 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2840 | 114 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2740 | 110 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2640 | 106 | 83-125 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2710 | 108 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2720 | 109 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2460 | 98 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2970 | 119 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2890 | 116 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2810 | 112 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2640 | 106 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2880 | 115 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2720 | 109 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2670 | 107 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2670 | 107 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2760 | 110 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2760 | 110 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2530 | 101 | 63-140 |
| 79-20-9 | Methyl Acetate | 2500 | 2540 | 102 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2760 | 110 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 5390 | 108 | 77-121 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2810 | 112 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2750 | 110 | 71-124 |
| 100-42-5 | Styrene | 2500 | 2780 | 111 | 79-125 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9762-BS | D239614.D | 1 | 04/18/16 | AJ | n/a | n/a | VD9762 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2650 | 106 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2560 | 102 | 70-135 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2850 | 114 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2900 | 116 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2940 | 118 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2560 | 102 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2690 | 108 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 2520 | 101 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2310 | 92 | 57-136 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 112% | 68-124% |
| 2037-26-5 | Toluene-D8 | 97% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9763-BS | D239679.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4, JC18297-5

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 2500 | 2410 | 96 | 77-122 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2490 | 100 | 79-118 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2440 | 98 | 75-118 |
| 100-41-4 | Ethylbenzene | 2500 | 2440 | 98 | 75-121 |
| 98-82-8 | Isopropylbenzene | 2500 | 2490 | 100 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2250 | 90 | 59-131 |
| 91-20-3 | Naphthalene | 2500 | 2790 | 112 | 74-126 |
| 108-88-3 | Toluene | 2500 | 2320 | 93 | 75-123 |
| | m,p-Xylene | 5000 | 4980 | 100 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2520 | 101 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7510 | 100 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9765-BS | D239731.D | 1 | 04/21/16 | AJ | n/a | n/a | VD9765 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-3

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 2500 | 2420 | 97 | 77-122 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-BS | D239768.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-4, JC18297-5

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2490 | 100 | 30-150 |
| 74-97-5 | Bromochloromethane | 2500 | 2590 | 104 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2480 | 99 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2640 | 106 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2260 | 90 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2450 | 98 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2470 | 99 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2580 | 103 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2560 | 102 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2340 | 94 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2650 | 106 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2270 | 91 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2410 | 96 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2430 | 97 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2500 | 100 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2440 | 98 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2530 | 101 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2500 | 100 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2530 | 101 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2540 | 102 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2530 | 101 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2530 | 101 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2430 | 97 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2420 | 97 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2450 | 98 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2320 | 93 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2370 | 95 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2380 | 95 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2490 | 100 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2590 | 104 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2010 | 80 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2470 | 99 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2250 | 90 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2310 | 92 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4450 | 89 | 77-121 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2290 | 92 | 73-141 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-BS | D239768.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-4, JC18297-5

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | 2500 | 2460 | 98 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2700 | 108 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2540 | 102 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2320 | 93 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2400 | 96 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2440 | 98 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2470 | 99 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2520 | 101 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2540 | 102 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2290 | 92 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2520 | 101 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 2600 | 104 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2370 | 95 | 57-136 |
| | m,p-Xylene | 5000 | 5110 | 102 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2500 | 100 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7620 | 102 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-BS2 | D239800.D | 1 | 04/23/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 2380 | 95 | 30-150 |
| 71-43-2 | Benzene | 2500 | 2640 | 106 | 77-122 |
| 74-97-5 | Bromochloromethane | 2500 | 2780 | 111 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2670 | 107 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2810 | 112 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2300 | 92 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2540 | 102 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2490 | 100 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2600 | 104 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2700 | 108 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2240 | 90 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2830 | 113 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2030 | 81 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2390 | 96 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2720 | 109 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2710 | 108 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2650 | 106 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2720 | 109 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2680 | 107 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2690 | 108 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2360 | 94 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2680 | 107 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2700 | 108 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2460 | 98 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2540 | 102 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2570 | 103 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2510 | 100 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2520 | 101 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2520 | 101 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2640 | 106 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2580 | 103 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2410 | 96 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2760 | 110 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2430 | 97 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2330 | 93 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 4620 | 92 | 77-121 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9766-BS2 | D239800.D | 1 | 04/23/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2480 | 99 | 73-141 |
| 75-09-2 | Methylene chloride | 2500 | 2560 | 102 | 71-124 |
| 91-20-3 | Naphthalene | 2500 | 2830 | 113 | 74-126 |
| 100-42-5 | Styrene | 2500 | 2670 | 107 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2600 | 104 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2520 | 101 | 70-135 |
| 108-88-3 | Toluene | 2500 | 2610 | 104 | 75-123 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2780 | 111 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2810 | 112 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2630 | 105 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2460 | 98 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2660 | 106 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 2350 | 94 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 2120 | 85 | 57-136 |
| | m,p-Xylene | 5000 | 5460 | 109 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2690 | 108 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 8150 | 109 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9767-BS | D239838.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-4

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 2500 | 2710 | 108 | 77-122 |
| 98-82-8 | Isopropylbenzene | 2500 | 2870 | 115 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2540 | 102 | 59-131 |
| | m,p-Xylene | 5000 | 5490 | 110 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2770 | 111 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 8260 | 110 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VD9768-BS | D239876.D | 1 | 04/26/16 | AJ | n/a | n/a | VD9768 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-2

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 2500 | 2830 | 113 | 77-122 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18295-9MS | D239665.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9MSD | D239666.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9 | D239662.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9 | D239663.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | JC18295-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 14100 | 13800 | 98 | 14100 | 13200 | 93 | 4 | 10-180/33 |
| 74-97-5 | Bromochloromethane | ND | | 14100 | 14500 | 103 | 14100 | 14800 | 105 | 2 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 14100 | 14300 | 101 | 14100 | 14400 | 102 | 1 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 14100 | 15000 | 106 | 14100 | 15000 | 106 | 0 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 14100 | 9900 | 70 | 14100 | 10400 | 74 | 5 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 14100 | 14100 | 100 | 14100 | 14000 | 99 | 1 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 14100 | 14200 | 100 | 14100 | 14200 | 100 | 0 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 14100 | 14700 | 104 | 14100 | 15100 | 107 | 3 | 43-152/31 |
| 108-90-7 | Chlorobenzene | 64.1 | J | 14100 | 14900 | 105 | 14100 | 15100 | 107 | 1 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 14100 | 11700 | 83 | 14100 | 11900 | 84 | 2 | 26-154/34 |
| 67-66-3 | Chloroform | 559 | J | 14100 | 15900 | 112 | 14100 | 15800 | 112 | 1 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 14100 | 11600 | 82 | 14100 | 11600 | 82 | 0 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 14100 | 13600 | 96 | 14100 | 14000 | 99 | 3 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 14100 | 15000 | 106 | 14100 | 15600 | 110 | 4 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 14100 | 14900 | 105 | 14100 | 15200 | 107 | 2 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 14100 | 14200 | 100 | 14100 | 14300 | 101 | 1 | 46-139/24 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 14100 | 14800 | 105 | 14100 | 14800 | 105 | 0 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 14100 | 14800 | 105 | 14100 | 14900 | 105 | 1 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 14100 | 12700 | 90 | 14100 | 13100 | 93 | 3 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 14100 | 14700 | 104 | 14100 | 14600 | 103 | 1 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | 550 | | 14100 | 15100 | 107 | 14100 | 15000 | 106 | 1 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | 487 | | 14100 | 14400 | 102 | 14100 | 14500 | 103 | 1 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | 704 | | 14100 | 14600 | 103 | 14100 | 14400 | 102 | 1 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | 1280 | | 14100 | 15500 | 110 | 14100 | 15500 | 110 | 0 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 14100 | 13800 | 98 | 14100 | 13600 | 96 | 1 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 14100 | 13500 | 95 | 14100 | 13800 | 98 | 2 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 14100 | 13400 | 95 | 14100 | 13700 | 97 | 2 | 36-148/27 |
| 100-41-4 | Ethylbenzene | ND | | 14100 | 14600 | 103 | 14100 | 14600 | 103 | 0 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 14100 | 14900 | 105 | 14100 | 15400 | 109 | 3 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 14100 | 11500 | 81 | 14100 | 11900 | 84 | 3 | 16-176/32 |
| 79-20-9 | Methyl Acetate | ND | | 14100 | 13200 | 93 | 14100 | 13100 | 93 | 1 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | ND | | 14100 | 13800 | 98 | 14100 | 14100 | 100 | 2 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 28300 | 26300 | 93 | 28300 | 27100 | 96 | 3 | 54-129/25 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 14100 | 13600 | 96 | 14100 | 13600 | 96 | 0 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 14100 | 14300 | 101 | 14100 | 14300 | 101 | 0 | 47-133/25 |
| 100-42-5 | Styrene | ND | | 14100 | 14600 | 103 | 14100 | 14400 | 102 | 1 | 32-156/31 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18295-9MS | D239665.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9MSD | D239666.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9 | D239662.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |
| JC18295-9 | D239663.D | 1 | 04/19/16 | AJ | n/a | n/a | VD9762 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4

| CAS No. | Compound | JC18295-9 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 14100 | 13800 | 98 | 14100 | 13900 | 98 | 1 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | 93500 | b | 14100 | 121000 | 194* | a 14100 | 121000 | 194* | a 0 | 34-163/31 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 14100 | 15900 | 112 | 14100 | 17100 | 121 | 7 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 14100 | 16100 | 114 | 14100 | 17300 | 122 | 7 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 14100 | 14800 | 105 | 14100 | 15100 | 107 | 2 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | 2580 | | 14100 | 15400 | 90 | 14100 | 15600 | 91 | 1 | 43-146/27 |
| 79-01-6 | Trichloroethene | 37400 | | 14100 | 53100 | 130 | 14100 | 52600 | 127 | 1 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 14100 | 13300 | 94 | 14100 | 13600 | 96 | 2 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 14100 | 12000 | 85 | 14100 | 12500 | 88 | 4 | 38-149/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18295-9 | JC18295-9 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 103% | 105% | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 102% | 99% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 95% | 94% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 100% | 103% | 103% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Result is from Run #2.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18295-4MS | D239691.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| JC18295-4MSD | D239692.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| JC18295-4 | D239683.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |
| JC18295-4 | D239684.D | 1 | 04/20/16 | AJ | n/a | n/a | VD9763 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-3, JC18297-4, JC18297-5

| CAS No. | Compound | JC18295-4 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND [a] | | 13600 | 14500 | 107 | 13600 | 14600 | 108 | 1 | 48-136/30 |
| 95-50-1 | 1,2-Dichlorobenzene | ND [a] | | 13600 | 14800 | 109 | 13600 | 14900 | 110 | 1 | 30-144/30 |
| 106-46-7 | 1,4-Dichlorobenzene | ND [a] | | 13600 | 14500 | 107 | 13600 | 14600 | 108 | 1 | 30-142/31 |
| 100-41-4 | Ethylbenzene | ND [a] | | 13600 | 14600 | 108 | 13600 | 14500 | 107 | 1 | 34-145/29 |
| 98-82-8 | Isopropylbenzene | ND [a] | | 13600 | 15200 | 112 | 13600 | 15300 | 113 | 1 | 36-145/33 |
| 79-20-9 | Methyl Acetate | ND [a] | | 13600 | 13100 | 97 | 13600 | 12700 | 94 | 3 | 26-176/29 |
| 91-20-3 | Naphthalene | ND [a] | | 13600 | 16400 | 121 | 13600 | 16900 | 125 | 3 | 12-160/33 |
| 108-88-3 | Toluene | ND [a] | | 13600 | 14000 | 103 | 13600 | 13900 | 102 | 1 | 40-141/30 |
| | m,p-Xylene | ND [a] | | 27100 | 29800 | 110 | 27100 | 29700 | 109 | 0 | 32-148/30 |
| 95-47-6 | o-Xylene | ND [a] | | 13600 | 14700 | 108 | 13600 | 14900 | 110 | 1 | 36-145/30 |
| 1330-20-7 | Xylene (total) | ND [a] | | 40700 | 44400 | 109 | 40700 | 44600 | 110 | 0 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18295-4 | JC18295-4 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 105% | 106% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 102% | 99% | 101% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 94% | 93% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 99% | 102% | 102% | 72-130% |

(a) Result is from Run #2.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18400-16MS | D239764.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9765 |
| JC18400-16MSD | D239765.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9765 |
| JC18400-16 | D239740.D | 1 | 04/21/16 | AJ | n/a | n/a | VD9765 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-3

| CAS No. | Compound | JC18400-16 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | | 3170 | 3450 | 109 | 3170 | 3430 | 108 | 1 | 48-136/30 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18400-16 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 104% | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 101% | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 93% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 97% | 102% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18422-2MS | D239788.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| JC18422-2MSD | D239789.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| JC18422-2 | D239774.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-4, JC18297-5, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | JC18422-2 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 3010 | 3100 | 103 | 3010 | 2800 | 93 | 10 | 10-180/33 |
| 71-43-2 | Benzene | ND | | 3010 | 3410 | 113 | 3010 | 2980 | 99 | 13 | 48-136/30 |
| 74-97-5 | Bromochloromethane | ND | | 3010 | 3420 | 113 | 3010 | 3040 | 101 | 12 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 3010 | 3330 | 110 | 3010 | 2930 | 97 | 13 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 3010 | 3300 | 109 | 3010 | 2930 | 97 | 12 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 3010 | 1350 | 45 | 3010 | 1440 | 48 | 6 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 3010 | 3220 | 107 | 3010 | 2910 | 97 | 10 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 3010 | 3560 | 118 | 3010 | 3070 | 102 | 15 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | 1500 | | 3010 | 5250 | -74* [a] | 3010 | 4580 | -97* [a] | 14 | 43-152/31 |
| 108-90-7 | Chlorobenzene | 482 | | 3010 | 3840 | 47 | 3010 | 3460 | 35* [b] | 10 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 3010 | 910 | 30 | 3010 | 1000 | 33 | 9 | 26-154/34 |
| 67-66-3 | Chloroform | 111 | J | 3010 | 3680 | 104 | 3010 | 3290 | 91 | 11 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 3010 | 2420 | 80 | 3010 | 2370 | 79 | 2 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 3010 | 3570 | 118 | 3010 | 2980 | 99 | 18 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 3010 | 3600 | 119 | 3010 | 3200 | 106 | 12 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 3010 | 3490 | 116 | 3010 | 3130 | 104 | 11 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 3010 | 3200 | 106 | 3010 | 2870 | 95 | 11 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | 14.9 | J | 3010 | 3490 | 113 | 3010 | 3120 | 101 | 11 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 3010 | 3380 | 112 | 3010 | 3040 | 101 | 11 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 3010 | 3350 | 111 | 3010 | 3060 | 102 | 9 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 3010 | 2950 | 98 | 3010 | 2860 | 95 | 3 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 3010 | 3500 | 116 | 3010 | 3090 | 103 | 12 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | 94.8 | | 3010 | 3450 | 99 | 3010 | 3020 | 84 | 13 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 3010 | 3510 | 116 | 3010 | 3080 | 102 | 13 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | 51.9 | J | 3010 | 3330 | 102 | 3010 | 2940 | 89 | 12 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 3010 | 3420 | 113 | 3010 | 3030 | 101 | 12 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 3010 | 3220 | 107 | 3010 | 2800 | 93 | 14 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 3010 | 3060 | 102 | 3010 | 2750 | 91 | 11 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 3010 | 2970 | 99 | 3010 | 2690 | 89 | 10 | 36-148/27 |
| 100-41-4 | Ethylbenzene | ND | | 3010 | 3380 | 112 | 3010 | 2980 | 99 | 13 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 3010 | 4060 | 135 | 3010 | 3290 | 109 | 21 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 3010 | 2720 | 90 | 3010 | 2350 | 78 | 15 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | ND | | 3010 | 3650 | 121 | 3010 | 3240 | 107 | 12 | 36-145/33 |
| 79-20-9 | Methyl Acetate | ND | | 3010 | 3280 | 109 | 3010 | 2800 | 93 | 16 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | ND | | 3010 | 3720 | 123 | 3010 | 2960 | 98 | 23 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 6030 | 6350 | 105 | 6030 | 5470 | 91 | 15 | 54-129/25 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18422-2MS | D239788.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| JC18422-2MSD | D239789.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |
| JC18422-2 | D239774.D | 1 | 04/22/16 | AJ | n/a | n/a | VD9766 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-2, JC18297-4, JC18297-5, JC18297-6, JC18297-7, JC18297-8, JC18297-9, JC18297-10

| CAS No. | Compound | JC18422-2 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 3010 | 3210 | 106 | 3010 | 2800 | 93 | 14 | 33-154/29 |
| 75-09-2 | Methylene chloride | ND | | 3010 | 3490 | 116 | 3010 | 3050 | 101 | 13 | 47-133/25 |
| 91-20-3 | Naphthalene | ND | | 3010 | 3930 | 120 | 3010 | 3420 | 103 | 14 | 12-160/33 |
| 100-42-5 | Styrene | ND | | 3010 | 3270 | 108 | 3010 | 2910 | 97 | 12 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 1380 | | 3010 | 4450 | -81* [a] | 3010 | 4160 | -91* [a] | 7 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | 80100 | E | 3010 | 83300 | -10507* [a] | 3010 | 81400 | -10570* [a] | 2 | 34-163/31 |
| 108-88-3 | Toluene | ND | | 3010 | 3250 | 108 | 3010 | 2900 | 96 | 11 | 40-141/30 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 35.8 | J | 3010 | 3950 | 125 | 3010 | 3480 | 110 | 13 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 153 | J | 3010 | 4170 | 113 | 3010 | 3650 | 96 | 13 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | 32.8 | J | 3010 | 3720 | 118 | 3010 | 3220 | 101 | 14 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | 2010 | | 3010 | 4920 | -169* [a] | 3010 | 4590 | -179* [a] | 7 | 43-146/27 |
| 79-01-6 | Trichloroethene | 4480 | | 3010 | 7700 | -488* [a] | 3010 | 7320 | -500* [a] | 5 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 3010 | 3140 | 104 | 3010 | 3070 | 102 | 2 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 3010 | 2740 | 91 | 3010 | 2700 | 90 | 1 | 38-149/29 |
| | m,p-Xylene | ND | | 6030 | 6870 | 114 | 6030 | 6100 | 101 | 12 | 32-148/30 |
| 95-47-6 | o-Xylene | 19.8 | J | 3010 | 3490 | 112 | 3010 | 3030 | 97 | 14 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 19.8 | J | 9040 | 10400 | 114 | 9040 | 9140 | 100 | 13 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18422-2 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 106% | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 103% | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 95% | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 101% | 102% | 72-130% |

(a) Outside control limits due to high level in sample relative to spike amount.
(b) Outside control limits due to matrix interference.

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18762-1MS | D239852.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |
| JC18762-1MSD | D239853.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |
| JC18762-1 | D239847.D | 1 | 04/25/16 | AJ | n/a | n/a | VD9767 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-1, JC18297-4

| CAS No. | Compound | JC18762-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | | 3050 | 2810 | 92 | 3050 | 2800 | 92 | 0 | 48-136/30 |
| 98-82-8 | Isopropylbenzene | 1080 | | 3050 | 4020 | 96 | 3050 | 3960 | 94 | 2 | 36-145/33 |
| 79-20-9 | Methyl Acetate | ND | | 3050 | 2770 | 91 | 3050 | 2670 | 87 | 4 | 26-176/29 |
| | m,p-Xylene | 33.7 | J | 6110 | 6740 | 110 | 6110 | 6770 | 110 | 0 | 32-148/30 |
| 95-47-6 | o-Xylene | 23.6 | J | 3050 | 3470 | 113 | 3050 | 3540 | 115 | 2 | 36-145/30 |
| 1330-20-7 | Xylene (total) | 57.3 | J | 9160 | 10200 | 111 | 9160 | 10300 | 112 | 1 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18762-1 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 101% | 102% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 98% | 99% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 95% | 96% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 92% | 89% | 89% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18642-61MS | D239891.D | 1 | 04/26/16 | AJ | n/a | n/a | VD9768 |
| JC18642-61MSD | D239892.D | 1 | 04/26/16 | AJ | n/a | n/a | VD9768 |
| JC18642-61 [a] | D239879.D | 1 | 04/26/16 | AJ | n/a | n/a | VD9768 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18297-2

| CAS No. | Compound | JC18642-61 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | 39.2 | J | 6750 | 7310 | 108 | 6750 | 7200 | 106 | 2 | 48-136/30 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18642-61 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 104% | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 100% | 100% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 93% | 92% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 98% | 101% | 72-130% |

(a) Diluted due to high concentration of non-target compound and matrix interference. Sample received outside the holding time.

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9757-BFB
**Lab File ID:** D239460A.D
**Instrument ID:** GCMSD
**Injection Date:** 04/11/16
**Injection Time:** 20:52



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 17364 | 19.1 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 45208 | 49.7 | | Pass |
| 95 | Base peak, 100% relative abundance | 91016 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6238 | 6.85 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 76458 | 84.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5572 | 6.12 | (7.29) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 74749 | 82.1 | (97.8) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4942 | 5.43 | (6.61) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9757-IC9757 | D239461.D | 04/11/16 | 21:23 | 00:31 | Initial cal 0.2 |
| VD9757-IC9757 | D239462.D | 04/11/16 | 21:54 | 01:02 | Initial cal 0.5 |
| VD9757-IC9757 | D239463.D | 04/11/16 | 22:25 | 01:33 | Initial cal 1.0 |
| VD9757-IC9757 | D239464.D | 04/11/16 | 22:56 | 02:04 | Initial cal 2.0 |
| VD9757-IC9757 | D239465.D | 04/11/16 | 23:27 | 02:35 | Initial cal 4.0 |
| VD9757-IC9757 | D239466.D | 04/11/16 | 23:58 | 03:06 | Initial cal 8.0 |
| VD9757-IC9757 | D239467.D | 04/12/16 | 00:28 | 03:36 | Initial cal 20.0 |
| VD9757-ICC9757 | D239468.D | 04/12/16 | 00:59 | 04:07 | Initial cal 50.0 |
| VD9757-IC9757 | D239469.D | 04/12/16 | 01:30 | 04:38 | Initial cal 100.0 |
| VD9757-IC9757 | D239470.D | 04/12/16 | 02:01 | 05:09 | Initial cal 200.0 |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9757-BFB2
**Lab File ID:** D239476.D
**Instrument ID:** GCMSD
**Injection Date:** 04/12/16
**Injection Time:** 09:00

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 18274 | 19.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 47592 | 49.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 96074 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6768 | 7.04 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 78101 | 81.3 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 6163 | 6.41 | (7.89) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 76549 | 79.7 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5082 | 5.29 | (6.64) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9757-ICV9757 | D239477.D | 04/12/16 | 09:30 | 00:30 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9762-BFB
**Lab File ID:** D239610.D
**Instrument ID:** GCMSD
**Injection Date:** 04/18/16
**Injection Time:** 07:31

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 17320 | 20.1 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 44141 | 51.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 86011 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5883 | 6.84 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 68331 | 79.4 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5074 | 5.90 | (7.43) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 66128 | 76.9 | (96.8) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4456 | 5.18 | (6.74) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9762-CC9757 | D239611.D | 04/18/16 | 08:02 | 00:31 | Continuing cal 50 |
| VD9762-MB | D239613.D | 04/18/16 | 09:07 | 01:36 | Method Blank |
| ZZZZZZ | D239613A.D | 04/18/16 | 09:07 | 01:36 | (unrelated sample) |
| VD9762-BS | D239614.D | 04/18/16 | 09:38 | 02:07 | Blank Spike |
| ZZZZZZ | D239618.D | 04/18/16 | 11:41 | 04:10 | (unrelated sample) |
| JC18297-1 | D239619.D | 04/18/16 | 12:12 | 04:41 | SI-05+ SI-06 BASELINE(A) |
| JC18297-2 | D239622.D | 04/18/16 | 13:45 | 06:14 | SI-05+ SI-06 BASELINE(B) |
| JC18297-3 | D239623.D | 04/18/16 | 14:16 | 06:45 | SI-05+ SI-06 BASELINE(C) |
| JC18297-4 | D239624.D | 04/18/16 | 14:47 | 07:16 | SI-05-90-INITIAL |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9762-BFB2
**Lab File ID:** D239655.D
**Instrument ID:** GCMSD
**Injection Date:** 04/19/16
**Injection Time:** 16:36



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 21627 | 18.3 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 56699 | 48.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 118187 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 8082 | 6.84 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 98592 | 83.4 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7275 | 6.16 | (7.38) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 95920 | 81.2 | (97.3) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 6243 | 5.28 | (6.51) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9762-CC9757 | D239656.D | 04/19/16 | 17:07 | 00:31 | Continuing cal 20 |
| VD9762-CC9757 | D239657.D | 04/19/16 | 17:38 | 01:02 | Continuing cal 20 |
| VD9762-MB2 | D239659.D | 04/19/16 | 18:41 | 02:05 | Method Blank |
| ZZZZZZ | D239659A.D | 04/19/16 | 18:41 | 02:05 | (unrelated sample) |
| VD9762-BS2 | D239660.D | 04/19/16 | 19:12 | 02:36 | Blank Spike |
| JC18295-9 | D239662.D | 04/19/16 | 20:14 | 03:38 | (used for QC only; not part of job JC18297) |
| JC18295-9 | D239663.D | 04/19/16 | 20:45 | 04:09 | (used for QC only; not part of job JC18297) |
| JC18295-9MS | D239665.D | 04/19/16 | 21:47 | 05:11 | Matrix Spike |
| JC18295-9MSD | D239666.D | 04/19/16 | 22:18 | 05:42 | Matrix Spike Duplicate |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9763-BFB
**Lab File ID:** D239674.D
**Instrument ID:** GCMSD
**Injection Date:** 04/20/16
**Injection Time:** 08:41



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 16403 | 18.6 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 42906 | 48.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 88002 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6024 | 6.85 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 72682 | 82.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5425 | 6.16 | (7.46) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 70626 | 80.3 | (97.2) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4764 | 5.41 | (6.75) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9763-CC9757 | D239675.D | 04/20/16 | 09:12 | 00:31 | Continuing cal 50 |
| VD9763-CC9757 | D239676.D | 04/20/16 | 09:42 | 01:01 | Continuing cal 50 |
| VD9763-MB | D239678.D | 04/20/16 | 10:44 | 02:03 | Method Blank |
| ZZZZZZ | D239678A.D | 04/20/16 | 10:44 | 02:03 | (unrelated sample) |
| VD9763-BS | D239679.D | 04/20/16 | 11:15 | 02:34 | Blank Spike |
| ZZZZZZ | D239681.D | 04/20/16 | 12:17 | 03:36 | (unrelated sample) |
| JC18295-4 | D239683.D | 04/20/16 | 13:42 | 05:01 | (used for QC only; not part of job JC18297) |
| JC18295-4 | D239684.D | 04/20/16 | 14:13 | 05:32 | (used for QC only; not part of job JC18297) |
| JC18297-1 | D239685.D | 04/20/16 | 14:44 | 06:03 | SI-05+ SI-06 BASELINE(A) |
| JC18297-2 | D239686.D | 04/20/16 | 15:15 | 06:34 | SI-05+ SI-06 BASELINE(B) |
| JC18297-3 | D239687.D | 04/20/16 | 15:46 | 07:05 | SI-05+ SI-06 BASELINE(C) |
| JC18297-4 | D239688.D | 04/20/16 | 16:17 | 07:36 | SI-05-90-INITIAL |
| JC18297-5 | D239689.D | 04/20/16 | 16:48 | 08:07 | SI-05-90-20 |
| JC18295-4MS | D239691.D | 04/20/16 | 17:50 | 09:09 | Matrix Spike |
| JC18295-4MSD | D239692.D | 04/20/16 | 18:21 | 09:40 | Matrix Spike Duplicate |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9765-BFB
**Lab File ID:** D239725.D
**Instrument ID:** GCMSD
**Injection Date:** 04/21/16
**Injection Time:** 11:42

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 13729 | 18.6 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 35944 | 48.7 | | Pass |
| 95 | Base peak, 100% relative abundance | 73773 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 4882 | 6.62 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 61648 | 83.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 4540 | 6.15 | (7.36) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 59920 | 81.2 | (97.2) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3919 | 5.31 | (6.54) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9765-CC9757 | D239726.D | 04/21/16 | 12:13 | 00:31 | Continuing cal 20 |
| VD9765-CC9757 | D239728.D | 04/21/16 | 13:01 | 01:19 | Continuing cal 4.0 |
| ZZZZZZ | D239730A.D | 04/21/16 | 14:02 | 02:20 | (unrelated sample) |
| VD9765-MB | D239730.D | 04/21/16 | 14:02 | 02:20 | Method Blank |
| VD9765-BS | D239731.D | 04/21/16 | 14:33 | 02:51 | Blank Spike |
| ZZZZZZ | D239733.D | 04/21/16 | 15:35 | 03:53 | (unrelated sample) |
| ZZZZZZ | D239734.D | 04/21/16 | 16:06 | 04:24 | (unrelated sample) |
| ZZZZZZ | D239735.D | 04/21/16 | 16:37 | 04:55 | (unrelated sample) |
| JC18297-3 | D239736.D | 04/21/16 | 17:08 | 05:26 | SI-05+ SI-06 BASELINE(C) |
| JC18400-1 | D239737.D | 04/21/16 | 17:39 | 05:57 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239738.D | 04/21/16 | 18:09 | 06:27 | (unrelated sample) |
| JC18400-16 | D239740.D | 04/21/16 | 19:10 | 07:28 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239741.D | 04/21/16 | 19:41 | 07:59 | (unrelated sample) |
| ZZZZZZ | D239742.D | 04/21/16 | 20:12 | 08:30 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9765-BFB2
**Lab File ID:** D239747.D
**Instrument ID:** GCMSD
**Injection Date:** 04/22/16
**Injection Time:** 00:37

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 17451 | 18.3 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 46741 | 48.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 95528 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6431 | 6.73 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 78397 | 82.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5890 | 6.17 | (7.51) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 75344 | 78.9 | (96.1) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5081 | 5.32 | (6.74) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9765-CC9757 | D239748.D | 04/22/16 | 01:08 | 00:31 | Continuing cal 50 |
| VD9765-MB2 | D239750.D | 04/22/16 | 02:09 | 01:32 | Method Blank |
| ZZZZZZ | D239751.D | 04/22/16 | 02:39 | 02:02 | (unrelated sample) |
| ZZZZZZ | D239752.D | 04/22/16 | 03:10 | 02:33 | (unrelated sample) |
| ZZZZZZ | D239753.D | 04/22/16 | 03:40 | 03:03 | (unrelated sample) |
| ZZZZZZ | D239754.D | 04/22/16 | 04:11 | 03:34 | (unrelated sample) |
| ZZZZZZ | D239755.D | 04/22/16 | 04:41 | 04:04 | (unrelated sample) |
| ZZZZZZ | D239756.D | 04/22/16 | 05:11 | 04:34 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9766-BFB
**Lab File ID:** D239758.D
**Instrument ID:** GCMSD
**Injection Date:** 04/22/16
**Injection Time:** 06:12



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 18666 | 18.9 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 49093 | 49.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 98552 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6668 | 6.77 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 79856 | 81.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5799 | 5.88 | (7.26) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 77677 | 78.8 | (97.3) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5096 | 5.17 | (6.56) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9766-CC9757 | D239760.D | 04/22/16 | 07:35 | 01:23 | Continuing cal 50 |
| ZZZZZZ | D239762A.D | 04/22/16 | 08:39 | 02:27 | (unrelated sample) |
| VD9765-MB2 | D239762.D | 04/22/16 | 08:39 | 02:27 | Method Blank |
| VD9765-BS2 | D239763.D | 04/22/16 | 09:09 | 02:57 | Blank Spike |
| JC18400-16MS | D239764.D | 04/22/16 | 09:41 | 03:29 | Matrix Spike |
| JC18400-16MSD | D239765.D | 04/22/16 | 10:11 | 03:59 | Matrix Spike Duplicate |
| VD9766-MB | D239767.D | 04/22/16 | 11:13 | 05:01 | Method Blank |
| VD9766-BS | D239768.D | 04/22/16 | 11:44 | 05:32 | Blank Spike |
| ZZZZZZ | D239770.D | 04/22/16 | 12:45 | 06:33 | (unrelated sample) |
| JC18297-4 | D239772.D | 04/22/16 | 13:46 | 07:34 | SI-05-90-INITIAL |
| JC18297-5 | D239773.D | 04/22/16 | 14:17 | 08:05 | SI-05-90-20 |
| JC18422-2 | D239774.D | 04/22/16 | 14:48 | 08:36 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239776.D | 04/22/16 | 15:53 | 09:41 | (unrelated sample) |
| ZZZZZZ | D239777.D | 04/22/16 | 16:33 | 10:21 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9766-BFB2
**Lab File ID:** D239782.D
**Instrument ID:** GCMSD
**Injection Date:** 04/22/16
**Injection Time:** 19:16

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 18247 | 19.4 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 47181 | 50.2 | | Pass |
| 95 | Base peak, 100% relative abundance | 94024 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6636 | 7.06 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 75744 | 80.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5770 | 6.14 | (7.62) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 74475 | 79.2 | (98.3) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5045 | 5.37 | (6.77) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9766-CC9757 | D239783.D | 04/22/16 | 19:47 | 00:31 | Continuing cal 50 |
| VD9766-CC9757 | D239785.D | 04/22/16 | 20:55 | 01:39 | Continuing cal 4 |
| VD9766-MB2 | D239786.D | 04/22/16 | 21:25 | 02:09 | Method Blank |
| ZZZZZZ | D239787.D | 04/22/16 | 22:06 | 02:50 | (unrelated sample) |
| JC18422-2MS | D239788.D | 04/22/16 | 22:36 | 03:20 | Matrix Spike |
| JC18422-2MSD | D239789.D | 04/22/16 | 23:07 | 03:51 | Matrix Spike Duplicate |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9766-BFB3
**Lab File ID:** D239796.D
**Instrument ID:** GCMSD
**Injection Date:** 04/23/16
**Injection Time:** 14:06



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 15334 | 18.5 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 40864 | 49.2 | | Pass |
| 95 | Base peak, 100% relative abundance | 83053 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5641 | 6.79 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 69027 | 83.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5011 | 6.03 | (7.26) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 66176 | 79.7 | (95.9) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4431 | 5.34 | (6.70) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9766-CC9757 | D239797.D | 04/23/16 | 14:37 | 00:31 | Continuing cal 20 |
| ZZZZZZ | D239799A.D | 04/23/16 | 15:40 | 01:34 | (unrelated sample) |
| VD9766-MB3 | D239799.D | 04/23/16 | 15:40 | 01:34 | Method Blank |
| VD9766-BS2 | D239800.D | 04/23/16 | 16:10 | 02:04 | Blank Spike |
| JC18604-2 | D239802.D | 04/23/16 | 17:12 | 03:06 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239803.D | 04/23/16 | 17:42 | 03:36 | (unrelated sample) |
| JC18297-6 | D239804.D | 04/23/16 | 18:13 | 04:07 | SI-05-90-40 |
| JC18297-7 | D239805.D | 04/23/16 | 18:44 | 04:38 | SI-05-90-60 |
| JC18297-1 | D239806.D | 04/23/16 | 19:14 | 05:08 | SI-05+ SI-06 BASELINE(A) |
| JC18297-2 | D239807.D | 04/23/16 | 19:45 | 05:39 | SI-05+ SI-06 BASELINE(B) |
| JC18297-8 | D239808.D | 04/23/16 | 20:15 | 06:09 | SI-05-90-80 |
| JC18297-9 | D239809.D | 04/23/16 | 20:46 | 06:40 | SI-05-90-100 |
| JC18297-10 | D239810.D | 04/23/16 | 21:17 | 07:11 | SI-05-90-POST |
| ZZZZZZ | D239811.D | 04/23/16 | 21:47 | 07:41 | (unrelated sample) |
| ZZZZZZ | D239812.D | 04/23/16 | 22:18 | 08:12 | (unrelated sample) |
| ZZZZZZ | D239816.D | 04/24/16 | 00:20 | 10:14 | (unrelated sample) |
| ZZZZZZ | D239817.D | 04/24/16 | 00:51 | 10:45 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9767-BFB
**Lab File ID:** D239833.D
**Instrument ID:** GCMSD
**Injection Date:** 04/25/16
**Injection Time:** 06:55



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 17169 | 18.7 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 45912 | 49.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 92013 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6370 | 6.92 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 77397 | 84.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5934 | 6.45 | (7.67) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 74698 | 81.2 | (96.5) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5187 | 5.64 | (6.94) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9767-CC9757 | D239835.D | 04/25/16 | 08:04 | 01:09 | Continuing cal 20 |
| ZZZZZZ | D239837A.D | 04/25/16 | 09:10 | 02:15 | (unrelated sample) |
| VD9767-MB | D239837.D | 04/25/16 | 09:10 | 02:15 | Method Blank |
| VD9767-BS | D239838.D | 04/25/16 | 09:43 | 02:48 | Blank Spike |
| ZZZZZZ | D239840.D | 04/25/16 | 10:44 | 03:49 | (unrelated sample) |
| ZZZZZZ | D239841.D | 04/25/16 | 11:15 | 04:20 | (unrelated sample) |
| ZZZZZZ | D239842.D | 04/25/16 | 11:45 | 04:50 | (unrelated sample) |
| ZZZZZZ | D239843.D | 04/25/16 | 12:16 | 05:21 | (unrelated sample) |
| ZZZZZZ | D239844.D | 04/25/16 | 12:46 | 05:51 | (unrelated sample) |
| ZZZZZZ | D239845.D | 04/25/16 | 13:17 | 06:22 | (unrelated sample) |
| JC18762-1 | D239847.D | 04/25/16 | 14:18 | 07:23 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239848.D | 04/25/16 | 14:49 | 07:54 | (unrelated sample) |
| JC18297-4 | D239850.D | 04/25/16 | 15:51 | 08:56 | SI-05-90-INITIAL |
| JC18762-1MS | D239852.D | 04/25/16 | 16:52 | 09:57 | Matrix Spike |
| JC18762-1MSD | D239853.D | 04/25/16 | 17:23 | 10:28 | Matrix Spike Duplicate |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9767-BFB2
**Lab File ID:** D239859.D
**Instrument ID:** GCMSD
**Injection Date:** 04/25/16
**Injection Time:** 20:26



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 16732 | 18.7 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 43741 | 48.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 89533 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6161 | 6.88 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 72597 | 81.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5375 | 6.00 | (7.40) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 70213 | 78.4 | (96.7) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4957 | 5.54 | (7.06) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9767-CC9757 | D239859A.D | 04/25/16 | 20:59 | 00:33 | Continuing cal 50 |
| VD9767-MB2 | D239861.D | 04/25/16 | 23:28 | 03:02 | Method Blank |
| ZZZZZZ | D239863.D | 04/26/16 | 00:29 | 04:03 | (unrelated sample) |
| ZZZZZZ | D239864.D | 04/26/16 | 01:00 | 04:34 | (unrelated sample) |
| ZZZZZZ | D239866.D | 04/26/16 | 02:01 | 05:35 | (unrelated sample) |
| JC18297-1 | D239867.D | 04/26/16 | 02:31 | 06:05 | SI-05+ SI-06 BASELINE(A) |

# Instrument Performance Check (BFB)



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VD9768-BFB
**Lab File ID:** D239872.D
**Instrument ID:** GCMSD
**Injection Date:** 04/26/16
**Injection Time:** 06:25



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 12912 | 19.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 34499 | 50.7 | | Pass |
| 95 | Base peak, 100% relative abundance | 67992 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 4904 | 7.21 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 54085 | 79.5 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 4000 | 5.88 | (7.40) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 52608 | 77.4 | (97.3) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3335 | 4.90 | (6.34) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VD9768-CC9757 | D239873.D | 04/26/16 | 07:07 | 00:42 | Continuing cal 20 |
| ZZZZZZ | D239875A.D | 04/26/16 | 08:12 | 01:47 | (unrelated sample) |
| VD9768-MB | D239875.D | 04/26/16 | 08:12 | 01:47 | Method Blank |
| VD9768-BS | D239876.D | 04/26/16 | 09:05 | 02:40 | Blank Spike |
| JC18763-2 | D239878.D | 04/26/16 | 10:06 | 03:41 | (used for QC only; not part of job JC18297) |
| JC18642-61 | D239879.D | 04/26/16 | 10:37 | 04:12 | (used for QC only; not part of job JC18297) |
| ZZZZZZ | D239880.D | 04/26/16 | 11:07 | 04:42 | (unrelated sample) |
| JC18297-2 | D239881.D | 04/26/16 | 11:38 | 05:13 | SI-05+ SI-06 BASELINE(B) |
| ZZZZZZ | D239882.D | 04/26/16 | 12:09 | 05:44 | (unrelated sample) |
| ZZZZZZ | D239883.D | 04/26/16 | 12:40 | 06:15 | (unrelated sample) |
| ZZZZZZ | D239884.D | 04/26/16 | 13:10 | 06:45 | (unrelated sample) |
| ZZZZZZ | D239888.D | 04/26/16 | 15:13 | 08:48 | (unrelated sample) |
| JC18642-61MS | D239891.D | 04/26/16 | 16:46 | 10:21 | Matrix Spike |
| JC18642-61MSD | D239892.D | 04/26/16 | 17:16 | 10:51 | Matrix Spike Duplicate |

# Volatile Surrogate Recovery Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC18297-1 | D239806.D | 106 | 101 | 91 | 102 |
| JC18297-1 | D239685.D | 107 | 103 | 85 | 102 |
| JC18297-1 | D239867.D | 104 | 97 | 90 | 101 |
| JC18297-1 | D239619.D | 110 | 50* | 87 | 106 |
| JC18297-2 | D239686.D | 106 | 103 | 85 | 102 |
| JC18297-2 | D239807.D | 105 | 101 | 92 | 101 |
| JC18297-2 | D239881.D | 104 | 99 | 91 | 99 |
| JC18297-2 | D239622.D | 108 | 48* | 86 | 104 |
| JC18297-3 | D239736.D | 102 | 98 | 94 | 102 |
| JC18297-3 | D239687.D | 103 | 97 | 92 | 103 |
| JC18297-3 | D239623.D | 105 | 53* | 87 | 104 |
| JC18297-4 | D239688.D | 105 | 100 | 93 | 102 |
| JC18297-4 | D239772.D | 104 | 99 | 92 | 102 |
| JC18297-4 | D239850.D | 105 | 96 | 86 | 96 |
| JC18297-4 | D239624.D | 103 | 90 | 86 | 98 |
| JC18297-5 | D239773.D | 105 | 102 | 92 | 102 |
| JC18297-5 | D239689.D | 106 | 101 | 93 | 106 |
| JC18297-6 | D239804.D | 103 | 100 | 92 | 102 |
| JC18297-7 | D239805.D | 103 | 100 | 93 | 104 |
| JC18297-8 | D239808.D | 105 | 101 | 90 | 100 |
| JC18297-9 | D239809.D | 105 | 101 | 91 | 101 |
| JC18297-10 | D239810.D | 106 | 101 | 90 | 100 |
| JC18295-4MS | D239691.D | 105 | 102 | 95 | 101 |
| JC18295-4MSD | D239692.D | 105 | 102 | 94 | 99 |
| JC18295-9MS | D239665.D | 105 | 101 | 94 | 100 |
| JC18295-9MSD | D239666.D | 103 | 102 | 95 | 100 |
| JC18400-16MS | D239764.D | 106 | 102 | 93 | 99 |
| JC18400-16MSD | D239765.D | 104 | 101 | 93 | 97 |
| JC18422-2MS | D239788.D | 106 | 103 | 95 | 98 |
| JC18422-2MSD | D239789.D | 106 | 103 | 95 | 101 |
| JC18642-61MS | D239891.D | 104 | 99 | 93 | 98 |
| JC18642-61MSD | D239892.D | 104 | 100 | 93 | 98 |
| JC18762-1MS | D239852.D | 102 | 100 | 94 | 92 |
| JC18762-1MSD | D239853.D | 101 | 98 | 95 | 89 |
| VD9762-BS | D239614.D | 108 | 112 | 97 | 99 |
| VD9762-MB | D239613.D | 108 | 111 | 96 | 104 |
| VD9763-BS | D239679.D | 105 | 102 | 95 | 99 |
| VD9763-MB | D239678.D | 105 | 101 | 92 | 103 |
| VD9765-BS | D239731.D | 105 | 104 | 95 | 103 |
| VD9765-MB | D239730.D | 106 | 102 | 93 | 104 |

