9531563B

File: 541.460.000n
M.D.

THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

AR File Number 953

Part IX of IV

MEMORANDUM **CH2MHILL**

Data Validation Summary – Memphis Depot, Groundwater Sampling 2007

TO: David Nelson/CH2M HILL/ATL

FROM: Camden Robinson/CH2M HILL/ATL
Kaye Walker/CH2M HILL/MGM

DATE: March 12, 2008

The purpose of this memorandum is to present the results of the data validation process for the samples collected for Memphis Depot, Groundwater Sampling 2007. The samples were collected on September 12th, 2007 thru November 10th, 2007.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were reviewed and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA *National Functional Guidelines for Organic Data Review (EPA 1999)*. Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to Kemron Environmental Services, in Marietta, Ohio for the following analyses: SW-846 8260B Volatile Organic Compounds (VOC).

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the one, two/three-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

[=] Detected. The analyte was analyzed for and detected at the concentration shown.

[J] Estimated. The analyte was present but the reported value may not be accurate or precise.

[U] Undetected. The analyte was analyzed for but not detected above the method detection limit.

[UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.

[R] Rejected. The data is not useable.

Secondary Qualifier Codes

Code	Definition
2SH	Second Source Accuracy High
2SL	Second Source Accuracy Low
BD	Blank Spike/Blank Spike Duplicate (LCS/LCSD) Precision
BL	Blank
BSH	Blank Spike/LCS Recovery High
BSL	Blank Spike/LCS Recovery Low
CCH	Continuing Calibration Verification Accuracy High
CCL	Continuing Calibration Verification Accuracy Low
DL	Dilution
FD	Field Duplicate
HT	Holding Time
ICH	Initial Calibration High
ICL	Initial Calibration Low
ISH	Internal Standard Area Response High
ISL	Internal Standard Area Response Low
LR	Linear Range (Exceeded calibration range)
MD	Matrix Spike/Matrix Spike Duplicate Precision
MSH	Matrix Spike and/or Matrix Spike Duplicate Recovery High
MSL	Matrix Spike and/or Matrix Spike Duplicate Recovery Low
OT	Other
RE	Re-extraction
SSH	Spiked Surrogate Recovery High
SSL	Spiked Surrogate Recovery Low
TN	Tune
P	Primary/Confirmatory Column Criteria greater than 40%
M	Matrix Interference with quantitation of analytes
LD	Laboratory Duplicate
ST	Sample Temperature
CO	Carry Over Noted

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

SDG	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Analyses Performed
L0709256	MW231-192	L0709256-03	W	N	09/12/2007	[1]
L0710087	MW231-177-190-0929-1	L0710087-01	W	N	09/29/2007	[1]
L0710087	MW231-177-190-0930-1	L0710087-02	W	N	09/30/2007	[1]
L0710087	MW231-177-190-0930-2	L0710087-03	W	N	09/30/2007	[1]
L0710087	MW231-177-190-1001-1	L0710087-04	W	N	10/01/2007	[1]
L0710087	MW231-177-190-1001-2	L0710087-05	W	N	10/01/2007	[1]
L0710087	MW231-177-190-1002-1	L0710087-06	W	N	10/02/2007	[1]
L0710087	TB-1-1002	L0710087-07	WQ	TB	10/02/2007	[1]
L0710324	MW232-169-1003-1	L0710324-01	W	N	10/03/2007	[1]
L0710324	MW232-169-1004-1	L0710324-02	W	N	10/04/2007	[1]
L0710324	MW232-169-1004-1-AB	L0710324-03	WQ	AB	10/04/2007	[1]
L0710324	TB-1-1010	L0710324-04	WQ	TB	09/07/2007	[1]
L0711164	MW232-161	L0711164-01	W	N	11/05/2007	[1]
L0711164	MW239-169	L0711164-02	W	N	11/06/2007	[1]
L0711164	MW237-172	L0711164-03	W	N	11/06/2007	[1]
L0711164	MW238-190	L0711164-04	W	N	11/06/2007	[1]
L0711164	MW234-170	L0711164-05	W	N	11/06/2007	[1]
L0711164	MW231-181	L0711164-06	W	N	11/06/2007	[1]
L0711164	MW235-59	L0711164-07	W	N	11/06/2007	[1]
L0711164	MW236-34	L0711164-08	W	N	11/06/2007	[1]
L0711164	TB-1-1106	L0711164-09	WQ	TB	11/06/2007	[1]
L0711408	MW14-77.5	L0711408-01	W	N	11/07/2007	[1]
L0711408	MW14-77.5 MS	L0711408-02	W	MS	11/07/2007	[1]
L0711408	MW14-77.5 SD	L0711408-03	WQ	SD	11/07/2007	[1]
L0711408	MW3-71	L0711408-04	WQ	N	11/07/2007	[1]
L0711408	MW15-75	L0711408-05	W	N	11/07/2007	[1]
L0711408	MW6-69	L0711408-06	W	N	11/07/2007	[1]
L0711408	MW6-69-D	L0711408-07	W	FD	11/07/2007	[1]
L0711408	MW29-42	L0711408-08	W	N	11/07/2007	[1]