# Volatile Surrogate Recovery Summary



**Job Number:** JC18297
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| VD9766-BS | D239768.D | 105 | 103 | 94 | 101 |
| VD9766-BS2 | D239800.D | 104 | 103 | 94 | 101 |
| VD9766-MB | D239767.D | 103 | 100 | 92 | 103 |
| VD9766-MB3 | D239799.D | 105 | 102 | 92 | 102 |
| VD9767-BS | D239838.D | 108 | 105 | 92 | 99 |
| VD9767-MB | D239837.D | 106 | 104 | 91 | 99 |
| VD9767-MB2 | D239861.D | 102 | 96 | 89 | 98 |
| VD9768-BS | D239876.D | 106 | 102 | 93 | 100 |
| VD9768-MB | D239875.D | 104 | 101 | 90 | 101 |
| VD9762-MB2 | D239659.D | 103 | 99 | 95 | 104 |
| VD9765-MB2 | D239750.D | 105 | 101 | 91 | 99 |
| VD9765-MB2 | D239762.D | 108 | 102 | 90 | 101 |
| VD9766-MB2 | D239786.D | 106 | 103 | 92 | 101 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 70-122% |
| **S2** = 1,2-Dichloroethane-D4 | 68-124% |
| **S3** = Toluene-D8 | 77-125% |
| **S4** = 4-Bromofluorobenzene | 72-130% |

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Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

SGS Accutest Job Number: JC18511

Sampling Date: 04/15/16

Report to:

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Total number of pages in report: **41**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC18511

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC18511-1 | 04/15/16 | 13:30 | JDM | 04/16/16 | SO | Soil | SI-06-90-INITAL |
| JC18511-2 | 04/15/16 | 13:50 | JDM | 04/16/16 | SO | Soil | SI-06-90-20 |
| JC18511-3 | 04/15/16 | 14:10 | JDM | 04/16/16 | SO | Soil | SI-06-90-40 |
| JC18511-4 | 04/15/16 | 14:30 | JDM | 04/16/16 | SO | Soil | SI-06-90-60 |
| JC18511-5 | 04/15/16 | 14:50 | JDM | 04/16/16 | SO | Soil | SI-06-90-80 |
| JC18511-6 | 04/15/16 | 15:10 | JDM | 04/16/16 | SO | Soil | SI-06-90-100 |
| JC18511-7 | 04/15/16 | 15:30 | JDM | 04/16/16 | SO | Soil | SI-06-90-POST |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits



**Job Number:** JC18511
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/15/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18511-1** | **SI-06-90-INITAL** | | | | | |
| Benzene | | 22500000 | 110000 | 30000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 19000 | 18000 | 2000 | ug/kg | SW846 8260C |
| Chlorobenzene | | 8170 J | 18000 | 1400 | ug/kg | SW846 8260C |
| Cyclohexane | | 10300 J | 18000 | 2800 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 1490000 | 8900 | 1100 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 22300 | 8900 | 1400 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 123000 | 8900 | 2000 | ug/kg | SW846 8260C |
| Ethylbenzene | | 146000 | 8900 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 417000 | 18000 | 950 | ug/kg | SW846 8260C |
| Methyl Acetate | | 293000 | 45000 | 7700 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 24800 | 18000 | 2000 | ug/kg | SW846 8260C |
| Naphthalene | | 2610000 | 1100000 | 42000 | ug/kg | SW846 8260C |
| Toluene | | 6330000 | 220000 | 46000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 4640 J | 45000 | 1500 | ug/kg | SW846 8260C |
| m,p-Xylene | | 1400000 | 8900 | 3100 | ug/kg | SW846 8260C |
| o-Xylene | | 403000 | 8900 | 2400 | ug/kg | SW846 8260C |
| Xylene (total) | | 1800000 | 8900 | 2400 | ug/kg | SW846 8260C |
| **JC18511-2** | **SI-06-90-20** | | | | | |
| Benzene | | 32700000 | 210000 | 55000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 23500 J | 33000 | 3800 | ug/kg | SW846 8260C |
| Chlorobenzene | | 10100 J | 33000 | 2600 | ug/kg | SW846 8260C |
| Cyclohexane | | 18100 J | 33000 | 5300 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | | 2370000 | 17000 | 2000 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | | 34800 | 17000 | 2600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | | 206000 | 17000 | 3800 | ug/kg | SW846 8260C |
| Ethylbenzene | | 214000 | 17000 | 2700 | ug/kg | SW846 8260C |
| Isopropylbenzene | | 665000 | 33000 | 1800 | ug/kg | SW846 8260C |
| Methyl Acetate | | 307000 | 83000 | 14000 | ug/kg | SW846 8260C |
| Methylcyclohexane | | 44600 | 33000 | 3800 | ug/kg | SW846 8260C |
| Naphthalene | | 6470000 | 2100000 | 79000 | ug/kg | SW846 8260C |
| Toluene | | 10700000 | 420000 | 87000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 7720 J | 83000 | 2800 | ug/kg | SW846 8260C |
| m,p-Xylene | | 2100000 | 17000 | 5900 | ug/kg | SW846 8260C |
| o-Xylene | | 606000 | 17000 | 4600 | ug/kg | SW846 8260C |
| Xylene (total) | | 2700000 | 17000 | 4600 | ug/kg | SW846 8260C |
| **JC18511-3** | **SI-06-90-40** | | | | | |
| Benzene | | 16200000 | 94000 | 25000 | ug/kg | SW846 8260C |
| Carbon disulfide | | 9440 J | 19000 | 2200 | ug/kg | SW846 8260C |
| Chlorobenzene | | 5140 J | 19000 | 1500 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18511
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/15/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| Cyclohexane | 7420 J | 19000 | 3000 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1140000 | 9400 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 15700 | 9400 | 1500 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 94000 | 9400 | 2100 | ug/kg | SW846 8260C |
| Ethylbenzene | 101000 | 9400 | 1500 | ug/kg | SW846 8260C |
| Isopropylbenzene | 300000 | 19000 | 1000 | ug/kg | SW846 8260C |
| Methyl Acetate | 214000 | 47000 | 8100 | ug/kg | SW846 8260C |
| Methylcyclohexane | 17000 J | 19000 | 2100 | ug/kg | SW846 8260C |
| Naphthalene | 2480000 | 940000 | 36000 | ug/kg | SW846 8260C |
| Toluene | 5030000 | 190000 | 39000 | ug/kg | SW846 8260C |
| m,p-Xylene | 971000 | 9400 | 3300 | ug/kg | SW846 8260C |
| o-Xylene | 281000 | 9400 | 2600 | ug/kg | SW846 8260C |
| Xylene (total) | 1250000 | 9400 | 2600 | ug/kg | SW846 8260C |
| **JC18511-4 SI-06-90-60** | | | | | |
| Benzene | 14300000 | 50000 | 13000 | ug/kg | SW846 8260C |
| Carbon disulfide | 6780 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | 4920 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | 5500 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1110000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 15700 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 90000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 95500 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | 287000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 221000 | 50000 | 8600 | ug/kg | SW846 8260C |
| Methylcyclohexane | 14600 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 2800000 | 500000 | 19000 | ug/kg | SW846 8260C |
| Toluene | 4730000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | 914000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | 266000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | 1180000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC18511-5 SI-06-90-80** | | | | | |
| Benzene | 13700000 | 50000 | 13000 | ug/kg | SW846 8260C |
| Carbon disulfide | 7500 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | 4290 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | 5920 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1020000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 14200 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 82700 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 88200 | 10000 | 1600 | ug/kg | SW846 8260C |
| Isopropylbenzene | 259000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 201000 | 50000 | 8600 | ug/kg | SW846 8260C |

# Summary of Hits

**Job Number:** JC18511
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/15/16

| Lab Sample ID / Client Sample ID / Analyte | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|
| Methylcyclohexane | 15600 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 2730000 | 500000 | 19000 | ug/kg | SW846 8260C |
| Toluene | 4560000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | 846000 | 10000 | 3500 | ug/kg | SW846 8260C |
| o-Xylene | 250000 | 10000 | 2700 | ug/kg | SW846 8260C |
| Xylene (total) | 1100000 | 10000 | 2700 | ug/kg | SW846 8260C |
| **JC18511-6 SI-06-90-100** | | | | | |
| Benzene | 13700000 | 51000 | 14000 | ug/kg | SW846 8260C |
| Carbon disulfide | 7730 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | 5110 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | 6940 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1240000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 17400 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 105000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 109000 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | 313000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 207000 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | 19800 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 3110000 | 510000 | 19000 | ug/kg | SW846 8260C |
| Toluene | 4630000 | 100000 | 21000 | ug/kg | SW846 8260C |
| m,p-Xylene | 1040000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | 304000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | 1340000 | 10000 | 2800 | ug/kg | SW846 8260C |
| **JC18511-7 SI-06-90-POST** | | | | | |
| Benzene | 20300000 | 100000 | 27000 | ug/kg | SW846 8260C |
| Carbon disulfide | 9620 J | 20000 | 2300 | ug/kg | SW846 8260C |
| Chlorobenzene | 6150 J | 20000 | 1600 | ug/kg | SW846 8260C |
| Cyclohexane | 9640 J | 20000 | 3200 | ug/kg | SW846 8260C |
| 1,2-Dichlorobenzene | 1560000 | 10000 | 1200 | ug/kg | SW846 8260C |
| 1,3-Dichlorobenzene | 22300 | 10000 | 1600 | ug/kg | SW846 8260C |
| 1,4-Dichlorobenzene | 128000 | 10000 | 2300 | ug/kg | SW846 8260C |
| Ethylbenzene | 131000 | 10000 | 1700 | ug/kg | SW846 8260C |
| Isopropylbenzene | 423000 | 20000 | 1100 | ug/kg | SW846 8260C |
| Methyl Acetate | 192000 | 51000 | 8800 | ug/kg | SW846 8260C |
| Methylcyclohexane | 26300 | 20000 | 2300 | ug/kg | SW846 8260C |
| Naphthalene | 4910000 | 1000000 | 39000 | ug/kg | SW846 8260C |
| Toluene | 7200000 | 200000 | 42000 | ug/kg | SW846 8260C |
| 1,2,4-Trichlorobenzene | 4100 J | 51000 | 1700 | ug/kg | SW846 8260C |
| m,p-Xylene | 1270000 | 10000 | 3600 | ug/kg | SW846 8260C |
| o-Xylene | 371000 | 10000 | 2800 | ug/kg | SW846 8260C |
| Xylene (total) | 1640000 | 10000 | 2800 | ug/kg | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-INITAL | | |
| **Lab Sample ID:** | JC18511-1 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234668.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234736.D | 2500 | 04/25/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.6 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.6 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 89000 | 20000 | ug/kg | |
| 71-43-2 | Benzene | 22500000 [b] | 110000 | 30000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 45000 | 2800 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 18000 | 1400 | ug/kg | |
| 75-25-2 | Bromoform | ND | 45000 | 2100 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 45000 | 3200 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 89000 | 17000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 19000 | 18000 | 2000 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 18000 | 2100 | ug/kg | |
| 108-90-7 | Chlorobenzene | 8170 | 18000 | 1400 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 45000 | 4300 | ug/kg | |
| 67-66-3 | Chloroform | ND | 18000 | 1300 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 45000 | 2300 | ug/kg | |
| 110-82-7 | Cyclohexane | 10300 | 18000 | 2800 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 18000 | 4900 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 18000 | 1800 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 8900 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1490000 | 8900 | 1100 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 22300 | 8900 | 1400 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 123000 | 8900 | 2000 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 45000 | 3200 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 8900 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 8900 | 1200 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 8900 | 5300 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 8900 | 7000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 8900 | 5300 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 18000 | 2100 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 18000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 18000 | 1600 | ug/kg | |
| 100-41-4 | Ethylbenzene | 146000 | 8900 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 45000 | 4000 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 45000 | 12000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-INITAL | | |
| **Lab Sample ID:** | JC18511-1 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 417000 | 18000 | 950 | ug/kg | |
| 79-20-9 | Methyl Acetate | 293000 | 45000 | 7700 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 24800 | 18000 | 2000 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 8900 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 45000 | 4100 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 45000 | 8800 | ug/kg | |
| 91-20-3 | Naphthalene | 2610000 [b] | 1100000 | 42000 | ug/kg | |
| 100-42-5 | Styrene | ND | 18000 | 1600 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 18000 | 1600 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 18000 | 2700 | ug/kg | |
| 108-88-3 | Toluene | 6330000 [b] | 220000 | 46000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 45000 | 1600 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4640 | 45000 | 1500 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 18000 | 1300 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 18000 | 1300 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 8900 | 1300 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 45000 | 2200 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 18000 | 1800 | ug/kg | |
| | m,p-Xylene | 1400000 | 8900 | 3100 | ug/kg | |
| 95-47-6 | o-Xylene | 403000 | 8900 | 2400 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1800000 | 8900 | 2400 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 92% | 94% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 100% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-20 | | |
| **Lab Sample ID:** | JC18511-2 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234669.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234748.D | 2500 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 3.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 3.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 170000 | 37000 | ug/kg | |
| 71-43-2 | Benzene | 32700000 [b] | 210000 | 55000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 83000 | 5200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 33000 | 2600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 83000 | 3900 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 83000 | 6100 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 170000 | 32000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 23500 | 33000 | 3800 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 33000 | 3800 | ug/kg | |
| 108-90-7 | Chlorobenzene | 10100 | 33000 | 2600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 83000 | 8000 | ug/kg | |
| 67-66-3 | Chloroform | ND | 33000 | 2500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 83000 | 4400 | ug/kg | |
| 110-82-7 | Cyclohexane | 18100 | 33000 | 5300 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 33000 | 9100 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 33000 | 3400 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 17000 | 2200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 2370000 | 17000 | 2000 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 34800 | 17000 | 2600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 206000 | 17000 | 3800 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 83000 | 6000 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 17000 | 2400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 17000 | 2200 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 17000 | 9900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 17000 | 13000 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 17000 | 9900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 33000 | 4000 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 33000 | 2000 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 33000 | 3000 | ug/kg | |
| 100-41-4 | Ethylbenzene | 214000 | 17000 | 2700 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 83000 | 7500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 83000 | 22000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-20 | | |
| **Lab Sample ID:** | JC18511-2 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 665000 | 33000 | 1800 | ug/kg | |
| 79-20-9 | Methyl Acetate | 307000 | 83000 | 14000 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 44600 | 33000 | 3800 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 17000 | 2600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 83000 | 7700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 83000 | 16000 | ug/kg | |
| 91-20-3 | Naphthalene | 6470000 [b] | 2100000 | 79000 | ug/kg | |
| 100-42-5 | Styrene | ND | 33000 | 3000 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 33000 | 2900 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 33000 | 5000 | ug/kg | |
| 108-88-3 | Toluene | 10700000 [b] | 420000 | 87000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 83000 | 2900 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 7720 | 83000 | 2800 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 33000 | 2500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 33000 | 2500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 17000 | 2500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 83000 | 4200 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 33000 | 3300 | ug/kg | |
| | m,p-Xylene | 2100000 | 17000 | 5900 | ug/kg | |
| 95-47-6 | o-Xylene | 606000 | 17000 | 4600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 2700000 | 17000 | 4600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 108% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 100% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-40 | | |
| **Lab Sample ID:** | JC18511-3 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234670.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234743.D | 2000 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.3 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.3 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 94000 | 21000 | ug/kg | |
| 71-43-2 | Benzene | 16200000 [b] | 94000 | 25000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 47000 | 2900 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 19000 | 1500 | ug/kg | |
| 75-25-2 | Bromoform | ND | 47000 | 2200 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 47000 | 3400 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 94000 | 18000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 9440 | 19000 | 2200 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 19000 | 2200 | ug/kg | |
| 108-90-7 | Chlorobenzene | 5140 | 19000 | 1500 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 47000 | 4500 | ug/kg | |
| 67-66-3 | Chloroform | ND | 19000 | 1400 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 47000 | 2500 | ug/kg | |
| 110-82-7 | Cyclohexane | 7420 | 19000 | 3000 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 19000 | 5100 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 19000 | 1900 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 9400 | 1200 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1140000 | 9400 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 15700 | 9400 | 1500 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 94000 | 9400 | 2100 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 47000 | 3400 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 9400 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 9400 | 7300 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 9400 | 5600 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 19000 | 2200 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 19000 | 1100 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 19000 | 1700 | ug/kg | |
| 100-41-4 | Ethylbenzene | 101000 | 9400 | 1500 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 47000 | 4200 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 47000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-40 | | |
| **Lab Sample ID:** | JC18511-3 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 300000 | 19000 | 1000 | ug/kg | |
| 79-20-9 | Methyl Acetate | 214000 | 47000 | 8100 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 17000 | 19000 | 2100 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 9400 | 1400 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 47000 | 4300 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 47000 | 9300 | ug/kg | |
| 91-20-3 | Naphthalene | 2480000 [b] | 940000 | 36000 | ug/kg | |
| 100-42-5 | Styrene | ND | 19000 | 1700 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 19000 | 1700 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 19000 | 2800 | ug/kg | |
| 108-88-3 | Toluene | 5030000 [b] | 190000 | 39000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 47000 | 1700 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 47000 | 1600 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 19000 | 1400 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 9400 | 1400 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 47000 | 2300 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 19000 | 1900 | ug/kg | |
| | m,p-Xylene | 971000 | 9400 | 3300 | ug/kg | |
| 95-47-6 | o-Xylene | 281000 | 9400 | 2600 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1250000 | 9400 | 2600 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 107% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 98% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-60 | | |
| **Lab Sample ID:** | JC18511-4 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234671.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234744.D | 1000 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 14300000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 6780 | 20000 | 2300 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 4920 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | 5500 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1110000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 15700 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 90000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 95500 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-60 | | |
| **Lab Sample ID:** | JC18511-4 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 287000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 221000 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 14600 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 2800000 [b] | 500000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 4730000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 914000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 266000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1180000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 108% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 101% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis



| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-80 | | |
| **Lab Sample ID:** | JC18511-5 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234672.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234745.D | 1000 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 5.0 g | 10.0 ml | 1.0 ul |
| Run #2 | 5.0 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 22000 | ug/kg | |
| 71-43-2 | Benzene | 13700000 [b] | 50000 | 13000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 50000 | 3100 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 50000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 50000 | 3600 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 7500 | 20000 | 2300 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 4290 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 50000 | 4800 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 50000 | 2600 | ug/kg | |
| 110-82-7 | Cyclohexane | 5920 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5400 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1020000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 14200 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 82700 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 50000 | 3600 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1300 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7800 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 5900 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 88200 | 10000 | 1600 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 50000 | 4500 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 50000 | 13000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-80 | | |
| **Lab Sample ID:** | JC18511-5 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 259000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 201000 | 50000 | 8600 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 15600 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1500 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 50000 | 4600 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 50000 | 9800 | ug/kg | |
| 91-20-3 | Naphthalene | 2730000 [b] | 500000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3000 | ug/kg | |
| 108-88-3 | Toluene | 4560000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 50000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 50000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 50000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 846000 | 10000 | 3500 | ug/kg | |
| 95-47-6 | o-Xylene | 250000 | 10000 | 2700 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1100000 | 10000 | 2700 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 107% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 106% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 101% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-100 | | |
| **Lab Sample ID:** | JC18511-6 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234673.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234746.D | 1000 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 13700000 [b] | 51000 | 14000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 7730 | 20000 | 2300 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 5110 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | 6940 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1240000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 17400 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 105000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 109000 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-100 | | |
| **Lab Sample ID:** | JC18511-6 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 313000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 207000 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 19800 | 20000 | 2300 | ug/kg | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 3110000 [b] | 510000 | 19000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 4630000 [b] | 100000 | 21000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 51000 | 1700 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 1040000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 304000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1340000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 107% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 101% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-POST | | |
| **Lab Sample ID:** | JC18511-7 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | E234674.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| Run #2 | E234747.D | 2000 | 04/26/16 | TDN | n/a | n/a | VE10218 |

| | Initial Weight | Final Volume | Methanol Aliquot |
|---|---|---|---|
| Run #1 | 4.9 g | 10.0 ml | 1.0 ul |
| Run #2 | 4.9 g | 10.0 ml | 100 ul |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 100000 | 23000 | ug/kg | |
| 71-43-2 | Benzene | 20300000 [b] | 100000 | 27000 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 51000 | 3200 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 20000 | 1600 | ug/kg | |
| 75-25-2 | Bromoform | ND | 51000 | 2400 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 51000 | 3700 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 100000 | 19000 | ug/kg | |
| 75-15-0 | Carbon disulfide | 9620 | 20000 | 2300 | ug/kg | J |
| 56-23-5 | Carbon tetrachloride | ND | 20000 | 2300 | ug/kg | |
| 108-90-7 | Chlorobenzene | 6150 | 20000 | 1600 | ug/kg | J |
| 75-00-3 | Chloroethane | ND | 51000 | 4900 | ug/kg | |
| 67-66-3 | Chloroform | ND | 20000 | 1500 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 51000 | 2700 | ug/kg | |
| 110-82-7 | Cyclohexane | 9640 | 20000 | 3200 | ug/kg | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 20000 | 5600 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 20000 | 2100 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 10000 | 1300 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | 1560000 | 10000 | 1200 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | 22300 | 10000 | 1600 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | 128000 | 10000 | 2300 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 51000 | 3700 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 10000 | 1400 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 10000 | 6000 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 10000 | 7900 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 10000 | 6100 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 20000 | 2400 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 20000 | 1200 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 20000 | 1800 | ug/kg | |
| 100-41-4 | Ethylbenzene | 131000 | 10000 | 1700 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 51000 | 4600 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 51000 | 14000 | ug/kg | |

ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-POST | | |
| **Lab Sample ID:** | JC18511-7 | **Date Sampled:** | 04/15/16 |
| **Matrix:** | SO - Soil | **Date Received:** | 04/16/16 |
| **Method:** | SW846 8260C | **Percent Solids:** | n/a [a] |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List**

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 423000 | 20000 | 1100 | ug/kg | |
| 79-20-9 | Methyl Acetate | 192000 | 51000 | 8800 | ug/kg | |
| 108-87-2 | Methylcyclohexane | 26300 | 20000 | 2300 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 10000 | 1600 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 51000 | 4700 | ug/kg | |
| 75-09-2 | Methylene chloride | ND | 51000 | 10000 | ug/kg | |
| 91-20-3 | Naphthalene | 4910000 [b] | 1000000 | 39000 | ug/kg | |
| 100-42-5 | Styrene | ND | 20000 | 1800 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 20000 | 1800 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 20000 | 3100 | ug/kg | |
| 108-88-3 | Toluene | 7200000 [b] | 200000 | 42000 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 51000 | 1800 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 4100 | 51000 | 1700 | ug/kg | J |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 20000 | 1500 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 10000 | 1500 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 51000 | 2500 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 20000 | 2000 | ug/kg | |
| | m,p-Xylene | 1270000 | 10000 | 3600 | ug/kg | |
| 95-47-6 | o-Xylene | 371000 | 10000 | 2800 | ug/kg | |
| 1330-20-7 | Xylene (total) | 1640000 | 10000 | 2800 | ug/kg | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 107% | 68-124% |
| 2037-26-5 | Toluene-D8 | 94% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 99% | 72-130% |

(a) All results reported on a wet weight basis.
(b) Result is from Run# 2

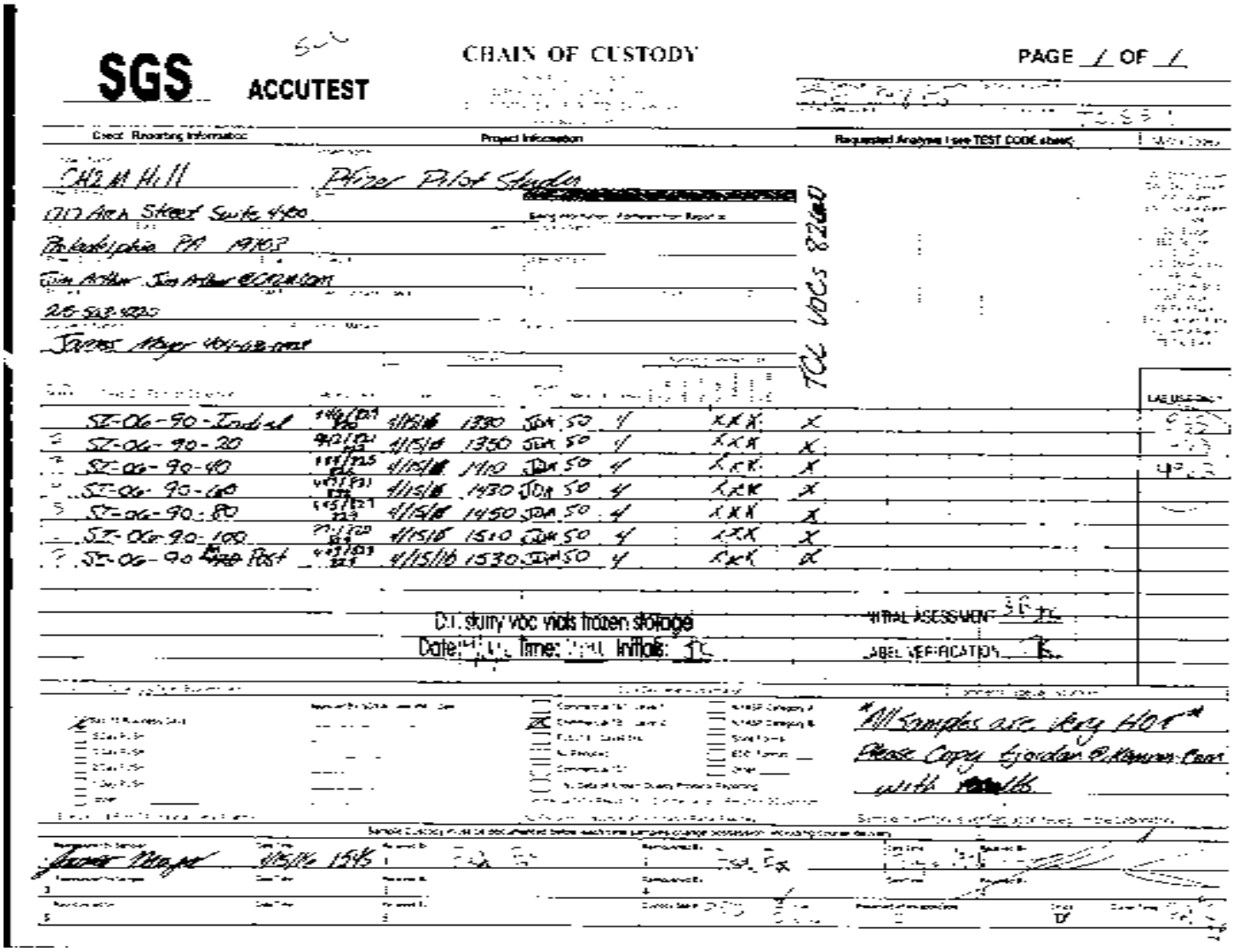
ND = Not detected MDL = Method Detection Limit
RL = Reporting Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



**SGS ACCUTEST**

CHAIN OF CUSTODY

PAGE 1 OF 1

Direct Reporting Information | Project Information | Requested Analysis (see TEST CODE sheet)

CH2M Hill
1717 Arch Street Suite 4400
Philadelphia PA 19103
Jim Arthur Jim Arthur@CH2M.com
215-563-4220
James Mayer 404-638-[illegible]

Pfizer Pilot Study
[redacted]

TCL VOCs 8260

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | SI-06-90-Initial | [illegible] | 4/15/16 | 1330 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90-20 | [illegible] | 4/15/16 | 1350 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90-40 | [illegible] | 4/15/16 | 1410 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90-60 | [illegible] | 4/15/16 | 1430 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90-80 | [illegible] | 4/15/16 | 1450 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90-100 | [illegible] | 4/15/16 | 1510 | JDA | 50 | 4 | XXX | X | |
| | SI-06-90 ~~[illegible]~~ Post | [illegible] | 4/15/16 | 1530 | JDA | 50 | 4 | XXX | X | |

D.I. slurry voc vials frozen storage
Date: [illegible] Time: [illegible] Initials: JC

INITIAL ASSESSMENT: SC JC
LABEL VERIFICATION: JC

*All samples are very HOT*
Please copy tjordan@kennon.com
with results

Sample Custody must be documented below each time samples change possession, including courier delivery.

James Mayer | 4/15/16 1545

JC18511: Chain of Custody
Page 1 of 2

# SGS Accutest Sample Receipt Summary

**Job Number:** JC18511 **Client:** **Project:**

**Date / Time Received:** 4/16/2016 9:45:00 AM **Delivery Method:** **Airbill #'s:**

Cooler Temps (Raw Measured) °C: Cooler 1: (2.9);

Cooler Temps (Corrected) °C: Cooler 1: (3.3);

| Cooler Security | Y | or | N | | Y | or | N |
|---|---|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | | ☐ | 3. COC Present: | ☑ | | ☐ |
| 2. Custody Seals Intact: | ☑ | | ☐ | 4. Smpl Dates/Time OK | ☑ | | ☐ |

| Cooler Temperature | Y | or | N |
|---|---|---|---|
| 1. Temp criteria achieved: | ☑ | | ☐ |
| 2. Cooler temp verification: | IR Gun | | |
| 3. Cooler media: | Ice (Bag) | | |
| 4. No. Coolers: | 1 | | |

| Quality Control Preservation | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | | ☐ | |
| 4. VOCs headspace free: | ☐ | | ☐ | ☑ |

| Sample Integrity - Documentation | Y | or | N |
|---|---|---|---|
| 1. Sample labels present on bottles: | ☑ | | ☐ |
| 2. Container labeling complete: | ☑ | | ☐ |
| 3. Sample container label / COC agree: | ☑ | | ☐ |

| Sample Integrity - Condition | Y | or | N |
|---|---|---|---|
| 1. Sample recvd within HT: | ☑ | | ☐ |
| 2. All containers accounted for: | ☑ | | ☐ |
| 3. Condition of sample: | Intact | | |

| Sample Integrity - Instructions | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | | ☐ | |
| 4. Compositing instructions clear: | ☐ | | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | | ☐ | ☑ |

Comments

**JC18511: Chain of Custody**
**Page 2 of 2**

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10216-MB1 | E234657.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 500 | 110 | ug/kg | |
| 74-97-5 | Bromochloromethane | ND | 250 | 15 | ug/kg | |
| 75-27-4 | Bromodichloromethane | ND | 100 | 7.8 | ug/kg | |
| 75-25-2 | Bromoform | ND | 250 | 12 | ug/kg | |
| 74-83-9 | Bromomethane | ND | 250 | 18 | ug/kg | |
| 78-93-3 | 2-Butanone (MEK) | ND | 500 | 96 | ug/kg | |
| 75-15-0 | Carbon disulfide | ND | 100 | 11 | ug/kg | |
| 56-23-5 | Carbon tetrachloride | ND | 100 | 12 | ug/kg | |
| 108-90-7 | Chlorobenzene | ND | 100 | 7.8 | ug/kg | |
| 75-00-3 | Chloroethane | ND | 250 | 24 | ug/kg | |
| 67-66-3 | Chloroform | ND | 100 | 7.5 | ug/kg | |
| 74-87-3 | Chloromethane | ND | 250 | 13 | ug/kg | |
| 110-82-7 | Cyclohexane | ND | 100 | 16 | ug/kg | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 100 | 27 | ug/kg | |
| 124-48-1 | Dibromochloromethane | ND | 100 | 10 | ug/kg | |
| 106-93-4 | 1,2-Dibromoethane | ND | 50 | 6.6 | ug/kg | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 50 | 6.1 | ug/kg | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 50 | 7.9 | ug/kg | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 50 | 11 | ug/kg | |
| 75-71-8 | Dichlorodifluoromethane | ND | 250 | 18 | ug/kg | |
| 75-34-3 | 1,1-Dichloroethane | ND | 50 | 7.1 | ug/kg | |
| 107-06-2 | 1,2-Dichloroethane | ND | 50 | 6.7 | ug/kg | |
| 75-35-4 | 1,1-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 50 | 39 | ug/kg | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 50 | 30 | ug/kg | |
| 78-87-5 | 1,2-Dichloropropane | ND | 100 | 12 | ug/kg | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 100 | 5.9 | ug/kg | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 100 | 8.9 | ug/kg | |
| 100-41-4 | Ethylbenzene | ND | 50 | 8.2 | ug/kg | |
| 76-13-1 | Freon 113 | ND | 250 | 22 | ug/kg | |
| 591-78-6 | 2-Hexanone | ND | 250 | 67 | ug/kg | |
| 98-82-8 | Isopropylbenzene | ND | 100 | 5.3 | ug/kg | |
| 79-20-9 | Methyl Acetate | ND | 250 | 43 | ug/kg | |
| 108-87-2 | Methylcyclohexane | ND | 100 | 11 | ug/kg | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 50 | 7.7 | ug/kg | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 250 | 23 | ug/kg | |

# Method Blank Summary

**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10216-MB1 | E234657.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | 250 | 49 | ug/kg | |
| 100-42-5 | Styrene | ND | 100 | 8.9 | ug/kg | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 100 | 8.8 | ug/kg | |
| 127-18-4 | Tetrachloroethene | ND | 100 | 15 | ug/kg | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 250 | 8.8 | ug/kg | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 250 | 8.5 | ug/kg | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 100 | 7.5 | ug/kg | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 100 | 7.4 | ug/kg | |
| 79-01-6 | Trichloroethene | ND | 50 | 7.4 | ug/kg | |
| 75-69-4 | Trichlorofluoromethane | ND | 250 | 12 | ug/kg | |
| 75-01-4 | Vinyl chloride | ND | 100 | 9.9 | ug/kg | |
| | m,p-Xylene | ND | 50 | 18 | ug/kg | |
| 95-47-6 | o-Xylene | ND | 50 | 14 | ug/kg | |
| 1330-20-7 | Xylene (total) | ND | 50 | 14 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10218-MB1 | E234720.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/kg | |

# Method Blank Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10218-MB2 | E234742.D | 1 | 04/26/16 | TDN | n/a | n/a | VE10218 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 25 | 6.7 | ug/kg | |
| 91-20-3 | Naphthalene | ND | 250 | 9.5 | ug/kg | |
| 108-88-3 | Toluene | ND | 50 | 10 | ug/kg | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 68-124% |
| 2037-26-5 | Toluene-D8 | 93% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-130% |

# Blank Spike Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10216-BS | E234658.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 2500 | 1990 | 80 | 30-150 |
| 74-97-5 | Bromochloromethane | 2500 | 2660 | 106 | 81-126 |
| 75-27-4 | Bromodichloromethane | 2500 | 2530 | 101 | 82-130 |
| 75-25-2 | Bromoform | 2500 | 2500 | 100 | 78-134 |
| 74-83-9 | Bromomethane | 2500 | 2680 | 107 | 56-141 |
| 78-93-3 | 2-Butanone (MEK) | 2500 | 2460 | 98 | 61-139 |
| 75-15-0 | Carbon disulfide | 2500 | 2780 | 111 | 68-131 |
| 56-23-5 | Carbon tetrachloride | 2500 | 2790 | 112 | 73-139 |
| 108-90-7 | Chlorobenzene | 2500 | 2540 | 102 | 79-120 |
| 75-00-3 | Chloroethane | 2500 | 2800 | 112 | 64-150 |
| 67-66-3 | Chloroform | 2500 | 2800 | 112 | 77-123 |
| 74-87-3 | Chloromethane | 2500 | 2940 | 118 | 50-140 |
| 110-82-7 | Cyclohexane | 2500 | 2700 | 108 | 66-131 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 2500 | 2580 | 103 | 70-128 |
| 124-48-1 | Dibromochloromethane | 2500 | 2570 | 103 | 82-129 |
| 106-93-4 | 1,2-Dibromoethane | 2500 | 2570 | 103 | 83-125 |
| 95-50-1 | 1,2-Dichlorobenzene | 2500 | 2570 | 103 | 79-118 |
| 541-73-1 | 1,3-Dichlorobenzene | 2500 | 2510 | 100 | 76-119 |
| 106-46-7 | 1,4-Dichlorobenzene | 2500 | 2530 | 101 | 75-118 |
| 75-71-8 | Dichlorodifluoromethane | 2500 | 2940 | 118 | 31-170 |
| 75-34-3 | 1,1-Dichloroethane | 2500 | 2800 | 112 | 78-129 |
| 107-06-2 | 1,2-Dichloroethane | 2500 | 2700 | 108 | 77-140 |
| 75-35-4 | 1,1-Dichloroethene | 2500 | 2890 | 116 | 71-128 |
| 156-59-2 | cis-1,2-Dichloroethene | 2500 | 2610 | 104 | 73-123 |
| 156-60-5 | trans-1,2-Dichloroethene | 2500 | 2760 | 110 | 72-122 |
| 78-87-5 | 1,2-Dichloropropane | 2500 | 2560 | 102 | 80-129 |
| 10061-01-5 | cis-1,3-Dichloropropene | 2500 | 2560 | 102 | 75-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 2500 | 2480 | 99 | 75-129 |
| 100-41-4 | Ethylbenzene | 2500 | 2530 | 101 | 75-121 |
| 76-13-1 | Freon 113 | 2500 | 2790 | 112 | 67-136 |
| 591-78-6 | 2-Hexanone | 2500 | 2240 | 90 | 63-140 |
| 98-82-8 | Isopropylbenzene | 2500 | 2640 | 106 | 70-126 |
| 79-20-9 | Methyl Acetate | 2500 | 2290 | 92 | 59-131 |
| 108-87-2 | Methylcyclohexane | 2500 | 2410 | 96 | 62-131 |
| 1634-04-4 | Methyl Tert Butyl Ether | 5000 | 5350 | 107 | 77-121 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 2500 | 2490 | 100 | 73-141 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10216-BS | E234658.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | 2500 | 2750 | 110 | 71-124 |
| 100-42-5 | Styrene | 2500 | 2500 | 100 | 79-125 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 2500 | 2430 | 97 | 72-121 |
| 127-18-4 | Tetrachloroethene | 2500 | 2700 | 108 | 70-135 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 2500 | 2760 | 110 | 76-128 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 2500 | 2770 | 111 | 74-129 |
| 71-55-6 | 1,1,1-Trichloroethane | 2500 | 2880 | 115 | 75-134 |
| 79-00-5 | 1,1,2-Trichloroethane | 2500 | 2380 | 95 | 78-130 |
| 79-01-6 | Trichloroethene | 2500 | 2650 | 106 | 79-127 |
| 75-69-4 | Trichlorofluoromethane | 2500 | 3060 | 122 | 64-141 |
| 75-01-4 | Vinyl chloride | 2500 | 3010 | 120 | 57-136 |
| | m,p-Xylene | 5000 | 5170 | 103 | 75-122 |
| 95-47-6 | o-Xylene | 2500 | 2690 | 108 | 76-121 |
| 1330-20-7 | Xylene (total) | 7500 | 7860 | 105 | 76-121 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 68-124% |
| 2037-26-5 | Toluene-D8 | 96% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 72-130% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| VE10218-BS | E234721.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | Spike ug/kg | BSP ug/kg | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 2500 | 2570 | 103 | 77-122 |
| 91-20-3 | Naphthalene | 2500 | 2720 | 109 | 74-126 |
| 108-88-3 | Toluene | 2500 | 2520 | 101 | 75-123 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 68-124% |
| 2037-26-5 | Toluene-D8 | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18603-1MS | E234665.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| JC18603-1MSD | E234666.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| JC18603-1 | E234661.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | JC18603-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 6330 | 5520 | 87 | 6330 | 5180 | 82 | 6 | 10-180/33 |
| 74-97-5 | Bromochloromethane | ND | | 6330 | 6660 | 105 | 6330 | 6550 | 103 | 2 | 53-137/26 |
| 75-27-4 | Bromodichloromethane | ND | | 6330 | 6470 | 102 | 6330 | 6060 | 96 | 7 | 50-145/28 |
| 75-25-2 | Bromoform | ND | | 6330 | 6230 | 98 | 6330 | 5980 | 94 | 4 | 39-148/24 |
| 74-83-9 | Bromomethane | ND | | 6330 | 4740 | 75 | 6330 | 4820 | 76 | 2 | 12-156/32 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 6330 | 6410 | 101 | 6330 | 6180 | 98 | 4 | 26-164/30 |
| 75-15-0 | Carbon disulfide | ND | | 6330 | 7110 | 112 | 6330 | 6780 | 107 | 5 | 34-146/31 |
| 56-23-5 | Carbon tetrachloride | ND | | 6330 | 7180 | 113 | 6330 | 6620 | 105 | 8 | 43-152/31 |
| 108-90-7 | Chlorobenzene | ND | | 6330 | 6560 | 104 | 6330 | 6330 | 100 | 4 | 38-144/29 |
| 75-00-3 | Chloroethane | ND | | 6330 | 4260 | 67 | 6330 | 3980 | 63 | 7 | 26-154/34 |
| 67-66-3 | Chloroform | ND | | 6330 | 7130 | 113 | 6330 | 6890 | 109 | 3 | 52-134/27 |
| 74-87-3 | Chloromethane | ND | | 6330 | 7130 | 113 | 6330 | 6850 | 108 | 4 | 41-142/28 |
| 110-82-7 | Cyclohexane | ND | | 6330 | 7030 | 111 | 6330 | 6710 | 106 | 5 | 22-154/33 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 6330 | 6480 | 102 | 6330 | 6360 | 100 | 2 | 29-145/26 |
| 124-48-1 | Dibromochloromethane | ND | | 6330 | 6460 | 102 | 6330 | 6200 | 98 | 4 | 49-142/24 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 6330 | 6560 | 104 | 6330 | 6340 | 100 | 3 | 46-139/24 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 6330 | 6700 | 106 | 6330 | 6460 | 102 | 4 | 30-144/30 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 6330 | 6520 | 103 | 6330 | 6220 | 98 | 5 | 28-148/31 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 6330 | 6540 | 103 | 6330 | 6240 | 99 | 5 | 30-142/31 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 6330 | 7210 | 114 | 6330 | 6920 | 109 | 4 | 31-161/28 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 6330 | 7210 | 114 | 6330 | 6940 | 110 | 4 | 54-137/28 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 6330 | 6700 | 106 | 6330 | 6450 | 102 | 4 | 56-140/24 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 6330 | 7340 | 116 | 6330 | 7020 | 111 | 4 | 41-143/30 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 6330 | 6660 | 105 | 6330 | 6530 | 103 | 2 | 45-137/28 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 6330 | 7130 | 113 | 6330 | 6870 | 108 | 4 | 42-141/30 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 6330 | 6680 | 105 | 6330 | 6230 | 98 | 7 | 53-139/27 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 6330 | 6660 | 105 | 6330 | 6180 | 98 | 7 | 41-144/26 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 6330 | 6330 | 100 | 6330 | 5970 | 94 | 6 | 36-148/27 |
| 100-41-4 | Ethylbenzene | ND | | 6330 | 6510 | 103 | 6330 | 6200 | 98 | 5 | 34-145/29 |
| 76-13-1 | Freon 113 | ND | | 6330 | 7430 | 117 | 6330 | 7100 | 112 | 5 | 30-152/29 |
| 591-78-6 | 2-Hexanone | ND | | 6330 | 6020 | 95 | 6330 | 5650 | 89 | 6 | 16-176/32 |
| 98-82-8 | Isopropylbenzene | ND | | 6330 | 7040 | 111 | 6330 | 6650 | 105 | 6 | 36-145/33 |
| 79-20-9 | Methyl Acetate | ND | | 6330 | 6170 | 97 | 6330 | 6040 | 95 | 2 | 26-176/29 |
| 108-87-2 | Methylcyclohexane | ND | | 6330 | 6880 | 109 | 6330 | 6280 | 99 | 9 | 14-153/33 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 12700 | 13700 | 108 | 12700 | 13100 | 103 | 4 | 54-129/25 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 6330 | 6540 | 103 | 6330 | 6130 | 97 | 6 | 33-154/29 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18603-1MS | E234665.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| JC18603-1MSD | E234666.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |
| JC18603-1 | E234661.D | 1 | 04/22/16 | TDN | n/a | n/a | VE10216 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | JC18603-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | | 6330 | 6880 | 109 | 6330 | 6700 | 106 | 3 | 47-133/25 |
| 100-42-5 | Styrene | ND | | 6330 | 6400 | 101 | 6330 | 6090 | 96 | 5 | 32-156/31 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 6330 | 6360 | 100 | 6330 | 6020 | 95 | 5 | 31-149/25 |
| 127-18-4 | Tetrachloroethene | ND | | 6330 | 6950 | 110 | 6330 | 6630 | 105 | 5 | 34-163/31 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 6330 | 7300 | 115 | 6330 | 7000 | 111 | 4 | 14-153/35 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 6330 | 7250 | 114 | 6330 | 6870 | 108 | 5 | 14-156/36 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 6330 | 7280 | 115 | 6330 | 6940 | 110 | 5 | 48-144/29 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 6330 | 6100 | 96 | 6330 | 5790 | 91 | 5 | 43-146/27 |
| 79-01-6 | Trichloroethene | ND | | 6330 | 6780 | 107 | 6330 | 6390 | 101 | 6 | 42-152/29 |
| 75-69-4 | Trichlorofluoromethane | ND | | 6330 | 7140 | 113 | 6330 | 6880 | 109 | 4 | 39-153/27 |
| 75-01-4 | Vinyl chloride | ND | | 6330 | 7340 | 116 | 6330 | 7100 | 112 | 3 | 38-149/29 |
| | m,p-Xylene | ND | | 12700 | 13500 | 107 | 12700 | 12800 | 101 | 5 | 32-148/30 |
| 95-47-6 | o-Xylene | ND | | 6330 | 6960 | 110 | 6330 | 6620 | 105 | 5 | 36-145/30 |
| 1330-20-7 | Xylene (total) | ND | | 19000 | 20400 | 107 | 19000 | 19500 | 103 | 5 | 34-146/29 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18603-1 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 106% | 105% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 104% | 105% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 98% | 96% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 102% | 101% | 72-130% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18429-1MS | E234728.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |
| JC18429-1MSD | E234729.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |
| JC18429-1 | E234731.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |
| JC18429-1 | E234732.D | 1 | 04/25/16 | TDN | n/a | n/a | VE10218 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18511-1, JC18511-2, JC18511-3, JC18511-4, JC18511-5, JC18511-6, JC18511-7

| CAS No. | Compound | JC18429-1 ug/kg | Q | Spike ug/kg | MS ug/kg | MS % | Spike ug/kg | MSD ug/kg | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | 4410 | | 12900 | 17500 | 101 | 12900 | 17400 | 101 | 1 | 48-136/30 |
| 91-20-3 | Naphthalene | ND | a | 12900 | 14100 | 109 | 12900 | 14500 | 112 | 3 | 12-160/33 |
| 108-88-3 | Toluene | 57500 | a | 12900 | 87200 | 230* | b | 12900 | 85800 | 219* | b | 2 | 40-141/30 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18429-1 | JC18429-1 | Limits |
|---|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 106% | 104% | 106% | 70-122% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 102% | 104% | 104% | 68-124% |
| 2037-26-5 | Toluene-D8 | 97% | 98% | 95% | 95% | 77-125% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 99% | 99% | 100% | 72-130% |

(a) Result is from Run #2.
(b) Outside control limits due to high level in sample relative to spike amount.