SDG	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Analyses Performed
L0711408	MW13-75	L0711408-09	W	N	11/07/2007	[1]
L0711408	MW34-149	L0711408-10	W	N	11/07/2007	[1]
L0711408	MW8-RD-EB	L0711408-11	WQ	EB	11/07/2007	[1]
L0711408	MW91-69	L0711408-12	W	N	11/07/2007	[1]
L0711408	MW35-84	L0711408-13	W	N	11/07/2007	[1]
L0711408	MW126-24.5	L0711408-14	W	N	11/07/2007	[1]
L0711408	MW30-54	L0711408-15	W	N	11/07/2007	[1]
L0711408	MW240-90	L0711408-16	W	N	11/07/2007	[1]
L0711408	MW127-64	L0711408-17	W	N	11/08/2007	[1]
L0711408	MW42-57	L0711408-18	W	N	11/08/2007	[1]
L0711408	MW128-69.5	L0711408-19	W	N	11/08/2007	[1]
L0711408	MW128-69.5-D	L0711408-20	W	FD	11/08/2007	[1]
L0711408	MW182-70	L0711408-21	W	N	11/08/2007	[1]
L0711408	MW129-74.5	L0711408-22	W	N	11/08/2007	[1]
L0711408	MW185-90.5	L0711408-23	W	N	11/08/2007	[1]
L0711408	MW51-61	L0711408-24	W	N	11/08/2007	[1]
L0711408	MW183-168	L0711408-25	W	N	11/08/2007	[1]
L0711408	MW78-59	L0711408-26	W	N	11/08/2007	[1]
L0711408	MW134-84	L0711408-27	W	N	11/08/2007	[1]
L0711408	MW180-81	L0711408-28	W	N	11/08/2007	[1]
L0711408	MW80-71	L0711408-29	W	N	11/08/2007	[1]
L0711408	MW134-84-RD-EB	L0711408-30	WQ	EB	11/08/2007	[1]
L0711408	MW132-82	L0711408-31	W	N	11/08/2007	[1]
L0711408	MW179-86	L0711408-32	W	N	11/08/2007	[1]
L0711408	MW187-81	L0711408-33	W	N	11/08/2007	[1]
L0711408	MW176-85	L0711408-34	W	N	11/08/2007	[1]
L0711408	MW176-85-D	L0711408-35	W	FD	11/08/2007	[1]
L0711408	MW58-66.5	L0711408-36	W	N	11/08/2007	[1]
L0711410	MW87-68	L0711410-01	W	N	11/09/2007	[1]
L0711410	MW175-77	L0711410-02	W	N	11/09/2007	[1]
L0711410	MW186-153	L0711410-03	W	N	11/09/2007	[1]
L0711410	MW-186-153-RD-EB	L0711410-04	WQ	EB	11/09/2007	[1]

SDG	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Analyses Performed
L0711410	MW189-86	L0711410-05	W	N	11/09/2007	[1]
L0711410	MW74-85	L0711410-06	W	N	11/09/2007	[1]
L0711410	MW75-87	L0711410-07	W	N	11/09/2007	[1]
L0711410	MW75-87-D	L0711410-08	W	FD	11/09/2007	[1]
L0711410	MW190-86	L0711410-09	W	N	11/09/2007	[1]
L0711410	MW190-86 MS	L0711410-10	WQ	MS	11/09/2007	[1]
L0711410	MW190-86 SD	L0711410-11	WQ	SD	11/09/2007	[1]
L0711410	MW172-77	L0711410-12	W	N	11/09/2007	[1]
L0711410	MW59-81	L0711410-13	W	N	11/09/2007	[1]
L0711410	MW174-76	L0711410-14	W	N	11/09/2007	[1]
L0711410	MW60-77	L0711410-15	W	N	11/09/2007	[1]
L0711410	MW195-79	L0711410-16	W	N	11/09/2007	[1]
L0711410	MW195-79-D	L0711410-17	W	FD	11/09/2007	[1]
L0711410	MW61-74	L0711410-18	W	N	11/09/2007	[1]
L0711410	MW193-80	L0711410-19	W	N	11/09/2007	[1]
L0711410	MW220-75	L0711410-20	W	N	11/09/2007	[1]
L0711410	MW225-88	L0711410-21	W	N	11/09/2007	[1]
L0711410	MW184-68	L0711410-22	W	N	11/09/2007	[1]
L0711410	MW191-77	L0711410-23	W	N	11/09/2007	[1]
L0711410	MW226-83	L0711410-24	W	N	11/09/2007	[1]
L0711410	MW12-83	L0711410-25	W	N	11/09/2007	[1]
L0711410	MW4-78	L0711410-26	W	N	11/09/2007	[1]
L0711410	MW226-83-D	L0711410-27	W	FD	11/09/2007	[1]
L0711410	MW222-84	L0711410-28	W	N	11/09/2007	[1]
L0711410	MW223-84	L0711410-29	W	N	11/09/2007	[1]
L0711410	MW221-85	L0711410-30	W	N	11/09/2007	[1]
L0711410	MW178-84.85	L0711410-31	W	N	11/09/2007	[1]
L0711410	MW224-84.5	L0711410-32	W	N	11/10/2007	[1]
L0711410	MW227-78	L0711410-33	W	N	11/10/2007	[1]
L0711410	MW228-78	L0711410-34	W	N	11/10/2007	[1]
L0711410	MW56-69	L0711410-35	W	N	11/10/2007	[1]
L0711410	MW174-76-SB	L0711410-36	WQ	AB	11/09/2007	[1]

SDG	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Analyses Performed
L0711410	MW225-88-SB	L0711410-37	WQ	AB	11/09/2007	[1]
L0711410	TB-1-1113	L0711410-38	WQ	TB	11/02/2007	[1]
L0711410	TB-2-1113	L0711410-39	WQ	TB	11/02/2007	[1]

MATRIX CODE

W – Water
WQ – Water Quality Control

SAMPLE TYPE CODE

N - Native Sample
FD – Field Duplicate
TB – Trip Blank
AB – Ambient Blank
EB – Equipment Blank
MS – Matrix Spike
SD – Matrix Spike Duplicate

ANALYSIS CODE

[1] – VOC –Volatile Organic Compounds by SW-846 method 8260B

Organic Parameters

Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks and trip blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and it's duplicate. This information can only be determined when target compounds are detected.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.

Volatile Organic Compounds (VOC) Analyses

The QA/QC parameters for the VOC analyses for all of the samples were within acceptable control limits, except as noted below:

Continuing Calibration

All continuing calibration criteria were met, except as listed in Table 1.