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10206-BFB
**Lab File ID:** E234316.D
**Instrument ID:** GCMSE
**Injection Date:** 04/11/16
**Injection Time:** 20:55

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8171 | 18.1 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 21194 | 46.9 | | Pass |
| 95 | Base peak, 100% relative abundance | 45186 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3045 | 6.74 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 41941 | 92.8 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3226 | 7.14 | (7.69) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41088 | 90.9 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2750 | 6.09 | (6.69) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10206-IC10206 | E234317.D | 04/11/16 | 21:30 | 00:35 | Initial cal 0.2 |
| VE10206-IC10206 | E234318.D | 04/11/16 | 22:05 | 01:10 | Initial cal 0.5 |
| VE10206-IC10206 | E234319.D | 04/11/16 | 22:39 | 01:44 | Initial cal 1 |
| VE10206-IC10206 | E234320.D | 04/11/16 | 23:13 | 02:18 | Initial cal 2 |
| VE10206-IC10206 | E234321.D | 04/11/16 | 23:48 | 02:53 | Initial cal 4 |
| VE10206-IC10206 | E234322.D | 04/12/16 | 00:22 | 03:27 | Initial cal 8 |
| VE10206-IC10206 | E234323.D | 04/12/16 | 00:57 | 04:02 | Initial cal 20 |
| VE10206-ICC10206 | E234324.D | 04/12/16 | 01:31 | 04:36 | Initial cal 50 |
| VE10206-IC10206 | E234325.D | 04/12/16 | 02:05 | 05:10 | Initial cal 100 |
| VE10206-IC10206 | E234326.D | 04/12/16 | 02:40 | 05:45 | Initial cal 200 |

# Instrument Performance Check (BFB)



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10206-BFB2
**Lab File ID:** E234331.D
**Instrument ID:** GCMSE
**Injection Date:** 04/12/16
**Injection Time:** 08:24



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 7980 | 17.8 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 20882 | 46.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 44882 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2884 | 6.43 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 43069 | 96.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3341 | 7.44 | (7.76) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41770 | 93.1 | (97.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2658 | 5.92 | (6.36) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10206-ICV10206 | E234332.D | 04/12/16 | 08:59 | 00:35 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10216-BFB
**Lab File ID:** E234654.D
**Instrument ID:** GCMSE
**Injection Date:** 04/22/16
**Injection Time:** 06:41



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 9032 | 17.9 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 23301 | 46.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 50362 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3417 | 6.78 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 48237 | 95.8 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3696 | 7.34 | (7.66) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 46357 | 92.0 | (96.1) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3101 | 6.16 | (6.69) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10216-CC10206 | E234655.D | 04/22/16 | 07:17 | 00:36 | Continuing cal 50 |
| ZZZZZZ | E234657B.D | 04/22/16 | 08:28 | 01:47 | (unrelated sample) |
| VE10216-MB1 | E234657.D | 04/22/16 | 08:28 | 01:47 | Method Blank |
| VE10216-BS | E234658.D | 04/22/16 | 09:02 | 02:21 | Blank Spike |
| ZZZZZZ | E234660.D | 04/22/16 | 10:11 | 03:30 | (unrelated sample) |
| JC18603-1 | E234661.D | 04/22/16 | 10:45 | 04:04 | (used for QC only; not part of job JC18511) |
| ZZZZZZ | E234662.D | 04/22/16 | 11:20 | 04:39 | (unrelated sample) |
| ZZZZZZ | E234663.D | 04/22/16 | 11:54 | 05:13 | (unrelated sample) |
| JC18603-1MS | E234665.D | 04/22/16 | 13:03 | 06:22 | Matrix Spike |
| JC18603-1MSD | E234666.D | 04/22/16 | 13:37 | 06:56 | Matrix Spike Duplicate |
| JC18511-1 | E234668.D | 04/22/16 | 14:46 | 08:05 | SI-06-90-INITAL |
| JC18511-2 | E234669.D | 04/22/16 | 15:21 | 08:40 | SI-06-90-20 |
| JC18511-3 | E234670.D | 04/22/16 | 15:56 | 09:15 | SI-06-90-40 |
| JC18511-4 | E234671.D | 04/22/16 | 16:30 | 09:49 | SI-06-90-60 |
| JC18511-5 | E234672.D | 04/22/16 | 17:05 | 10:24 | SI-06-90-80 |
| JC18511-6 | E234673.D | 04/22/16 | 17:40 | 10:59 | SI-06-90-100 |
| JC18511-7 | E234674.D | 04/22/16 | 18:15 | 11:34 | SI-06-90-POST |

# Instrument Performance Check (BFB)



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10218-BFB
**Lab File ID:** E234716.D
**Instrument ID:** GCMSE
**Injection Date:** 04/25/16
**Injection Time:** 08:52



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8252 | 18.8 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 20866 | 47.6 | | Pass |
| 95 | Base peak, 100% relative abundance | 43826 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 2837 | 6.47 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 43229 | 98.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3415 | 7.79 | (7.90) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 41797 | 95.4 | (96.7) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2932 | 6.69 | (7.01) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10218-CC10206 | E234718.D | 04/25/16 | 10:01 | 01:09 | Continuing cal 20 |
| VE10218-MB1 | E234720.D | 04/25/16 | 11:09 | 02:17 | Method Blank |
| VE10218-BS | E234721.D | 04/25/16 | 11:44 | 02:52 | Blank Spike |
| ZZZZZZ | E234722.D | 04/25/16 | 12:18 | 03:26 | (unrelated sample) |
| ZZZZZZ | E234723.D | 04/25/16 | 12:53 | 04:01 | (unrelated sample) |
| ZZZZZZ | E234724.D | 04/25/16 | 13:26 | 04:34 | (unrelated sample) |
| ZZZZZZ | E234725.D | 04/25/16 | 14:01 | 05:09 | (unrelated sample) |
| ZZZZZZ | E234726.D | 04/25/16 | 14:35 | 05:43 | (unrelated sample) |
| JC18429-1MS | E234728.D | 04/25/16 | 15:44 | 06:52 | Matrix Spike |
| JC18429-1MSD | E234729.D | 04/25/16 | 16:18 | 07:26 | Matrix Spike Duplicate |
| JC18429-1 | E234731.D | 04/25/16 | 17:27 | 08:35 | (used for QC only; not part of job JC18511) |
| JC18429-1 | E234732.D | 04/25/16 | 18:02 | 09:10 | (used for QC only; not part of job JC18511) |
| JC18511-1 | E234736.D | 04/25/16 | 20:18 | 11:26 | SI-06-90-INITAL |

# Instrument Performance Check (BFB)



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** VE10218-BFB2
**Lab File ID:** E234739.D
**Instrument ID:** GCMSE
**Injection Date:** 04/25/16
**Injection Time:** 22:00

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8523 | 17.9 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 21952 | 46.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 47682 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3105 | 6.51 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 44136 | 92.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3425 | 7.18 | (7.76) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 43192 | 90.6 | (97.9) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2870 | 6.02 | (6.64) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| VE10218-CC10206 | E234740.D | 04/25/16 | 22:34 | 00:34 | Continuing cal 50 |
| VE10218-CC10206 | E234741A.D | 04/25/16 | 23:43 | 01:43 | Continuing cal 4 |
| VE10218-MB2 | E234742.D | 04/26/16 | 00:17 | 02:17 | Method Blank |
| JC18511-3 | E234743.D | 04/26/16 | 00:50 | 02:50 | SI-06-90-40 |
| JC18511-4 | E234744.D | 04/26/16 | 01:25 | 03:25 | SI-06-90-60 |
| JC18511-5 | E234745.D | 04/26/16 | 01:59 | 03:59 | SI-06-90-80 |
| JC18511-6 | E234746.D | 04/26/16 | 02:33 | 04:33 | SI-06-90-100 |
| JC18511-7 | E234747.D | 04/26/16 | 03:08 | 05:08 | SI-06-90-POST |
| JC18511-2 | E234748.D | 04/26/16 | 03:42 | 05:42 | SI-06-90-20 |

# Volatile Surrogate Recovery Summary



**Job Number:** JC18511
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** SO

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC18511-1 | E234736.D | 106 | 104 | 94 | 100 |
| JC18511-1 | E234668.D | 107 | 104 | 92 | 102 |
| JC18511-2 | E234748.D | 106 | 108 | 95 | 100 |
| JC18511-2 | E234669.D | 106 | 104 | 94 | 101 |
| JC18511-3 | E234743.D | 105 | 107 | 95 | 98 |
| JC18511-3 | E234670.D | 106 | 104 | 93 | 104 |
| JC18511-4 | E234744.D | 105 | 108 | 95 | 101 |
| JC18511-4 | E234671.D | 105 | 104 | 93 | 102 |
| JC18511-5 | E234745.D | 107 | 106 | 95 | 101 |
| JC18511-5 | E234672.D | 105 | 102 | 95 | 99 |
| JC18511-6 | E234746.D | 106 | 107 | 93 | 101 |
| JC18511-6 | E234673.D | 106 | 103 | 94 | 97 |
| JC18511-7 | E234747.D | 106 | 107 | 95 | 99 |
| JC18511-7 | E234674.D | 105 | 103 | 94 | 102 |
| JC18429-1MS | E234728.D | 107 | 106 | 97 | 99 |
| JC18429-1MSD | E234729.D | 106 | 102 | 98 | 99 |
| JC18603-1MS | E234665.D | 105 | 104 | 98 | 103 |
| JC18603-1MSD | E234666.D | 106 | 105 | 96 | 102 |
| VE10216-BS | E234658.D | 106 | 106 | 96 | 100 |
| VE10216-MB1 | E234657.D | 104 | 104 | 95 | 100 |
| VE10218-BS | E234721.D | 105 | 106 | 95 | 102 |
| VE10218-MB1 | E234720.D | 105 | 105 | 95 | 99 |
| VE10218-MB2 | E234742.D | 105 | 105 | 93 | 99 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 70-122% |
| **S2** = 1,2-Dichloroethane-D4 | 68-124% |
| **S3** = Toluene-D8 | 77-125% |
| **S4** = 4-Bromofluorobenzene | 72-130% |

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*e-Hardcopy 2.0*
*Automated Report*

Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

SGS Accutest Job Number: JC18878

Sampling Date: 04/21/16

Report to:

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Total number of pages in report: 53

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

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Laboratory Director

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# Sample Summary

CH2M Hill

**Job No:** JC18878

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC18878-1 | 04/21/16 | 10:40 | TJ | 04/22/16 | SO | Solid | SI-05-90-ISS |
| JC18878-1A | 04/21/16 | 10:40 | TJ | 04/22/16 | SO | Solid | SI-05-90-ISS |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits

**Job Number:** JC18878
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/21/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18878-1** | **SI-05-90-ISS** | | | | | |
| Benzene | | 1.88 | 0.025 | 0.012 | mg/l | SW846 8260C |
| Carbon disulfide | | 0.0015 J | 0.010 | 0.0013 | mg/l | SW846 8260C |
| Chlorobenzene | | 0.0017 J | 0.0050 | 0.00093 | mg/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 0.421 | 0.0050 | 0.00093 | mg/l | SW846 8260C |
| 1,3-Dichlorobenzene | | 0.0057 | 0.0050 | 0.0011 | mg/l | SW846 8260C |
| 1,4-Dichlorobenzene | | 0.0311 | 0.0050 | 0.0014 | mg/l | SW846 8260C |
| Ethylbenzene | | 0.0271 | 0.0050 | 0.0013 | mg/l | SW846 8260C |
| Isopropylbenzene | | 0.0570 | 0.010 | 0.0012 | mg/l | SW846 8260C |
| Naphthalene | | 1.41 | 0.25 | 0.010 | mg/l | SW846 8260C |
| Toluene | | 1.07 | 0.050 | 0.0081 | mg/l | SW846 8260C |
| m,p-Xylene | | 0.265 | 0.0050 | 0.0019 | mg/l | SW846 8260C |
| o-Xylene | | 0.0895 | 0.0050 | 0.00083 | mg/l | SW846 8260C |
| Xylene (total) | | 0.355 | 0.0050 | 0.00083 | mg/l | SW846 8260C |
| Total TIC, Volatile | | 0.524 J | | | mg/l | |
| **JC18878-1A** | **SI-05-90-ISS** | | | | | |
| pH, SPLP Leachate | | 10.77 | | | su | SW846 1312 VOA |
| Volume, SPLP Leachate | | 0.5020 | | | l | SW846 1312 VOA |
| Weight, SPLP Leachate | | 0.02510 | | | kg | SW846 1312 VOA |
| Dry Weight, SPLP Leachate | | 0.01611 | | | kg | SW846 1312 VOA |
| Acetone | | 251 | 100 | 33 | ug/l | SW846 8260C |
| Benzene | | 45300 | 500 | 240 | ug/l | SW846 8260C |
| 2-Butanone (MEK) | | 36.8 | 10 | 5.6 | ug/l | SW846 8260C |
| Carbon disulfide | | 29.7 | 2.0 | 0.25 | ug/l | SW846 8260C |
| Chlorobenzene | | 11.4 | 1.0 | 0.19 | ug/l | SW846 8260C |
| Chloroform | | 0.45 J | 1.0 | 0.19 | ug/l | SW846 8260C |
| Cyclohexane | | 3.4 J | 5.0 | 0.28 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 1070 | 10 | 1.9 | ug/l | SW846 8260C |
| 1,3-Dichlorobenzene | | 14.7 | 1.0 | 0.23 | ug/l | SW846 8260C |
| 1,4-Dichlorobenzene | | 85.4 | 1.0 | 0.27 | ug/l | SW846 8260C |
| Ethylbenzene | | 127 | 1.0 | 0.27 | ug/l | SW846 8260C |
| 2-Hexanone | | 16.5 | 5.0 | 1.7 | ug/l | SW846 8260C |
| Isopropylbenzene | | 173 | 1.0 | 0.23 | ug/l | SW846 8260C |
| Methylcyclohexane | | 3.3 J | 5.0 | 0.22 | ug/l | SW846 8260C |
| 4-Methyl-2-pentanone(MIBK) | | 9.3 | 5.0 | 1.0 | ug/l | SW846 8260C |
| Naphthalene | | 3090 | 500 | 20 | ug/l | SW846 8260C |
| Toluene | | 9210 | 100 | 16 | ug/l | SW846 8260C |
| 1,2,4-Trichlorobenzene | | 1.1 | 1.0 | 0.21 | ug/l | SW846 8260C |
| 1,1,1-Trichloroethane | | 0.30 J | 1.0 | 0.25 | ug/l | SW846 8260C |
| m,p-Xylene | | 1050 | 10 | 3.8 | ug/l | SW846 8260C |
| o-Xylene | | 388 | 10 | 1.7 | ug/l | SW846 8260C |
| Xylene (total) | | 1440 | 10 | 1.7 | ug/l | SW846 8260C |

# Summary of Hits

**Job Number:** JC18878
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/21/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| Total TIC, Volatile | | 6859 J | | | ug/l | |
| Total Alkanes | | 15 J | | | ug/l | |



SGS ACCUTEST
JC18878

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1 | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 3B126507.D | 5 | 05/03/16 | HA | 04/29/16 | GP97301 | V3B5667 |
| Run #2 | 3B126527.D | 50 | 05/03/16 | HA | 04/29/16 | GP97301 | V3B5668 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Compound | Result | HW# | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | | 0.050 | 0.017 | mg/l | |
| 71-43-2 | Benzene | 1.88 [a] | D018 | 0.50 | 0.025 | 0.012 | mg/l | |
| 74-97-5 | Bromochloromethane | ND | | | 0.025 | 0.0019 | mg/l | |
| 75-27-4 | Bromodichloromethane | ND | | | 0.0050 | 0.0011 | mg/l | |
| 75-25-2 | Bromoform | ND | | | 0.020 | 0.0012 | mg/l | |
| 74-83-9 | Bromomethane | ND | | | 0.010 | 0.0021 | mg/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | D035 | 200 | 0.10 | 0.028 | mg/l | |
| 75-15-0 | Carbon disulfide | 0.0015 | | | 0.010 | 0.0013 | mg/l | J |
| 56-23-5 | Carbon tetrachloride | ND | D019 | 0.50 | 0.0050 | 0.0011 | mg/l | |
| 108-90-7 | Chlorobenzene | 0.0017 | D021 | 100 | 0.0050 | 0.00093 | mg/l | J |
| 75-00-3 | Chloroethane | ND | | | 0.0050 | 0.0017 | mg/l | |
| 67-66-3 | Chloroform | ND | D022 | 6.0 | 0.0050 | 0.00094 | mg/l | |
| 74-87-3 | Chloromethane | ND | | | 0.0050 | 0.0020 | mg/l | |
| 110-82-7 | Cyclohexane | ND | | | 0.025 | 0.0014 | mg/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | | 0.050 | 0.0050 | mg/l | |
| 124-48-1 | Dibromochloromethane | ND | | | 0.0050 | 0.00077 | mg/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | | | 0.010 | 0.0012 | mg/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 0.421 | | | 0.0050 | 0.00093 | mg/l | |
| 541-73-1 | 1,3-Dichlorobenzene | 0.0057 | | | 0.0050 | 0.0011 | mg/l | |
| 106-46-7 | 1,4-Dichlorobenzene | 0.0311 | D027 | 7.5 | 0.0050 | 0.0014 | mg/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | | | 0.010 | 0.0045 | mg/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | | | 0.0050 | 0.00086 | mg/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | D028 | 0.50 | 0.0050 | 0.00090 | mg/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | D029 | 0.70 | 0.0050 | 0.0026 | mg/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | | 0.0050 | 0.0014 | mg/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | | 0.0050 | 0.0032 | mg/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | | | 0.0050 | 0.0020 | mg/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | | 0.0050 | 0.0010 | mg/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | | 0.0050 | 0.00093 | mg/l | |
| 100-41-4 | Ethylbenzene | 0.0271 | | | 0.0050 | 0.0013 | mg/l | |
| 76-13-1 | Freon 113 | ND | | | 0.025 | 0.0026 | mg/l | |
| 591-78-6 | 2-Hexanone | ND | | | 0.025 | 0.0087 | mg/l | |

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 261 6/96)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1 | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Compound | Result | HW# | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 0.0570 | | | 0.010 | 0.0012 | mg/l | |
| 79-20-9 | Methyl Acetate | ND | | | 0.025 | 0.0094 | mg/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | | 0.0050 | 0.0012 | mg/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | | 0.025 | 0.0051 | mg/l | |
| 75-09-2 | Methylene chloride | ND | | | 0.010 | 0.0011 | mg/l | |
| 108-87-2 | Methylcyclohexane | ND | | | 0.025 | 0.0011 | mg/l | |
| 91-20-3 | Naphthalene | 1.41 [a] | | | 0.25 | 0.010 | mg/l | |
| 100-42-5 | Styrene | ND | | | 0.025 | 0.0014 | mg/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | | 0.010 | 0.0010 | mg/l | |
| 127-18-4 | Tetrachloroethene | ND | D039 | 0.70 | 0.0050 | 0.0020 | mg/l | |
| 108-88-3 | Toluene | 1.07 [a] | | | 0.050 | 0.0081 | mg/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | | 0.025 | 0.0011 | mg/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | | 0.025 | 0.0010 | mg/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | | 0.0050 | 0.0013 | mg/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | | 0.0050 | 0.0011 | mg/l | |
| 79-01-6 | Trichloroethene | ND | D040 | 0.50 | 0.0050 | 0.0011 | mg/l | |
| 75-69-4 | Trichlorofluoromethane | ND | | | 0.025 | 0.0021 | mg/l | |
| 75-01-4 | Vinyl chloride | ND | D043 | 0.20 | 0.0050 | 0.00074 | mg/l | |
| | m,p-Xylene | 0.265 | | | 0.0050 | 0.0019 | mg/l | |
| 95-47-6 | o-Xylene | 0.0895 | | | 0.0050 | 0.00083 | mg/l | |
| 1330-20-7 | Xylene (total) | 0.355 | | | 0.0050 | 0.00083 | mg/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 116% | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 103% | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 107% | 101% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| 109-60-4 | n-Propyl acetate | 12.43 | .048 | mg/l | JN |
| | Propanoic acid,methyl,-methylethyl ester | 13.83 | .039 | mg/l | J |
| | Butanoic acid, -methylethyl ester | 14.60 | .052 | mg/l | J |
| 108-67-8 | Benzene, 1,3,5-trimethyl- | 16.68 | .042 | mg/l | JN |
| | Benzene, 1,2,4-trimethyl- | 17.10 | .071 | mg/l | J |
| | C4 alkyl benzene | 17.29 | .032 | mg/l | J |
| 496-11-7 | Indane | 17.86 | .033 | mg/l | JN |
| | C5 alkyl benzene | 18.26 | .026 | mg/l | J |
| 700-88-9 | Benzene, cyclopentyl- | 20.16 | .071 | mg/l | JN |

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 261 6/96)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1 | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| 827-52-1 | Benzene, cyclohexyl- | 21.42 | .11 | mg/l | JN |
| | Total TIC, Volatile | | .524 | mg/l | J |
| | Total Alkanes | | 0 | mg/l | |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 261 6/96)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1A | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1312 | **Percent Solids:** | 64.2 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 2V31820.D | 1 | 04/25/16 | AM | 04/23/16 | GP97152 | V2V1253 |
| Run #2 | 2V31956.D | 10 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |
| Run #3 | 2V31955.D | 100 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |
| Run #4 | 2V31961.D | 1000 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |
| Run #3 | 5.0 ml |
| Run #4 | 5.0 ml |

**VOA TCL List by leachated** **SPLP Leachate method SW846 1312**

| CAS No. | Compound | Result | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 251 [a] | | 100 | 33 | ug/l | |
| 71-43-2 | Benzene | 45300 [b] | | 500 | 240 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | 36.8 | | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | 29.7 | | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | 11.4 | | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | 0.45 | | 1.0 | 0.19 | ug/l | J |
| 74-87-3 | Chloromethane | ND | | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | 3.4 | | 5.0 | 0.28 | ug/l | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 1070 [a] | | 10 | 1.9 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | 14.7 | | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | 85.4 | | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 1.0 | 0.21 | ug/l | |

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (not available)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1A | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1312 | **Percent Solids:** | 64.2 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List by leachated** **SPLP Leachate method SW846 1312**

| CAS No. | Compound | Result | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | 127 | | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | 16.5 | | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | 173 | | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | 3.3 | | 5.0 | 0.22 | ug/l | J |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 1.0 | 0.24 | ug/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 9.3 | | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | 3090 [c] | | 500 | 20 | ug/l | |
| 100-42-5 | Styrene | ND | | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | 9210 [c] | | 100 | 16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | 1.1 | | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | 0.30 | | 1.0 | 0.25 | ug/l | J |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | 1050 [a] | | 10 | 3.8 | ug/l | |
| 95-47-6 | o-Xylene | 388 [a] | | 10 | 1.7 | ug/l | |
| 1330-20-7 | Xylene (total) | 1440 [a] | | 10 | 1.7 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Run# 3 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 110% | 110% | 109% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 106% | 118% | 114% | 64-135% |
| 2037-26-5 | Toluene-D8 | 96% | 101% | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 104% | 105% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | unknown | 11.10 | 6500 | ug/l | J |
| 110-02-1 | Thiophene | 11.32 | 27 | ug/l | JN |
| | unknown | 13.34 | 13 | ug/l | J |
| | ketones | 13.50 | 27 | ug/l | J |
| | unknown | 13.86 | 12 | ug/l | J |

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (not available)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1A | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| **Method:** | SW846 8260C SW846 1312 | **Percent Solids:** | 64.2 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List by leachated** **SPLP Leachate method SW846 1312**

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | ketones | 14.87 | 15 | ug/l | J |
| | C3 alkyl benzene | 15.75 | 14 | ug/l | J |
| 108-67-8 | Benzene, 1,3,5-trimethyl- | 15.82 | 36 | ug/l | JN |
| 95-63-6 | Benzene, 1,2,4-trimethyl- | 16.17 | 64 | ug/l | JN |
| 135-98-8 | Benzene, (1-methylpropyl)- | 16.32 | 18 | ug/l | JN |
| 496-11-7 | Indane | 16.77 | 31 | ug/l | JN |
| 98-86-2 | Acetophenone | 17.36 | 49 | ug/l | JN |
| 700-88-9 | Benzene, cyclopentyl- | 18.53 | 24 | ug/l | JN |
| | Naphthalene, methyl- isomer | 19.45 | 29 | ug/l | J |
| | Total TIC, Volatile | | 6859 | ug/l | J |
| | Total Alkanes | | 15 | ug/l | J |

(a) Result is from Run# 2
(b) Result is from Run# 4
(c) Result is from Run# 3

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (not available)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-05-90-ISS | | |
| **Lab Sample ID:** | JC18878-1A | **Date Sampled:** | 04/21/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/22/16 |
| | | **Percent Solids:** | 64.2 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**General Chemistry**

| Analyte | Result | RL | Units | DF | Analyzed | By | Method |
|---|---|---|---|---|---|---|---|
| **SPLP Ratio for Volatiles** | | | | | | | |
| pH, SPLP Leachate | 10.77 | | su | 1 | 04/24/16 03:00 | GD | SW846 1312 VOA |
| Volume, SPLP Leachate | 0.5020 | | l | 1 | 04/24/16 03:00 | GD | SW846 1312 VOA |
| Weight, SPLP Leachate | 0.02510 | | kg | 1 | 04/24/16 03:00 | GD | SW846 1312 VOA |
| Dry Weight, SPLP Leachate | 0.01611 | | kg | 1 | 04/24/16 03:00 | GD | SW846 1312 VOA |
| Solids, Percent | 64.2 | | % | 1 | 04/29/16 10:00 | KP | SM2540 G-97 |

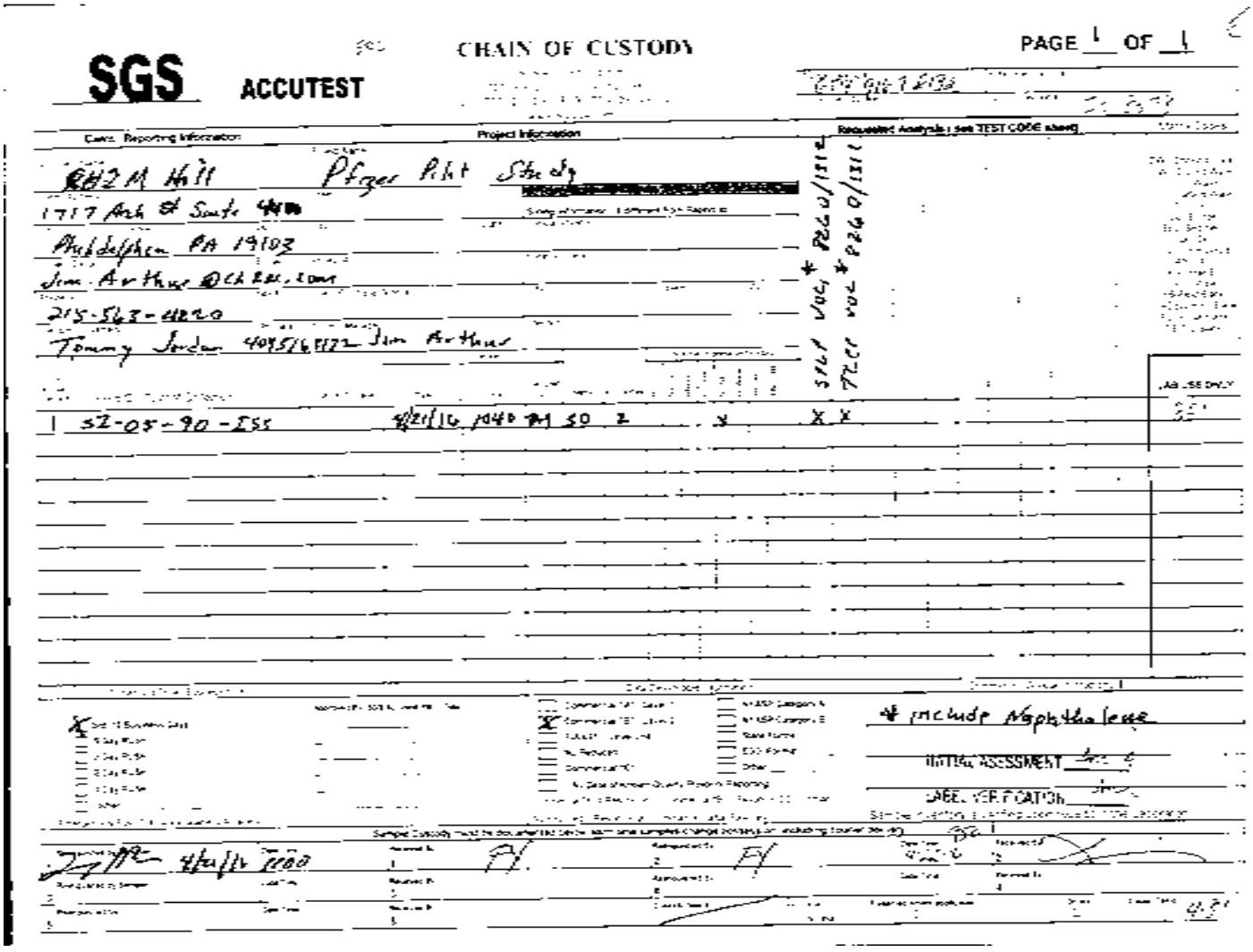
RL = Reporting Limit

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



SGS ACCUTEST

CHAIN OF CUSTODY

PAGE 1 OF 1

Client Reporting Information

RH2M Hill
1717 Arch St Suite 4400
Philadelphia PA 19103
Jim.Arthur@ch2m.com
215-563-4220
Tommy Jordan 4095161122 Jim Arthur

Project Information

Pfizer Pilot Study

[redacted]

Requested Analysis (see TEST CODE sheet)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SI-05-90-ISS | 4/21/16 | 1040 | PM | SO | 2 | X | X | X |

* include Naphthalene

INITIAL ASSESSMENT

LABEL VERIFICATION

Sample Custody must be documented below each time samples change possession, including courier delivery.

4/21/16 1100

JC18878: Chain of Custody
Page 1 of 2

# SGS Accutest Sample Receipt Summary

**Job Number:** JC18878 **Client:** _____ **Project:** _____

**Date / Time Received:** 4/22/2016 9:50:00 AM **Delivery Method:** _____ **Airbill #'s:** _____

Cooler Temps (Raw Measured) °C: Cooler 1: (4.8);

Cooler Temps (Corrected) °C: Cooler 1: (5.2);

**Cooler Security**

| | Y | or | N | | Y | or | N |
|---|---|---|---|---|---|---|---|
| 1. Custody Seals Present: | ☑ | | ☐ | 3. COC Present: | ☑ | | ☐ |
| 2. Custody Seals Intact: | ☑ | | ☐ | 4. Smpl Dates/Time OK | ☑ | | ☐ |

**Cooler Temperature**

| | Y | or | N |
|---|---|---|---|
| 1. Temp criteria achieved: | ☑ | | ☐ |
| 2. Cooler temp verification: | IR Gun | | |
| 3. Cooler media: | Ice (Bag) | | |
| 4. No. Coolers: | 1 | | |

**Quality Control Preservation**

| | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | | ☑ | ☐ |
| 3. Samples preserved properly: | ☑ | | ☐ | |
| 4. VOCs headspace free: | ☐ | | ☐ | ☑ |

**Sample Integrity - Documentation**

| | Y | or | N |
|---|---|---|---|
| 1. Sample labels present on bottles: | ☑ | | ☐ |
| 2. Container labeling complete: | ☑ | | ☐ |
| 3. Sample container label / COC agree: | ☑ | | ☐ |

**Sample Integrity - Condition**

| | Y | or | N |
|---|---|---|---|
| 1. Sample recvd within HT: | ☑ | | ☐ |
| 2. All containers accounted for: | ☑ | | ☐ |
| 3. Condition of sample: | Intact | | |

**Sample Integrity - Instructions**

| | Y | or | N | N/A |
|---|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☑ | | ☐ | |
| 4. Compositing instructions clear: | ☐ | | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | | ☐ | ☑ |

Comments

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1253-MB | 2V31813.D | 1 | 04/25/16 | AM | n/a | n/a | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |

# Method Blank Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1253-MB | 2V31813.D | 1 | 04/25/16 | AM | n/a | n/a | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1256-MB | 2V31944.D | 1 | 04/28/16 | AM | n/a | n/a | V2V1256 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 108% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5667-MB | 3B126496.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5667 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |

# Method Blank Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5667-MB | 3B126496.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5667 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 114% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5668-MB | 3B126520.D | 1 | 05/03/16 | HA | n/a | n/a | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5666-MB | 3B126472.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5666 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

GP97301-LB14, GP97301-LS16

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Method Blank Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5666-MB | 3B126472.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5666 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

GP97301-LB14, GP97301-LS16

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 111% | 64-135% |
| 2037-26-5 | Toluene-D8 | 101% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Leachate Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97152-LB21 | 2V31817.D | 1 | 04/25/16 | AM | 04/23/16 | GP97152 | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Leachate Blank Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97152-LB21 | 2V31817.D | 1 | 04/25/16 | AM | 04/23/16 | GP97152 | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Leachate Blank Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97301-LB14 | 3B126475.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 50 | 17 | ug/l | |
| 71-43-2 | Benzene | ND | 2.5 | 1.2 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 5.0 | 1.9 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 5.0 | 1.1 | ug/l | |
| 75-25-2 | Bromoform | ND | 5.0 | 1.2 | ug/l | |
| 74-83-9 | Bromomethane | ND | 10 | 2.1 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 50 | 28 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 10 | 1.3 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 5.0 | 1.1 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 5.0 | 0.93 | ug/l | |
| 75-00-3 | Chloroethane | ND | 5.0 | 1.7 | ug/l | |
| 67-66-3 | Chloroform | ND | 5.0 | 0.94 | ug/l | |
| 74-87-3 | Chloromethane | ND | 5.0 | 2.0 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 25 | 1.4 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 10 | 5.0 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 5.0 | 0.77 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 5.0 | 1.2 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 5.0 | 0.93 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 5.0 | 1.1 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 5.0 | 1.4 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 10 | 4.5 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 5.0 | 0.86 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 5.0 | 0.90 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 5.0 | 2.6 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 5.0 | 1.4 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 5.0 | 3.2 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 5.0 | 2.0 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 5.0 | 1.0 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 5.0 | 0.93 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 5.0 | 1.3 | ug/l | |
| 76-13-1 | Freon 113 | ND | 25 | 2.6 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 25 | 8.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 5.0 | 1.2 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 25 | 9.4 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 25 | 1.1 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 5.0 | 1.2 | ug/l | |

# Leachate Blank Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97301-LB14 | 3B126475.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 25 | 5.1 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 10 | 3.6 | ug/l | |
| 91-20-3 | Naphthalene | ND | 25 | 1.0 | ug/l | |
| 100-42-5 | Styrene | ND | 5.0 | 1.4 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 5.0 | 1.0 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 5.0 | 2.0 | ug/l | |
| 108-88-3 | Toluene | ND | 5.0 | 0.81 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 5.0 | 1.1 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 5.0 | 1.0 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 5.0 | 1.3 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 5.0 | 1.1 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 5.0 | 1.1 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 10 | 2.1 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 5.0 | 0.74 | ug/l | |
| | m,p-Xylene | ND | 5.0 | 1.9 | ug/l | |
| 95-47-6 | o-Xylene | ND | 5.0 | 0.83 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 5.0 | 0.83 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | alkane | 12.43 | 44 | ug/l | J |
| | alkane | 13.83 | 38 | ug/l | J |
| | alkane | 14.60 | 50 | ug/l | J |
| | Total TIC, Volatile | | 132 | ug/l | J |

# Blank Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1253-BS | 2V31814.D | 1 | 04/25/16 | AM | n/a | n/a | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 74-97-5 | Bromochloromethane | 50 | 55.5 | 111 | 78-124 |
| 75-27-4 | Bromodichloromethane | 50 | 54.0 | 108 | 77-128 |
| 75-25-2 | Bromoform | 50 | 51.4 | 103 | 67-141 |
| 74-83-9 | Bromomethane | 50 | 59.4 | 119 | 53-152 |
| 78-93-3 | 2-Butanone (MEK) | 50 | 57.9 | 116 | 64-130 |
| 75-15-0 | Carbon disulfide | 50 | 61.3 | 123 | 59-140 |
| 56-23-5 | Carbon tetrachloride | 50 | 55.8 | 112 | 75-148 |
| 108-90-7 | Chlorobenzene | 50 | 51.5 | 103 | 76-124 |
| 75-00-3 | Chloroethane | 50 | 57.5 | 115 | 54-147 |
| 67-66-3 | Chloroform | 50 | 59.5 | 119 | 77-124 |
| 74-87-3 | Chloromethane | 50 | 46.7 | 93 | 46-144 |
| 110-82-7 | Cyclohexane | 50 | 62.1 | 124 | 62-127 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 50 | 50.3 | 101 | 64-134 |
| 124-48-1 | Dibromochloromethane | 50 | 52.3 | 105 | 76-132 |
| 106-93-4 | 1,2-Dibromoethane | 50 | 50.7 | 101 | 75-130 |
| 541-73-1 | 1,3-Dichlorobenzene | 50 | 51.2 | 102 | 73-124 |
| 106-46-7 | 1,4-Dichlorobenzene | 50 | 50.3 | 101 | 71-123 |
| 75-71-8 | Dichlorodifluoromethane | 50 | 52.3 | 105 | 42-152 |
| 75-34-3 | 1,1-Dichloroethane | 50 | 60.8 | 122 | 72-124 |
| 107-06-2 | 1,2-Dichloroethane | 50 | 57.1 | 114 | 66-150 |
| 75-35-4 | 1,1-Dichloroethene | 50 | 64.0 | 128 | 61-132 |
| 156-59-2 | cis-1,2-Dichloroethene | 50 | 54.0 | 108 | 71-119 |
| 156-60-5 | trans-1,2-Dichloroethene | 50 | 54.6 | 109 | 71-123 |
| 78-87-5 | 1,2-Dichloropropane | 50 | 56.2 | 112 | 75-120 |
| 10061-01-5 | cis-1,3-Dichloropropene | 50 | 55.1 | 110 | 77-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 50 | 55.9 | 112 | 75-132 |
| 100-41-4 | Ethylbenzene | 50 | 52.9 | 106 | 77-124 |
| 76-13-1 | Freon 113 | 50 | 69.6 | 139 | 58-149 |
| 591-78-6 | 2-Hexanone | 50 | 53.8 | 108 | 58-136 |
| 98-82-8 | Isopropylbenzene | 50 | 54.0 | 108 | 60-136 |
| 79-20-9 | Methyl Acetate | 50 | 56.6 | 113 | 57-139 |
| 108-87-2 | Methylcyclohexane | 50 | 58.1 | 116 | 73-130 |
| 1634-04-4 | Methyl Tert Butyl Ether | 100 | 110 | 110 | 72-127 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 50 | 58.4 | 117 | 63-135 |
| 75-09-2 | Methylene chloride | 50 | 57.2 | 114 | 69-122 |
| 100-42-5 | Styrene | 50 | 52.9 | 106 | 78-126 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1253-BS | 2V31814.D | 1 | 04/25/16 | AM | n/a | n/a | V2V1253 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 50 | 53.0 | 106 | 66-125 |
| 127-18-4 | Tetrachloroethene | 50 | 50.7 | 101 | 70-136 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 50 | 48.4 | 97 | 62-132 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 50 | 49.1 | 98 | 67-132 |
| 71-55-6 | 1,1,1-Trichloroethane | 50 | 58.5 | 117 | 77-136 |
| 79-00-5 | 1,1,2-Trichloroethane | 50 | 54.3 | 109 | 75-123 |
| 79-01-6 | Trichloroethene | 50 | 54.3 | 109 | 79-126 |
| 75-69-4 | Trichlorofluoromethane | 50 | 57.0 | 114 | 56-154 |
| 75-01-4 | Vinyl chloride | 50 | 52.5 | 105 | 56-146 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 115% | 64-135% |
| 2037-26-5 | Toluene-D8 | 101% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 105% | 72-122% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V2V1256-BS | 2V31945.D | 1 | 04/28/16 | AM | n/a | n/a | V2V1256 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 50 | 48.9 | 98 | 51-151 |
| 71-43-2 | Benzene | 50 | 52.0 | 104 | 75-122 |
| 95-50-1 | 1,2-Dichlorobenzene | 50 | 50.9 | 102 | 74-125 |
| 91-20-3 | Naphthalene | 50 | 49.5 | 99 | 37-146 |
| 108-88-3 | Toluene | 50 | 54.7 | 109 | 76-126 |
| | m,p-Xylene | 100 | 106 | 106 | 77-125 |
| 95-47-6 | o-Xylene | 50 | 53.7 | 107 | 76-126 |
| 1330-20-7 | Xylene (total) | 150 | 159 | 106 | 77-125 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 114% | 64-135% |
| 2037-26-5 | Toluene-D8 | 103% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 72-122% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5667-BS | 3B126497.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5667 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 50 | 60.8 | 122 | 51-151 |
| 74-97-5 | Bromochloromethane | 50 | 51.6 | 103 | 78-124 |
| 75-27-4 | Bromodichloromethane | 50 | 55.2 | 110 | 77-128 |
| 75-25-2 | Bromoform | 50 | 47.8 | 96 | 67-141 |
| 74-83-9 | Bromomethane | 50 | 50.3 | 101 | 53-152 |
| 78-93-3 | 2-Butanone (MEK) | 50 | 53.1 | 106 | 64-130 |
| 75-15-0 | Carbon disulfide | 50 | 48.9 | 98 | 59-140 |
| 56-23-5 | Carbon tetrachloride | 50 | 50.9 | 102 | 75-148 |
| 108-90-7 | Chlorobenzene | 50 | 49.1 | 98 | 76-124 |
| 75-00-3 | Chloroethane | 50 | 57.2 | 114 | 54-147 |
| 67-66-3 | Chloroform | 50 | 58.4 | 117 | 77-124 |
| 74-87-3 | Chloromethane | 50 | 49.0 | 98 | 46-144 |
| 110-82-7 | Cyclohexane | 50 | 51.9 | 104 | 62-127 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 50 | 46.4 | 93 | 64-134 |
| 124-48-1 | Dibromochloromethane | 50 | 49.4 | 99 | 76-132 |
| 106-93-4 | 1,2-Dibromoethane | 50 | 49.2 | 98 | 75-130 |
| 95-50-1 | 1,2-Dichlorobenzene | 50 | 50.0 | 100 | 74-125 |
| 541-73-1 | 1,3-Dichlorobenzene | 50 | 49.9 | 100 | 73-124 |
| 106-46-7 | 1,4-Dichlorobenzene | 50 | 47.8 | 96 | 71-123 |
| 75-71-8 | Dichlorodifluoromethane | 50 | 50.9 | 102 | 42-152 |
| 75-34-3 | 1,1-Dichloroethane | 50 | 58.5 | 117 | 72-124 |
| 107-06-2 | 1,2-Dichloroethane | 50 | 54.6 | 109 | 66-150 |
| 75-35-4 | 1,1-Dichloroethene | 50 | 52.5 | 105 | 61-132 |
| 156-59-2 | cis-1,2-Dichloroethene | 50 | 48.7 | 97 | 71-119 |
| 156-60-5 | trans-1,2-Dichloroethene | 50 | 45.6 | 91 | 71-123 |
| 78-87-5 | 1,2-Dichloropropane | 50 | 52.3 | 105 | 75-120 |
| 10061-01-5 | cis-1,3-Dichloropropene | 50 | 54.3 | 109 | 77-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 50 | 53.5 | 107 | 75-132 |
| 100-41-4 | Ethylbenzene | 50 | 51.8 | 104 | 77-124 |
| 76-13-1 | Freon 113 | 50 | 55.1 | 110 | 58-149 |
| 591-78-6 | 2-Hexanone | 50 | 52.4 | 105 | 58-136 |
| 98-82-8 | Isopropylbenzene | 50 | 51.0 | 102 | 60-136 |
| 79-20-9 | Methyl Acetate | 50 | 52.3 | 105 | 57-139 |
| 108-87-2 | Methylcyclohexane | 50 | 52.9 | 106 | 73-130 |
| 1634-04-4 | Methyl Tert Butyl Ether | 100 | 108 | 108 | 72-127 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 50 | 52.8 | 106 | 63-135 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5667-BS | 3B126497.D | 1 | 05/02/16 | HA | n/a | n/a | V3B5667 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | 50 | 51.7 | 103 | 69-122 |
| 100-42-5 | Styrene | 50 | 48.9 | 98 | 78-126 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 50 | 51.7 | 103 | 66-125 |
| 127-18-4 | Tetrachloroethene | 50 | 46.8 | 94 | 70-136 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 50 | 46.2 | 92 | 62-132 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 50 | 45.9 | 92 | 67-132 |
| 71-55-6 | 1,1,1-Trichloroethane | 50 | 55.9 | 112 | 77-136 |
| 79-00-5 | 1,1,2-Trichloroethane | 50 | 51.7 | 103 | 75-123 |
| 79-01-6 | Trichloroethene | 50 | 51.2 | 102 | 79-126 |
| 75-69-4 | Trichlorofluoromethane | 50 | 53.5 | 107 | 56-154 |
| 75-01-4 | Vinyl chloride | 50 | 46.9 | 94 | 56-146 |
| | m,p-Xylene | 100 | 102 | 102 | 77-125 |
| 95-47-6 | o-Xylene | 50 | 51.2 | 102 | 76-126 |
| 1330-20-7 | Xylene (total) | 150 | 154 | 103 | 77-125 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 106% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 114% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 105% | 72-122% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5668-BS | 3B126521.D | 1 | 05/03/16 | HA | n/a | n/a | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 50 | 51.0 | 102 | 75-122 |
| 91-20-3 | Naphthalene | 50 | 45.4 | 91 | 37-146 |
| 108-88-3 | Toluene | 50 | 51.1 | 102 | 76-126 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17609-22RTMS | 2V31821.D | 5 | 04/25/16 | AM | n/a | n/a | V2V1253 |
| JC17609-22RTMSD | 2V31822.D | 5 | 04/25/16 | AM | n/a | n/a | V2V1253 |
| JC17609-22RT | 2V31818.D | 5 | 04/25/16 | AM | 04/17/16 | GP96981 | V2V1253 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | JC17609-22RT ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 74-97-5 | Bromochloromethane | ND | | 250 | 247 | 99 | 250 | 254 | 102 | 3 | 70-129/11 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 248 | 99 | 250 | 258 | 103 | 4 | 70-135/13 |
| 75-25-2 | Bromoform | ND | | 250 | 246 | 98 | 250 | 251 | 100 | 2 | 53-139/13 |
| 74-83-9 | Bromomethane | ND | | 250 | 265 | 106 | 250 | 287 | 115 | 8 | 44-150/18 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 268 | 107 | 250 | 284 | 114 | 6 | 58-140/14 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 233 | 93 | 250 | 246 | 98 | 5 | 34-136/21 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 242 | 97 | 250 | 251 | 100 | 4 | 50-161/18 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 248 | 99 | 250 | 253 | 101 | 2 | 65-128/12 |
| 75-00-3 | Chloroethane | ND | | 250 | 247 | 99 | 250 | 274 | 110 | 10 | 41-151/18 |
| 67-66-3 | Chloroform | ND | | 250 | 265 | 106 | 250 | 278 | 111 | 5 | 66-132/14 |
| 74-87-3 | Chloromethane | ND | | 250 | 200 | 80 | 250 | 226 | 90 | 12 | 35-149/22 |
| 110-82-7 | Cyclohexane | ND | | 250 | 260 | 104 | 250 | 275 | 110 | 6 | 29-158/18 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 247 | 99 | 250 | 250 | 100 | 1 | 58-141/14 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 250 | 100 | 250 | 256 | 102 | 2 | 67-134/12 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 242 | 97 | 250 | 247 | 99 | 2 | 69-130/11 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 246 | 98 | 250 | 251 | 100 | 2 | 63-128/13 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 244 | 98 | 250 | 248 | 99 | 2 | 63-126/13 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 243 | 97 | 250 | 255 | 102 | 5 | 24-170/24 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 262 | 105 | 250 | 276 | 110 | 5 | 59-132/15 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 260 | 104 | 250 | 264 | 106 | 2 | 59-153/15 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 260 | 104 | 250 | 273 | 109 | 5 | 41-144/17 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 241 | 96 | 250 | 252 | 101 | 4 | 57-131/13 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 234 | 94 | 250 | 243 | 97 | 4 | 55-131/15 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 253 | 101 | 250 | 263 | 105 | 4 | 67-125/12 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 256 | 102 | 250 | 265 | 106 | 3 | 68-126/13 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 260 | 104 | 250 | 269 | 108 | 3 | 68-134/13 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 254 | 102 | 250 | 258 | 103 | 2 | 37-143/13 |
| 76-13-1 | Freon 113 | ND | | 250 | 314 | 126 | 250 | 332 | 133 | 6 | 33-159/19 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 284 | 114 | 250 | 285 | 114 | 0 | 53-145/17 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 268 | 107 | 250 | 271 | 108 | 1 | 48-141/15 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 264 | 106 | 250 | 270 | 108 | 2 | 46-147/18 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 279 | 112 | 250 | 295 | 118 | 6 | 36-156/18 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 499 | 100 | 500 | 520 | 104 | 4 | 53-139/14 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 290 | 116 | 250 | 293 | 117 | 1 | 57-141/14 |
| 75-09-2 | Methylene chloride | ND | | 250 | 244 | 98 | 250 | 254 | 102 | 4 | 59-129/12 |
| 100-42-5 | Styrene | ND | | 250 | 256 | 102 | 250 | 260 | 104 | 2 | 60-135/13 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC17609-22RTMS | 2V31821.D | 5 | 04/25/16 | AM | n/a | n/a | V2V1253 |
| JC17609-22RTMSD | 2V31822.D | 5 | 04/25/16 | AM | n/a | n/a | V2V1253 |
| JC17609-22RT | 2V31818.D | 5 | 04/25/16 | AM | 04/17/16 | GP96981 | V2V1253 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | JC17609-22RT ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 255 | 102 | 250 | 259 | 104 | 2 | 62-126/13 |
| 127-18-4 | Tetrachloroethene | ND | | 250 | 236 | 94 | 250 | 243 | 97 | 3 | 48-145/15 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 238 | 95 | 250 | 247 | 99 | 4 | 54-137/14 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 241 | 96 | 250 | 251 | 100 | 4 | 59-135/13 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 254 | 102 | 250 | 270 | 108 | 6 | 55-149/18 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 250 | 100 | 250 | 260 | 104 | 4 | 70-127/12 |
| 79-01-6 | Trichloroethene | ND | | 250 | 246 | 98 | 250 | 255 | 102 | 4 | 53-141/15 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 261 | 104 | 250 | 275 | 110 | 5 | 35-169/23 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 228 | 91 | 250 | 257 | 103 | 12 | 34-151/20 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC17609-22RT | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 104% | 106% | 111% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 111% | 113% | 116% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 101% | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 107% | 107% | 105% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19013-1BMS | 2V31959.D | 5 | 04/28/16 | AM | n/a | n/a | V2V1256 |
| JC19013-1BMSD | 2V31960.D | 5 | 04/28/16 | AM | n/a | n/a | V2V1256 |
| JC19013-1B | 2V31950.D | 5 | 04/28/16 | AM | 04/27/16 | GP97249 | V2V1256 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | JC19013-1B ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 151 | | 250 | 345 | 78 | 250 | 358 | 83 | 4 | 44-157/20 |
| 71-43-2 | Benzene | ND | | 250 | 242 | 97 | 250 | 253 | 101 | 4 | 38-139/13 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 237 | 95 | 250 | 247 | 99 | 4 | 65-128/12 |
| 91-20-3 | Naphthalene | ND | | 250 | 237 | 95 | 250 | 242 | 97 | 2 | 34-156/15 |
| 108-88-3 | Toluene | ND | | 250 | 250 | 100 | 250 | 261 | 104 | 4 | 44-141/14 |
| | m,p-Xylene | ND | | 500 | 488 | 98 | 500 | 508 | 102 | 4 | 32-146/13 |
| 95-47-6 | o-Xylene | ND | | 250 | 253 | 101 | 250 | 262 | 105 | 3 | 46-141/12 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 741 | 99 | 750 | 770 | 103 | 4 | 36-144/13 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC19013-1B | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 105% | 106% | 112% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 110% | 111% | 117% | 64-135% |
| 2037-26-5 | Toluene-D8 | 101% | 101% | 102% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 107% | 106% | 103% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19390-29MS | 3B126501.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5667 |
| JC19390-29MSD | 3B126502.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5667 |
| JC19390-29 | 3B126500.D | 5 | 05/03/16 | HA | 05/01/16 | GP97335 | V3B5667 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | JC19390-29 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 24.3 | J | 250 | 333 | 123 | 250 | 350 | 130 | 5 | 44-157/20 |
| 74-97-5 | Bromochloromethane | ND | | 250 | 263 | 105 | 250 | 262 | 105 | 0 | 70-129/11 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 281 | 112 | 250 | 272 | 109 | 3 | 70-135/13 |
| 75-25-2 | Bromoform | ND | | 250 | 245 | 98 | 250 | 242 | 97 | 1 | 53-139/13 |
| 74-83-9 | Bromomethane | ND | | 250 | 255 | 102 | 250 | 248 | 99 | 3 | 44-150/18 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 278 | 111 | 250 | 284 | 114 | 2 | 58-140/14 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 264 | 106 | 250 | 259 | 104 | 2 | 34-136/21 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 261 | 104 | 250 | 249 | 100 | 5 | 50-161/18 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 250 | 100 | 250 | 246 | 98 | 2 | 65-128/12 |
| 75-00-3 | Chloroethane | ND | | 250 | 291 | 116 | 250 | 293 | 117 | 1 | 41-151/18 |
| 67-66-3 | Chloroform | ND | | 250 | 295 | 118 | 250 | 295 | 118 | 0 | 66-132/14 |
| 74-87-3 | Chloromethane | ND | | 250 | 252 | 101 | 250 | 251 | 100 | 0 | 35-149/22 |
| 110-82-7 | Cyclohexane | ND | | 250 | 266 | 106 | 250 | 254 | 102 | 5 | 29-158/18 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 242 | 97 | 250 | 235 | 94 | 3 | 58-141/14 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 252 | 101 | 250 | 245 | 98 | 3 | 67-134/12 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 253 | 101 | 250 | 245 | 98 | 3 | 69-130/11 |
| 95-50-1 | 1,2-Dichlorobenzene | 1.3 | J | 250 | 254 | 101 | 250 | 254 | 101 | 0 | 65-128/12 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 247 | 99 | 250 | 249 | 100 | 1 | 63-128/13 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 240 | 96 | 250 | 242 | 97 | 1 | 63-126/13 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 234 | 94 | 250 | 232 | 93 | 1 | 24-170/24 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 296 | 118 | 250 | 298 | 119 | 1 | 59-132/15 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 279 | 112 | 250 | 271 | 108 | 3 | 59-153/15 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 281 | 112 | 250 | 274 | 110 | 3 | 41-144/17 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 246 | 98 | 250 | 247 | 99 | 0 | 57-131/13 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 234 | 94 | 250 | 237 | 95 | 1 | 55-131/15 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 266 | 106 | 250 | 264 | 106 | 1 | 67-125/12 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 273 | 109 | 250 | 270 | 108 | 1 | 68-126/13 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 271 | 108 | 250 | 268 | 107 | 1 | 68-134/13 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 262 | 105 | 250 | 260 | 104 | 1 | 37-143/13 |
| 76-13-1 | Freon 113 | ND | | 250 | 250 | 100 | 250 | 242 | 97 | 3 | 33-159/19 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 292 | 117 | 250 | 282 | 113 | 3 | 53-145/17 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 252 | 101 | 250 | 252 | 101 | 0 | 48-141/15 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 257 | 103 | 250 | 258 | 103 | 0 | 46-147/18 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 240 | 96 | 250 | 231 | 92 | 4 | 36-156/18 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 551 | 110 | 500 | 533 | 107 | 3 | 53-139/14 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 285 | 114 | 250 | 277 | 111 | 3 | 57-141/14 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19390-29MS | 3B126501.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5667 |
| JC19390-29MSD | 3B126502.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5667 |
| JC19390-29 | 3B126500.D | 5 | 05/03/16 | HA | 05/01/16 | GP97335 | V3B5667 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | JC19390-29 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 75-09-2 | Methylene chloride | ND | | 250 | 271 | 108 | 250 | 267 | 107 | 1 | 59-129/12 |
| 100-42-5 | Styrene | ND | | 250 | 251 | 100 | 250 | 247 | 99 | 2 | 60-135/13 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 258 | 103 | 250 | 254 | 102 | 2 | 62-126/13 |
| 127-18-4 | Tetrachloroethene | ND | | 250 | 236 | 94 | 250 | 235 | 94 | 0 | 48-145/15 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 236 | 94 | 250 | 232 | 93 | 2 | 54-137/14 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 236 | 94 | 250 | 230 | 92 | 3 | 59-135/13 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 288 | 115 | 250 | 281 | 112 | 2 | 55-149/18 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 263 | 105 | 250 | 258 | 103 | 2 | 70-127/12 |
| 79-01-6 | Trichloroethene | ND | | 250 | 260 | 104 | 250 | 257 | 103 | 1 | 53-141/15 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 270 | 108 | 250 | 266 | 106 | 1 | 35-169/23 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 238 | 95 | 250 | 239 | 96 | 0 | 34-151/20 |
| | m,p-Xylene | ND | | 500 | 523 | 105 | 500 | 520 | 104 | 1 | 32-146/13 |
| 95-47-6 | o-Xylene | ND | | 250 | 260 | 104 | 250 | 255 | 102 | 2 | 46-141/12 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 783 | 104 | 750 | 775 | 103 | 1 | 36-144/13 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC19390-29 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 108% | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 114% | 115% | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 103% | 101% | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 106% | 103% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19379-11AMS | 3B126530.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5668 |
| JC19379-11AMSD | 3B126531.D | 5 | 05/03/16 | HA | n/a | n/a | V3B5668 |
| JC19379-11A | 3B126529.D | 5 | 05/03/16 | HA | 05/01/16 | GP97335 | V3B5668 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | JC19379-11A ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | | 250 | 266 | 106 | 250 | 258 | 103 | 3 | 38-139/13 |
| 91-20-3 | Naphthalene | ND | | 250 | 245 | 98 | 250 | 237 | 94 | 3 | 34-156/15 |
| 108-88-3 | Toluene | ND | | 250 | 269 | 108 | 250 | 263 | 105 | 2 | 44-141/14 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC19379-11A | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 103% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 101% | 101% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 102% | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 104% | 104% | 101% | 72-122% |

* = Outside of Control Limits.

# Leachate Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97152-LS21 | 2V31958.D | 1 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |
| JC18777-13A | 2V31954.D | 1 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | JC18777-13A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 27.9 | | 50 | 108 | 160* [a] | 44-157 |
| 71-43-2 | Benzene | 6.1 | | 50 | 51.5 | 91 | 38-139 |
| 74-97-5 | Bromochloromethane | ND | | 50 | 53.5 | 107 | 70-129 |
| 75-27-4 | Bromodichloromethane | ND | | 50 | 52.7 | 105 | 70-135 |
| 75-25-2 | Bromoform | ND | | 50 | 51.1 | 102 | 53-139 |
| 74-83-9 | Bromomethane | ND | | 50 | 58.6 | 117 | 44-150 |
| 78-93-3 | 2-Butanone (MEK) | 5.7 | J | 50 | 70.4 | 129 | 58-140 |
| 75-15-0 | Carbon disulfide | 3.9 | | 50 | 52.1 | 96 | 34-136 |
| 56-23-5 | Carbon tetrachloride | ND | | 50 | 44.1 | 88 | 50-161 |
| 108-90-7 | Chlorobenzene | ND | | 50 | 47.2 | 94 | 65-128 |
| 75-00-3 | Chloroethane | ND | | 50 | 48.2 | 96 | 41-151 |
| 67-66-3 | Chloroform | ND | | 50 | 54.2 | 108 | 66-132 |
| 74-87-3 | Chloromethane | ND | | 50 | 41.0 | 82 | 35-149 |
| 110-82-7 | Cyclohexane | 4.2 | J | 50 | 48.6 | 89 | 29-158 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 50 | 47.6 | 95 | 58-141 |
| 124-48-1 | Dibromochloromethane | ND | | 50 | 48.2 | 96 | 67-134 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 50 | 49.2 | 98 | 69-130 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 50 | 48.6 | 97 | 65-128 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 50 | 46.7 | 93 | 63-128 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 50 | 46.7 | 93 | 63-126 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 50 | 41.7 | 83 | 24-170 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 50 | 51.5 | 103 | 59-132 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 50 | 56.4 | 113 | 59-153 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 50 | 51.0 | 102 | 41-144 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 50 | 49.0 | 98 | 57-131 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 50 | 47.3 | 95 | 55-131 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 50 | 50.3 | 101 | 67-125 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 50 | 52.3 | 105 | 68-126 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 50 | 54.9 | 110 | 68-134 |
| 100-41-4 | Ethylbenzene | 5.7 | | 50 | 48.0 | 85 | 37-143 |
| 76-13-1 | Freon 113 | ND | | 50 | 53.8 | 108 | 33-159 |
| 591-78-6 | 2-Hexanone | ND | | 50 | 67.4 | 135 | 53-145 |
| 98-82-8 | Isopropylbenzene | 4.8 | | 50 | 45.1 | 81 | 48-141 |
| 79-20-9 | Methyl Acetate | ND | | 50 | 47.5 | 95 | 46-147 |
| 108-87-2 | Methylcyclohexane | 2.7 | J | 50 | 40.5 | 76 | 36-156 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 100 | 94.5 | 95 | 53-139 |

* = Outside of Control Limits.

# Leachate Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97152-LS21 | 2V31958.D | 1 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |
| JC18777-13A | 2V31954.D | 1 | 04/28/16 | AM | 04/23/16 | GP97152 | V2V1256 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1A

| CAS No. | Compound | JC18777-13A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 50 | 58.0 | 116 | 57-141 |
| 75-09-2 | Methylene chloride | ND | | 50 | 51.9 | 104 | 59-129 |
| 91-20-3 | Naphthalene | 54.4 | | 50 | 83.6 | 58 | 34-156 |
| 100-42-5 | Styrene | ND | | 50 | 48.7 | 97 | 60-135 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 50 | 50.2 | 100 | 62-126 |
| 127-18-4 | Tetrachloroethene | ND | | 50 | 58.9 | 118 | 48-145 |
| 108-88-3 | Toluene | 1.3 | | 50 | 49.9 | 97 | 44-141 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 50 | 46.7 | 93 | 54-137 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 50 | 46.5 | 93 | 59-135 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 50 | 48.2 | 96 | 55-149 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 50 | 55.0 | 110 | 70-127 |
| 79-01-6 | Trichloroethene | ND | | 50 | 48.8 | 98 | 53-141 |
| 75-69-4 | Trichlorofluoromethane | ND | | 50 | 44.6 | 89 | 35-169 |
| 75-01-4 | Vinyl chloride | ND | | 50 | 39.4 | 79 | 34-151 |
| | m,p-Xylene | 21.3 | | 100 | 108 | 87 | 32-146 |
| 95-47-6 | o-Xylene | 12.4 | | 50 | 59.4 | 94 | 46-141 |
| 1330-20-7 | Xylene (total) | 33.7 | | 150 | 167 | 89 | 36-144 |

| CAS No. | Surrogate Recoveries | LS | JC18777-13A | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 109% | 113% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 116% | 120% | 64-135% |
| 2037-26-5 | Toluene-D8 | 103% | 102% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 98% | 72-122% |

(a) Outside control limits due to matrix interference.

* = Outside of Control Limits.

# Leachate Spike Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97301-LS16 | 3B126482A.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |
| JC18531-7A | 3B126476.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | JC18531-7A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 250 | 328 | 131 | 44-157 |
| 71-43-2 | Benzene | ND | | 250 | 278 | 111 | 38-139 |
| 74-97-5 | Bromochloromethane | ND | | 250 | 274 | 110 | 70-129 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 286 | 114 | 70-135 |
| 75-25-2 | Bromoform | ND | | 250 | 252 | 101 | 53-139 |
| 74-83-9 | Bromomethane | ND | | 250 | 257 | 103 | 44-150 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 302 | 121 | 58-140 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 278 | 111 | 34-136 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 265 | 106 | 50-161 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 259 | 104 | 65-128 |
| 75-00-3 | Chloroethane | ND | | 250 | 271 | 108 | 41-151 |
| 67-66-3 | Chloroform | ND | | 250 | 310 | 124 | 66-132 |
| 74-87-3 | Chloromethane | ND | | 250 | 255 | 102 | 35-149 |
| 110-82-7 | Cyclohexane | ND | | 250 | 279 | 112 | 29-158 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 252 | 101 | 58-141 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 259 | 104 | 67-134 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 258 | 103 | 69-130 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 266 | 106 | 65-128 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 266 | 106 | 63-128 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 255 | 102 | 63-126 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 248 | 99 | 24-170 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 312 | 125 | 59-132 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 282 | 113 | 59-153 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 293 | 117 | 41-144 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 255 | 102 | 57-131 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 242 | 97 | 55-131 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 275 | 110 | 67-125 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 293 | 117 | 68-126 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 290 | 116 | 68-134 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 274 | 110 | 37-143 |
| 76-13-1 | Freon 113 | ND | | 250 | 272 | 109 | 33-159 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 286 | 114 | 53-145 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 272 | 109 | 48-141 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 285 | 114 | 46-147 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 258 | 103 | 36-156 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 559 | 112 | 53-139 |

* = Outside of Control Limits.

# Leachate Spike Summary

**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97301-LS16 | 3B126482A.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |
| JC18531-7A | 3B126476.D | 5 | 05/02/16 | HA | 04/29/16 | GP97301 | V3B5666 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18878-1

| CAS No. | Compound | JC18531-7A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 291 | 116 | 57-141 |
| 75-09-2 | Methylene chloride | ND | | 250 | 280 | 112 | 59-129 |
| 91-20-3 | Naphthalene | ND | | 250 | 252 | 101 | 34-156 |
| 100-42-5 | Styrene | ND | | 250 | 259 | 104 | 60-135 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 276 | 110 | 62-126 |
| 127-18-4 | Tetrachloroethene | ND | | 250 | 247 | 99 | 48-145 |
| 108-88-3 | Toluene | ND | | 250 | 273 | 109 | 44-141 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 245 | 98 | 54-137 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 242 | 97 | 59-135 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 300 | 120 | 55-149 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 272 | 109 | 70-127 |
| 79-01-6 | Trichloroethene | 1.4 | J | 250 | 271 | 108 | 53-141 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 278 | 111 | 35-169 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 243 | 97 | 34-151 |
| | m,p-Xylene | ND | | 500 | 547 | 109 | 32-146 |
| 95-47-6 | o-Xylene | ND | | 250 | 270 | 108 | 46-141 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 817 | 109 | 36-144 |

| CAS No. | Surrogate Recoveries | LS | JC18531-7A | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 107% | 107% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 115% | 113% | 64-135% |
| 2037-26-5 | Toluene-D8 | 101% | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 108% | 104% | 72-122% |

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V2V1239-BFB
**Lab File ID:** 2V31476.D
**Instrument ID:** GCMS2V
**Injection Date:** 04/12/16
**Injection Time:** 10:19

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 9099 | 15.2 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 25499 | 42.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 59981 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3990 | 6.65 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 50965 | 85.0 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3934 | 6.56 | (7.72) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 49040 | 81.8 | (96.2) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 3355 | 5.59 | (6.84) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V2V1239-IC1239 | 2V31477.D | 04/12/16 | 11:01 | 00:42 | Initial cal 0.2 |
| V2V1239-IC1239 | 2V31478.D | 04/12/16 | 11:28 | 01:09 | Initial cal 0.5 |
| V2V1239-IC1239 | 2V31479.D | 04/12/16 | 11:55 | 01:36 | Initial cal 1 |
| V2V1239-IC1239 | 2V31480.D | 04/12/16 | 12:22 | 02:03 | Initial cal 2 |
| V2V1239-IC1239 | 2V31481.D | 04/12/16 | 12:49 | 02:30 | Initial cal 5 |
| V2V1239-IC1239 | 2V31482.D | 04/12/16 | 13:17 | 02:58 | Initial cal 10 |
| V2V1239-IC1239 | 2V31483.D | 04/12/16 | 13:44 | 03:25 | Initial cal 20 |
| V2V1239-ICC1239 | 2V31484.D | 04/12/16 | 14:11 | 03:52 | Initial cal 50 |
| V2V1239-IC1239 | 2V31485.D | 04/12/16 | 14:38 | 04:19 | Initial cal 100 |
| V2V1239-IC1239 | 2V31486.D | 04/12/16 | 15:06 | 04:47 | Initial cal 200 |
| V2V1239-ICV1239 | 2V31489.D | 04/12/16 | 16:28 | 06:09 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V2V1253-BFB
**Lab File ID:** 2V31810.D
**Instrument ID:** GCMS2V
**Injection Date:** 04/25/16
**Injection Time:** 09:27



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 8316 | 16.3 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 23131 | 45.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 51056 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 3414 | 6.69 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 41568 | 81.4 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 3157 | 6.18 | (7.59) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 39600 | 77.6 | (95.3) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 2609 | 5.11 | (6.59) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V2V1253-CC1239 | 2V31811.D | 04/25/16 | 09:57 | 00:30 | Continuing cal 20 |
| V2V1253-MB | 2V31813.D | 04/25/16 | 11:12 | 01:45 | Method Blank |
| V2V1253-BS | 2V31814.D | 04/25/16 | 11:39 | 02:12 | Blank Spike |
| GP97152-LB21 | 2V31817.D | 04/25/16 | 13:00 | 03:33 | Leachate Blank |
| JC17609-22RT | 2V31818.D | 04/25/16 | 13:27 | 04:00 | (used for QC only; not part of job JC18878) |
| ZZZZZZ | 2V31819.D | 04/25/16 | 13:54 | 04:27 | (unrelated sample) |
| JC18878-1A | 2V31820.D | 04/25/16 | 14:26 | 04:59 | SI-05-90-ISS |
| JC17609-22RTMS | 2V31821.D | 04/25/16 | 14:53 | 05:26 | Matrix Spike |
| JC17609-22RTMSD | 2V31822.D | 04/25/16 | 15:20 | 05:53 | Matrix Spike Duplicate |
| GP96981-LS10 | 2V31822A.D | 04/25/16 | 15:20 | 05:53 | Leachate Spike |
| GP97106-LS19 | 2V31823.D | 04/25/16 | 15:47 | 06:20 | Leachate Spike |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V2V1256-BFB
**Lab File ID:** 2V31941.D
**Instrument ID:** GCMS2V
**Injection Date:** 04/28/16
**Injection Time:** 08:45

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 13495 | 16.2 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 36299 | 43.5 | | Pass |
| 95 | Base peak, 100% relative abundance | 83533 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5872 | 7.03 | | Pass |
| 173 | Less than 2.0% of mass 174 | 630 | 0.75 | (0.89) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 70432 | 84.3 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5144 | 6.16 | (7.30) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 68381 | 81.9 | (97.1) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4539 | 5.43 | (6.64) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V2V1256-CC1239 | 2V31942.D | 04/28/16 | 09:16 | 00:31 | Continuing cal 20 |
| V2V1256-MB | 2V31944.D | 04/28/16 | 10:24 | 01:39 | Method Blank |
| V2V1256-BS | 2V31945.D | 04/28/16 | 10:51 | 02:06 | Blank Spike |
| ZZZZZZ | 2V31946.D | 04/28/16 | 11:18 | 02:33 | (unrelated sample) |
| GP97249-LB10 | 2V31947.D | 04/28/16 | 11:45 | 03:00 | Leachate Blank |
| GP97250-LB11 | 2V31948.D | 04/28/16 | 12:12 | 03:27 | Leachate Blank |
| ZZZZZZ | 2V31949.D | 04/28/16 | 12:39 | 03:54 | (unrelated sample) |
| JC19013-1B | 2V31950.D | 04/28/16 | 13:06 | 04:21 | (used for QC only; not part of job JC18878) |
| ZZZZZZ | 2V31951.D | 04/28/16 | 13:33 | 04:48 | (unrelated sample) |
| ZZZZZZ | 2V31952.D | 04/28/16 | 14:00 | 05:15 | (unrelated sample) |
| ZZZZZZ | 2V31953.D | 04/28/16 | 14:27 | 05:42 | (unrelated sample) |
| ZZZZZZ | 2V31954.D | 04/28/16 | 14:54 | 06:09 | (unrelated sample) |
| JC18878-1A | 2V31955.D | 04/28/16 | 15:21 | 06:36 | SI-05-90-ISS |
| JC18878-1A | 2V31956.D | 04/28/16 | 15:49 | 07:04 | SI-05-90-ISS |
| GP97152-LS21 | 2V31958.D | 04/28/16 | 16:43 | 07:58 | Leachate Spike |
| JC19013-1BMS | 2V31959.D | 04/28/16 | 17:10 | 08:25 | Matrix Spike |
| JC19013-1BMSD | 2V31960.D | 04/28/16 | 17:37 | 08:52 | Matrix Spike Duplicate |
| JC18878-1A | 2V31961.D | 04/28/16 | 18:04 | 09:19 | SI-05-90-ISS |
| ZZZZZZ | 2V31962.D | 04/28/16 | 18:31 | 09:46 | (unrelated sample) |
| ZZZZZZ | 2V31963.D | 04/28/16 | 18:58 | 10:13 | (unrelated sample) |
| ZZZZZZ | 2V31964.D | 04/28/16 | 19:25 | 10:40 | (unrelated sample) |
| ZZZZZZ | 2V31965.D | 04/28/16 | 19:52 | 11:07 | (unrelated sample) |
| ZZZZZZ | 2V31966.D | 04/28/16 | 20:19 | 11:34 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5652-BFB
**Lab File ID:** 3B126034.D
**Instrument ID:** GCMS3B
**Injection Date:** 04/18/16
**Injection Time:** 12:23

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 15122 | 16.7 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 40907 | 45.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 90339 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5916 | 6.55 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 83792 | 92.8 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 6199 | 6.86 | (7.40) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 82112 | 90.9 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5914 | 6.55 | (7.20) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5652-IC5652 | 3B126035.D | 04/18/16 | 12:54 | 00:31 | Initial cal 0.2 |
| V3B5652-IC5652 | 3B126036.D | 04/18/16 | 13:24 | 01:01 | Initial cal 0.5 |
| V3B5652-IC5652 | 3B126039.D | 04/18/16 | 14:55 | 02:32 | Initial cal 5 |
| V3B5652-IC5652 | 3B126040.D | 04/18/16 | 15:26 | 03:03 | Initial cal 10 |
| V3B5652-IC5652 | 3B126041.D | 04/18/16 | 15:56 | 03:33 | Initial cal 20 |
| V3B5652-ICC5652 | 3B126042.D | 04/18/16 | 16:27 | 04:04 | Initial cal 50 |
| V3B5652-IC5652 | 3B126043.D | 04/18/16 | 16:57 | 04:34 | Initial cal 100 |
| V3B5652-IC5652 | 3B126044.D | 04/18/16 | 17:27 | 05:04 | Initial cal 200 |
| V3B5652-IC5652 | 3B126048.D | 04/18/16 | 19:28 | 07:05 | Initial cal 1 |
| V3B5652-IC5652 | 3B126049.D | 04/18/16 | 19:59 | 07:36 | Initial cal 2 |
| V3B5652-ICV5652 | 3B126050.D | 04/18/16 | 20:29 | 08:06 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5666-BFB
**Lab File ID:** 3B126469.D
**Instrument ID:** GCMS3B
**Injection Date:** 05/02/16
**Injection Time:** 09:07

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 20400 | 17.8 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 52757 | 46.0 | | Pass |
| 95 | Base peak, 100% relative abundance | 114765 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 8212 | 7.16 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 99384 | 86.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7321 | 6.38 | (7.37) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 98115 | 85.5 | (98.7) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 6096 | 5.31 | (6.21) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5666-CC5652 | 3B126470.D | 05/02/16 | 09:43 | 00:36 | Continuing cal 20 |
| V3B5666-MB | 3B126472.D | 05/02/16 | 10:50 | 01:43 | Method Blank |
| V3B5666-BS | 3B126473.D | 05/02/16 | 11:26 | 02:19 | Blank Spike |
| GP97301-LB14 | 3B126475.D | 05/02/16 | 12:36 | 03:29 | Leachate Blank |
| JC18531-7A | 3B126476.D | 05/02/16 | 13:06 | 03:59 | (used for QC only; not part of job JC18878) |
| ZZZZZZ | 3B126477.D | 05/02/16 | 13:36 | 04:29 | (unrelated sample) |
| ZZZZZZ | 3B126478.D | 05/02/16 | 14:06 | 04:59 | (unrelated sample) |
| ZZZZZZ | 3B126479.D | 05/02/16 | 14:36 | 05:29 | (unrelated sample) |
| ZZZZZZ | 3B126480.D | 05/02/16 | 15:05 | 05:58 | (unrelated sample) |
| ZZZZZZ | 3B126481.D | 05/02/16 | 15:36 | 06:29 | (unrelated sample) |
| GP97301-LS16 | 3B126482A.D | 05/02/16 | 16:14 | 07:07 | Leachate Spike |
| JC18531-7AMS | 3B126482.D | 05/02/16 | 16:14 | 07:07 | Matrix Spike |
| JC18531-7AMSD | 3B126483.D | 05/02/16 | 16:44 | 07:37 | Matrix Spike Duplicate |
| GP97334-LB18 | 3B126485.D | 05/02/16 | 17:45 | 08:38 | Leachate Blank |
| ZZZZZZ | 3B126486.D | 05/02/16 | 18:15 | 09:08 | (unrelated sample) |
| ZZZZZZ | 3B126487.D | 05/02/16 | 18:44 | 09:37 | (unrelated sample) |
| ZZZZZZ | 3B126488.D | 05/02/16 | 19:15 | 10:08 | (unrelated sample) |
| ZZZZZZ | 3B126489.D | 05/02/16 | 19:45 | 10:38 | (unrelated sample) |
| ZZZZZZ | 3B126490.D | 05/02/16 | 20:15 | 11:08 | (unrelated sample) |
| ZZZZZZ | 3B126491.D | 05/02/16 | 20:45 | 11:38 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5667-BFB
**Lab File ID:** 3B126493.D
**Instrument ID:** GCMS3B
**Injection Date:** 05/02/16
**Injection Time:** 21:46



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 19296 | 18.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 49893 | 46.4 | | Pass |
| 95 | Base peak, 100% relative abundance | 107451 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 6901 | 6.42 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 92976 | 86.5 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7120 | 6.63 | (7.66) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 92616 | 86.2 | (99.6) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5974 | 5.56 | (6.45) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5667-CC5652 | 3B126494.D | 05/02/16 | 22:16 | 00:30 | Continuing cal 50 |
| V3B5667-MB | 3B126496.D | 05/02/16 | 23:16 | 01:30 | Method Blank |
| V3B5667-BS | 3B126497.D | 05/02/16 | 23:46 | 02:00 | Blank Spike |
| GP97335-LB19 | 3B126499.D | 05/03/16 | 00:46 | 03:00 | Leachate Blank |
| JC19390-29 | 3B126500.D | 05/03/16 | 01:17 | 03:31 | (used for QC only; not part of job JC18878) |
| JC19390-29MS | 3B126501.D | 05/03/16 | 01:47 | 04:01 | Matrix Spike |
| GP97335-LS21 | 3B126501A.D | 05/03/16 | 01:47 | 04:01 | Leachate Spike |
| JC19390-29MSD | 3B126502.D | 05/03/16 | 02:17 | 04:31 | Matrix Spike Duplicate |
| ZZZZZZ | 3B126504.D | 05/03/16 | 03:18 | 05:32 | (unrelated sample) |
| ZZZZZZ | 3B126505.D | 05/03/16 | 03:48 | 06:02 | (unrelated sample) |
| ZZZZZZ | 3B126506.D | 05/03/16 | 04:18 | 06:32 | (unrelated sample) |
| JC18878-1 | 3B126507.D | 05/03/16 | 04:48 | 07:02 | SI-05-90-ISS |
| ZZZZZZ | 3B126509.D | 05/03/16 | 05:48 | 08:02 | (unrelated sample) |
| ZZZZZZ | 3B126510.D | 05/03/16 | 06:18 | 08:32 | (unrelated sample) |
| ZZZZZZ | 3B126511.D | 05/03/16 | 06:48 | 09:02 | (unrelated sample) |
| ZZZZZZ | 3B126512.D | 05/03/16 | 07:19 | 09:33 | (unrelated sample) |
| ZZZZZZ | 3B126513.D | 05/03/16 | 07:49 | 10:03 | (unrelated sample) |
| ZZZZZZ | 3B126514.D | 05/03/16 | 08:19 | 10:33 | (unrelated sample) |
| ZZZZZZ | 3B126515.D | 05/03/16 | 08:48 | 11:02 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5668-BFB
**Lab File ID:** 3B126517.D
**Instrument ID:** GCMS3B
**Injection Date:** 05/03/16
**Injection Time:** 10:44



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 18059 | 16.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 49469 | 43.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 112923 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 7244 | 6.41 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 105565 | 93.5 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7724 | 6.84 | (7.32) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 101957 | 90.3 | (96.6) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 7202 | 6.38 | (7.06) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5668-CC5652 | 3B126518.D | 05/03/16 | 11:16 | 00:32 | Continuing cal 20 |
| V3B5668-MB | 3B126520.D | 05/03/16 | 12:22 | 01:38 | Method Blank |
| V3B5668-BS | 3B126521.D | 05/03/16 | 13:02 | 02:18 | Blank Spike |
| JC18878-1 | 3B126527.D | 05/03/16 | 16:05 | 05:21 | SI-05-90-ISS |
| ZZZZZZ | 3B126528.D | 05/03/16 | 16:38 | 05:54 | (unrelated sample) |
| JC19379-11A | 3B126529.D | 05/03/16 | 17:08 | 06:24 | (used for QC only; not part of job JC18878) |
| JC19379-11AMS | 3B126530.D | 05/03/16 | 17:38 | 06:54 | Matrix Spike |
| JC19379-11AMSD | 3B126531.D | 05/03/16 | 18:09 | 07:25 | Matrix Spike Duplicate |
| GP97188-LB5 | 3B126533.D | 05/03/16 | 19:09 | 08:25 | Leachate Blank |
| ZZZZZZ | 3B126539.D | 05/03/16 | 22:11 | 11:27 | (unrelated sample) |
| ZZZZZZ | 3B126547.D | 05/04/16 | 02:12 | 15:28 | (unrelated sample) |
| ZZZZZZ | 3B126548.D | 05/04/16 | 02:42 | 15:58 | (unrelated sample) |
| ZZZZZZ | 3B126553.D | 05/04/16 | 05:12 | 18:28 | (unrelated sample) |
| ZZZZZZ | 3B126554.D | 05/04/16 | 05:43 | 18:59 | (unrelated sample) |
| ZZZZZZ | 3B126555.D | 05/04/16 | 06:13 | 19:29 | (unrelated sample) |
| ZZZZZZ | 3B126556.D | 05/04/16 | 06:43 | 19:59 | (unrelated sample) |
| ZZZZZZ | 3B126557.D | 05/04/16 | 07:14 | 20:30 | (unrelated sample) |

# Volatile Surrogate Recovery Summary



**Job Number:** JC18878
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** LEACHATE

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC18878-1 | 3B126527.D | 103 | 98 | 99 | 101 |
| JC18878-1 | 3B126507.D | 107 | 116 | 103 | 107 |
| JC18878-1A | 2V31961.D | 107 | 111 | 99 | 106 |
| JC18878-1A | 2V31956.D | 110 | 118 | 101 | 104 |
| JC18878-1A | 2V31820.D | 110 | 106 | 96 | 102 |
| JC18878-1A | 2V31955.D | 109 | 114 | 99 | 105 |
| GP97152-LB21 | 2V31817.D | 109 | 113 | 99 | 106 |
| GP97152-LS21 | 2V31958.D | 109 | 116 | 103 | 106 |
| GP97301-LB14 | 3B126475.D | 106 | 113 | 100 | 103 |
| GP97301-LS16 | 3B126482A.D | 107 | 115 | 101 | 108 |
| JC17609-22RTMS | 2V31821.D | 104 | 111 | 100 | 107 |
| JC17609-22RTMSD | 2V31822.D | 106 | 113 | 101 | 107 |
| JC19013-1BMS | 2V31959.D | 105 | 110 | 101 | 107 |
| JC19013-1BMSD | 2V31960.D | 106 | 111 | 101 | 106 |
| JC19379-11AMS | 3B126530.D | 102 | 101 | 102 | 104 |
| JC19379-11AMSD | 3B126531.D | 103 | 101 | 102 | 104 |
| JC19390-29MS | 3B126501.D | 107 | 114 | 103 | 104 |
| JC19390-29MSD | 3B126502.D | 108 | 115 | 101 | 106 |
| V2V1253-BS | 2V31814.D | 107 | 115 | 101 | 105 |
| V2V1253-MB | 2V31813.D | 108 | 113 | 99 | 104 |
| V2V1256-BS | 2V31945.D | 107 | 114 | 103 | 106 |
| V2V1256-MB | 2V31944.D | 108 | 113 | 100 | 104 |
| V3B5667-BS | 3B126497.D | 106 | 114 | 102 | 105 |
| V3B5667-MB | 3B126496.D | 107 | 114 | 100 | 103 |
| V3B5668-BS | 3B126521.D | 102 | 98 | 102 | 103 |
| V3B5668-MB | 3B126520.D | 101 | 98 | 100 | 101 |
| V3B5666-MB | 3B126472.D | 106 | 111 | 101 | 103 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 76-120% |
| **S2** = 1,2-Dichloroethane-D4 | 64-135% |
| **S3** = Toluene-D8 | 76-117% |
| **S4** = 4-Bromofluorobenzene | 72-122% |

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Technical Report for

CH2M Hill

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

SGS Accutest Job Number: JC18959

Sampling Date: 04/22/16

Report to:

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Total number of pages in report: 50

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Nancy Cole
Laboratory Director

Client Service contact: Marty Vitanza 732-329-0200

Certifications: NJ(12129), NY(10983), CA, CT, DE, FL, IL, IN, KS, KY, LA, MA, MD, MI, MT, NC, OH VAP (CL0056), AK (UST-103), AZ (AZ0786), PA, RI, SC, TN, TX, VA, WV, DoD ELAP (L-A-B L2248)

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# Sample Summary

CH2M Hill

**Job No:** JC18959

OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample Number | Collected Date | Time | By | Received | Matrix Code | Type | Client Sample ID |
|---|---|---|---|---|---|---|---|
| JC18959-1 | 04/22/16 | 13:55 | TAJ | 04/23/16 | SO | Solid | SI-06-90-ISS |
| JC18959-1A | 04/22/16 | 13:55 | TAJ | 04/23/16 | SO | Solid | SI-06-90-ISS |

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

# Summary of Hits



**Job Number:** JC18959
**Account:** CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ
**Collected:** 04/22/16

| Lab Sample ID / Analyte | Client Sample ID | Result/ Qual | RL | MDL | Units | Method |
|---|---|---|---|---|---|---|
| **JC18959-1** | **SI-06-90-ISS** | | | | | |
| Acetone | | 0.0693 | 0.050 | 0.017 | mg/l | SW846 8260C |
| Benzene | | 39.4 | 0.10 | 0.047 | mg/l | SW846 8260C |
| Carbon disulfide | | 0.0301 | 0.010 | 0.0013 | mg/l | SW846 8260C |
| Chlorobenzene | | 0.0131 | 0.0050 | 0.00093 | mg/l | SW846 8260C |
| Cyclohexane | | 0.0018 J | 0.025 | 0.0014 | mg/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 1.33 | 0.20 | 0.037 | mg/l | SW846 8260C |
| 1,3-Dichlorobenzene | | 0.0178 | 0.0050 | 0.0011 | mg/l | SW846 8260C |
| 1,4-Dichlorobenzene | | 0.0996 | 0.0050 | 0.0014 | mg/l | SW846 8260C |
| Ethylbenzene | | 0.160 | 0.0050 | 0.0013 | mg/l | SW846 8260C |
| Isopropylbenzene | | 0.217 | 0.010 | 0.0012 | mg/l | SW846 8260C |
| Methylcyclohexane | | 0.0014 J | 0.025 | 0.0011 | mg/l | SW846 8260C |
| Naphthalene | | 3.15 | 1.0 | 0.040 | mg/l | SW846 8260C |
| Toluene | | 12.1 | 0.20 | 0.032 | mg/l | SW846 8260C |
| m,p-Xylene | | 1.59 | 0.0050 | 0.0019 | mg/l | SW846 8260C |
| o-Xylene | | 0.539 | 0.0050 | 0.00083 | mg/l | SW846 8260C |
| Xylene (total) | | 2.13 | 0.0050 | 0.00083 | mg/l | SW846 8260C |
| Total TIC, Volatile | | 0.761 J | | | mg/l | |
| **JC18959-1A** | **SI-06-90-ISS** | | | | | |
| pH, SPLP Leachate | | 10.78 | | | su | SW846 1312 VOA |
| Volume, SPLP Leachate | | 0.5060 | | | l | SW846 1312 VOA |
| Weight, SPLP Leachate | | 0.02530 | | | kg | SW846 1312 VOA |
| Dry Weight, SPLP Leachate | | 0.01541 | | | kg | SW846 1312 VOA |
| Benzene | | 92900 | 1000 | 470 | ug/l | SW846 8260C |
| 1,2-Dichlorobenzene | | 1390 | 200 | 37 | ug/l | SW846 8260C |
| 1,4-Dichlorobenzene | | 117 J | 200 | 55 | ug/l | SW846 8260C |
| Ethylbenzene | | 251 | 200 | 54 | ug/l | SW846 8260C |
| Isopropylbenzene | | 275 | 200 | 47 | ug/l | SW846 8260C |
| Naphthalene | | 3320 | 1000 | 40 | ug/l | SW846 8260C |
| Toluene | | 22800 | 200 | 32 | ug/l | SW846 8260C |
| m,p-Xylene | | 2180 | 200 | 75 | ug/l | SW846 8260C |
| o-Xylene | | 712 | 200 | 33 | ug/l | SW846 8260C |
| Xylene (total) | | 2890 | 200 | 33 | ug/l | SW846 8260C |

## Sample Results

Report of Analysis

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1 | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 3B126358.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |
| Run #2 | 3B126374.D | 200 | 04/28/16 | HA | 04/26/16 | GP97219 | V3B5663 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Compound | Result | HW# | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | 0.0693 | | | 0.050 | 0.017 | mg/l | |
| 71-43-2 | Benzene | 39.4 [a] | D018 | 0.50 | 0.10 | 0.047 | mg/l | |
| 74-97-5 | Bromochloromethane | ND | | | 0.025 | 0.0019 | mg/l | |
| 75-27-4 | Bromodichloromethane | ND | | | 0.0050 | 0.0011 | mg/l | |
| 75-25-2 | Bromoform | ND | | | 0.020 | 0.0012 | mg/l | |
| 74-83-9 | Bromomethane | ND | | | 0.010 | 0.0021 | mg/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | D035 | 200 | 0.10 | 0.028 | mg/l | |
| 75-15-0 | Carbon disulfide | 0.0301 | | | 0.010 | 0.0013 | mg/l | |
| 56-23-5 | Carbon tetrachloride | ND | D019 | 0.50 | 0.0050 | 0.0011 | mg/l | |
| 108-90-7 | Chlorobenzene | 0.0131 | D021 | 100 | 0.0050 | 0.00093 | mg/l | |
| 75-00-3 | Chloroethane | ND | | | 0.0050 | 0.0017 | mg/l | |
| 67-66-3 | Chloroform | ND | D022 | 6.0 | 0.0050 | 0.00094 | mg/l | |
| 74-87-3 | Chloromethane | ND | | | 0.0050 | 0.0020 | mg/l | |
| 110-82-7 | Cyclohexane | 0.0018 | | | 0.025 | 0.0014 | mg/l | J |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | | 0.050 | 0.0050 | mg/l | |
| 124-48-1 | Dibromochloromethane | ND | | | 0.0050 | 0.00077 | mg/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | | | 0.010 | 0.0012 | mg/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 1.33 [a] | | | 0.20 | 0.037 | mg/l | |
| 541-73-1 | 1,3-Dichlorobenzene | 0.0178 | | | 0.0050 | 0.0011 | mg/l | |
| 106-46-7 | 1,4-Dichlorobenzene | 0.0996 | D027 | 7.5 | 0.0050 | 0.0014 | mg/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | | | 0.010 | 0.0045 | mg/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | | | 0.0050 | 0.00086 | mg/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | D028 | 0.50 | 0.0050 | 0.00090 | mg/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | D029 | 0.70 | 0.0050 | 0.0026 | mg/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | | 0.0050 | 0.0014 | mg/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | | 0.0050 | 0.0032 | mg/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | | | 0.0050 | 0.0020 | mg/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | | 0.0050 | 0.0010 | mg/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | | 0.0050 | 0.00093 | mg/l | |
| 100-41-4 | Ethylbenzene | 0.160 | | | 0.0050 | 0.0013 | mg/l | |
| 76-13-1 | Freon 113 | ND | | | 0.025 | 0.0026 | mg/l | |
| 591-78-6 | 2-Hexanone | ND | | | 0.025 | 0.0087 | mg/l | |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
MCL = Maximum Contamination Level (40 CFR 261 6/96) B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1 | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Compound | Result | HW# | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 0.217 | | | 0.010 | 0.0012 | mg/l | |
| 79-20-9 | Methyl Acetate | ND | | | 0.025 | 0.0094 | mg/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | | 0.0050 | 0.0012 | mg/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | | 0.025 | 0.0051 | mg/l | |
| 75-09-2 | Methylene chloride | ND | | | 0.010 | 0.0011 | mg/l | |
| 108-87-2 | Methylcyclohexane | 0.0014 | | | 0.025 | 0.0011 | mg/l | J |
| 91-20-3 | Naphthalene | 3.15 [a] | | | 1.0 | 0.040 | mg/l | |
| 100-42-5 | Styrene | ND | | | 0.025 | 0.0014 | mg/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | | 0.010 | 0.0010 | mg/l | |
| 127-18-4 | Tetrachloroethene | ND | D039 | 0.70 | 0.0050 | 0.0020 | mg/l | |
| 108-88-3 | Toluene | 12.1 [a] | | | 0.20 | 0.032 | mg/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | | 0.025 | 0.0011 | mg/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | | 0.025 | 0.0010 | mg/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | | 0.0050 | 0.0013 | mg/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | | 0.0050 | 0.0011 | mg/l | |
| 79-01-6 | Trichloroethene | ND | D040 | 0.50 | 0.0050 | 0.0011 | mg/l | |
| 75-69-4 | Trichlorofluoromethane | ND | | | 0.025 | 0.0021 | mg/l | |
| 75-01-4 | Vinyl chloride | ND | D043 | 0.20 | 0.0050 | 0.00074 | mg/l | |
| | m,p-Xylene | 1.59 | | | 0.0050 | 0.0019 | mg/l | |
| 95-47-6 | o-Xylene | 0.539 | | | 0.0050 | 0.00083 | mg/l | |
| 1330-20-7 | Xylene (total) | 2.13 | | | 0.0050 | 0.00083 | mg/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 102% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 105% | 102% | 64-135% |
| 2037-26-5 | Toluene-D8 | 98% | 97% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 97% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | unknown | 12.43 | .029 | mg/l | J |
| | C3 alkyl benzene | 16.60 | .028 | mg/l | J |
| 108-67-8 | Benzene, 1,3,5-trimethyl- | 16.68 | .098 | mg/l | JN |
| 95-63-6 | Benzene, 1,2,4-trimethyl- | 17.10 | .17 | mg/l | JN |
| | C4 alkyl benzene | 17.29 | .054 | mg/l | J |
| 496-11-7 | Indane | 17.86 | .079 | mg/l | JN |
| | C5 alkyl benzene | 18.26 | .028 | mg/l | J |
| 98-86-2 | Acetophenone | 18.61 | .095 | mg/l | JN |
| 700-88-9 | Benzene, cyclopentyl- | 20.16 | .08 | mg/l | JN |

ND = Not detected MDL = Method Detection Limit J = Indicates an estimated value
MCL = Maximum Contamination Level (40 CFR 261 6/96) B = Indicates analyte found in associated method blank
E = Indicates value exceeds calibration range N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1 | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| **Method:** | SW846 8260C SW846 1311 | **Percent Solids:** | n/a |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List** **TCLP Leachate method SW846 1311**

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Naphthalene, methyl- isomer | 21.42 | .1 | mg/l | J |
| | Total TIC, Volatile | | .761 | mg/l | J |
| | Total Alkanes | | 0 | mg/l | |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (40 CFR 261 6/96)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1A | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| **Method:** | SW846 8260C SW846 1312 | **Percent Solids:** | 60.9 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

| | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| Run #1 | 3B126570.D | 200 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |
| Run #2 | 3B126573.D | 2000 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |

| | Purge Volume |
|---|---|
| Run #1 | 5.0 ml |
| Run #2 | 5.0 ml |

**VOA TCL List by leachated** **SPLP Leachate method SW846 1312**

| CAS No. | Compound | Result | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 2000 | 660 | ug/l | |
| 71-43-2 | Benzene | 92900 [a] | | 1000 | 470 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | | 200 | 74 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | | 200 | 45 | ug/l | |
| 75-25-2 | Bromoform | ND | | 200 | 47 | ug/l | |
| 74-83-9 | Bromomethane | ND | | 400 | 85 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | | 2000 | 1100 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | | 400 | 51 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | | 200 | 44 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | | 200 | 37 | ug/l | |
| 75-00-3 | Chloroethane | ND | | 200 | 68 | ug/l | |
| 67-66-3 | Chloroform | ND | | 200 | 37 | ug/l | |
| 74-87-3 | Chloromethane | ND | | 200 | 81 | ug/l | |
| 110-82-7 | Cyclohexane | ND | | 1000 | 56 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 400 | 200 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | | 200 | 31 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | | 200 | 46 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | 1390 | | 200 | 37 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 200 | 45 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | 117 | | 200 | 55 | ug/l | J |
| 75-71-8 | Dichlorodifluoromethane | ND | | 400 | 180 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | | 200 | 34 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | | 200 | 36 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | | 200 | 100 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 200 | 55 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 200 | 130 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | | 200 | 79 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 200 | 41 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 200 | 37 | ug/l | |
| 100-41-4 | Ethylbenzene | 251 | | 200 | 54 | ug/l | |
| 76-13-1 | Freon 113 | ND | | 1000 | 100 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | | 1000 | 350 | ug/l | |

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (not available)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1A | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| **Method:** | SW846 8260C SW846 1312 | **Percent Solids:** | 60.9 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**VOA TCL List by leachated** **SPLP Leachate method SW846 1312**

| CAS No. | Compound | Result | MCL | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|---|
| 98-82-8 | Isopropylbenzene | 275 | | 200 | 47 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | | 1000 | 380 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | | 1000 | 44 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 200 | 47 | ug/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 1000 | 200 | ug/l | |
| 75-09-2 | Methylene chloride | ND | | 400 | 150 | ug/l | |
| 91-20-3 | Naphthalene | 3320 | | 1000 | 40 | ug/l | |
| 100-42-5 | Styrene | ND | | 200 | 54 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 200 | 41 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | | 200 | 80 | ug/l | |
| 108-88-3 | Toluene | 22800 | | 200 | 32 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 200 | 45 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 200 | 42 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 200 | 50 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 200 | 43 | ug/l | |
| 79-01-6 | Trichloroethene | ND | | 200 | 45 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | | 400 | 86 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | | 200 | 29 | ug/l | |
| | m,p-Xylene | 2180 | | 200 | 75 | ug/l | |
| 95-47-6 | o-Xylene | 712 | | 200 | 33 | ug/l | |
| 1330-20-7 | Xylene (total) | 2890 | | 200 | 33 | ug/l | |

| CAS No. | Surrogate Recoveries | Run# 1 | Run# 2 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 100% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 103% | 102% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |
| | Total Alkanes | | 0 | ug/l | |

(a) Result is from Run# 2

ND = Not detected MDL = Method Detection Limit
MCL = Maximum Contamination Level (not available)
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

# Report of Analysis





| | | | |
|---|---|---|---|
| **Client Sample ID:** | SI-06-90-ISS | | |
| **Lab Sample ID:** | JC18959-1A | **Date Sampled:** | 04/22/16 |
| **Matrix:** | SO - Solid | **Date Received:** | 04/23/16 |
| | | **Percent Solids:** | 60.9 |
| **Project:** | OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ | | |

**General Chemistry**

| Analyte | Result | RL | Units | DF | Analyzed | By | Method |
|---|---|---|---|---|---|---|---|
| **SPLP Ratio for Volatiles** | | | | | | | |
| pH, SPLP Leachate | 10.78 | | su | 1 | 04/26/16 09:00 | YR | SW846 1312 VOA |
| Volume, SPLP Leachate | 0.5060 | | l | 1 | 04/26/16 09:00 | YR | SW846 1312 VOA |
| Weight, SPLP Leachate | 0.02530 | | kg | 1 | 04/26/16 09:00 | YR | SW846 1312 VOA |
| Dry Weight, SPLP Leachate | 0.01541 | | kg | 1 | 04/26/16 09:00 | YR | SW846 1312 VOA |
| Solids, Percent | 60.9 | | % | 1 | 04/28/16 17:00 | KP | SM2540 G-97 |

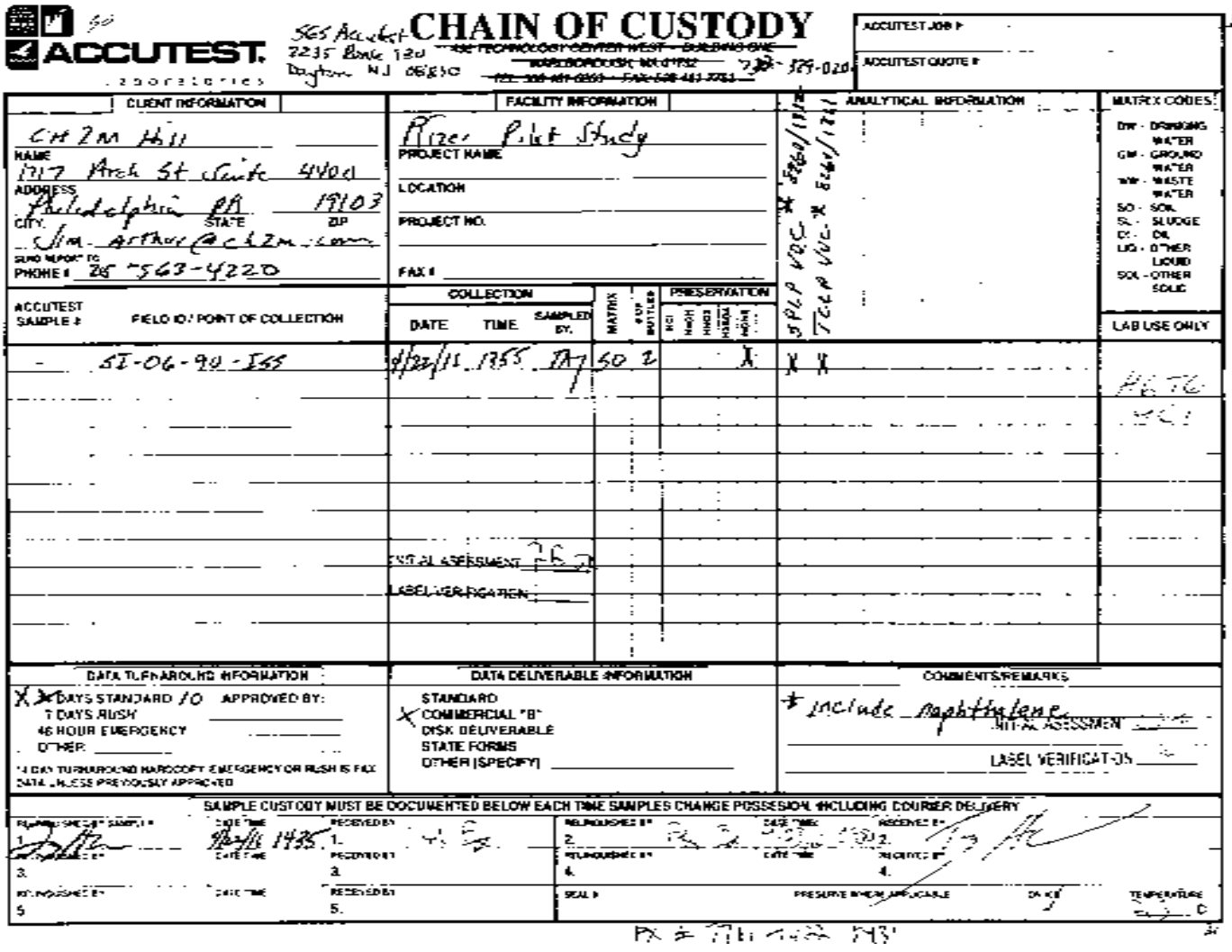
RL = Reporting Limit

## Misc. Forms

### Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody



ACCUTEST Laboratories

SGS Accutest
2235 Route 130
Dayton NJ 08810

# CHAIN OF CUSTODY

~~[illegible] TECHNOLOGY CENTER WEST - BUILDING ONE~~
~~WAREBOROOKS, MA 01752~~ 732-329-0200
~~TEL 508-481-6860 FAX 508-481-7561~~

ACCUTEST JOB #:
ACCUTEST QUOTE #:

**CLIENT INFORMATION**

NAME: CH2M Hill
ADDRESS: 1717 Arch St Suite 4400
CITY: Philadelphia STATE: PA ZIP: 19103
SEND REPORT TO: Jim Arthur@ch2m.com
PHONE #: 215-563-4220

**FACILITY INFORMATION**

PROJECT NAME: Rizer Pilot Study
LOCATION:
PROJECT NO.:
FAX #:

**ANALYTICAL INFORMATION**

SPLP VOC * 8260/1312
TCLP VOC * 8260/1311

**MATRIX CODES**

DW - DRINKING WATER
GW - GROUND WATER
WW - WASTE WATER
SO - SOIL
SL - SLUDGE
OL - OIL
LIQ - OTHER LIQUID
SOL - OTHER SOLID

| ACCUTEST SAMPLE # | FIELD ID / POINT OF COLLECTION | COLLECTION DATE | COLLECTION TIME | SAMPLED BY | MATRIX | # OF BOTTLES | PRESERVATION HCl | PRESERVATION HNO3 | PRESERVATION H2SO4 | PRESERVATION NONE | SPLP VOC * | TCLP VOC * | LAB USE ONLY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| - | SI-06-90-ISS | 9/22/11 | 1355 | TAJ | SO | 2 | | | | X | X | X | |

INITIAL ASSESSMENT: [illegible]
LABEL VERIFICATION:

**DATA TURNAROUND INFORMATION**

X 14 DAYS STANDARD 10 APPROVED BY:
7 DAYS RUSH
48 HOUR EMERGENCY
OTHER:
*14 DAY TURNAROUND HARDCOPY. EMERGENCY OR RUSH IS FAX DATA UNLESS PREVIOUSLY APPROVED

**DATA DELIVERABLE INFORMATION**

STANDARD
X COMMERCIAL "B"
DISK DELIVERABLE
STATE FORMS
OTHER (SPECIFY)

**COMMENTS/REMARKS**

* include naphthalene
INITIAL ASSESSMENT
LABEL VERIFICATION

**SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESSION, INCLUDING COURIER DELIVERY**

| RELINQUISHED BY | DATE/TIME | RECEIVED BY | RELINQUISHED BY | DATE/TIME | RECEIVED BY |
|---|---|---|---|---|---|
| 1. [signature] | 9/22/11 1435 | 1. [signature] | 2. [signature] | [illegible] | 2. [signature] |
| 3. | | 3. | 4. | | 4. |
| 5. | | 5. | | | |

SEAL #: PRESERVE WHERE APPLICABLE: OK / TEMPERATURE: [illegible] C

FX # 7161 [illegible] 1431

4.1 4

**JC18959: Chain of Custody**
**Page 1 of 3**

# SGS Accutest Sample Receipt Summary

**Job Number:** JC18959 **Client:** CH2M HILL **Project:** Pfizer Pilot Study

**Date / Time Received:** 4/23/2016 9:50:00 AM **Delivery Method:** FedEx **Airbill #'s:** 7761 7422 5431

Cooler Temps (Raw Measured) °C: Cooler 1: (2.3);

Cooler Temps (Corrected) °C: Cooler 1: (2.7);

**Cooler Security**

| | Y or N | | Y or N |
|---|---|---|---|
| 1. Custody Seals Present: | ☑ ☐ | 3. COC Present: | ☑ ☐ |
| 2. Custody Seals Intact: | ☑ ☐ | 4. Smpl Dates/Time OK | ☑ ☐ |

**Cooler Temperature**

| | Y or N |
|---|---|
| 1. Temp criteria achieved: | ☑ ☐ |
| 2. Cooler temp verification: | IR Gun |
| 3. Cooler media: | Ice (Bag) |
| 4. No, Coolers | 1 |

**Quality Control Preservation**

| | Y | N | N/A |
|---|---|---|---|
| 1. Trip Blank present / cooler: | ☐ | ☑ | ☐ |
| 2. Trip Blank listed on COC: | ☐ | ☑ | ☐ |
| 3. Samples preserved properly: | ☐ | ☑ | |
| 4. VOCs headspace free: | ☐ | ☐ | ☑ |

**Sample Integrity - Documentation**

| | Y or N |
|---|---|
| 1. Sample labels present on bottles: | ☑ ☐ |
| 2. Container labeling complete: | ☑ ☐ |
| 3. Sample container label / COC agree: | ☑ ☐ |

**Sample Integrity - Condition**

| | Y or N |
|---|---|
| 1. Sample recvd within HT: | ☑ ☐ |
| 2. All containers accounted for: | ☑ ☐ |
| 3. Condition of sample: | Intact |

**Sample Integrity - Instructions**

| | Y | N | N/A |
|---|---|---|---|
| 1. Analysis requested is clear: | ☑ | ☐ | |
| 2. Bottles received for unspecified tests | ☐ | ☑ | |
| 3. Sufficient volume recvd for analysis: | ☐ | ☑ | |
| 4. Compositing instructions clear: | ☐ | ☐ | ☑ |
| 5. Filtering instructions clear: | ☐ | ☐ | ☑ |

Comments

Received (2) 60ml bottles instead of 25 gram encores. This is limited volume to run SPLP and TCLP VOC.
-The 60ml bottle labeled SPLPVOC has 39 grams of sample.
-The 60ml bottle labeled TCLPVOC has 42 grams of sample.

## Sample Receipt Summary - Problem Resolution

**Job Number:** JC18959 **Initiator:** timh

**CSR:** MV **Response Date:** 4/27/2016

**Response:** Proceed as noted. Comment limited volume.



**JC18959: Chain of Custody**
**Page 3 of 3**

## GC/MS Volatiles

### QC Data Summaries

Includes the following where applicable:

- Method Blank Summaries
- Blank Spike Summaries
- Matrix Spike and Duplicate Summaries
- Instrument Performance Checks (BFB)
- Surrogate Recovery Summaries

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-MB2 | 3B126355.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-MB2 | 3B126355.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 64-135% |
| 2037-26-5 | Toluene-D8 | 97% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5663-MB | 3B126365.D | 1 | 04/28/16 | HA | n/a | n/a | V3B5663 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 98% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 64-135% |
| 2037-26-5 | Toluene-D8 | 98% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 98% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5670-MB | 3B126567.D | 1 | 05/04/16 | HA | n/a | n/a | V3B5670 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Method Blank Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5670-MB | 3B126567.D | 1 | 05/04/16 | HA | n/a | n/a | V3B5670 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-MB | 3B126334.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

V3B5662-BS, GP97219-LB8, GP97219-LS8, JC18431-1MS, JC18431-1MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Method Blank Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-MB | 3B126334.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

V3B5662-BS, GP97219-LB8, GP97219-LS8, JC18431-1MS, JC18431-1MSD

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 98% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Method Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5668-MB | 3B126520.D | 1 | 05/03/16 | HA | n/a | n/a | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

GP97188-LB5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Method Blank Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5668-MB | 3B126520.D | 1 | 05/03/16 | HA | n/a | n/a | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

GP97188-LB5

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Leachate Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97188-LB5 | 3B126533.D | 1 | 05/03/16 | HA | 04/25/16 | GP97188 | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 10 | 3.3 | ug/l | |
| 71-43-2 | Benzene | ND | 0.50 | 0.24 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 1.0 | 0.37 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 1.0 | 0.23 | ug/l | |
| 75-25-2 | Bromoform | ND | 1.0 | 0.23 | ug/l | |
| 74-83-9 | Bromomethane | ND | 2.0 | 0.42 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 10 | 5.6 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 2.0 | 0.25 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 1.0 | 0.22 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 75-00-3 | Chloroethane | ND | 1.0 | 0.34 | ug/l | |
| 67-66-3 | Chloroform | ND | 1.0 | 0.19 | ug/l | |
| 74-87-3 | Chloromethane | ND | 1.0 | 0.41 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 5.0 | 0.28 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 2.0 | 0.99 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 1.0 | 0.15 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 1.0 | 0.23 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 1.0 | 0.19 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 1.0 | 0.27 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 2.0 | 0.90 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 1.0 | 0.17 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 1.0 | 0.18 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 1.0 | 0.51 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 1.0 | 0.27 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 1.0 | 0.65 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 1.0 | 0.39 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 1.0 | 0.21 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 1.0 | 0.19 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 1.0 | 0.27 | ug/l | |
| 76-13-1 | Freon 113 | ND | 5.0 | 0.52 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 5.0 | 1.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 1.0 | 0.23 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 5.0 | 1.9 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 5.0 | 0.22 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 1.0 | 0.24 | ug/l | |

# Leachate Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97188-LB5 | 3B126533.D | 1 | 05/03/16 | HA | 04/25/16 | GP97188 | V3B5668 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 5.0 | 1.0 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 2.0 | 0.73 | ug/l | |
| 91-20-3 | Naphthalene | ND | 5.0 | 0.20 | ug/l | |
| 100-42-5 | Styrene | ND | 1.0 | 0.27 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 1.0 | 0.21 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 1.0 | 0.40 | ug/l | |
| 108-88-3 | Toluene | ND | 1.0 | 0.16 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 1.0 | 0.23 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 1.0 | 0.21 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 1.0 | 0.25 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 1.0 | 0.21 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 1.0 | 0.22 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 2.0 | 0.43 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 1.0 | 0.15 | ug/l | |
| | m,p-Xylene | ND | 1.0 | 0.38 | ug/l | |
| 95-47-6 | o-Xylene | ND | 1.0 | 0.17 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 1.0 | 0.17 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 102% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 100% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 102% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| | Total TIC, Volatile | | 0 | ug/l | |

# Leachate Blank Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97219-LB8 | 3B126337.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | 50 | 17 | ug/l | |
| 71-43-2 | Benzene | ND | 2.5 | 1.2 | ug/l | |
| 74-97-5 | Bromochloromethane | ND | 5.0 | 1.9 | ug/l | |
| 75-27-4 | Bromodichloromethane | ND | 5.0 | 1.1 | ug/l | |
| 75-25-2 | Bromoform | ND | 5.0 | 1.2 | ug/l | |
| 74-83-9 | Bromomethane | ND | 10 | 2.1 | ug/l | |
| 78-93-3 | 2-Butanone (MEK) | ND | 50 | 28 | ug/l | |
| 75-15-0 | Carbon disulfide | ND | 10 | 1.3 | ug/l | |
| 56-23-5 | Carbon tetrachloride | ND | 5.0 | 1.1 | ug/l | |
| 108-90-7 | Chlorobenzene | ND | 5.0 | 0.93 | ug/l | |
| 75-00-3 | Chloroethane | ND | 5.0 | 1.7 | ug/l | |
| 67-66-3 | Chloroform | ND | 5.0 | 0.94 | ug/l | |
| 74-87-3 | Chloromethane | ND | 5.0 | 2.0 | ug/l | |
| 110-82-7 | Cyclohexane | ND | 25 | 1.4 | ug/l | |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | 10 | 5.0 | ug/l | |
| 124-48-1 | Dibromochloromethane | ND | 5.0 | 0.77 | ug/l | |
| 106-93-4 | 1,2-Dibromoethane | ND | 5.0 | 1.2 | ug/l | |
| 95-50-1 | 1,2-Dichlorobenzene | ND | 5.0 | 0.93 | ug/l | |
| 541-73-1 | 1,3-Dichlorobenzene | ND | 5.0 | 1.1 | ug/l | |
| 106-46-7 | 1,4-Dichlorobenzene | ND | 5.0 | 1.4 | ug/l | |
| 75-71-8 | Dichlorodifluoromethane | ND | 10 | 4.5 | ug/l | |
| 75-34-3 | 1,1-Dichloroethane | ND | 5.0 | 0.86 | ug/l | |
| 107-06-2 | 1,2-Dichloroethane | ND | 5.0 | 0.90 | ug/l | |
| 75-35-4 | 1,1-Dichloroethene | ND | 5.0 | 2.6 | ug/l | |
| 156-59-2 | cis-1,2-Dichloroethene | ND | 5.0 | 1.4 | ug/l | |
| 156-60-5 | trans-1,2-Dichloroethene | ND | 5.0 | 3.2 | ug/l | |
| 78-87-5 | 1,2-Dichloropropane | ND | 5.0 | 2.0 | ug/l | |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | 5.0 | 1.0 | ug/l | |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | 5.0 | 0.93 | ug/l | |
| 100-41-4 | Ethylbenzene | ND | 5.0 | 1.3 | ug/l | |
| 76-13-1 | Freon 113 | ND | 25 | 2.6 | ug/l | |
| 591-78-6 | 2-Hexanone | ND | 25 | 8.7 | ug/l | |
| 98-82-8 | Isopropylbenzene | ND | 5.0 | 1.2 | ug/l | |
| 79-20-9 | Methyl Acetate | ND | 25 | 9.4 | ug/l | |
| 108-87-2 | Methylcyclohexane | ND | 25 | 1.1 | ug/l | |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | 5.0 | 1.2 | ug/l | |

# Leachate Blank Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97219-LB8 | 3B126337.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Result | RL | MDL | Units | Q |
|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | 25 | 5.1 | ug/l | |
| 75-09-2 | Methylene chloride | ND | 10 | 3.6 | ug/l | |
| 91-20-3 | Naphthalene | ND | 25 | 1.0 | ug/l | |
| 100-42-5 | Styrene | ND | 5.0 | 1.4 | ug/l | |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | 5.0 | 1.0 | ug/l | |
| 127-18-4 | Tetrachloroethene | ND | 5.0 | 2.0 | ug/l | |
| 108-88-3 | Toluene | ND | 5.0 | 0.81 | ug/l | |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | 5.0 | 1.1 | ug/l | |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | 5.0 | 1.0 | ug/l | |
| 71-55-6 | 1,1,1-Trichloroethane | ND | 5.0 | 1.3 | ug/l | |
| 79-00-5 | 1,1,2-Trichloroethane | ND | 5.0 | 1.1 | ug/l | |
| 79-01-6 | Trichloroethene | ND | 5.0 | 1.1 | ug/l | |
| 75-69-4 | Trichlorofluoromethane | ND | 10 | 2.1 | ug/l | |
| 75-01-4 | Vinyl chloride | ND | 5.0 | 0.74 | ug/l | |
| | m,p-Xylene | ND | 5.0 | 1.9 | ug/l | |
| 95-47-6 | o-Xylene | ND | 5.0 | 0.83 | ug/l | |
| 1330-20-7 | Xylene (total) | ND | 5.0 | 0.83 | ug/l | |

| CAS No. | Surrogate Recoveries | | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 98% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 98% | 64-135% |
| 2037-26-5 | Toluene-D8 | 97% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 97% | 72-122% |

| CAS No. | Tentatively Identified Compounds | R.T. | Est. Conc. | Units | Q |
|---|---|---|---|---|---|
| 109-60-4 | n-Propyl acetate | 12.43 | 40 | ug/l | JN |
| | Propanoic acid, methyl,methylethyl ester | 13.83 | 36 | ug/l | J |
| 638-11-9 | Butanoic acid, 1-methylethyl ester | 14.60 | 46 | ug/l | JN |
| | Total TIC, Volatile | | 122 | ug/l | J |

# Blank Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-BS | 3B126335.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 50 | 51.4 | 103 | 51-151 |
| 74-97-5 | Bromochloromethane | 50 | 48.0 | 96 | 78-124 |
| 75-27-4 | Bromodichloromethane | 50 | 51.9 | 104 | 77-128 |
| 75-25-2 | Bromoform | 50 | 50.6 | 101 | 67-141 |
| 74-83-9 | Bromomethane | 50 | 43.4 | 87 | 53-152 |
| 78-93-3 | 2-Butanone (MEK) | 50 | 48.3 | 97 | 64-130 |
| 75-15-0 | Carbon disulfide | 50 | 42.5 | 85 | 59-140 |
| 56-23-5 | Carbon tetrachloride | 50 | 49.8 | 100 | 75-148 |
| 108-90-7 | Chlorobenzene | 50 | 50.2 | 100 | 76-124 |
| 75-00-3 | Chloroethane | 50 | 42.5 | 85 | 54-147 |
| 67-66-3 | Chloroform | 50 | 51.3 | 103 | 77-124 |
| 74-87-3 | Chloromethane | 50 | 37.2 | 74 | 46-144 |
| 110-82-7 | Cyclohexane | 50 | 47.8 | 96 | 62-127 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 50 | 46.9 | 94 | 64-134 |
| 124-48-1 | Dibromochloromethane | 50 | 49.5 | 99 | 76-132 |
| 106-93-4 | 1,2-Dibromoethane | 50 | 48.6 | 97 | 75-130 |
| 541-73-1 | 1,3-Dichlorobenzene | 50 | 50.7 | 101 | 73-124 |
| 106-46-7 | 1,4-Dichlorobenzene | 50 | 48.3 | 97 | 71-123 |
| 75-71-8 | Dichlorodifluoromethane | 50 | 46.1 | 92 | 42-152 |
| 75-34-3 | 1,1-Dichloroethane | 50 | 49.7 | 99 | 72-124 |
| 107-06-2 | 1,2-Dichloroethane | 50 | 49.8 | 100 | 66-150 |
| 75-35-4 | 1,1-Dichloroethene | 50 | 46.4 | 93 | 61-132 |
| 156-59-2 | cis-1,2-Dichloroethene | 50 | 43.4 | 87 | 71-119 |
| 156-60-5 | trans-1,2-Dichloroethene | 50 | 40.5 | 81 | 71-123 |
| 78-87-5 | 1,2-Dichloropropane | 50 | 47.8 | 96 | 75-120 |
| 10061-01-5 | cis-1,3-Dichloropropene | 50 | 52.3 | 105 | 77-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 50 | 51.5 | 103 | 75-132 |
| 100-41-4 | Ethylbenzene | 50 | 51.2 | 102 | 77-124 |
| 76-13-1 | Freon 113 | 50 | 54.2 | 108 | 58-149 |
| 591-78-6 | 2-Hexanone | 50 | 47.8 | 96 | 58-136 |
| 98-82-8 | Isopropylbenzene | 50 | 50.3 | 101 | 60-136 |
| 79-20-9 | Methyl Acetate | 50 | 45.6 | 91 | 57-139 |
| 108-87-2 | Methylcyclohexane | 50 | 47.5 | 95 | 73-130 |
| 1634-04-4 | Methyl Tert Butyl Ether | 100 | 91.2 | 91 | 72-127 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 50 | 47.6 | 95 | 63-135 |
| 75-09-2 | Methylene chloride | 50 | 46.8 | 94 | 69-122 |

* = Outside of Control Limits.

# Blank Spike Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5662-BS | 3B126335.D | 1 | 04/27/16 | HA | n/a | n/a | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 100-42-5 | Styrene | 50 | 48.9 | 98 | 78-126 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 50 | 48.1 | 96 | 66-125 |
| 127-18-4 | Tetrachloroethene | 50 | 50.7 | 101 | 70-136 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 50 | 46.2 | 92 | 62-132 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 50 | 46.5 | 93 | 67-132 |
| 71-55-6 | 1,1,1-Trichloroethane | 50 | 50.8 | 102 | 77-136 |
| 79-00-5 | 1,1,2-Trichloroethane | 50 | 49.7 | 99 | 75-123 |
| 79-01-6 | Trichloroethene | 50 | 50.1 | 100 | 79-126 |
| 75-69-4 | Trichlorofluoromethane | 50 | 49.0 | 98 | 56-154 |
| 75-01-4 | Vinyl chloride | 50 | 41.4 | 83 | 56-146 |
| | m,p-Xylene | 100 | 104 | 104 | 77-125 |
| 95-47-6 | o-Xylene | 50 | 50.7 | 101 | 76-126 |
| 1330-20-7 | Xylene (total) | 150 | 154 | 103 | 77-125 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 97% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 99% | 72-122% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5663-BS | 3B126366.D | 1 | 04/28/16 | HA | n/a | n/a | V3B5663 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 71-43-2 | Benzene | 50 | 51.5 | 103 | 75-122 |
| 95-50-1 | 1,2-Dichlorobenzene | 50 | 51.0 | 102 | 74-125 |
| 91-20-3 | Naphthalene | 50 | 45.4 | 91 | 37-146 |
| 108-88-3 | Toluene | 50 | 52.1 | 104 | 76-126 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 99% | 64-135% |
| 2037-26-5 | Toluene-D8 | 99% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 100% | 72-122% |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5670-BS | 3B126568.D | 1 | 05/04/16 | HA | n/a | n/a | V3B5670 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 67-64-1 | Acetone | 50 | 53.7 | 107 | 51-151 |
| 71-43-2 | Benzene | 50 | 51.2 | 102 | 75-122 |
| 74-97-5 | Bromochloromethane | 50 | 50.5 | 101 | 78-124 |
| 75-27-4 | Bromodichloromethane | 50 | 50.5 | 101 | 77-128 |
| 75-25-2 | Bromoform | 50 | 46.8 | 94 | 67-141 |
| 74-83-9 | Bromomethane | 50 | 49.7 | 99 | 53-152 |
| 78-93-3 | 2-Butanone (MEK) | 50 | 51.9 | 104 | 64-130 |
| 75-15-0 | Carbon disulfide | 50 | 51.0 | 102 | 59-140 |
| 56-23-5 | Carbon tetrachloride | 50 | 46.3 | 93 | 75-148 |
| 108-90-7 | Chlorobenzene | 50 | 49.0 | 98 | 76-124 |
| 75-00-3 | Chloroethane | 50 | 52.1 | 104 | 54-147 |
| 67-66-3 | Chloroform | 50 | 54.1 | 108 | 77-124 |
| 74-87-3 | Chloromethane | 50 | 47.2 | 94 | 46-144 |
| 110-82-7 | Cyclohexane | 50 | 52.1 | 104 | 62-127 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | 50 | 44.7 | 89 | 64-134 |
| 124-48-1 | Dibromochloromethane | 50 | 47.6 | 95 | 76-132 |
| 106-93-4 | 1,2-Dibromoethane | 50 | 47.6 | 95 | 75-130 |
| 95-50-1 | 1,2-Dichlorobenzene | 50 | 50.1 | 100 | 74-125 |
| 541-73-1 | 1,3-Dichlorobenzene | 50 | 49.7 | 99 | 73-124 |
| 106-46-7 | 1,4-Dichlorobenzene | 50 | 47.2 | 94 | 71-123 |
| 75-71-8 | Dichlorodifluoromethane | 50 | 49.4 | 99 | 42-152 |
| 75-34-3 | 1,1-Dichloroethane | 50 | 53.7 | 107 | 72-124 |
| 107-06-2 | 1,2-Dichloroethane | 50 | 47.7 | 95 | 66-150 |
| 75-35-4 | 1,1-Dichloroethene | 50 | 50.8 | 102 | 61-132 |
| 156-59-2 | cis-1,2-Dichloroethene | 50 | 47.0 | 94 | 71-119 |
| 156-60-5 | trans-1,2-Dichloroethene | 50 | 44.4 | 89 | 71-123 |
| 78-87-5 | 1,2-Dichloropropane | 50 | 49.5 | 99 | 75-120 |
| 10061-01-5 | cis-1,3-Dichloropropene | 50 | 52.9 | 106 | 77-124 |
| 10061-02-6 | trans-1,3-Dichloropropene | 50 | 51.7 | 103 | 75-132 |
| 100-41-4 | Ethylbenzene | 50 | 50.6 | 101 | 77-124 |
| 76-13-1 | Freon 113 | 50 | 49.7 | 99 | 58-149 |
| 591-78-6 | 2-Hexanone | 50 | 50.3 | 101 | 58-136 |
| 98-82-8 | Isopropylbenzene | 50 | 50.8 | 102 | 60-136 |
| 79-20-9 | Methyl Acetate | 50 | 48.9 | 98 | 57-139 |
| 108-87-2 | Methylcyclohexane | 50 | 45.0 | 90 | 73-130 |
| 1634-04-4 | Methyl Tert Butyl Ether | 100 | 96.2 | 96 | 72-127 |

* = Outside of Control Limits.

# Blank Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| V3B5670-BS | 3B126568.D | 1 | 05/04/16 | HA | n/a | n/a | V3B5670 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | Spike ug/l | BSP ug/l | BSP % | Limits |
|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | 50 | 50.5 | 101 | 63-135 |
| 75-09-2 | Methylene chloride | 50 | 51.7 | 103 | 69-122 |
| 91-20-3 | Naphthalene | 50 | 45.6 | 91 | 37-146 |
| 100-42-5 | Styrene | 50 | 48.6 | 97 | 78-126 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | 50 | 51.1 | 102 | 66-125 |
| 127-18-4 | Tetrachloroethene | 50 | 47.4 | 95 | 70-136 |
| 108-88-3 | Toluene | 50 | 51.6 | 103 | 76-126 |
| 87-61-6 | 1,2,3-Trichlorobenzene | 50 | 45.1 | 90 | 62-132 |
| 120-82-1 | 1,2,4-Trichlorobenzene | 50 | 45.2 | 90 | 67-132 |
| 71-55-6 | 1,1,1-Trichloroethane | 50 | 51.8 | 104 | 77-136 |
| 79-00-5 | 1,1,2-Trichloroethane | 50 | 50.0 | 100 | 75-123 |
| 79-01-6 | Trichloroethene | 50 | 49.4 | 99 | 79-126 |
| 75-69-4 | Trichlorofluoromethane | 50 | 51.7 | 103 | 56-154 |
| 75-01-4 | Vinyl chloride | 50 | 45.9 | 92 | 56-146 |
| | m,p-Xylene | 100 | 103 | 103 | 77-125 |
| 95-47-6 | o-Xylene | 50 | 51.5 | 103 | 76-126 |
| 1330-20-7 | Xylene (total) | 150 | 154 | 103 | 77-125 |

| CAS No. | Surrogate Recoveries | BSP | Limits |
|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18431-1MS | 3B126344.D | 5 | 04/27/16 | HA | n/a | n/a | V3B5662 |
| JC18431-1MSD | 3B126345.D | 5 | 04/27/16 | HA | n/a | n/a | V3B5662 |
| JC18431-1 | 3B126343.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | JC18431-1 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 250 | 255 | 102 | 250 | 248 | 99 | 3 | 44-157/20 |
| 74-97-5 | Bromochloromethane | ND | | 250 | 238 | 95 | 250 | 228 | 91 | 4 | 70-129/11 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 253 | 101 | 250 | 244 | 98 | 4 | 70-135/13 |
| 75-25-2 | Bromoform | ND | | 250 | 250 | 100 | 250 | 237 | 95 | 5 | 53-139/13 |
| 74-83-9 | Bromomethane | ND | | 250 | 196 | 78 | 250 | 181 | 72 | 8 | 44-150/18 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 249 | 100 | 250 | 230 | 92 | 8 | 58-140/14 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 227 | 91 | 250 | 224 | 90 | 1 | 34-136/21 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 242 | 97 | 250 | 233 | 93 | 4 | 50-161/18 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 241 | 96 | 250 | 233 | 93 | 3 | 65-128/12 |
| 75-00-3 | Chloroethane | ND | | 250 | 194 | 78 | 250 | 200 | 80 | 3 | 41-151/18 |
| 67-66-3 | Chloroform | ND | | 250 | 251 | 100 | 250 | 245 | 98 | 2 | 66-132/14 |
| 74-87-3 | Chloromethane | ND | | 250 | 162 | 65 | 250 | 157 | 63 | 3 | 35-149/22 |
| 110-82-7 | Cyclohexane | ND | | 250 | 238 | 95 | 250 | 233 | 93 | 2 | 29-158/18 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 235 | 94 | 250 | 230 | 92 | 2 | 58-141/14 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 243 | 97 | 250 | 234 | 94 | 4 | 67-134/12 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 240 | 96 | 250 | 228 | 91 | 5 | 69-130/11 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 244 | 98 | 250 | 238 | 95 | 2 | 63-128/13 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 234 | 94 | 250 | 229 | 92 | 2 | 63-126/13 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 194 | 78 | 250 | 185 | 74 | 5 | 24-170/24 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 244 | 98 | 250 | 237 | 95 | 3 | 59-132/15 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 246 | 98 | 250 | 237 | 95 | 4 | 59-153/15 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 236 | 94 | 250 | 234 | 94 | 1 | 41-144/17 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 211 | 84 | 250 | 211 | 84 | 0 | 57-131/13 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 203 | 81 | 250 | 198 | 79 | 2 | 55-131/15 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 232 | 93 | 250 | 229 | 92 | 1 | 67-125/12 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 255 | 102 | 250 | 246 | 98 | 4 | 68-126/13 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 249 | 100 | 250 | 244 | 98 | 2 | 68-134/13 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 247 | 99 | 250 | 238 | 95 | 4 | 37-143/13 |
| 76-13-1 | Freon 113 | ND | | 250 | 284 | 114 | 250 | 277 | 111 | 2 | 33-159/19 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 240 | 96 | 250 | 230 | 92 | 4 | 53-145/17 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 243 | 97 | 250 | 237 | 95 | 3 | 48-141/15 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 240 | 96 | 250 | 229 | 92 | 5 | 46-147/18 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 235 | 94 | 250 | 230 | 92 | 2 | 36-156/18 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 469 | 94 | 500 | 465 | 93 | 1 | 53-139/14 |
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 249 | 100 | 250 | 242 | 97 | 3 | 57-141/14 |
| 75-09-2 | Methylene chloride | ND | | 250 | 231 | 92 | 250 | 227 | 91 | 2 | 59-129/12 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18431-1MS | 3B126344.D | 5 | 04/27/16 | HA | n/a | n/a | V3B5662 |
| JC18431-1MSD | 3B126345.D | 5 | 04/27/16 | HA | n/a | n/a | V3B5662 |
| JC18431-1 | 3B126343.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | JC18431-1 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100-42-5 | Styrene | ND | | 250 | 237 | 95 | 250 | 228 | 91 | 4 | 60-135/13 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 236 | 94 | 250 | 230 | 92 | 3 | 62-126/13 |
| 127-18-4 | Tetrachloroethene | ND | | 250 | 249 | 100 | 250 | 237 | 95 | 5 | 48-145/15 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 226 | 90 | 250 | 224 | 90 | 1 | 54-137/14 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 224 | 90 | 250 | 222 | 89 | 1 | 59-135/13 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 245 | 98 | 250 | 239 | 96 | 2 | 55-149/18 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 239 | 96 | 250 | 233 | 93 | 3 | 70-127/12 |
| 79-01-6 | Trichloroethene | ND | | 250 | 242 | 97 | 250 | 238 | 95 | 2 | 53-141/15 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 222 | 89 | 250 | 213 | 85 | 4 | 35-169/23 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 180 | 72 | 250 | 175 | 70 | 3 | 34-151/20 |
| | m,p-Xylene | ND | | 500 | 497 | 99 | 500 | 484 | 97 | 3 | 32-146/13 |
| 95-47-6 | o-Xylene | ND | | 250 | 249 | 100 | 250 | 238 | 95 | 5 | 46-141/12 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 747 | 100 | 750 | 722 | 96 | 3 | 36-144/13 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18431-1 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 100% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 100% | 99% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 100% | 98% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 101% | 97% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC18437-12AMS | 3B126375.D | 5 | 04/28/16 | HA | n/a | n/a | V3B5663 |
| JC18437-12AMSD | 3B126376.D | 5 | 04/28/16 | HA | n/a | n/a | V3B5663 |
| JC18437-12A | 3B126373.D | 5 | 04/28/16 | HA | 04/27/16 | GP97249 | V3B5663 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | JC18437-12A ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 71-43-2 | Benzene | ND | | 250 | 252 | 101 | 250 | 251 | 100 | 0 | 38-139/13 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 254 | 102 | 250 | 254 | 102 | 0 | 65-128/12 |
| 91-20-3 | Naphthalene | ND | | 250 | 231 | 92 | 250 | 232 | 93 | 0 | 34-156/15 |
| 108-88-3 | Toluene | ND | | 250 | 256 | 102 | 250 | 255 | 102 | 0 | 44-141/14 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC18437-12A | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 101% | 102% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 101% | 100% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 100% | 97% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 101% | 98% | 72-122% |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19462-6MS | 3B126577.D | 5 | 05/04/16 | HA | n/a | n/a | V3B5670 |
| JC19462-6MSD | 3B126578.D | 5 | 05/04/16 | HA | n/a | n/a | V3B5670 |
| JC19462-6 | 3B126576.D | 5 | 05/04/16 | HA | 05/03/16 | GP97378 | V3B5670 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | JC19462-6 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 250 | 297 | 119 | 250 | 293 | 117 | 1 | 44-157/20 |
| 71-43-2 | Benzene | ND | | 250 | 261 | 104 | 250 | 253 | 101 | 3 | 38-139/13 |
| 74-97-5 | Bromochloromethane | ND | | 250 | 256 | 102 | 250 | 248 | 99 | 3 | 70-129/11 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 260 | 104 | 250 | 249 | 100 | 4 | 70-135/13 |
| 75-25-2 | Bromoform | ND | | 250 | 238 | 95 | 250 | 228 | 91 | 4 | 53-139/13 |
| 74-83-9 | Bromomethane | ND | | 250 | 245 | 98 | 250 | 261 | 104 | 6 | 44-150/18 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 271 | 108 | 250 | 265 | 106 | 2 | 58-140/14 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 257 | 103 | 250 | 268 | 107 | 4 | 34-136/21 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 234 | 94 | 250 | 233 | 93 | 0 | 50-161/18 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 251 | 100 | 250 | 237 | 95 | 6 | 65-128/12 |
| 75-00-3 | Chloroethane | ND | | 250 | 275 | 110 | 250 | 293 | 117 | 6 | 41-151/18 |
| 67-66-3 | Chloroform | ND | | 250 | 273 | 109 | 250 | 263 | 105 | 4 | 66-132/14 |
| 74-87-3 | Chloromethane | ND | | 250 | 235 | 94 | 250 | 257 | 103 | 9 | 35-149/22 |
| 110-82-7 | Cyclohexane | ND | | 250 | 255 | 102 | 250 | 261 | 104 | 2 | 29-158/18 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 242 | 97 | 250 | 233 | 93 | 4 | 58-141/14 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 242 | 97 | 250 | 231 | 92 | 5 | 67-134/12 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 247 | 99 | 250 | 233 | 93 | 6 | 69-130/11 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 253 | 101 | 250 | 245 | 98 | 3 | 65-128/12 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 250 | 100 | 250 | 239 | 96 | 4 | 63-128/13 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 241 | 96 | 250 | 232 | 93 | 4 | 63-126/13 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 240 | 96 | 250 | 258 | 103 | 7 | 24-170/24 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 274 | 110 | 250 | 265 | 106 | 3 | 59-132/15 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 245 | 98 | 250 | 234 | 94 | 5 | 59-153/15 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 257 | 103 | 250 | 267 | 107 | 4 | 41-144/17 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 234 | 94 | 250 | 231 | 92 | 1 | 57-131/13 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 223 | 89 | 250 | 224 | 90 | 0 | 55-131/15 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 250 | 100 | 250 | 242 | 97 | 3 | 67-125/12 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 267 | 107 | 250 | 253 | 101 | 5 | 68-126/13 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 262 | 105 | 250 | 250 | 100 | 5 | 68-134/13 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 257 | 103 | 250 | 247 | 99 | 4 | 37-143/13 |
| 76-13-1 | Freon 113 | ND | | 250 | 237 | 95 | 250 | 253 | 101 | 7 | 33-159/19 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 266 | 106 | 250 | 255 | 102 | 4 | 53-145/17 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 253 | 101 | 250 | 247 | 99 | 2 | 48-141/15 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 251 | 100 | 250 | 244 | 98 | 3 | 46-147/18 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 220 | 88 | 250 | 229 | 92 | 4 | 36-156/18 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 508 | 102 | 500 | 507 | 102 | 0 | 53-139/14 |

* = Outside of Control Limits.

# Matrix Spike/Matrix Spike Duplicate Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| JC19462-6MS | 3B126577.D | 5 | 05/04/16 | HA | n/a | n/a | V3B5670 |
| JC19462-6MSD | 3B126578.D | 5 | 05/04/16 | HA | n/a | n/a | V3B5670 |
| JC19462-6 | 3B126576.D | 5 | 05/04/16 | HA | 05/03/16 | GP97378 | V3B5670 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | JC19462-6 ug/l | Q | Spike ug/l | MS ug/l | MS % | Spike ug/l | MSD ug/l | MSD % | RPD | Limits Rec/RPD |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 273 | 109 | 250 | 268 | 107 | 2 | 57-141/14 |
| 75-09-2 | Methylene chloride | ND | | 250 | 263 | 105 | 250 | 264 | 106 | 0 | 59-129/12 |
| 91-20-3 | Naphthalene | ND | | 250 | 241 | 96 | 250 | 234 | 94 | 3 | 34-156/15 |
| 100-42-5 | Styrene | ND | | 250 | 247 | 99 | 250 | 236 | 94 | 5 | 60-135/13 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 261 | 104 | 250 | 249 | 100 | 5 | 62-126/13 |
| 127-18-4 | Tetrachloroethene | 2.4 | J | 250 | 242 | 96 | 250 | 231 | 91 | 5 | 48-145/15 |
| 108-88-3 | Toluene | ND | | 250 | 263 | 105 | 250 | 253 | 101 | 4 | 44-141/14 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 234 | 94 | 250 | 227 | 91 | 3 | 54-137/14 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 235 | 94 | 250 | 227 | 91 | 3 | 59-135/13 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 258 | 103 | 250 | 258 | 103 | 0 | 55-149/18 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 254 | 102 | 250 | 243 | 97 | 4 | 70-127/12 |
| 79-01-6 | Trichloroethene | ND | | 250 | 250 | 100 | 250 | 241 | 96 | 4 | 53-141/15 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 261 | 104 | 250 | 282 | 113 | 8 | 35-169/23 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 232 | 93 | 250 | 254 | 102 | 9 | 34-151/20 |
| | m,p-Xylene | ND | | 500 | 522 | 104 | 500 | 497 | 99 | 5 | 32-146/13 |
| 95-47-6 | o-Xylene | ND | | 250 | 259 | 104 | 250 | 249 | 100 | 4 | 46-141/12 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 781 | 104 | 750 | 746 | 99 | 5 | 36-144/13 |

| CAS No. | Surrogate Recoveries | MS | MSD | JC19462-6 | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 104% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 102% | 102% | 103% | 64-135% |
| 2037-26-5 | Toluene-D8 | 102% | 103% | 101% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 107% | 106% | 101% | 72-122% |

* = Outside of Control Limits.

# Leachate Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97188-LS5 | 3B126571.D | 200 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |
| JC18959-1A | 3B126570.D | 200 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |
| JC18959-1A | 3B126573.D | 2000 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | JC18959-1A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 10000 | 16300 | 163* [a] | 44-157 |
| 71-43-2 | Benzene | 92900 [c] | | 10000 | 115000 | 221* [b] | 38-139 |
| 74-97-5 | Bromochloromethane | ND | | 10000 | 9940 | 99 | 70-129 |
| 75-27-4 | Bromodichloromethane | ND | | 10000 | 10200 | 102 | 70-135 |
| 75-25-2 | Bromoform | ND | | 10000 | 9410 | 94 | 53-139 |
| 74-83-9 | Bromomethane | ND | | 10000 | 8040 | 80 | 44-150 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 10000 | 12200 | 122 | 58-140 |
| 75-15-0 | Carbon disulfide | ND | | 10000 | 5610 | 56 | 34-136 |
| 56-23-5 | Carbon tetrachloride | ND | | 10000 | 8220 | 82 | 50-161 |
| 108-90-7 | Chlorobenzene | ND | | 10000 | 9540 | 95 | 65-128 |
| 75-00-3 | Chloroethane | ND | | 10000 | 8540 | 85 | 41-151 |
| 67-66-3 | Chloroform | ND | | 10000 | 10400 | 104 | 66-132 |
| 74-87-3 | Chloromethane | ND | | 10000 | 6940 | 69 | 35-149 |
| 110-82-7 | Cyclohexane | ND | | 10000 | 8280 | 83 | 29-158 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 10000 | 9390 | 94 | 58-141 |
| 124-48-1 | Dibromochloromethane | ND | | 10000 | 9490 | 95 | 67-134 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 10000 | 9620 | 96 | 69-130 |
| 95-50-1 | 1,2-Dichlorobenzene | 1390 | | 10000 | 11400 | 100 | 65-128 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 10000 | 9860 | 99 | 63-128 |
| 106-46-7 | 1,4-Dichlorobenzene | 117 | J | 10000 | 9500 | 94 | 63-126 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 10000 | 6790 | 68 | 24-170 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 10000 | 9670 | 97 | 59-132 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 10000 | 11800 | 118 | 59-153 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 10000 | 7140 | 71 | 41-144 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 10000 | 8830 | 88 | 57-131 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 10000 | 7370 | 74 | 55-131 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 10000 | 9540 | 95 | 67-125 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 10000 | 10600 | 106 | 68-126 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 10000 | 10400 | 104 | 68-134 |
| 100-41-4 | Ethylbenzene | 251 | | 10000 | 9860 | 96 | 37-143 |
| 76-13-1 | Freon 113 | ND | | 10000 | 10800 | 108 | 33-159 |
| 591-78-6 | 2-Hexanone | ND | | 10000 | 11500 | 115 | 53-145 |
| 98-82-8 | Isopropylbenzene | 275 | | 10000 | 10100 | 98 | 48-141 |
| 79-20-9 | Methyl Acetate | ND | | 10000 | 9800 | 98 | 46-147 |
| 108-87-2 | Methylcyclohexane | ND | | 10000 | 9220 | 92 | 36-156 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 20000 | 19800 | 99 | 53-139 |

* = Outside of Control Limits.

# Leachate Spike Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97188-LS5 | 3B126571.D | 200 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |
| JC18959-1A | 3B126570.D | 200 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |
| JC18959-1A | 3B126573.D | 2000 | 05/04/16 | HA | 04/25/16 | GP97188 | V3B5670 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1A

| CAS No. | Compound | JC18959-1A ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 10000 | 10600 | 106 | 57-141 |
| 75-09-2 | Methylene chloride | ND | | 10000 | 9500 | 95 | 59-129 |
| 91-20-3 | Naphthalene | 3320 | | 10000 | 12900 | 96 | 34-156 |
| 100-42-5 | Styrene | ND | | 10000 | 9480 | 95 | 60-135 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 10000 | 10400 | 104 | 62-126 |
| 127-18-4 | Tetrachloroethene | ND | | 10000 | 8780 | 88 | 48-145 |
| 108-88-3 | Toluene | 22800 | | 10000 | 32200 | 94 | 44-141 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 10000 | 9040 | 90 | 54-137 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 10000 | 8930 | 89 | 59-135 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 10000 | 9210 | 92 | 55-149 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 10000 | 10100 | 101 | 70-127 |
| 79-01-6 | Trichloroethene | ND | | 10000 | 9070 | 91 | 53-141 |
| 75-69-4 | Trichlorofluoromethane | ND | | 10000 | 8920 | 89 | 35-169 |
| 75-01-4 | Vinyl chloride | ND | | 10000 | 7170 | 72 | 34-151 |
| | m,p-Xylene | 2180 | | 20000 | 21700 | 98 | 32-146 |
| 95-47-6 | o-Xylene | 712 | | 10000 | 10600 | 99 | 46-141 |
| 1330-20-7 | Xylene (total) | 2890 | | 30000 | 32200 | 98 | 36-144 |

| CAS No. | Surrogate Recoveries | LS | JC18959-1A | JC18959-1A | Limits |
|---|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 103% | 103% | 103% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 103% | 100% | 100% | 64-135% |
| 2037-26-5 | Toluene-D8 | 103% | 102% | 100% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 106% | 103% | 102% | 72-122% |

(a) Outside control limits due to matrix interference.
(b) Outside control limits due to high level in sample relative to spike amount.
(c) Result is from Run #2.

* = Outside of Control Limits.

# Leachate Spike Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97219-LS8 | 3B126344A.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |
| JC18431-1 | 3B126343.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |



**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | JC18431-1 ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 67-64-1 | Acetone | ND | | 250 | 255 | 102 | 44-157 |
| 71-43-2 | Benzene | ND | | 250 | 242 | 97 | 38-139 |
| 74-97-5 | Bromochloromethane | ND | | 250 | 238 | 95 | 70-129 |
| 75-27-4 | Bromodichloromethane | ND | | 250 | 253 | 101 | 70-135 |
| 75-25-2 | Bromoform | ND | | 250 | 250 | 100 | 53-139 |
| 74-83-9 | Bromomethane | ND | | 250 | 196 | 78 | 44-150 |
| 78-93-3 | 2-Butanone (MEK) | ND | | 250 | 249 | 100 | 58-140 |
| 75-15-0 | Carbon disulfide | ND | | 250 | 227 | 91 | 34-136 |
| 56-23-5 | Carbon tetrachloride | ND | | 250 | 242 | 97 | 50-161 |
| 108-90-7 | Chlorobenzene | ND | | 250 | 241 | 96 | 65-128 |
| 75-00-3 | Chloroethane | ND | | 250 | 194 | 78 | 41-151 |
| 67-66-3 | Chloroform | ND | | 250 | 251 | 100 | 66-132 |
| 74-87-3 | Chloromethane | ND | | 250 | 162 | 65 | 35-149 |
| 110-82-7 | Cyclohexane | ND | | 250 | 238 | 95 | 29-158 |
| 96-12-8 | 1,2-Dibromo-3-chloropropane | ND | | 250 | 235 | 94 | 58-141 |
| 124-48-1 | Dibromochloromethane | ND | | 250 | 243 | 97 | 67-134 |
| 106-93-4 | 1,2-Dibromoethane | ND | | 250 | 240 | 96 | 69-130 |
| 95-50-1 | 1,2-Dichlorobenzene | ND | | 250 | 246 | 98 | 65-128 |
| 541-73-1 | 1,3-Dichlorobenzene | ND | | 250 | 244 | 98 | 63-128 |
| 106-46-7 | 1,4-Dichlorobenzene | ND | | 250 | 234 | 94 | 63-126 |
| 75-71-8 | Dichlorodifluoromethane | ND | | 250 | 194 | 78 | 24-170 |
| 75-34-3 | 1,1-Dichloroethane | ND | | 250 | 244 | 98 | 59-132 |
| 107-06-2 | 1,2-Dichloroethane | ND | | 250 | 246 | 98 | 59-153 |
| 75-35-4 | 1,1-Dichloroethene | ND | | 250 | 236 | 94 | 41-144 |
| 156-59-2 | cis-1,2-Dichloroethene | ND | | 250 | 211 | 84 | 57-131 |
| 156-60-5 | trans-1,2-Dichloroethene | ND | | 250 | 203 | 81 | 55-131 |
| 78-87-5 | 1,2-Dichloropropane | ND | | 250 | 232 | 93 | 67-125 |
| 10061-01-5 | cis-1,3-Dichloropropene | ND | | 250 | 255 | 102 | 68-126 |
| 10061-02-6 | trans-1,3-Dichloropropene | ND | | 250 | 249 | 100 | 68-134 |
| 100-41-4 | Ethylbenzene | ND | | 250 | 247 | 99 | 37-143 |
| 76-13-1 | Freon 113 | ND | | 250 | 284 | 114 | 33-159 |
| 591-78-6 | 2-Hexanone | ND | | 250 | 240 | 96 | 53-145 |
| 98-82-8 | Isopropylbenzene | ND | | 250 | 243 | 97 | 48-141 |
| 79-20-9 | Methyl Acetate | ND | | 250 | 240 | 96 | 46-147 |
| 108-87-2 | Methylcyclohexane | ND | | 250 | 235 | 94 | 36-156 |
| 1634-04-4 | Methyl Tert Butyl Ether | ND | | 500 | 469 | 94 | 53-139 |

* = Outside of Control Limits.

# Leachate Spike Summary

**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

| Sample | File ID | DF | Analyzed | By | Prep Date | Prep Batch | Analytical Batch |
|---|---|---|---|---|---|---|---|
| GP97219-LS8 | 3B126344A.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |
| JC18431-1 | 3B126343.D | 5 | 04/27/16 | HA | 04/26/16 | GP97219 | V3B5662 |

**The QC reported here applies to the following samples:** **Method:** SW846 8260C

JC18959-1

| CAS No. | Compound | JC18431-1 ug/l | Q | Spike ug/l | LS ug/l | LS % | Limits |
|---|---|---|---|---|---|---|---|
| 108-10-1 | 4-Methyl-2-pentanone(MIBK) | ND | | 250 | 249 | 100 | 57-141 |
| 75-09-2 | Methylene chloride | ND | | 250 | 231 | 92 | 59-129 |
| 91-20-3 | Naphthalene | ND | | 250 | 222 | 89 | 34-156 |
| 100-42-5 | Styrene | ND | | 250 | 237 | 95 | 60-135 |
| 79-34-5 | 1,1,2,2-Tetrachloroethane | ND | | 250 | 236 | 94 | 62-126 |
| 127-18-4 | Tetrachloroethene | ND | | 250 | 249 | 100 | 48-145 |
| 108-88-3 | Toluene | ND | | 250 | 246 | 98 | 44-141 |
| 87-61-6 | 1,2,3-Trichlorobenzene | ND | | 250 | 226 | 90 | 54-137 |
| 120-82-1 | 1,2,4-Trichlorobenzene | ND | | 250 | 224 | 90 | 59-135 |
| 71-55-6 | 1,1,1-Trichloroethane | ND | | 250 | 245 | 98 | 55-149 |
| 79-00-5 | 1,1,2-Trichloroethane | ND | | 250 | 239 | 96 | 70-127 |
| 79-01-6 | Trichloroethene | ND | | 250 | 242 | 97 | 53-141 |
| 75-69-4 | Trichlorofluoromethane | ND | | 250 | 222 | 89 | 35-169 |
| 75-01-4 | Vinyl chloride | ND | | 250 | 180 | 72 | 34-151 |
| | m,p-Xylene | ND | | 500 | 497 | 99 | 32-146 |
| 95-47-6 | o-Xylene | ND | | 250 | 249 | 100 | 46-141 |
| 1330-20-7 | Xylene (total) | ND | | 750 | 747 | 100 | 36-144 |

| CAS No. | Surrogate Recoveries | LS | JC18431-1 | Limits |
|---|---|---|---|---|
| 1868-53-7 | Dibromofluoromethane | 100% | 99% | 76-120% |
| 17060-07-0 | 1,2-Dichloroethane-D4 | 101% | 99% | 64-135% |
| 2037-26-5 | Toluene-D8 | 100% | 98% | 76-117% |
| 460-00-4 | 4-Bromofluorobenzene | 101% | 97% | 72-122% |

* = Outside of Control Limits.

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5652-BFB
**Lab File ID:** 3B126034.D
**Instrument ID:** GCMS3B
**Injection Date:** 04/18/16
**Injection Time:** 12:23

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 15122 | 16.7 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 40907 | 45.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 90339 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5916 | 6.55 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 83792 | 92.8 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 6199 | 6.86 | (7.40) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 82112 | 90.9 | (98.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5914 | 6.55 | (7.20) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5652-IC5652 | 3B126035.D | 04/18/16 | 12:54 | 00:31 | Initial cal 0.2 |
| V3B5652-IC5652 | 3B126036.D | 04/18/16 | 13:24 | 01:01 | Initial cal 0.5 |
| V3B5652-IC5652 | 3B126039.D | 04/18/16 | 14:55 | 02:32 | Initial cal 5 |
| V3B5652-IC5652 | 3B126040.D | 04/18/16 | 15:26 | 03:03 | Initial cal 10 |
| V3B5652-IC5652 | 3B126041.D | 04/18/16 | 15:56 | 03:33 | Initial cal 20 |
| V3B5652-ICC5652 | 3B126042.D | 04/18/16 | 16:27 | 04:04 | Initial cal 50 |
| V3B5652-IC5652 | 3B126043.D | 04/18/16 | 16:57 | 04:34 | Initial cal 100 |
| V3B5652-IC5652 | 3B126044.D | 04/18/16 | 17:27 | 05:04 | Initial cal 200 |
| V3B5652-IC5652 | 3B126048.D | 04/18/16 | 19:28 | 07:05 | Initial cal 1 |
| V3B5652-IC5652 | 3B126049.D | 04/18/16 | 19:59 | 07:36 | Initial cal 2 |
| V3B5652-ICV5652 | 3B126050.D | 04/18/16 | 20:29 | 08:06 | Initial cal verification 50 |

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5662-BFB
**Lab File ID:** 3B126330.D
**Instrument ID:** GCMS3B
**Injection Date:** 04/27/16
**Injection Time:** 08:07

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 13127 | 17.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 35277 | 45.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 77061 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5249 | 6.81 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 75787 | 98.3 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5467 | 7.09 | (7.21) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 73509 | 95.4 | (97.0) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5014 | 6.51 | (6.82) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5662-CC5652 | 3B126332.D | 04/27/16 | 09:40 | 01:33 | Continuing cal 20 |
| V3B5662-MB | 3B126334.D | 04/27/16 | 10:47 | 02:40 | Method Blank |
| V3B5662-BS | 3B126335.D | 04/27/16 | 11:27 | 03:20 | Blank Spike |
| GP97219-LB8 | 3B126337.D | 04/27/16 | 12:34 | 04:27 | Leachate Blank |
| ZZZZZZ | 3B126338.D | 04/27/16 | 13:04 | 04:57 | (unrelated sample) |
| ZZZZZZ | 3B126339.D | 04/27/16 | 13:35 | 05:28 | (unrelated sample) |
| ZZZZZZ | 3B126340.D | 04/27/16 | 14:05 | 05:58 | (unrelated sample) |
| ZZZZZZ | 3B126341.D | 04/27/16 | 14:35 | 06:28 | (unrelated sample) |
| ZZZZZZ | 3B126342.D | 04/27/16 | 15:05 | 06:58 | (unrelated sample) |
| JC18431-1 | 3B126343.D | 04/27/16 | 15:35 | 07:28 | (used for QC only; not part of job JC18959) |
| GP97219-LS8 | 3B126344A.D | 04/27/16 | 16:10 | 08:03 | Leachate Spike |
| JC18431-1MS | 3B126344.D | 04/27/16 | 16:10 | 08:03 | Matrix Spike |
| JC18431-1MSD | 3B126345.D | 04/27/16 | 16:40 | 08:33 | Matrix Spike Duplicate |
| GP97132-LB20 | 3B126347.D | 04/27/16 | 17:41 | 09:34 | Leachate Blank |
| ZZZZZZ | 3B126348.D | 04/27/16 | 18:11 | 10:04 | (unrelated sample) |
| ZZZZZZ | 3B126349.D | 04/27/16 | 18:41 | 10:34 | (unrelated sample) |
| ZZZZZZ | 3B126350.D | 04/27/16 | 19:11 | 11:04 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5662-BFB2
**Lab File ID:** 3B126352.D
**Instrument ID:** GCMS3B
**Injection Date:** 04/27/16
**Injection Time:** 20:12

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 13971 | 17.4 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 36357 | 45.3 | | Pass |
| 95 | Base peak, 100% relative abundance | 80333 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 5545 | 6.90 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 77171 | 96.1 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 5546 | 6.90 | (7.19) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 75789 | 94.3 | (98.2) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 5132 | 6.39 | (6.77) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5662-CC5652 | 3B126353.D | 04/27/16 | 20:42 | 00:30 | Continuing cal 50 |
| V3B5662-MB2 | 3B126355.D | 04/27/16 | 21:42 | 01:30 | Method Blank |
| ZZZZZZ | 3B126356.D | 04/27/16 | 22:13 | 02:01 | (unrelated sample) |
| JC18959-1 | 3B126358.D | 04/27/16 | 23:13 | 03:01 | SI-06-90-ISS |

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5663-BFB
**Lab File ID:** 3B126362.D
**Instrument ID:** GCMS3B
**Injection Date:** 04/28/16
**Injection Time:** 08:21

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 12287 | 17.4 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 31547 | 44.7 | | Pass |
| 95 | Base peak, 100% relative abundance | 70539 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 4517 | 6.40 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 67928 | 96.3 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 4974 | 7.05 | (7.32) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 65963 | 93.5 | (97.1) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 4408 | 6.25 | (6.68) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5663-CC5652 | 3B126363.D | 04/28/16 | 08:57 | 00:36 | Continuing cal 20 |
| V3B5663-MB | 3B126365.D | 04/28/16 | 10:07 | 01:46 | Method Blank |
| V3B5663-BS | 3B126366.D | 04/28/16 | 10:44 | 02:23 | Blank Spike |
| GP97249-LB10 | 3B126368.D | 04/28/16 | 11:52 | 03:31 | Leachate Blank |
| ZZZZZZ | 3B126369.D | 04/28/16 | 12:22 | 04:01 | (unrelated sample) |
| ZZZZZZ | 3B126370.D | 04/28/16 | 12:52 | 04:31 | (unrelated sample) |
| ZZZZZZ | 3B126371.D | 04/28/16 | 13:22 | 05:01 | (unrelated sample) |
| ZZZZZZ | 3B126372.D | 04/28/16 | 13:52 | 05:31 | (unrelated sample) |
| JC18437-12A | 3B126373.D | 04/28/16 | 14:28 | 06:07 | (used for QC only; not part of job JC18959) |
| JC18959-1 | 3B126374.D | 04/28/16 | 14:59 | 06:38 | SI-06-90-ISS |
| GP97249-LS12 | 3B126375A.D | 04/28/16 | 15:29 | 07:08 | Leachate Spike |
| JC18437-12AMS | 3B126375.D | 04/28/16 | 15:29 | 07:08 | Matrix Spike |
| JC18437-12AMSD | 3B126376.D | 04/28/16 | 15:59 | 07:38 | Matrix Spike Duplicate |
| ZZZZZZ | 3B126378.D | 04/28/16 | 16:59 | 08:38 | (unrelated sample) |
| ZZZZZZ | 3B126379.D | 04/28/16 | 17:29 | 09:08 | (unrelated sample) |
| ZZZZZZ | 3B126380.D | 04/28/16 | 17:59 | 09:38 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5668-BFB
**Lab File ID:** 3B126517.D
**Instrument ID:** GCMS3B
**Injection Date:** 05/03/16
**Injection Time:** 10:44

| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 18059 | 16.0 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 49469 | 43.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 112923 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 7244 | 6.41 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 105565 | 93.5 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7724 | 6.84 | (7.32) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 101957 | 90.3 | (96.6) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 7202 | 6.38 | (7.06) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5668-CC5652 | 3B126518.D | 05/03/16 | 11:16 | 00:32 | Continuing cal 20 |
| V3B5668-MB | 3B126520.D | 05/03/16 | 12:22 | 01:38 | Method Blank |
| V3B5668-BS | 3B126521.D | 05/03/16 | 13:02 | 02:18 | Blank Spike |
| ZZZZZZ | 3B126527.D | 05/03/16 | 16:05 | 05:21 | (unrelated sample) |
| ZZZZZZ | 3B126528.D | 05/03/16 | 16:38 | 05:54 | (unrelated sample) |
| JC19379-11A | 3B126529.D | 05/03/16 | 17:08 | 06:24 | (used for QC only; not part of job JC18959) |
| JC19379-11AMS | 3B126530.D | 05/03/16 | 17:38 | 06:54 | Matrix Spike |
| JC19379-11AMSD | 3B126531.D | 05/03/16 | 18:09 | 07:25 | Matrix Spike Duplicate |
| GP97188-LB5 | 3B126533.D | 05/03/16 | 19:09 | 08:25 | Leachate Blank |
| ZZZZZZ | 3B126539.D | 05/03/16 | 22:11 | 11:27 | (unrelated sample) |
| ZZZZZZ | 3B126556.D | 05/04/16 | 06:43 | 19:59 | (unrelated sample) |
| ZZZZZZ | 3B126557.D | 05/04/16 | 07:14 | 20:30 | (unrelated sample) |

# Instrument Performance Check (BFB)



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Sample:** V3B5670-BFB
**Lab File ID:** 3B126563.D
**Instrument ID:** GCMS3B
**Injection Date:** 05/04/16
**Injection Time:** 11:13



| m/e | Ion Abundance Criteria | Raw Abundance | % Relative Abundance | | Pass/Fail |
|---|---|---|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 19077 | 16.7 | | Pass |
| 75 | 30.0 - 60.0% of mass 95 | 51181 | 44.8 | | Pass |
| 95 | Base peak, 100% relative abundance | 114344 | 100.0 | | Pass |
| 96 | 5.0 - 9.0% of mass 95 | 7815 | 6.83 | | Pass |
| 173 | Less than 2.0% of mass 174 | 0 | 0.00 | (0.00) [a] | Pass |
| 174 | 50.0 - 120.0% of mass 95 | 101363 | 88.6 | | Pass |
| 175 | 5.0 - 9.0% of mass 174 | 7744 | 6.77 | (7.64) [a] | Pass |
| 176 | 95.0 - 101.0% of mass 174 | 101008 | 88.3 | (99.6) [a] | Pass |
| 177 | 5.0 - 9.0% of mass 176 | 6556 | 5.73 | (6.49) [b] | Pass |

(a) Value is % of mass 174
(b) Value is % of mass 176

**This check applies to the following Samples, MS, MSD, Blanks, and Standards:**

| Lab Sample ID | Lab File ID | Date Analyzed | Time Analyzed | Hours Lapsed | Client Sample ID |
|---|---|---|---|---|---|
| V3B5670-CC5652 | 3B126565.D | 05/04/16 | 12:18 | 01:05 | Continuing cal 20 |
| V3B5670-MB | 3B126567.D | 05/04/16 | 13:18 | 02:05 | Method Blank |
| V3B5670-BS | 3B126568.D | 05/04/16 | 13:54 | 02:41 | Blank Spike |
| JC18959-1A | 3B126570.D | 05/04/16 | 15:01 | 03:48 | SI-06-90-ISS |
| GP97188-LS5 | 3B126571.D | 05/04/16 | 15:45 | 04:32 | Leachate Spike |
| JC18959-1A | 3B126573.D | 05/04/16 | 16:45 | 05:32 | SI-06-90-ISS |
| GP97378-LB21 | 3B126575.D | 05/04/16 | 17:46 | 06:33 | Leachate Blank |
| JC19462-6 | 3B126576.D | 05/04/16 | 18:17 | 07:04 | (used for QC only; not part of job JC18959) |
| JC19462-6MS | 3B126577.D | 05/04/16 | 18:46 | 07:33 | Matrix Spike |
| JC19462-6MSD | 3B126578.D | 05/04/16 | 19:16 | 08:03 | Matrix Spike Duplicate |
| ZZZZZZ | 3B126580.D | 05/04/16 | 20:17 | 09:04 | (unrelated sample) |
| ZZZZZZ | 3B126581.D | 05/04/16 | 20:46 | 09:33 | (unrelated sample) |
| ZZZZZZ | 3B126582.D | 05/04/16 | 21:17 | 10:04 | (unrelated sample) |
| ZZZZZZ | 3B126583.D | 05/04/16 | 21:47 | 10:34 | (unrelated sample) |
| ZZZZZZ | 3B126584.D | 05/04/16 | 22:17 | 11:04 | (unrelated sample) |

# Volatile Surrogate Recovery Summary



**Job Number:** JC18959
**Account:** CMHLLPAP CH2M Hill
**Project:** OU8 AmCy Thermally Enhanced ISS Bench Study, 20 Polhemus Lane, Bridgewater, NJ

**Method:** SW846 8260C **Matrix:** LEACHATE

**Samples and QC shown here apply to the above method**

| Lab Sample ID | Lab File ID | S1 | S2 | S3 | S4 |
|---|---|---|---|---|---|
| JC18959-1 | 3B126374.D | 102 | 102 | 97 | 97 |
| JC18959-1 | 3B126358.D | 102 | 105 | 98 | 101 |
| JC18959-1A | 3B126570.D | 103 | 100 | 102 | 103 |
| JC18959-1A | 3B126573.D | 103 | 100 | 100 | 102 |
| GP97188-LB5 | 3B126533.D | 102 | 100 | 100 | 102 |
| GP97188-LS5 | 3B126571.D | 103 | 103 | 103 | 106 |
| GP97219-LB8 | 3B126337.D | 98 | 98 | 97 | 97 |
| GP97219-LS8 | 3B126344A.D | 100 | 101 | 100 | 101 |
| JC18431-1MS | 3B126344.D | 100 | 101 | 100 | 101 |
| JC18431-1MSD | 3B126345.D | 100 | 100 | 100 | 101 |
| JC18437-12AMS | 3B126375.D | 101 | 101 | 100 | 101 |
| JC18437-12AMSD | 3B126376.D | 102 | 101 | 100 | 101 |
| JC19462-6MS | 3B126577.D | 103 | 102 | 102 | 107 |
| JC19462-6MSD | 3B126578.D | 104 | 102 | 103 | 106 |
| V3B5662-BS | 3B126335.D | 99 | 97 | 100 | 99 |
| V3B5662-MB2 | 3B126355.D | 100 | 99 | 97 | 97 |
| V3B5663-BS | 3B126366.D | 99 | 99 | 99 | 100 |
| V3B5663-MB | 3B126365.D | 98 | 99 | 98 | 98 |
| V3B5670-BS | 3B126568.D | 103 | 101 | 102 | 106 |
| V3B5670-MB | 3B126567.D | 103 | 102 | 100 | 102 |
| V3B5662-MB | 3B126334.D | 98 | 98 | 99 | 97 |
| V3B5668-MB | 3B126520.D | 101 | 98 | 100 | 101 |

| Surrogate Compounds | Recovery Limits |
|---|---|
| **S1** = Dibromofluoromethane | 76-120% |
| **S2** = 1,2-Dichloroethane-D4 | 64-135% |
| **S3** = Toluene-D8 | 76-117% |
| **S4** = 4-Bromofluorobenzene | 72-122% |

# Appendix E3
# 2016 Dewatering Bench Study

# Mechanical Dewatering Bench-Scale Testing Report

| | |
|---|---|
| **PREPARED FOR:** | Mark Austin, U.S. Environmental Protection Agency<br>Ed Barth, U.S. Environmental Protection Agency |
| **COPY TO:** | Russ Downey, Pfizer Inc.<br>Vince D'Aco, Quantum Management Group, Inc. |
| **PREPARED BY:** | O'Brien & Gere Engineers, Inc. |
| **DATE:** | May 31, 2016 |

## BACKGROUND

As part of the focused feasibility study (FFS) for Operable Unit 8 (OU8) (i.e. Impoundments 1 and 2) at the American Cyanamid Superfund Site in Bridgewater, New Jersey (Site), a bench-scale study was performed on behalf of Wyeth Holdings LLC between January 2016 and March 2016 to evaluate the feasibility of mechanical dewatering to prepare impoundment materials for off-site beneficial reuse or thermal treatment at a cement kiln or incinerator. The bench-scale study was completed in accordance with the *Mechanical Dewatering Bench-Scale Testing Work Plan* approved by the U.S. Environmental Protection Agency (USEPA) on January 13, 2016. Conditional approval from USEPA was given on December 10, 2015 related to sample collection.

The bench-scale testing was designed to provide information to support the development of a remedial alternative involving dewatering of the impoundment material to allow off-site beneficial reuse or thermal treatment. The objectives of the mechanical bench-scale dewatering trial were the following:

- Collect samples for mechanical dewatering bench-scale testing (summarized in this report)
- Collect samples for thermally enhanced in-situ stabilization (ISS) bench-scale testing (ISS bench-scale testing summarized in a separate report)
- Evaluate dewatering potential of impoundment material, including viscous rubbery (VR) and hard crumbly (HC) impoundment tar material
- Evaluate potential for shipment of dewatered material as a solid
- Evaluate options for off-site beneficial reuse or thermal treatment of the dewatered material

This memorandum summarizes the following:

- Sample Collection
- Dewatering and Material Handling Tests
  - » Screening Tests
  - » Dewatering for Outlets

- » Mixing and Material Handling Tests
- » Viscosity Tests

- Results and Conclusions
- Evaluation of Beneficial Reuse and Treatment Outlets

## SAMPLE COLLECTION

Sample collection was performed from January 4, 2016 to January 8, 2016. Aqua Survey, Inc. (ASI) was subcontracted to support sample collection. ASI had previously conducted similar sample collection activities on Impoundments 1 and 2 in 2010 and again in 2012. ASI deployed a sampling platform vessel with an A-frame to Impoundment 2. ASI used a high powered electro-vibracoring unit with a 4-inch steel barrel and a polyethylene bag liner to collect the sediment cores.

ASI collected continuous samples to approximately 6 feet below the liner before refusal. Sample locations were recorded using a Global Positioning System (GPS). The sample location proposed in the Work Plan was modified because of low recoveries of VR material at that location. To recover a greater percentage of VR material, the vibracore was not pushed to refusal. Rather it was pushed a few feet and then re-inserted. Forty-one core samples were collected. Sample locations are shown on ***Figure 1***.

**Sample Collection**

A trailer was staged onsite for core processing as depicted on ***Figure 1***. Cores were brought to the core processing area and material was separated into three categories: primarily VR, primarily HC, and VR/HC mix (interface layer). Cores were logged prior to transferring to 5-gallon buckets, and core logs are included in ***Table 1***. Seventeen buckets of material were collected and transported to O'Brien & Gere's (OBG's) Applied Technology Development Laboratory, located in Liverpool, New York, to perform the bench-scale dewatering tests. The container log is provided as ***Table 2***.

Core samples collected on January 6 and January 7, 2016 were used in a thermally enhanced ISS bench-scale testing study (conducted by others). Approximately twenty gallons of material was collected, including two 5-gallon buckets of primarily VR material and two 5-gallon buckets of primarily HC material. There was additional VR/HC mix (interface) material that was not needed for the thermally enhanced ISS bench-scale study, and this material was provided to OBG as noted in ***Table 2***.

Air monitoring was conducted on the vessel and at the core processing area with a photoionization detector (PID) and a hydrogen sulfide meter. Downwind air monitoring of the sample collection was completed in accordance with the Work Plan.

## DEWATERING AND MATERIAL HANDLING TESTS

Dewatering potential via mechanical shearing of the material from the 17 buckets was evaluated on the bench-scale. Testing was performed in OBG's Applied Technology Development Laboratory in Liverpool, New York. Mechanical shearing was evaluated by processing samples through a single-screw meat grinder with an extrusion plate and extrusion tube. The intent was to dewater VR, HC, and VR/HC mix (interface layer) material separately. In order to optimize dewatering and handling of raw VR and HC following initial screening, the two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materials were mixed at various ratios to evaluate changes in material handling and dewatering efficiency. Dewatering was evaluated by comparing moisture content of raw and dewatered samples, as analyzed by the Karl Fischer method as specified in the approved Work Plan.

The goals of the dewatering tests were to achieve dewatered material that passes paint filter test and with a moisture content less than 30%.

The dewatering and material handling tests included the following efforts:

- Screening Tests,
- Dewatering for Outlets,
- Mixing and Material Handling Tests,
- Viscosity Testing.

**Equipment for Bench-Scale Mechanical Dewatering Tests**

The test matrices are included as ***Table 3, Table 4*** and ***Table 5***. The test nomenclature includes the bucket that material was utilized from and the test number (e.g., HC1-Test1 used material from bucket HC1).

## SCREENING TESTS

Screening tests used 6 to 7 pounds (lbs) of material. To perform screening tests, the weight of raw material fed to the equipment was recorded. Raw material was fed to the equipment, and dewatered material from the discharge was collected and weighed. The dewatering equipment discharge included a stainless steel knife, extrusion plate, and 1-1/8" diameter extrusion tube. This configuration was noted as "D1". All dewatering tests utilized this discharge, except for initial screening of VR. During the first screening test of VR, three discharge configurations were used:

- D1 – Stainless steel knife, extrusion plate, 1-1/8" diameter extrusion tube.
- D2 – Stainless steel knife, 3/8" plate.
- D3 – Stainless steel knife, 3/16" plate.

The data indicated that the D1 discharge configuration resulted in the lowest moisture content, and the data from the D1 configuration is included in ***Table 3***.

The weight and volume of separated Aqueous Phase was recorded, and the weight of residual material defined as material that remains in the equipment following testing was recorded. With these weight data, and accounting for any samples collected during testing, a test recovery (e.g., mass balance) was calculated. Complete recovery would result in 100%. Recoveries from screening tests were generally >90%. Refer to ***Table 3*** for additional information. Moisture content of raw and dewatered material were evaluated for each test by SGS Accutest, located in Dayton, New Jersey, and these data are also presented in ***Table 3***.

Screening tests were performed using material at room temperature (62 degrees Fahrenheit [°F] to 67 °F) and refrigerated material (46 °F to 51 °F).


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## DEWATERING FOR OUTLETS

Once it was determined that dewatering the material was feasible, three potential outlets requested representative samples of material for evaluation to develop preliminary acceptance rates. Table 1-1 below summarizes the sample requests.

**Table 1-1. Summary of Sample Requests from Potential Outlets**

| Outlet Name | Location | Type | VR | HC | VR/HC Mix (Interface) |
|---|---|---|---|---|---|
| **Outlet 1** | Midwest US | Cement Kiln | 2 gallons (raw) | 2 gallons (dewatered) | 2 gallons (dewatered) |
| **Outlet 2** | Midwest US | Cement Kiln | 1 quart (raw) | 1 quart (dewatered) | 1 quart (dewatered) |
| **Outlet 3** | Midwest US | Incinerator | 2 gallons (raw) | 2 gallons (dewatered) | 2 gallons (dewatered) |

Each 2-gallon sample of dewatered material was generated as a single dewatering test. Similar to the Screening trials, weights of material fed and collected from the equipment were recorded to develop a test recovery percentage. Two raw and two dewatered samples were collected for moisture analysis from each as well as one dewatered sample analysis of flash point.

Raw VR material was provided to potential outlets. The moisture content of raw VR (<15%) suggests that VR may be shipped in the raw form, but may require some surface absorbents to manage potential free liquid.

Data collected from the dewatered material for Potential Outlet evaluation are included as ***Table 4***.

### Shaker Testing

Shaker testing was utilized to evaluate the release of free liquid. One gallon of dewatered material from each Dewatering for Outlets test was added to a paint can and shook (via a paint can shaker) for 5 minutes and 15 minutes. The presence of free liquid after 5 minutes and 15 minutes was recorded and defined as *Pass* or *Fail*, as noted on ***Table 4***.

### Paint Filter Testing

Paint filter testing was performed to confirm whether the dewatered material may be classified as a solid. Paint filter testing was performed by OBG utilizing dewatered material from each of the two-gallon buckets generated during the Dewatering for Outlets tests. Additionally, one sample from each two-gallon bucket was analyzed for moisture content by SGS Accutest.

**Paint Filter Testing**

## HC AND VR MIXING TESTS

The objective of the mixing tests were to evaluate if HC and VR could be mixed together or if they remain separate, and to determine the resulting properties of the mixes.

### Mixing of HC and VR and Evaluation of Properties

HC and VR material were mixed together by hand to evaluate how well the material mixed together and subsequent material handling properties. Three mixing tests were conducted at different mix ratios as indicated in the table below. The target weight of material in each test is also provided.


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**Table 1-2. Summary of HC and VR Mixing Tests**

| | HC | VR | HC (lbs) | VR (lbs) | HC/VR Test Mix (lbs) |
|---|---|---|---|---|---|
| **Test 1** | 50% | 50% | 12 | 12 | 24 |
| **Test 2** | 25% | 75% | 8 | 16 | 24 |
| **Test 3** | 75% | 25% | 16 | 8 | 24 |

Material was transferred from their 5-gallon raw sample buckets to plastic-lined 15 quart totes for weighing. Material from raw buckets HC4, HC5, VR3, and VR4 were used (refer to ***Table 2*** and ***Table 5***). Once weighed, material was combined to a single tote and mixed by hand for approximately 5 minutes. Material properties of the resulting mixes were evaluated as described below. The material properties of raw HC, raw VR, and raw VR/HC Mix (interface) material were also evaluated for comparison. The objective of the mix tests was to evaluate how similar mixes of VR and HC (Tests 1 – 3 above) compare to field-collected interface material and raw material.

Material property observations included:

- Compressibility – Material was squeezed by hand to observe the bulking quality of the material. The thumb penetration test (used for soil classification) was also utilized.
- Plasticity – A sample was molded into a ball and attempted to be rolled into threads as thin as 1/8-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. This procedure is used for soil classification (Atterberg limits test).
- Unconfined Compressive Strength – A pocket penetrometer was used to evaluate unconfined compressive strength. The penetrometer is a spring loaded device with a 1/4" diameter piston that is pushed a 1/4" into the material. For soft materials, a foot adapter is used that has a 1" diameter. The gauge is direct reading in tons per square foot or kilograms per square centimeter. Using the adapter foot requires the direct reading in tons per square foot (TSF) to be divided by 16 to account for the increased surface area.

**Pocket Penetrometer**

- Shear Strength – A pocket shear van tester was used to evaluate shear strength of cohesive solids. Readings can be made from 0 to 2.5 TSF.
- Granularity – Material was squeezed between thumb and index finger to evaluate granular size of the material.
- Tackiness – Visual observation of how well the material released from gloves and metal surfaces.

**Pocket Shear Vane Tester**

**Flowability and Tackiness**

Flowability was evaluated by allowing the material to sit overnight in a plastic-lined tote. The tote was tipped to an approximate 90 degree angle and the discharge of the material was recorded by video. This test was intended to simulate discharge of the material from a dump trailer. Following discharge of the material from the tote, the material was separated from the plastic to further evaluate tackiness as it relates to off-site handling. Visual observations were made during the separation process.

Raw HC, VR, and Interface material were evaluated for comparison, as well as the three dewatered Mix tests (Tests 1-3).



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### Viscosity

Viscosity testing was performed using a Brookfield Engineering Laboratories viscometer (model DV2THA). Testing was evaluated from approximately 32 °F to 100 °F in 10 °F increments. Viscosities for raw HC, raw VR, raw interface, and raw Mix Test 2 (25% HC/75% VR) were evaluated. The viscosity of dewatered Mixt Test 3 (75% HC/25% VR) was also evaluated.

Viscosity data are presented as ***Figure 2***.

### Dewatering of Mixed Material

Mixed material generated from the mixing tests (Tests 1-3) was dewatered in the same manner as the dewatering for outlet tests. Material from each mixing test (approximately 24 lbs) was dewatered as one dewatering test. Dewatered material was collected in a plastic-lined tote and then transferred to a 2.5 gallon bucket suitable for shipment to outlets if requested.

Raw and dewatered moisture content were evaluated twice for each test and is included in ***Table 3***.

## RESULTS AND CONCLUSIONS

HC, VR, and mixed material can be effectively dewatered via standard mechanical methods to produce a material suitable for offsite shipment and acceptance at offsite beneficial reuse or treatment outlets. Results are presented in ***Table 3***, ***Table 4*** and ***Table 5***. A discussion of the results and conclusions from the dewatering and material handling tests are presented below.

### HARD AND CRUMBLY (HC)

HC was successfully dewatered and the moisture content of the dewatered material ranged from 3.7% to 8.1%. The dewatered material passed paint filter. During dewatering, a 20°F to 30°F temperature rise was observed. The average aqueous phase removal was 23% of the starting weight of raw material. Raw HC material formed a monolithic block during storage in the sample bucket and was difficult to remove from the bucket. Removal required fracture of the material into smaller pieces by hand and with the use of a trowel. Raw HC crumbled when worked by hand and did not exhibit plasticity.

When refrigerated, raw HC exhibited a lower moisture content than raw HC at room temperature. The lower moisture content in refrigerated material is supported by the reduced amount of aqueous phase removed during dewatering. These data may indicate that raw HC at low temperatures has less propensity to retain free liquid. The viscosity of raw HC decreased with increasing temperature, and the effects of temperature on viscosity was greater below 60 °F.

### VISCOUS RUBBERY (VR)

VR was successfully dewatered and the moisture content of dewatered material ranged from 2% to 4%. The average aqueous phase removal was 3% of the starting weight. The mechanical clearances of the bench-scale equipment were not tight enough to continually force VR through the system and would frequently clog the meat grinder. However, the bench-scale dewatering equipment would continue to spin and there was no appreciable temperature rise in the material from dewatering. This indicates that the material behaved more like an oil.

Raw VR material resembled a heavy sludge, was tacky, and left a residue on plastic and metal surfaces. The moisture content of raw VR ranged from 7.2% to 14.3%, and is below the 15% target provided by some offsite outlets. Raw VR was provided to outlets for evaluation. Raw VR did not pass paint filter, however, the raw moisture content is low and it may be feasible to remove any free liquid with the use of absorbents. Additional evaluation of shipping raw VR with absorbents to manage free liquid may be required.


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Refrigerated raw VR was not dewatered. Viscosity testing indicated minimal change in viscosity between 32 °F and 100 °F.

### MIX MATERIAL

#### VR/HC Interface

Field collected VR/HC Mix or interface material was successfully dewatered and the moisture content of the dewatered material ranged from 2.2% to 11.6%. The dewatered material passed paint filter. During dewatering, a 10°F to 20°F temperature rise was observed. The average aqueous phase removal was 15% of the starting raw weight. Raw mix material generally exhibited properties similar to HC. The material was easier to remove from the bucket than HC.

When refrigerated, raw VR/HC interface material exhibited a lower moisture content than raw VR/HC interface material at room temperature. The lower moisture content in refrigerated material is supported by the reduced amount of aqueous phase removed during dewatering. These data may indicate that raw VR/HC interface material at low temperatures has less propensity to retain free liquid. The viscosity of raw VR/HC interface material (indicated as "MIX Raw" on ***Figure 2***) decreased with increasing temperature, and the effects of temperature on viscosity were generally linear.

#### VR and HC Mix Tests

VR and HC mixes (mixed in the laboratory) were observed to handle easier than either raw HC or raw VR. A percentage of HC greater than or equal to 50% (Mix Tests 1 and 3) reduced the temperature rise from dewatering, and improved the speed at which material was fed to the equipment. The mix ratio of 75%VR/25%HC (Mix Test 2) improved dewatering as compared to raw VR, but still resulted in periodic clogging of the machine. Dewatered material from each of the three mix tests passed paint filter.

The viscosity of raw mixed material (indicated as "MTest2 Raw" on ***Figure 2***) decreased with increasing temperature, and the effects of temperature on viscosity were generally linear. The viscosity of dewatered mix material (indicated as "MTest3 Dewatered" on ***Figure 2***) exhibited an exponential relationship to temperature with viscosity decreasing significantly with increasing temperature.

## EVALUATION OF TREATMENT AND DISPOSAL OUTLETS

Three outlets requested and received material for evaluation as noted above. Each outlet indicated that they could accept the material. Specific waste acceptance criteria, limitations, and material handling capabilities were obtained from each, and a summary is provided in the table below.

**Table 1-3. Summary of Waste Acceptance Criteria**

| Outlet Name | Type | Water Content | Heat Content | Sulfur Content |
|---|---|---|---|---|
| **Outlet 1** | Cement Kiln | <40% | >3,000 BTU | No Specified Limit (will affect feed rate) |
| **Outlet 2** | Cement Kiln | No Specified Limit (will affect feed rate) | >5,000 BTU | No Specified Limit (will affect feed rate) |
| **Outlet 3** | Incinerator | No Specified Limit | No Specified Limit (will affect feed rate) | <10% (or surcharges apply) |

In addition to water, heat, and sulfur content, the outlets have provided limits for heavy metals and debris content. Each outlet is currently permitted to receive waste under the Comprehensive Environmental Response,


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Compensation, and Liability Act (CERCLA). Each facility has also confirmed that their RCRA permit allows them to process materials carrying D018 (benzene), D027 (1,4-dichlorobenzene) and D036 (nitrobenzene) codes. Average acceptance rates range from 130 to 315 tons per week.

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# TABLES

# Table 1 - Sample Collection - Core Log

| Core No. | Date | Time | GPS Coordinates N | GPS Coordinates E | VR (Viscous Rubbery) | VR/HC Mix (Interface) | (Hard and Crumbly) |
|---|---|---|---|---|---|---|---|
| 1 | 1/4/16 | 1251 | 626612.8 | 2032370.1 | 0 to 1.5' | 1.5' to 3' | 3' to 3'10" |
| 2 | 1/4/16 | 1350 | 626631.2 | 2032358.2 | 0 to 1'1" | 1'1" to 2'5" | 2'5" to 4'7" |
| 3 | 1/4/16 | 1402 | 626628.8 | 2032358.4 | 0 to 1'6" | 1'6" to 2'6" | 2'6" to 4' |
| 4 | 1/4/16 | 1415 | 626624.3 | 2032357.9 | 0 to 9" | 9" to 2'2" | 2'2" to 4'10" |
| 5 | 1/5/16 | 0929 | 626627.7 | 2032360.3 | 0 to 1' | 1' to 3' | 3' to 4'7" |
| 6 | 1/5/16 | 1034 | 626622 | 2032368.3 | 0 to 9" | 9" to 1'10" | 1'10" to 3'4" |
| 7 | 1/5/16 | 1124 | 626622.5 | 2032364.6 | 0 to 1" | 1" to 1'10" | 1'10" to 3'10" |
| 8 | 1/5/16 | 1140 | 626628.8 | 2032366 | 0 to 1'2" | 1'2" to 2'1" | 2'1" to 3'7" |
| 9 | 1/5/16 | 1203 | 626626.5 | 2032360 | 0 to 9" | 9" to 2'2" | 2'2" to 3'9" |
| 10 | 1/5/16 | 1343 | 626629.3 | 2032361.6 | 0 to 9" | 9" to 2'11" | 2'11" to 4' |
| 11 | 1/5/16 | 1404 | 626626.5 | 2032365.1 | 0 to 1' | 1' to 2' | 2' to 4' |
| 12 | 1/5/16 | 1427 | 626630 | 2032364.1 | 0 to 1' | 1' to 2' | 2' to 4' |
| 13 | 1/5/16 | 1444 | 626627.8 | 2032359.4 | 0 to 9" | 9" to 2' | 2' to 3'10" |
| 14 | 1/5/16 | 1455 | 626627.5 | 2032353.2 | 0 to 10" | 10" to 1'6" | 1'6" to 4' |
| 15 | 1/6/16 | 1002 | 626749.5 | 2032406 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 16 | 1/6/16 | 1021 | 626746.8 | 2032407 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 17 | 1/6/16 | 1049 | 626751.3 | 2032402.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 18 | 1/6/16 | 1107 | 626755.3 | 2032407.3 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 19 | 1/6/16 | 1122 | 626754.3 | 2032403.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 20 | 1/6/16 | 1332 | 626706.7 | 2032516 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 21 | 1/6/16 | 1351 | 626725.7 | 2032476.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 22 | 1/6/16 | 1444 | 626752.2 | 2032405.6 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 23 | 1/6/16 | 1512 | 626753.9 | 2032399.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 24 | 1/7/16 | 1014 | 626678.4 | 2032554.2 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 25 | 1/7/16 | 1029 | 626678.4 | 2032554.2 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 26 | 1/7/16 | 1051 | 626673.4 | 2032560.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 27 | 1/7/16 | 1106 | 626673.4 | 2032560.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 28 | 1/7/16 | 1315 | 626676 | 2032558.5 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 29 | 1/7/16 | 1332 | 626678.2 | 2032558.1 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |

# Table 1 - Sample Collection - Core Log

| Core No. | Date | Time | GPS Coordinates N | GPS Coordinates E | VR (Viscous Rubbery) | VR/HC Mix (Interface) | (Hard and Crumbly) |
|---|---|---|---|---|---|---|---|
| 30 | 1/7/16 | 1338 | 626677.2 | 2032556 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 31 | 1/7/16 | 1353 | 626677.2 | 2032556 | Core provided for Thermally Enhanced ISS Bench-Scale Testing | | |
| 32 | 1/7/16 | 1448 | 626671.6 | 2032558.3 | 0 to 1'3"<br>1'10" to 2'6"<br>3' to 3'6"<br>4' to 5'6" | 1'3" to 1'10"<br>2'6" to 3' | 3'6" to 4' |
| 33 | 1/7/16 | 1505 | 626673.3 | 2032558.2 | 0 to 1'<br>1'6" to 2'<br>2'6" to 3'<br>3'6" to 3'9"<br>4'6" to 5'<br>5'9" to 7' | 1' to 1'6"<br>2' to 2'6"<br>3' to 3'6"<br>5'3" to 5'6" | 3'9" to 4'6"<br>5'6" to 5'9" |
| 34 | 1/8/16 | 0852 | 626674.1 | 2032554.8 | 0 to 4'6"<br>(Some interface mixed in) | 5' to 5'6" | 4'6" to 5' |
| 35 | 1/8/16 | 0909 | 626674.6 | 2032557.3 | 0 to 1'<br>1'6" to 2'3"<br>3' to 3'9" | 1' to 1'6"<br>2'3" to 2'6" | 2'6" to 3'<br>4' to 5'6" |
| 36 | 1/8/16 | 0925 | 626674.7 | 2032553.3 | 0 to 1' | 1' to 3'6" | 3'6" to 5' |
| 37 | 1/8/16 | 0941 | 626675.4 | 2032554.5 | 0 to 1'<br>2' to 2'4"<br>2'9" to 4'6" | 1' to 2'<br>2'4" to 2'9"<br>4'6" to 5'6" | |
| 38 | 1/8/16 | 1151 | 626675.9 | 2032557.4 | 0 to 1'<br>1'6" to 2'6"<br>3' to 3'6"<br>4'6" to 5' | 3'6" to 4'6"<br>5' to 5'3" | 1' to 1'6"<br>2'6" to 3' |

# Table 1 - Sample Collection - Core Log

| Core No. | Date | Time | GPS Coordinates N | GPS Coordinates E | VR (Viscous Rubbery) | VR/HC Mix (Interface) | (Hard and Crumbly) |
|---|---|---|---|---|---|---|---|
| 39 | 1/8/16 | 1205 | 626675.4 | 2032557.1 | 0 to 1'3"<br>1'6" to 2'<br>3' to 3'6"<br>4' to 4'6"<br>5' to 5'6" | | 1'3" to 1'6"<br>2' to 3'<br>3'6" to 4'<br>4'6" to 5'<br>5'6" to 6' |
| 40 | 1/8/16 | 1220 | 626680.9 | 2032557.4 | 0 to 1'<br>1'6" to 2'6" | 1' to 1'6" | 2'6" to 4'6" |
| 41 | 1/8/16 | 1235 | 626680.1 | 2032557 | 0 to 1'<br>1'6" to 4' | 4' to 5'6" | 1' to 1'6" |

Notes:

[1] - GPS coordinatates are in NJ State Plane NAD 83 in survey feet.

# Table 2 - Sample Collection - Container Log

| Container ID | Material Notes |
|---|---|
| **Viscous Rubbery (VR)** | |
| OBG-160105-I2VR1 | Material from cores 1 through 14. |
| OBG-160108-I2VR2 | Material from cores 32 through 34. |
| OBG-160108-I2VR3 | Material from cores 35 through 38 |
| OBG-160108-I2VR4 | Material from cores 39 through 41. |
| **Hard and Crumbly (HC)** | |
| OBG-160104-I2HC1 | Material from cores 1 through 4. |
| OBG-160105-I2HC2 | Material from cores 5 through 9. |
| OBG-160105-I2HC3 | Material from cores 10 through 14. |
| OBG-160108-I2HC4 | Material from cores 32 through 38. |
| OBG-160108-I2HC5 | Material from cores 39 through 41. |
| **VR/HC Mix (Interface)** | |
| OBG-160104-I2MX1 | Material from cores 1 through 7. |
| OBG-160105-I2MX2 | Material from cores 8 through 14. |
| OBG-160105-I2MX3 | Extra not needed for Thermally Enhanced ISS Bench-Scale Study |
| OBG-160105-I2MX4 | Extra not needed for Thermally Enhanced ISS Bench-Scale Study |
| OBG-160108-I2MX5 | Extra not needed for Thermally Enhanced ISS Bench-Scale Study |
| OBG-160108-I2MX6 | Material from Boat (vibracore head) |
| OBG-160108-I2MX7 | Material from cores 32 through 38. |
| OBG-160108-I2MX8 | Material from cores 39 through 41. |

| Test ID | Test Date | Bucket ID | Temperature | RAW MATERIAL | | DEWATERED MATERIAL | | | Aqueous Phase Removed (% by Wt) | Test Mass Recovery |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Raw Weight (lbs) | Raw Moisture Content (%)[1] | Dewatered Weight (lbs) | Dewatered Temperature | Dewatered Moisture Content (%) [1] | | |
| **MIX MATERIAL** | | | | | | | | | | |
| **VR/HC Mix (Interface)** | | | | | | | | | | |
| **Screening Tests** | | | | | | | | | | |
| Mix1-Test1 | 1/13/2016 | OBG-160104-I2MX1 | Room Temp | 6.09 | **33.5** | 3.89 | Not Tested | **4.6** | 18% | 94% |
| Mix1-Test2 | 1/13/2016 | OBG-160104-I2MX1 | Room Temp | 6.61 | **26.1** | 2.96 | Not Tested | **8.5** | 16% | 90% |
| Mix1-Test3 | 1/13/2016 | OBG-160104-I2MX1 | Room Temp | 6.52 | **23.7** | 3.71 | Not Tested | **11.6** | 27% | 93% |
| Mix1-Test4 | 1/14/2016 | OBG-160104-I2MX1 | 62 deg F | 7.3 | **15.5** | 2.83 | 72 deg F | **5.5** | 21% | 90% |
| Mix5-Test5 | 2/10/2016 | OBG-160108-I2MX5 | 46 deg F | 6.06 | **6.6** | 5.11 | 62 to 68 deg F | **6.3** | 4% | 95% |
| Mix5-Test6 | 2/10/2016 | OBG-160108-I2MX5 | 51 deg F | 6.74 | **8.2** | 4.99 | 61 to 66 deg F | **5.3** | 9% | 96% |
| **Dewatering for Outlets** | | | | | | | | | | |
| Mix2-Btest1 (For Outlet 1) | 2/10/2016 | OBG-160105-I2MX2 | 61 deg F | 29.18 | **6.8**<br>**20.2** | 18.38 | 72 to 82 deg F | **4.3**<br>**4** | 18% | 96% |
| Mix7-Btest2 (For Outlet 3) | 2/10/2016 | OBG-160108-I2MX7 | 63 deg F | 36.38 | **8.6**<br>**3.5** | 30.53 | 64 to 70 deg F | **3.9**<br>**2.2** | 7% | 96% |
| **Mixed Material from VR/HC Mixing Tests** | | | | | | | | | | |
| MTest 1 (50%HC/50%VR) | 3/29/2016 | MTest1 | 56 deg F | 23.1 | **2.8**<br>**5.3** | 19.61 | 63 to 65 deg F | **9.9**<br>**3.5** | 8% | 94% |
| MTest 2 (25%HC/75%VR) | 3/29/2016 | MTest2 | 57 deg F | 23.5 | **6.6**<br>**5.7** | 11.36 | 63 deg F | **3.9**<br>**4.5** | 3% | 78% |
| MTest 3 (75%HC/25%VR) | 3/29/2016 | MTest3 | 57 deg F | 22.2 | **13.2**<br>**9.9** | 18.42 | 67 deg F | **7.1**<br>**10.9** | 10% | 95% |
| **HC MATERIAL** | | | | | | | | | | |
| **Screening Tests** | | | | | | | | | | |
| HC1-Test1 | 1/13/2016 | OBG-160104-I2HC1 | Room Temp | 7.94 | **23.9** | 2.59 | Not Tested | **6.6** | 29% | 96% |
| HC1-Test2 | 1/14/2016 | OBG-160104-I2HC1 | 62 to 65 deg F | 7.44 | **7.3** | 3.05 | 80 to 100 deg F | **8.1** | 24% | 87% |
| HC1-Test3 | 2/9/2016 | OBG-160104-I2HC1 | 57 deg F | 6.11 | **18.5** | 3.08 | 67 to 73 deg F | **3.9** | 24% | 93% |
| HC1-Test4 | 2/9/2016 | OBG-160104-I2HC1 | 60 deg F | 5.98 | **7.3** | 2.02 | 66 to 77 deg F | **4.4** | 28% | 92% |
| HC4-Test5 | 2/9/2016 | OBG-160108-I2HC4 | 49 deg F | 6.24 | **16.4** | 4.87 | 66 to 70 deg F | **4.6** | 12% | 96% |
| HC4-Test6 | 2/9/2016 | OBG-160108-I2HC4 | 47 deg F | 6.91 | **3.3** | 5.58 | 65 deg F | **4.4** | 6% | 92% |
| **Dewatering for Outlets** | | | | | | | | | | |
| HC2-Btest1 (For Outlet 1) | 2/10/2016 | OBG-160105-I2HC2 | 64 deg F | 33.12 | **16**<br>**10.3** | 16.94 | 83 to 102 deg F | **4.1**<br>**6.6** | 31% | 93% |
| HC3-Btest2 (For Outlet 3) | 2/11/2016 | OBG-160105-I2HC3 | 62 deg F | 33.86 | **13.6**<br>**11.9** | 14.92 | 79 to 93 deg F | **6.8**<br>**3.7** | 26% | 91% |
| **VR MATERIAL** | | | | | | | | | | |
| **Screening Tests** | | | | | | | | | | |
| VR3-Test1 | 1/13/2016 | OBG-160108-I2VR3 | Room Temp | 6.87 | **12.7** | 4.02 | Not Tested | **3.4** | Intermixed Residual | 95% |
| VR3-Test2 | 2/10/2016 | OBG-160108-I2VR3 | 67 deg F | 7.14 | **8.5** | 5.38 | 67 deg F | **9.6** | 2% | 86% |
| VR3-Test3 | 2/10/2016 | OBG-160108-I2VR3 | 67 deg F | 6.28 | **7.2** | 2.85 | 67 deg F | **4.2** | 4% | 103% |
| VR3-Test4 | *Test Not Conducted[2]* | | | | | | | | | |
| VR3-Test5 | *Test Not Conducted[2]* | | | | | | | | | |
| VR3-Test6 | *Test Not Conducted[2]* | | | | | | | | | |
| **Dewatering for Outlets** | | | | | | | | | | |
| VR1-Btest1 (For Outlet 1) | 2/11/2016 | OBG-160105-I2VR1 | 65 deg F | Not Weighed (filled bucket) | **11.7**<br>**11.5** | NA | NA | NA | NA | NA |
| VR2-Btest2 (For Outlet 3) | 2/11/2016 | OBG-160108-I2VR2 | 60 deg F | Not Weighed (filled bucket) | **9.6**<br>**14.3** | NA | NA | NA | NA | NA |

Legend:
HC - Hard and Crumbly material
VR - Viscous Rubbery material
MIX - Interface layer of HC and VR
NA - Not applicable

Notes:
[1] - Moisture content is based on wet basis.
[2] - Additional tests were not conducted as the equipment used was identified to not have tight enough mechanical clearances to force the material out of the grinder.

## TABLE 4 | DEWATERED MATERIAL FOR OUTLETS EVALUATION

| Test ID | Test Date | Bucket ID | Dewatered Moisture Content (%) [1] | Flash Point (deg F) | Shaker Test | Paint Filter (ml/100g) |
|---|---|---|---|---|---|---|
| **MIX MATERIAL** | | | | | | |
| **VR/HC Mix (Interface)** | | | | | | |
| **Dewatering for Outlets** | | | | | | |
| Mix2-Btest1 (For Outlet 1) | 2/10/2016 | OBG-160105-I2MX2 | **4.3** | 69.2 | Pass | 2 by OBG (Pass) |
| | | | **4** | 72.2 | | <0.50 |
| Mix7-Btest2 (For Outlet 3) | 2/10/2016 | OBG-160108-I2MX7 | **3.9** | 77.2 | Pass | 2 by OBG (Pass) |
| | | | **2.2** | 70.2 | | <0.50 |
| **HC MATERIAL** | | | | | | |
| **Dewatering for Outlets** | | | | | | |
| HC2-Btest1 (For Outlet 1) | 2/10/2016 | OBG-160105-I2HC2 | **4.1** | 71.5 | Pass | 2 by OBG (Pass) |
| | | | **6.6** | 72.2 | | <0.50 |
| HC3-Btest2 (For Outlet 3) | 2/11/2016 | OBG-160105-I2HC3 | **6.8** | 73.8 | Pass | 2 by OBG (Pass) |
| | | | **3.7** | 72.2 | | <0.50 |
| **VR MATERIAL** | | | | | | |
| **Dewatering for Outlets** | | | | | | |
| VR1-Btest1 (For Outlet 1) | 2/11/2016 | OBG-160105-I2VR1 | NA | 71.2 | Fail (RAW) | *RAW* OBG (Fail) |
| | | | | 74.2 | | **3** |
| VR2-Btest2 (For Outlet 3) | 2/11/2016 | OBG-160108-I2VR2 | NA | 70.2 | Fail (RAW) | *RAW* OBG (Fail) |
| | | | | 106 | | **7** |

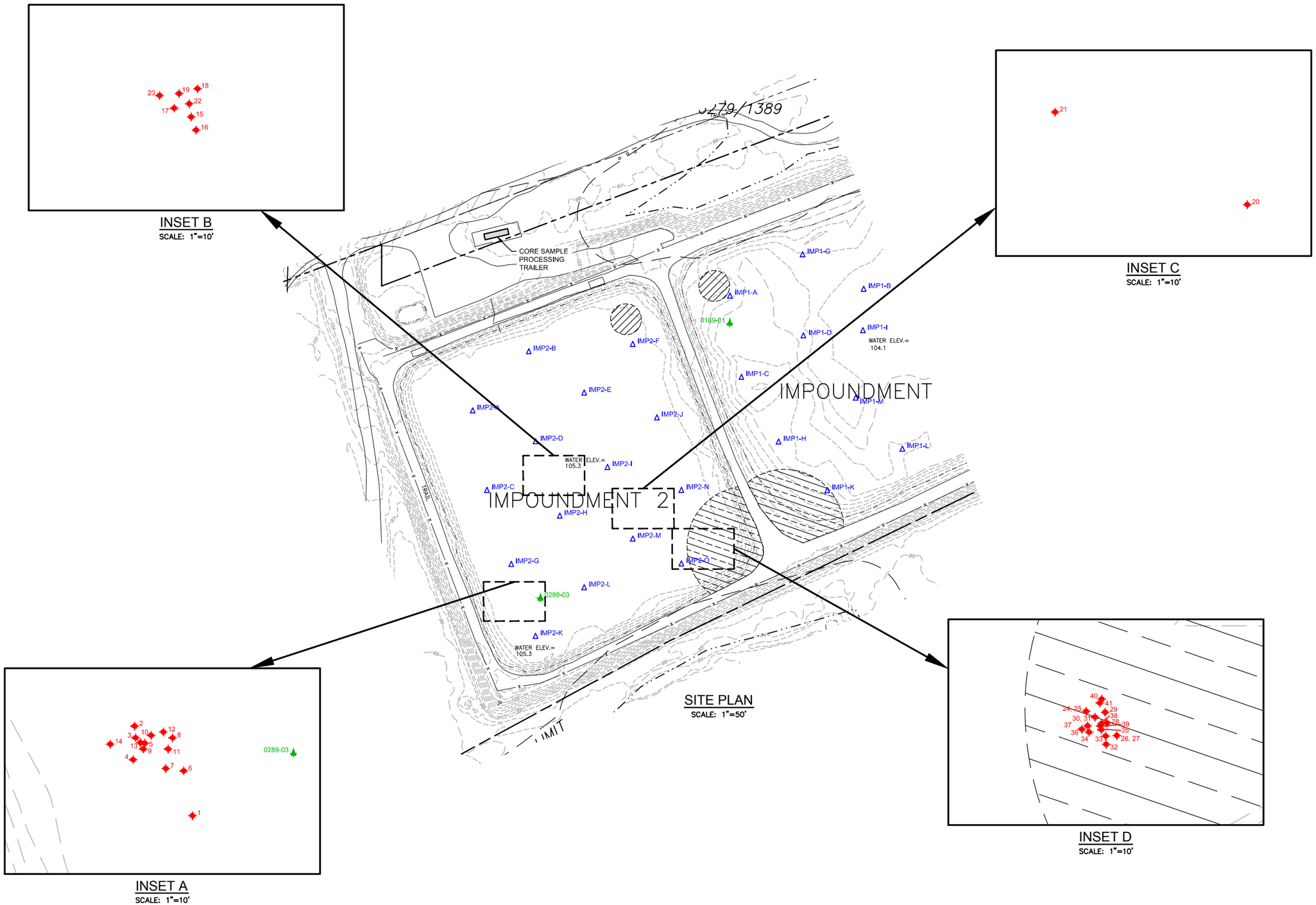
Legend:
HC - Hard and Crumbly material
VR - Viscous Rubbery material
MIX - Interface layer of HC and VR
NA - Not applicable

Notes:
[1] - Moisture content is based on wet basis.

# Table 5 - HC and VR Mixing Tests - Test Matrix

| Parameter | HC and VR Mixing Tests | | | | | | Field Collected Raw Material | | |
|---|---|---|---|---|---|---|---|---|---|
| | Test 1 (50%HC/50%VR) | | Test 2 (25%HC/75%VR) | | Test 3 (75%HC/25%VR) | | HC | VR | VR/HC Mix (Interface) |
| | RAW | DEWATERED | RAW | DEWATERED | RAW | DEWATERED | RAW | RAW | RAW |
| **Weight of Matieral** | | | | | | | | | |
| Weight of Material(s) [Refer to Table 2 for container log] | 12lbs HC5<br>12 lbs VR4 | --- | 6 lbs HC5<br>18 lbs VR<br>(13 lbs VR4, 5 lbs VR3) | --- | 18 lbs HC<br>(3.5 lbs HC5, 14.5 lbs HC4)<br>6 lbs VR3 | --- | 10 lbs HC4 | 18 lbs VR<br>(2 lbs VR3, 16 lbs VR1) | 13 lbs MIX8 |
| **Material Properties** | | | | | | | | | |
| Compressibility | Thumb imprint, was able to release thumb | Thumb imprint, was able to release thumb | Thumb imprint, was able to release thumb | Thumb imprint, was able to release thumb | Crumbled apart during thumb imprint | Thumb imprint, was able to release | Thumb imprint, was able to release thumb, crumbled | Thumb imprint, able to form into a disc | Thumb imprint, was able to release thumb |
| Plasticity | 1/2" to 1" threads | 1/4" threads | 1/4" to 1/2" threads | 1/4" threads | Crumbled apart during test | 1/4" to 1/2" threads | Material crumbles | 1/2" to 3/4" threads | 1/2" threads |
| Unconfined Compressive Strength (tons per square foot) | 0.05 | 0.06 | 0.06 | 0.06 | 0.12 | 0.08 | 0.08 | 0.05 | 0.10 |
| Shear Strength (tons per square foot) | 1.6 | 3.8 | 2.4 | 6.0 | 2.8 | 4.0 | 4.4 | 2.6 | 3.4 |
| Granularity | No determinable particle size, smeared like a paste | No determinable particle size, smeared like a paste | No determinable particle size, smeared like a paste | No determinable particle size, smeared like a paste | Spreads and crumbles, may have a fine grain particle | No determinable particle size | Spreads and crumbles | Spreads and breaks up | Spreads and breaks up |
| Tackiness | Released from gloves, but left residue | Released from gloves without leaving residue | Released from gloves, left some residue | Released from gloves leaving minimal residue | Released from gloves, left some particulate | Released from gloves leaving minimal residue | Released from gloves leaving minimal residue | Released from gloves, left some residue | Released from gloves, left some residue |
| **Flowability and Tackiness** | | | | | | | | | |
| **Dump Test** | | | | | | | | | |
| Observations | Dumped as fairly solid block, portions stuck to plastic, was able to be broken apart | Dumped as solid block, released from plastic, maintained shape when lifted | Dumped as solid block, portions stuck to plastic, did not break apart | Dumped as solid block, released from plastic, maintained shape when lifted | Dumped as solid block, released cleanly from plastic, was able to be broken apart | Dumped as solid block, released from plastic, maintained shape | Dumped as a fairly solid block, released cleanly from plastic, broke apart by hand | Dumped as a solid block, left some residue on plastic, some portions able to be broken apart | Dumped as a solid block, released cleanly from plastic, broke in half when folded |
| **Viscosity** | | | | | | | | | |
| Viscosity Range | Not tested | No tested | Refer to Figure 2 | Not tested | Not tested | Refer to Figure 2 | Refer to Figure 2 | Refer to Figure 2 | Refer to Figure 2 |
| **Dewatering of Mix Material** | | | | | | | | | |
| Moisture Content | Refer to Table 3 | Refer to Table 3 | Refer to Table 3 | Refer to Table 3 | Refer to Table 3 | Refer to Table 3 | Not tested | Not tested | Not tested |
| Paint Filter (Dewatered) | Not tested | Pass | Fail | Pass | Not tested | Pass | Not tested | Not tested | Not tested |

# FIGURES




LEGEND

- PROPERTY LINE
- ELEVATION CONTOURS (5' INTERVALS)
- ELEVATION CONTOURS (1' INTERVALS)
- WETLANDS LIMIT
- EDGE OF WATER
- FENCE
- RAILROAD TRACKS
- APPROXIMATE GEO BORING LOCATIONS (2010)
- DISCREET HISTORICAL SAMPLING LOCATIONS (2010)
- APPROXIMATE LOCATION OF NON-DISCREET HISTORICAL SAMPLES (1995)
- APPROXIMATE LOCATION OF NON-DISCREET HISTORICAL SAMPLES (2000)
- 2016 CORE SAMPLE LOCATION

NOTE:
1. REFER TO TABLE 1 FOR CORE LOG.

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IMPOUNDMENTS 1 & 2
MECHANICAL
DEW ATERING &
BENCH SCALE TESTING

2016
CORE SAMPLE
LOCATIONS

FIGURE 1

1"=50' 50 0 50

FILE NO. 4529.62515
MAY 2016

O'BRIEN & GERE ENGINEERS, INC.

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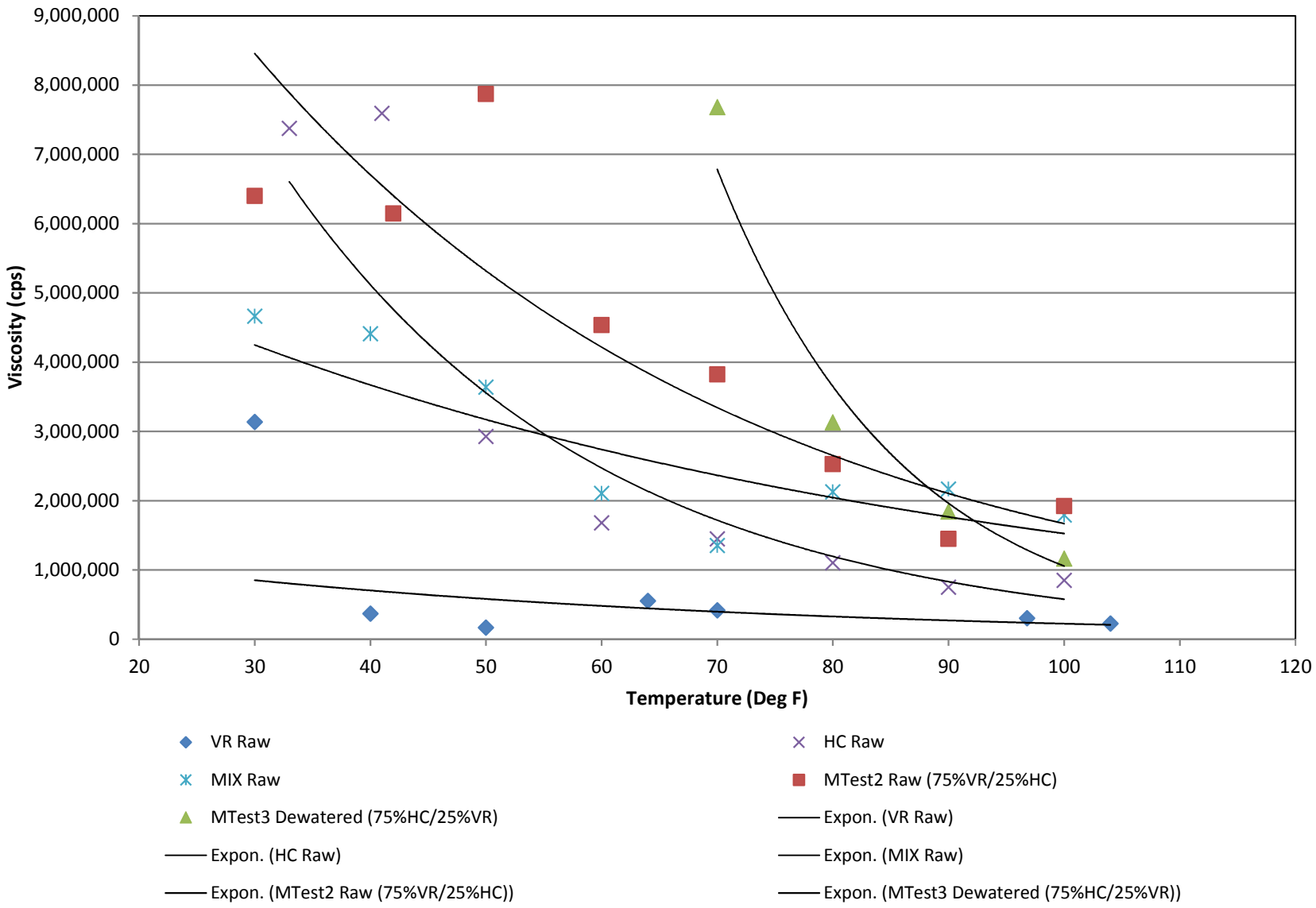
**FIGURE 2**
**Impoundment 2 Material - Viscosity Tests**



# Appendix F
# Acid Tar Site in NY - Air Emission and Odor Control Techniques

# Acid Tar Site in NY - Air Emission and Odor Control Techniques

| | |
|---|---|
| **PREPARED FOR:** | Mark Austin, U.S. Environmental Protection Agency<br>Ed Barth, U.S. Environmental Protection Agency |
| **COPY TO:** | Russell Downey, Pfizer Inc.<br>Vince D'Aco, BSI |
| **PREPARED BY:** | O'Brien & Gere Engineers, Inc. |
| **DATE:** | March 9, 2018 |

## PURPOSE

The purpose of this technical memorandum is to provide information regarding air emission and odor control techniques demonstrated to be effective at an acid tar remediation site in New York State (NY Site) and provide similarities to Operable Unit 8 (OU8) (i.e., Impoundments 1 and 2) at the American Cyanamid Superfund Site in Bridgewater, New Jersey (ACSS). The Site details provided below are available in documents prepared for regulatory agencies and therefore publicly available.

## NEW YORK SITE PROJECT BACKGROUND

The NY Site is estimated to contain less than 50,000 tons of acid tar in several ponds. The acid tar consists of an organic (tar-like) and an acid phase (aqueous phase) with the organic phase containing primarily benzene, toluene, xylene, and naphthalene at levels up to 5% by volume of each compound and the acid phase having a pH between 1 and 2.6.

Previous field efforts have assisted in identifying the following components of the remedy:

- Excavation of acid tar
- On-site dewatering of acid tar as needed to remove free liquids for transport
- Transport of acid tar off-site to a Resource Conservation and Recovery Act (RCRA) permitted thermal processing facility for beneficial reuse as fuel in a cement kiln
- Use of temporary spray-on covers, shrouds and other methods as needed (e.g., orchard fans) for air emission and odor controls
- Community air and odor monitoring

Approximately 30,500 tons of acid tar have been shipped off-site for beneficial reuse (used as fuel for cement kilns) since 2014. The NY Site components of the remedy, along with techniques used to monitor and control air and odor emissions are discussed in the following sections. These demonstrated techniques used for the NY Site are consistent with the description of Alternative 6 being considered as a potential remedy for ACSS OU8 as presented in the Focused Feasibility Study Report.

## NEW YORK SITE – OFF-SITE THERMAL PROCESSING FOR BENEFICIAL REUSE

### EXCAVATION

#### NY Site Overview

Acid tar was removed with a long reach tracked excavator and either direct loaded into shipping containers or into dewatering equipment prior to loading into shipping containers, which included dry bulk tankers, modified dry bulk tankers, or dump trailers. Excavation of acid tar has been performed through surface water on the pond(s) and when the surfaces were dry. Peninsula roads were constructed within each pond to access the center of the ponds. Open excavation areas were minimized and spray-on covers were applied during excavation as needed and as a cover during times when active excavation in that area was not occurring.

#### Air Emission and Odor Control Techniques

The primary air emission and odor control technique was spray-on fiber-based covers, which are used to cover the pond's surfaces when surface water (due to precipitation) was not present. The spray-on covers were also used during remedial activities. The excavation activity has been identified as the primary source for potential air emissions and odors, both at the pond surface when excavation uncovered acid tar and at the excavator bucket when acid tar was moved from the pond to the dewatering and loading equipment. The spray-on cover of the ponds was maintained throughout each day of the NY Site activities (before, during and at the end of each work day). As needed to further minimize emissions, spray covers were applied to the excavation area (i.e., pond surface) and excavated material in the excavator bucket before its transport to dewatering and loading equipment. Occasionally during warmer weather, the spray-on cover of the pond surfaces was maintained during the weekend when there were no remedial activities.

Orchard fans, installed along parts of the NY Site perimeters closest to remedial activities, were used as contingency controls. The fans were effective at reducing property line odor and emission levels during periods of low ambient wind speeds (<5 mph), which are conditions when odors tend to be worst-case.

During periods of moderate to heavy precipitation, surface water developed on the pond surfaces, which was also an effective method for controlling air emissions and odors.

#### Spray Cover Effectiveness

During the execution of previous field efforts at the NY Site, three different short-term cover formulae (intended for application to last one day) and six different long-term cover formulae (intended for application to last several days), including varying mixtures of fiber (cellulosic) and polymer, were tested on pond material to evaluate their speed, effectiveness, and longevity in reducing air emissions, measured as total volatile organic compounds (TVOCs). The short-term cover selected and used at the NY Site instantly achieved greater than 98% reduction in TVOC emissions at the source. The long-term covers selected instantly achieved greater than 97% reduction in TVOCs at the source and maintained that effectiveness over several days. These spray covers were used effectively to manage air emissions and odors during the daily excavation and dewatering activities as well as throughout the weekends as necessary. The tests identified some cover products that were not as effective and slower at reducing emissions, and therefore were not selected for use at the NY Site. Prior to and after each year of tar removal, when there would be long periods of inactivity, cement-based spray-on cover was often applied to provide long-term emission and odor suppression.

#### Anticipated Similarities and Differences to ACSS Impoundments 1 and 2 (OU8)

Impoundments 1 and 2 at the ACSS are approximately 15 feet deep from the top of their berms, similar to the deepest portions of the NY Site's ponds. Impoundments 1 and 2 are both approximately 300 feet wide and 300 feet long similar to the widest portions of the NY Site's ponds. Long reach excavators and peninsula roads have been demonstrated to facilitate access at the NY Site for material excavation near the ponds' centers.



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A water cap is maintained on the surface of Impoundments 1 and 2 for air emission and odor suppression. It has been demonstrated during the acid tar project at the NY Site that excavation can be performed through a water cap. Should excavation of material from Impoundments 1 and 2 require removal of the water cap, spray-on fiber-based covers have been demonstrated to be effective for dry surfaces. These covers can also be used, as needed, on exposed excavated material.

The NY Site has multiple ponded areas of material which required monitoring for cracks of the surface covers. Impoundments 1 and 2 are proximate to each other, approximately 1/3 of the NY Site's surface area, and are covered by water, which reduces the potential for fugitive emissions from the impoundment not undergoing active remediation. Thus, spray covers are not likely to be required on the ACSS impoundments with a water cap.

In summary, (1) emissions from excavation of ACSS Impoundments 1 and 2 can be similarly controlled as demonstrated at the NY Site, and (2) given the constantly maintained water cap on the ACSS impoundment not being remediated, spray-on covers for this impoundment's surfaces should not be necessary.

## DEWATERING

### NY Site Overview

The NY Site's dewatering system included dewatering screw equipment and belt conveyors to transfer dewatered material to the shipping containers. It also included a drain box used to separate free liquid from the acid tar prior to transferring the material to the dewatering screw or directly to the shipping containers.

Dewatering using the dewatering screw conveyor was generally performed in warmer months (April through November), as there is a significant reduction in the throughput of the system when the temperature of the material falls below 40 degrees Fahrenheit (°F). This is attributed to the exponential increase in material viscosity as temperature decreases.

### Air Emission and Odor Control

Control of air emissions and odors included designing equipment to minimize contact of material with wind. These design components included the depth of the dewatering screw hopper and shrouds on the belt conveyor. Spray-on cover was sometimes applied to material placed in the hopper, however the need for this control was rare.

### Anticipated Similarities and Differences to ACSS Impoundments 1 and 2

Bench-scale mechanical dewatering tests on material from ACSS Impoundment 2, conducted in 2016[1], indicate that a dewatering system similar to that used at the NY Site will produce a shippable material for off-site beneficial reuse. The viscosity testing of material from ACSS Impoundment 2 (hard and crumbly (HC), viscous rubbery (VR), mix of HC/VR), indicates a viscosity that is an order of magnitude lower than that of the NY Site's acid tar. These results suggest that material from ACSS Impoundments 1 and 2 may be suitable for dewatering in colder temperatures, which could extend the active remediation season longer than what was achieved at the NY Site. Operating during colder ambient air temperatures is expected to reduce the volatilization of organics from the material and reduce potential air emissions and odors.

[1] O'Brien & Gere, 2016. Mechanical Dewatering Bench-Scale Testing Report. O'Brien & Gere, May 31, 2016


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In summary, the same dewatering systems and emission control techniques used at the NY Site can be effective for ACSS Impoundments 1 and 2, and emissions could be further reduced during cold weather operations.

## AIR AND ODOR MONITORING

### Overview

#### NY Site Community Receptors

The NY Site is bordered to the west, south and east by industrial properties and by major roads. The following are approximate distances from the closest NY Site remedial activity to potential receptors:

1) Nearest receptor: 280 feet
2) Nearest residence: 1,800 feet
3) Nearest highway: 150 feet
4) Nearest public area: 1,000 feet

#### NY Site Monitoring Program

Air sampling during previous excavation activities (field trials) at the NY Site detected the presence of volatile organic compounds (VOCs), consisting primarily of benzene, toluene, xylenes, and naphthalene; and hydrogen sulfide ($H_2S$) in the five ponds. The perimeter air monitoring program evaluated potential air quality impacts from VOCs, $H_2S$, odors, and dust. Ten fixed air monitoring stations were located along or inside the NY Site perimeter. In addition, one portable air monitoring station was positioned in between the two fixed stations most directly downwind of remedial activities. The portable air monitoring station was moved during the day if the predominant wind direction shifted into a new quadrant or if the work area changed. Wind direction was continuously monitored each day using an on-site weather station.

Continuous real-time air monitors for TVOC operated at each fixed station and the portable station, while dust ($PM_{10}$) monitors operated at four of the fixed stations and the portable station.

$H_2S$ monitoring consisted of real-time measurements; however, since the analyzer is not designed to operate in a continuous mode, measurements were made in a survey mode at approximately 3-hour intervals at each downwind air monitoring station. More frequent measurements at downwind stations were made if $H_2S$ detection or odors were observed downwind of site activities.

Odor levels were quantified in terms of "odor units" using a portable field olfactometer. Observations were made at approximately 3-hour intervals at each downwind air monitoring station. More frequent observations at downwind stations were made if increased odors were observed downwind of NY Site activities. If odors were observed, then additional controls and/or countermeasures of site-related odors were implemented.

The following are the air monitoring criteria established for the NY Site:

| Monitoring Parameters (units) | Investigate Level[a] | Control Level[b] | Work Perimeter Limit[c] |
|---|---|---|---|
| **TVOC (ppm)** | 0.5 | 0.7 | 0.9 |
| **$PM_{10}$ ($\mu g/m^3$)** | 100 | 125 | 150 |
| **$H_2S$ (ppb)** | 6 | 8 | 10 |

[a] Investigate possible emission source(s)
[b] Apply controls and countermeasures of suspected emission source(s)
[c] Temporarily halt or modify emission source activities


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The criteria were based on one-hour averages corrected for background. Background levels were determined by the monitoring results of upwind monitoring locations for respective time periods. The TVOC criteria presented above were developed for the NY Site using the composition of individual VOCs in the headspace of the ponds' material and the New York State Department of Environmental Conservation's Short-term Guideline Concentration (SGC). The TVOC criteria is based on benzene because it was found as the highest component in headspace and has the lowest SGC of the other detected compounds.

Over the four-year program, consisting of 494 days of excavation and dewatering activities (10 hr days), there were three one-hour periods when the work perimeter was reached, which represents 0.06 percent of the total program period. In each instance, immediate (prior to the end of the hourly averaging period) actions were taken to reduce emissions, such that perimeter air quality levels decreased to background levels for the subsequent one-hour average. There were no exceedances of the $PM_{10}$ and $H_2S$ work perimeter limits over the four-year program.

**NY Site Emission Control Coordination**

Action levels (Investigate and Control) and Work Perimeter limits were defined for the parameters. The monitoring system sent alerts (via text or email message) to the on-site air monitoring technician whenever action levels were exceeded. As an added precaution to prevent action level exceedances, alerts were also sent to inform the technician of elevated 1-minute average readings. The technician then informed the NY Site construction manager and/or lead emission control operator of the expected source of increased emissions and the need to initiate additional controls, or modify or halt operations.

### Anticipated Similarities and Differences to ACSS Impoundments 1 and 2

The ACSS is in an industrial/commercial area. OU8 (Impoundments 1 and 2) is in the southeast corner of the ACSS. Commuter and freight rail lines run through or bound the ACSS to the north and south. Industrial and commercial facilities are located to the west and east. Roads, including an interstate, border the ACSS on three sides. The southern portion of the ACSS is bordered by undeveloped wetlands and the Raritan River. Except for the adjacent Somerset Tire Service (STS) Property on the east side of the North Area, all potential receptors are separated from the ACSS by buffering space provided by railroad corridors, stream channels, highway/road embankments, wooded areas, wetland areas, and/or the Raritan River.

The following are the approximate distances between Impoundments 1 and 2 and the nearest receptors at the ACSS:

- Nearest receptor: approximately 400 feet to the north
- Nearest residential property: approximately 1,800 feet to the east
- Nearest highway: Interstate 287 approximately 950 feet to the east
- Nearest public area: Delaware and Raritan Canal Sate Park Trail: 900 feet to the south
- Nearest public area to the north: Somerset Patriots Baseball Park and New Jersey Transit train station approximately 2,200 feet to the north

The similarity between the NY Site and OU8 at the ACSS is that OU8 can also be closely monitored and closely coordinated for air emissions. The primary difference between the sites is that the distance to the nearest receptor is 280 feet for the NY Site and 400 feet for the ACSS. The additional distance at the ACSS would aid in the ability to minimize the potential for off-site air emissions and odors.


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## SUMMARY

The table below summarizes characteristics of the NY Site as compared to OU8 at the ACSS, as related to air emissions and odors. Based on the effective implementation of emission and odor controls at the NY Site, the smaller surface area of Impoundments 1 and 2, the constant water cap on the impoundments, and the longer distances to nearest receptor at OU8, it is anticipated that successful emission and odor controls can be achieved at the ACSS.

**Table 1: Comparison of the NY Site versus OU8 at the ACSS**

| Items | NY Site | OU8 at the ACSS |
|---|---|---|
| **Excavation** | ▪ Minimize open area<br>▪ Spray open area of pond, bucket, and hopper as required | ▪ Minimize open area<br>▪ Spray open area of Impoundment, bucket, and hopper as required |
| **Max Depth** | ▪ ~12 ft | ▪ ~15 ft |
| **Acres** | ▪ ~11 acres | ▪ ~4 acres |
| **Surface Water Cover** | ▪ Non-existent during dry weather conditions | ▪ Constantly maintained on "inactive" Impoundment |
| **Dewatering** | ▪ Covered conveyor<br>▪ Deep hopper | ▪ Covered conveyor<br>▪ Deep hopper |
| **Spray covers** | ▪ 98% reduction | ▪ Expected to be 98% reduction – use same spray covers and application methodology |
| **Nearest Receptor** | ▪ ~280 ft | ▪ ~400 ft |
| **Nearest Residence** | ▪ ~1800 ft | ▪ ~1800 ft |
| **Nearest Public Highway** | ▪ ~150 ft | ▪ ~950 ft |
| **Nearest Public Area** | ▪ ~1000 ft | ▪ ~900 ft |
| **Operating Season** | ▪ April – November | ▪ March - December |



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# Appendix G
# Alternative Cost Evaluation

# Appendix G - Cost Evaluation

## COMPARISON OF TOTAL COST OF REMEDIAL ACTION ALTERNATIVES FOR OU8

**Site:** American Cyanamid Superfund Site
**Location:** Bridgewater, NJ
**Phase:** FFS
**Base Year:** 2018
**Date:** 4/2/2018

| | Alternative 1 | Alternative 3 | Alternative 4 | Alternative 5 | Alternative 6 |
|---|---|---|---|---|---|
| | No Action | ISS Treatment, Inner HBW, Protective Cover | Steam-Enhanced ISS Treatment, Inner HBW, Protective Cover | Steam-Enhanced ISS Treatment, Excavation and Placement in CAMU, Protective Cover | Excavation, Dewatering, Treatment/Destruction Offsite, Protective Cover |
| **Time to Meet Remedial Action Objectives** | NA | 20 Months | 24 Months | 30 Months | 38 Months |
| **Total Project Duration** | 30 Years | 30 Years | 30 Years | 30 Years | 30 Years |
| **Capital Cost** | $0 | $44,000,000 | $56,000,000 | $62,900,000 | $71,800,000 |
| **Operations and Maintenance Cost** | $0 | $3,900,000 | $3,900,000 | $1,700,000 | $1,700,000 |
| **Periodic costs (5-Year Reviews)** | $0 | $150,000 | $150,000 | $150,000 | $150,000 |
| **Total Cost** | $0 | $48,000,000 | $60,000,000 | $65,000,000 | $74,000,000 |

Notes:
The AACE Classification Class 4 cost estimates are assumed to represent total installed costs within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. The cost estimate has been prepared for remedial alternative comparison purposes and is based on information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

COC = Constituent of Concern

HBW = Hydraulic Barrier Wall

ISS = In-situ Solidification and Stabilization

## Alternative 3

# CLASS 4 COST ESTIMATE SUMMARY

**Site:** American Cyanamid Superfund Site
**Location:** Bridgewater, NJ
**Phase:** Operable Unit 8 FFS
**Duration:** 20 Months
**Date:** 4/2/2018

**Description:** Alternative 3 involves using ISS to treat PTW and underlying soil and clay impacted by OU8 impoundment material resulting in COC reduction and constituent sequestration within a solidified matrix. Following treatment, engineering controls, including an HBW and protective cover will be installed to minimize future migration of COCs.

## CAPITAL COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Planning** | | | | | |
| Design | 1 | LS | $ 1,910,000 | $ 1,910,000 | |
| Permits/Plan | 1 | LS | $ 340,000 | $ 340,000 | |
| Survey | 1 | LS | $ 150,000 | $ 150,000 | |
| Contractor Procurement | 1 | LS | $ 30,000 | $ 30,000 | |
| Preconstruction Submittals | 1 | LS | $ 120,000 | $ 120,000 | |
| **SUBTOTAL** | | | | **$ 2,550,000** | |
| **Site Preparation/Infrastructure (2 months)** | | | | | |
| Utility Improvements | 1 | LS | $ 548,000 | $ 548,000 | Includes improvements for water, natural gas, and electricity |
| Mobilization | 1 | LS | $ 59,000 | $ 59,000 | |
| Facilities | 22 | MO | $ 6,000 | $ 132,000 | Site office and facilities for entire project + 2 months |
| Impoundment Improvements (benches) | 1 | LS | $ 690,000 | $ 690,000 | 20,000 CY for bench extension and grading |
| Berm Enhancements | 20,000 | CY | $ 15.00 | $ 300,000 | |
| Water Cap Maintenance | 8 | MO | $ 50,000 | $ 400,000 | Liner removal, treatment system, assumes treated water returned to impoundment |
| **SUBTOTAL** | | | | **$ 2,129,000** | |
| **ISS (8 months)** | | | | | |
| ISS Therm Ox Setup - Facility/Piping | 1 | LS | $ 75,000 | $ 75,000 | |
| ISS Thermal Oxidizer | 16 | MO | $ 197,000 | $ 3,152,000 | Two thermal oxidizers - includes management of 200k gallons of scrubber blowdown |
| ISS Therm Ox Tear Down - Facility/Piping | 1 | LS | $ 269,000 | $ 269,000 | |
| ISS Equipment Setup | 1 | LS | $ 300,000 | $ 300,000 | |
| ISS Shakedown | 1 | LS | $ 72,000 | $ 72,000 | |
| ISS Operations (Includes labor, equipment and reagent) | 70,000 | CY | $ 161 | $ 11,270,000 | Assumes 1,728 cells using shrouded auger, Vol = 55,000 CY for Imp material, plus 8,500 CY (15% for berm fringe), plus 6,500 CY for 2-feet below. 80% Admixture. |
| Working Surface (Vented) | 1 | LS | $ 1,490,000 | $ 1,490,000 | Includes blower, liner, gravel, and vent system |
| ISS Demob | 1 | LS | $ 140,000 | $ 140,000 | |
| Contractor's Field Oversight - ISS | 9 | MO | $ 223,000 | $ 2,007,000 | GC costs - field staff, safety, field engineer + 1 month for mobilization |
| Contractor's Office Support - ISS | 9 | MO | $ 18,000 | $ 162,000 | GC costs for office support + 1 month for mobilization |
| **SUBTOTAL** | | | | **$ 18,937,000** | |
| **Engineered Cover (8 months)** | | | | | |
| Mob Engineered Cover Contractor | 1 | LS | $ 45,000 | $ 45,000 | |
| Survey | 1 | LS | $ 20,000 | $ 20,000 | |
| Geotechnical/Liner Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Engineered Cover Installation | 34,550 | CY | $ 110 | $ 3,800,500 | |
| Contractor's Field Oversight - Eng. Cover | 8 | MO | $ 97,000 | $ 776,000 | Contractor's costs |
| Contractor's Office Support - Eng. Cover | 8 | MO | $ 18,000 | $ 144,000 | Contractor's costs |
| DeMob Engineered Cover Contractor | 1 | LS | $ 25,000 | $ 25,000 | |
| **SUBTOTAL** | | | | **$ 4,870,500** | |
| **Slurry Wall (2 months)** | | | | | |
| Mob Slurry Wall Contractor | 1 | LS | $ 43,000 | $ 43,000 | |
| Survey | 1 | LS | $ 15,000 | $ 15,000 | |
| Slurry mix design/test | 1 | LS | $ 50,000 | $ 50,000 | |
| Geotechnical Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Improve Work Area for Slurry Equip | 1 | LS | $ 198,000 | $ 198,000 | |
| Set-up Slurry Equip | 1 | LS | $ 28,000 | $ 28,000 | |
| Contractor's Field Oversight - Slurry Wall | 3 | MO | $ 227,000 | $ 681,000 | Contractor's costs |
| Contractor's Office Support - Slurry Wall | 3 | MO | $ 18,500 | $ 55,500 | Contractor's costs |
| Install Slurry Wall | 2,400 | LF | $ 175 | $ 420,000 | 2,400 LF of slurry wall 20 ft depth |
| Demob Slurry Equip | 1 | LS | $ 28,000 | $ 28,000 | |
| **SUBTOTAL** | | | | **$ 1,578,500** | |
| **Monitoring/Reporting (20 months)** | | | | | |
| Institutional Controls | 1 | LS | $ 22,500 | $ 22,500 | Deed notice for soil |
| Air Monitoring | 20 | MO | $ 66,000 | $ 1,320,000 | Equipment rental, labor, lab, data validation |
| Groundwater Monitoring | 20 | MO | $ 17,000 | $ 340,000 | |
| Sampling and Monitoring | 20 | MO | $ 13,500 | $ 270,000 | |
| Final Report | 1 | LS | $ 67,000 | $ 67,000 | Construction Closeout report |
| **SUBTOTAL** | | | | **$ 2,019,500** | |
| **Oversight/Management (20 months)** | | | | | |
| Field Engineering | 20 | MO | $ 40,000 | $ 800,000 | 2 FTE's |
| Project Management | 20 | MO | $ 54,000 | $ 1,080,000 | PM, controls, accounting, contracts, H&S, QC |
| Construction Management | 20 | MO | $ 100,000 | $ 2,000,000 | 5 FTEs - (Junior Civil, H&S, Clerical, QA/QC, Const. Mgr.), includes travel |
| **SUBTOTAL** | | | | **$ 3,880,000** | |
| **Contingency** | | | | | |
| Contingency | 1 | LS | $ 2,539,000 | $ 2,539,000 | Covers identifiable risks such as changes duration of scoped events, quantities, etc, equal to 5% of total cost of alternative. |
| Undefined Scope Allowance | 1 | LS | $ 5,395,000 | $ 5,395,000 | Unidentified contingency equal to 11% of total cost of alternative |
| **SUBTOTAL** | | | | **$ 7,934,000** | |
| **TOTAL CAPITAL COST** | | | | **$ 43,898,500** | |

## OPERATIONS AND MAINTENANCE COST

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Short Term O&M - Vapor System (10 Years)** | | | | | |
| Active Vapor Treatment Installation | 1 | LS | $ 65,000 | $ 65,000 | |
| Active Vapor GAC Usage | 10 | YR | $ 56,400 | $ 564,000 | GAC usage over ten year period, 24,000 lbs/yr |
| Active Vapor Treatment - O&M | 10 | YR | $ 153,000 | $ 1,530,000 | |
| **SUBTOTAL** | | | | **$ 2,159,000** | |
| **Long Term O&M - Vapor System (20 Years)** | | | | | |
| Passive Vapor Treatment - O&M | 20 | YR | $ 2,750 | $ 55,000 | Passive vapor treatment over a 20-year period |
| **SUBTOTAL** | | | | **$ 55,000** | |
| **Cover O&M (30 Years)** | | | | | |
| Routine O&M | 30 | YR | $ 30,000 | $ 900,000 | Includes labor, equipment, parts/supplies, mob/demob, general conditions |
| Annual Reporting | 30 | YR | $ 15,000 | $ 450,000 | |
| Construction & Project Management | 30 | YR | $ 5,000 | $ 150,000 | |
| Miscellaneous | 30 | YR | $ 5,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 1,650,000** | |
| **TOTAL O&M COSTS** | | | | **$3,864,000** | |

## PERIODIC COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **5 year Reviews** | | | | | |
| 5 year Reviews | 6 | LS | $ 25,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 150,000** | |
| **TOTAL PERIODIC COST** | | | | **$150,000** | |

## TOTAL COST FOR ALTERNATE 3 $ 48,000,000

Notes:
1 -The AACE Classification Class 4 cost estimates are assumed to represent total installed costs within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. The cost estimate has been prepared for remedial alternative comparison purposes and is based on information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

# Alternative 4 — CLASS 4 COST ESTIMATE SUMMARY

**Site:** American Cyanamid Superfund Site
**Location:** Bridgewater, NJ
**Phase:** Operable Unit 8 FFS
**Duration:** 24 Months
**Date:** 4/2/2018

**Description:** Alternative 4 involves using steam enhanced ISS to treat PTW and underlying soil and clay impacted by OU8 impoundment material resulting in COC reduction and constituent sequestration within a solidified matrix. Following treatment, engineering controls, including a HBW and protective cover will be installed to minimize future migration of COCs.

## CAPITAL COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Planning** | | | | | |
| Design | 1 | LS | $ 1,910,000 | $ 1,910,000 | |
| Permits/Plan | 1 | LS | $ 340,000 | $ 340,000 | |
| Survey | 1 | LS | $ 150,000 | $ 150,000 | |
| Contractor Procurement | 1 | LS | $ 30,000 | $ 30,000 | |
| Preconstruction Submittals | 1 | LS | $ 120,000 | $ 120,000 | |
| **SUBTOTAL** | | | | **$ 2,550,000** | |
| **Site Preparation/Infrastructure (2 months)** | | | | | |
| Utility Improvements | 1 | LS | $ 547,500 | $ 547,500 | Includes improvements for water, natural gas, and electricity |
| Mobilization | 1 | LS | $ 59,000 | $ 59,000 | |
| Facilities | 26 | MO | $ 6,300 | $ 163,800 | Site office and facilities for entire project + 2 Months |
| Impoundment Improvements (benches) | 1 | LS | $ 690,000 | $ 690,000 | 20,000 CY for bench extension and grading |
| Berm Enhancements | 20,000 | CY | $ 15 | $ 300,000 | |
| Water Cap Maintenance | 12 | MO | $ 50,000 | $ 600,000 | Liner removal, treatment system, assumes treated water returned to impoundment |
| **SUBTOTAL** | | | | **$ 2,360,300** | |
| **ISS (12 months)** | | | | | |
| ISS Therm Ox Setup - Facility/Piping | 1 | LS | $ 75,000 | $ 75,000 | Civil/ISS contractor |
| ISS Thermal Oxidizer | 24 | MO | $ 197,000 | $ 4,728,000 | Two thermal oxidizers - includes management of 200k gallons of scrubber blowdown |
| ISS Therm Ox Tear Down - Facility/Piping | 1 | LS | $ 269,000 | $ 269,000 | Civil/ISS contractor |
| ISS Equipment Setup | 1 | LS | $ 300,000 | $ 300,000 | ISS Contractor |
| ISS Shakedown | 1 | LS | $ 147,000 | $ 147,000 | ISS Contractor |
| ISS Operations (Includes labor, equipment and reagent) | 70,000 | CY | $ 239 | $ 16,730,000 | Assumes 1,728 cells using shrouded auger, Vol = 55,000 CY for Imp material, plus 8,500 CY (15% for berm fringe), plus 6,500 CY for 2-feet below. 80% Admixture. |
| Working Surface (Vented) | 1 | LS | $ 1,490,000 | $ 1,490,000 | Includes blower, liner, gravel, and vent system |
| ISS Demob | 1 | LS | $ 140,000 | $ 140,000 | |
| Contractor's Field Oversight - ISS | 13 | MO | $ 227,000 | $ 2,951,000 | GC costs - field staff, safety, field engineer + 1 month for mobilization |
| Contractor's Office Support - ISS | 13 | MO | $ 18,500 | $ 240,500 | GC costs for office support + 1 month for mobilization |
| Set-up Steam Equipment | 1 | LS | $ 224,000 | $ 224,000 | |
| Operate Steam Plant | 12 | MO | $ 32,500 | $ 390,000 | Two steam plants |
| **SUBTOTAL** | | | | **$ 27,684,500** | |
| **Engineered Cover (8 months)** | | | | | |
| Mob Engineered Cover Contractor | 1 | LS | $ 45,000 | $ 45,000 | |
| Survey | 1 | LS | $ 20,000 | $ 20,000 | |
| Geotechnical/Liner Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Engineered Cover Installation | 34,550 | CY | $ 110 | $ 3,800,500 | |
| Contractor's Field Oversight - Eng. Cover | 8 | MO | $ 97,000 | $ 776,000 | Contractor's costs |
| Contractor's Office Support - Eng. Cover | 8 | MO | $ 18,000 | $ 144,000 | Contractor's costs |
| DeMob Engineered Cover Contractor | 1 | LS | $ 25,000 | $ 25,000 | |
| **SUBTOTAL** | | | | **$ 4,870,500** | |
| **Slurry Wall (2 months)** | | | | | |
| Mob Slurry Wall Contractor | 1 | LS | $ 43,000 | $ 43,000 | |
| Survey | 1 | LS | $ 15,000 | $ 15,000 | |
| Slurry mix design/test | 1 | LS | $ 50,000 | $ 50,000 | |
| Geotechnical Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Improve Work Area for Slurry Equip | 1 | LS | $ 198,000 | $ 198,000 | |
| Set-up Slurry Equip | 1 | LS | $ 28,000 | $ 28,000 | |
| Contractor's Field Oversight - Slurry Wall | 3 | MO | $ 227,000 | $ 681,000 | Contractor's costs |
| Contractor's Office Support - Slurry Wall | 3 | MO | $ 18,500 | $ 55,500 | Contractor's costs |
| Install Slurry Wall | 2,400 | LF | $ 175 | $ 420,000 | 2,400 LF of slurry wall 20 ft depth |
| Demob Slurry Equip | 1 | LS | $ 28,000 | $ 28,000 | |
| **SUBTOTAL** | | | | **$ 1,578,500** | |
| **Monitoring/Reporting (24 months)** | | | | | |
| Institutional Controls | 1 | LS | $ 22,500 | $ 22,500 | Deed notice for soil |
| Air Monitoring | 24 | MO | $ 64,000 | $ 1,536,000 | Equipment rental, labor, lab, data validation |
| Groundwater Monitoring | 24 | MO | $ 5,500 | $ 132,000 | |
| Sampling and Monitoring | 24 | MO | $ 15,000 | $ 360,000 | |
| Final Report | 1 | LS | $ 66,500 | $ 66,500 | Construction Closeout report |
| **SUBTOTAL** | | | | **$ 2,117,000** | |
| **Oversight/Management (24 months)** | | | | | |
| Field Engineering | 24 | MO | $ 40,000 | $ 960,000 | 2 FTE's |
| Project Management | 24 | MO | $ 54,000 | $ 1,296,000 | PM, controls, accounting, contracts, H&S, QC |
| Construction Management | 24 | MO | $ 100,000 | $ 2,400,000 | 5 FTEs - (Junior Civil, H&S, Clerical, QA/QC, Const. Mgr.), includes travel |
| **SUBTOTAL** | | | | **$ 4,656,000** | |
| **Contingency** | | | | | |
| Contingency | 1 | LS | $ 3,413,000 | $ 3,413,000 | Covers identifiable risks such as changes duration of scoped events, quantities, etc, equal to 6% of total cost of alternative |
| Undefined Scope Allowance | 1 | LS | $ 6,873,000 | $ 6,873,000 | Unidentified contingency equal to 11% of total cost of alternative |
| **SUBTOTAL** | | | | **$ 10,286,000** | |
| **TOTAL CAPITAL COST** | | | | **$ 56,102,800** | |

## OPERATIONS AND MAINTENANCE COST

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Short Term O&M - Vapor System (10 Years)** | | | | | |
| Active Vapor Treatment Installation | 1 | LS | $ 65,000 | $ 65,000 | |
| Active Vapor GAC Usage | 10 | YR | $ 56,400 | $ 564,000 | GAC usage over ten year period, 24,000 lbs/yr |
| Active Vapor Treatment - O&M | 10 | YR | $ 153,000 | $ 1,530,000 | |
| **SUBTOTAL** | | | | **$ 2,159,000** | |
| **Long Term O&M - Vapor System (20 Years)** | | | | | |
| Passive Vapor Treatment - O&M | 20 | YR | $ 2,750 | $ 55,000 | Passive vapor treatment over a 20-year period |
| **SUBTOTAL** | | | | **$ 55,000** | |
| **Cover O&M (30 Years)** | | | | | |
| Routine O&M | 30 | YR | $ 30,000 | $ 900,000 | Includes labor, equipment, parts/supplies, mob/demob, general conditions |
| Annual Reporting | 30 | YR | $ 15,000 | $ 450,000 | |
| Construction & Project Management | 30 | YR | $ 5,000 | $ 150,000 | |
| Miscellaneous | 30 | YR | $ 5,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 1,650,000** | |
| **TOTAL O&M COSTS** | | | | **$3,864,000** | |

## PERIODIC COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **5 year Reviews** | | | | | |
| 5 year Reviews | 6 | LS | $ 25,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 150,000** | |
| **TOTAL PERIODIC COST** | | | | **$150,000** | |

## TOTAL COST FOR ALTERNATE 4 — $ 60,000,000

Notes
1 -The AACE Classification Class 4 cost estimates are assumed to represent total installed costs within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. The cost estimate has been prepared for remedial alternative comparison purposes and is based on information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

# Alternative 5

# CLASS 4 COST ESTIMATE SUMMARY

**Site:** American Cyanamid Superfund Site
**Location:** Bridgewater, NJ
**Phase:** Operable Unit 8 FFS
**Duration:** 30 Months
**Date:** 4/2/2018

**Description:** Alternative 5 involves using steam enhanced ISS to treat OU8 impoundment material and underlying soil and clay impacted by OU8 impoundment material resulting in COC reduction and increased strength to facilitate excavation. Treated OU8 impoundment material will then be excavated and placed in the onsite CAMU. Following removal, a protective cover will be installed to minimize future migration of COCs.

## CAPITAL COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Planning** | | | | | |
| Design | 1 | LS | $ 1,910,000 | $ 1,910,000 | |
| Permits/Plan | 1 | LS | $ 340,000 | $ 340,000 | |
| Survey | 1 | LS | $ 150,000 | $ 150,000 | |
| Contractor Procurement | 1 | LS | $ 30,000 | $ 30,000 | |
| Preconstruction Submittals | 1 | LS | $ 120,000 | $ 120,000 | |
| **SUBTOTAL** | | | | **$ 2,550,000** | |
| **Site Preparation/Infrastructure (2 months)** | | | | | |
| Utility Improvements | 1 | LS | $ 547,000 | $ 547,000 | Includes improvements for water, natural gas, and electricity |
| Mobilization | 1 | LS | $ 59,000 | $ 59,000 | |
| Facilities | 32 | MO | $ 6,500 | $ 208,000 | Site office and facilities for project duration + 2 months |
| Impoundment Improvements (benches) | 1 | LS | $ 690,000 | $ 690,000 | 20,000 CY of material for bench extension and grading to berm |
| Berm Enhancements | 20000 | CY | $ 15.00 | $ 300,000 | |
| Water Cap Maintenance | 12 | MO | $ 50,000 | $ 600,000 | Liner removal, treatment system, assumes treated water returned to impoundment |
| **SUBTOTAL** | | | | **$ 2,404,000** | |
| **ISS (12 months)** | | | | | |
| ISS Therm Ox Setup - Facility/Piping | 1 | LS | $ 75,000 | $ 75,000 | |
| ISS Thermal Oxidizer | 24 | MO | $ 197,000 | $ 4,728,000 | Two thermal oxidizers - includes management of 200k gallons of scrubber blowdown |
| ISS Therm Ox Tear Down - Facility/Piping | 1 | LS | $ 269,000 | $ 269,000 | |
| ISS Equipment Setup | 1 | LS | $ 300,000 | $ 300,000 | |
| ISS Shakedown | 1 | LS | $ 147,000 | $ 147,000 | |
| ISS Operations (Includes labor, equipment and reagent) | 70000 | CY | $ 153 | $ 10,710,000 | Assumes 1,728 cells using shrouded auger, vol = 55,000 CY for Imp material, plus 8,500 CY (15% for berm fringe), plus 6,500 CY for 2-feet below. 15% Admixture. |
| Working Surface (Vented) | 1 | LS | $ 1,490,000 | $ 1,490,000 | Includes blower, liner, gravel, and vent system |
| ISS Demob | 1 | LS | $ 140,000 | $ 140,000 | |
| Contractor's Field Oversight - ISS | 13 | MO | $ 151,000 | $ 1,963,000 | GC costs - field staff, safety, field engineer + 1 month for mobilization |
| Contractor's Office Support - ISS | 13 | MO | $ 15,000 | $ 195,000 | GC costs for office support + 1 month for mobilization |
| Set-up Steam Equipment | 1 | LS | $ 224,000 | $ 224,000 | |
| Operate Steam Plant | 12 | MO | $ 32,500 | $ 390,000 | Two steam plants |
| **SUBTOTAL** | | | | **$ 20,631,000** | |
| **Removal - Placement in CAMU (8 months)** | | | | | |
| Sprung Structure - Erect and move | 1 | LS | $ 5,333,000 | $ 5,333,000 | 2 structures: small structure at CAMU, large structure at impoundment |
| Move material to Impound 8 & Impound 8 Fees | 62500 | CY | $ 71 | $ 4,437,500 | Assumes 14,000 CY plus 15% bulking |
| UCS Adjustment at CAMU | 62500 | CY | $ 30 | $ 1,875,000 | Assumes 7% addition with Portland cement mixed with excavator |
| Contractor's Field Oversight - Transport | 8 | MO | $ 97,000 | $ 776,000 | General Contractor (GC costs): Costs are for GC field staff - H&S, field engineers, field staff, etc. |
| Contractor's Home Office Support- Transport | 8 | MO | $ 14,000 | $ 112,000 | General Contractor (GC costs): Costs are for GC office support |
| **SUBTOTAL** | | | | **$ 12,533,500** | |
| **Engineered Cover (8 months)** | | | | | |
| Mob Engineered Cover Contractor | 1 | LS | $ 45,000 | $ 45,000 | |
| Survey | 1 | LS | $ 20,000 | $ 20,000 | |
| Geotechnical/Liner Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Engineered Cover Installation | 34,550 | CY | $ 110 | $ 3,800,500 | |
| Contractor's Field Oversight - Eng. Cover | 8 | MO | $ 97,000 | $ 776,000 | Contractor's costs |
| Contractor's Office Support - Eng. Cover | 8 | MO | $ 18,000 | $ 144,000 | Contractor's costs |
| DeMob Engineered Cover Contractor | 1 | LS | $ 25,000 | $ 25,000 | |
| **SUBTOTAL** | | | | **$ 4,870,500** | |
| **Monitoring/Reporting (30 months)** | | | | | |
| Institutional Controls | 1 | LS | $ 23,000 | $ 23,000 | |
| Air Monitoring | 30 | MO | $ 64,000 | $ 1,920,000 | |
| Groundwater Monitoring | 30 | MO | $ 5,500 | $ 165,000 | |
| Sampling and Monitoring | 30 | MO | $ 14,700 | $ 441,000 | |
| Final Report | 1 | LS | $ 67,000 | $ 67,000 | |
| **SUBTOTAL** | | | | **$ 2,616,000** | |
| **Oversight/Management (30 months)** | | | | | |
| Field Engineering | 30 | MO | $ 40,000 | $ 1,200,000 | 2 FTE's |
| Project Management | 30 | MO | $ 54,000 | $ 1,620,000 | PM, controls, accounting, contracts, H&S, QC |
| Construction Management | 30 | MO | $ 100,000 | $ 3,000,000 | 5 FTEs - (Junior Civil, H&S, Clerical, QA/QC, Const. Mgr.), includes travel |
| **SUBTOTAL** | | | | **$ 5,820,000** | |
| **Contingency** | | | | | |
| Contingency | 1 | LS | $ 3,804,000 | $ 3,804,000 | Covers identifiable risks such as changes duration of scoped events, quantities, etc, equal to 6% of total cost of alternative |
| Undefined Scope Allowance | 1 | LS | $ 7,714,000 | $ 7,714,000 | Unidentified contingency equal to 12% of total cost of alternative |
| **SUBTOTAL** | | | | **$ 11,518,000** | |
| **TOTAL CAPITAL COST** | | | | **$ 62,943,000** | |

## OPERATIONS AND MAINTENANCE COST

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Cover O&M (30 Years)** | | | | | |
| Routine O&M | 30 | YR | $ 30,000 | $ 900,000 | Includes labor, equipment, parts/supplies, mob/demob, general conditions |
| Annual Reporting | 30 | YR | $ 15,000 | $ 450,000 | |
| Construction & Project Management | 30 | YR | $ 5,000 | $ 150,000 | |
| Miscellaneous | 30 | YR | $ 5,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 1,650,000** | |
| **TOTAL O&M COSTS** | | | | **$1,650,000** | |

## PERIODIC COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **5 year Reviews** | | | | | |
| 5 year Reviews | 6 | LS | $ 25,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 150,000** | |
| **TOTAL PERIODIC COST** | | | | **$150,000** | |

## TOTAL COST FOR ALTERNATE 5 $ 65,000,000

Notes
1 -The AACE Classification Class 4 cost estimates are assumed to represent total installed costs within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. The cost estimate has been prepared for remedial alternative comparison purposes and is based on information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

# Alternative 6

# CLASS 4 COST ESTIMATE SUMMARY

**Site:** American Cyanamid Superfund Site
**Location:** Bridgewater, NJ
**Phase:** Operable Unit 8 FFS
**Duration:** 38 Months
**Date:** 4/2/2018

**Description:** Alternative 6 involves the excavation and mechanical dewatering of acid tar (OU8 impoundment material), followed by shipping to an offsite facility, preferably a cement kiln, for treatment (destruction). Following acid tar removal, soil and clay impacted by OU8 impoundment material above PRGs will be treated using ISS and a protective cover will be installed to minimize future migration of COCs.

## CAPITAL COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Planning** | | | | | |
| Design | 1 | LS | $ 1,910,000 | $ 1,910,000 | |
| Permits/Plan | 1 | LS | $ 340,000 | $ 340,000 | |
| Survey | 1 | LS | $ 150,000 | $ 150,000 | |
| Contractor Procurement | 1 | LS | $ 30,000 | $ 30,000 | |
| Preconstruction Submittals | 1 | LS | $ 120,000 | $ 120,000 | |
| **SUBTOTAL** | | | | **$ 2,550,000** | |
| **Site Preparation/Infrastructure (2 months)** | | | | | |
| Mobilization | 3 | YR | $ 175,000 | $ 525,000 | Assumes three weeks for labor and rentals |
| Temporary Facilities | 3 | YR | $ 100,000 | $ 300,000 | Site trailer, etc. |
| Site Prep and Improvements | 3 | YR | $ 50,000 | $ 150,000 | Allowance to improve roads |
| Water and Liquids Management | 3 | YR | $ 50,000 | $ 150,000 | Pumping off water cap and re establishing it following production season |
| **SUBTOTAL** | | | | **$ 1,125,000** | |
| **Removal and T&D to Cement Kiln (27 months)** | | | | | |
| Excavation, Dewatering, & Loading | 3 | YR | $ 1,615,000 | $ 4,845,000 | Includes excavation/dewatering, aqueous phase treatment, and taxes |
| Emission Controls | 3 | YR | $ 820,000 | $ 2,460,000 | Includes spray machines, spray operator, and three different spay materials |
| Material T&D | 44,820 | TN | $ 740 | $ 33,166,800 | |
| Aqueous Phase Treatment | 3 | YR | $ 1,095,900 | $ 3,287,700 | |
| Taxes | 3 | YR | $ 131,000 | $ 393,000 | |
| **SUBTOTAL** | | | | **$ 44,152,500** | |
| **Treatment of Soil & Clay Impacted by OU8 Impoundment Material (1.5 months)** | | | | | |
| ISS of soil & clay impacted by OU8 impoundment material above PRGs | 10,300 | CY | $ 150 | $ 1,545,000 | Assumed treatment depth of 2-feet below bottom of tar (10,300) and assumed production rate of 400 CY/day |
| ISS Contractor Field Overhead | 1.5 | mo | $ 48,000 | $ 72,000 | Field Engineer, construction manager |
| **SUBTOTAL** | | | | **$ 1,617,000** | |
| **Protective Cover (8 months)** | | | | | |
| Mob Engineered Cover Contractor | 1 | LS | $ 45,000 | $ 45,000 | |
| Survey | 1 | LS | $ 20,000 | $ 20,000 | |
| Geotechnical/Liner Testing | 30 | DY | $ 2,000 | $ 60,000 | |
| Engineered Cover Installation | 34,550 | CY | $ 110 | $ 3,800,500 | |
| Contractor's Field Oversight - Eng. Cover | 8 | MO | $ 97,000 | $ 776,000 | Contractor's costs |
| Contractor's Office Support - Eng. Cover | 8 | MO | $ 18,000 | $ 144,000 | Contractor's costs |
| DeMob Engineered Cover Contractor | 1 | LS | $ 25,000 | $ 25,000 | |
| **SUBTOTAL** | | | | **$ 4,870,500** | |
| **Monitoring/Reporting (3 years)** | | | | | |
| Air Monitoring | 3 | YR | $ 570,000 | $ 1,710,000 | 10 fixed station monitoring TVOC and dust, routine, periodic sampling (handheld meters) for H2S and odors |
| **SUBTOTAL** | | | | **$ 1,710,000** | |
| **Oversight/Management (3 years)** | | | | | |
| Construction Management | 3 | YR | $ 662,000 | $ 1,986,000 | Field staff included under GC |
| **SUBTOTAL** | | | | **$ 1,986,000** | |
| **Contingency** | | | | | |
| Contingency | 1 | LS | $ 5,064,000 | $ 5,064,000 | Covers identifiable risks such as changes duration of scoped events, quantities, etc, equal to 7% of total cost of alternative |
| Undefined Scope Allowance | 1 | LS | $ 8,702,000 | $ 8,702,000 | Unidentified contingency equal to 12% of total cost of alternative |
| **SUBTOTAL** | | | | **$ 13,766,000** | |
| **TOTAL CAPITAL COST** | | | | **$ 71,777,000** | |

## OPERATIONS AND MAINTENANCE COST

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **Cover O&M (30 Years)** | | | | | |
| Routine O&M | 30 | YR | $ 30,000 | $ 900,000 | Includes labor, equipment, parts/supplies, mob/demob, general conditions |
| Annual Reporting | 30 | YR | $ 15,000 | $ 450,000 | |
| Construction & Project Management | 30 | YR | $ 5,000 | $ 150,000 | |
| Miscellaneous | 30 | YR | $ 5,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 1,650,000** | |
| **TOTAL O&M COSTS** | | | | **$1,650,000** | |

## PERIODIC COSTS

| DESCRIPTION | QTY | UNIT | UNIT COST | TOTAL | NOTES |
|---|---|---|---|---|---|
| **5 year Reviews** | | | | | |
| 5 year Reviews | 6 | LS | $ 25,000 | $ 150,000 | |
| **SUBTOTAL** | | | | **$ 150,000** | |
| **TOTAL PERIODIC COST** | | | | **$150,000** | |

## TOTAL COST FOR ALTERNATE 6 $ 74,000,000

Notes
1 -The AACE Classification Class 4 cost estimates are assumed to represent total installed costs within the range of -30 percent to +50 percent (% based on AACE) of the cost indicated. The cost estimate has been prepared for remedial alternative comparison purposes and is based on information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.