TABLE 1
Exceptions to Continuing Calibration: VOC
Memphis Depot Groundwater Sampling 2007

Instrument/Calibration Date	Analyte	%Relative Standard Deviation or R^2 (ICAL)/ %Difference (CCAL)	Associated Samples
CCV-HPMS11 / 11/18/07, 09:00	Bromomethane	30.8% high	MW14-77.5 MW3-71 MW29-42 MW13-75 MW34-149 MW91-69 MW35-84 MW126-24.5 MW30-54
CCV-HPMS11 / 11/18/07, 21:27	Bromomethane	30.3% high	MW127-64 MW42-57 MW128-69.5 MW128-69.5-D
CCV-HPMS11 / 11/20/07, 06:50	Bromomethane 2-Butanone	25.3% high 26.0% high	MW87-68 MW175-77 MW186-153
CCV-HPMS10 / 11/23/07, 11:40	Acetone 2-Butanone 2-Hexanone	25.1% high 28.6% high 25.8% high	MW227-78 MW228-78 MW56-69

CCV – Continuing Calibration

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was outside acceptance criteria in the continuing calibration, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated with a validation note of either "CCH" for high percent recoveries.

Second Source Calibration Criteria

All second source calibration criteria were met, except as listed in Table 2.

TABLE 2
Exceptions to Second Source Calibration Criteria: VOC
Memphis Depot Groundwater Sampling 2007

Instrument/Calibration Date	Analyte	%Relative Standard Deviation or R^2 (ICAL)/ %Difference (CCAL)	Associated Samples
SSCV-HPMS10 / 11/15/07, 17:52	Bromomethane	30.8% high	MW176-85 MW176-85-D MW58-66.5 MW226-83 MW12-83 MW4-78 MW226-83-D MW222-84 MW223-84 MW221-85 MW178-84.85 MW224-84.5 MW227-78 MW228-78 MW56-69

TABLE 2
Exceptions to Second Source Calibration Criteria: VOC
Memphis Depot Groundwater Sampling 2007

Instrument/Calibration Date	Analyte	%Relative Standard Deviation or R^2 (ICAL)/ %Difference (CCAL)	Associated Samples
SSCV-HPMS11 / 11/12/07, 18:30	Bromomethane	30.8% high	MW14-77.5
			MW3-71
			MW29-42
			MW13-75
			MW34-149
			MW91-69
			MW35-84
			MW126-24.5
			MW30-54
			MW127-64
			MW42-57
			MW128-69.5
			MW128-69.5-D
			MW87-68
			MW175-77
			MW186-153

SSCV – Second Source Calibration Verification

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was outside acceptance criteria in the second source calibration verification standard, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated with a validation note of either "2SH" for high percent recoveries or "2SL" for low percent recoveries.

Recoveries - Surrogates

All Surrogate recoveries were within acceptable quality control limits, except as noted in Table 3 below.

TABLE 3
Surrogate Recoveries Out of QC Limits: VOC
Memphis Depot Groundwater Sampling 2007

SDG	Sample	Parameter	Recovery	Recovery Limits	Associated Samples	Flag
L0710087	MW231-177-190-1001-1	1,2-Dichloroethane-d4	138%	80-120	MW231-177-190-1001-1	Detects-J
L0710087	MW231-177-190-1002-1	Toluene-d8	87.4%	88-110	MW231-177-190-1002-1	Detects-J Non-Detects-UJ
L0710324	MW232-169-1003-1	1,2-Dichloroethane-d4	132%	80-120	MW232-169-1003-1	Detects-J
L0710324	MW232-169-1004-1	1,2-Dichloroethane-d4	129%	80-120	MW232-169-1004-1	Detects-J
L0711164	MW235-59	1,2-Dichloroethane-d4	124%	80-120	MW235-59	Detects-J
L0711164	MW236-34	1,2-Dichloroethane-d4	124%	80-120	MW235-34	Detects-J

The volatile sample results for the samples listed above were qualified with a "J" for detects or a "UJ" for non-detects as estimated due to surrogate recoveries were outside the acceptable limits that are listed in Table 3 with a validation note of "SSH" for high percent recoveries or "SSL" for low percent recoveries. Please note that the samples were re-analyzed and yielded similar results.

Blanks

The VOC target parameters detected in blank samples are listed in Table 4.

TABLE 4
Blank Contamination: VOC
Memphis Depot Groundwater Sampling 2007

SDG	Sample ID	Sample Type	Parameter	Lab Result	Units	Samples Affected	Flag Concentrations less than the value listed below
L0711408	MW8-RD-EB	EB	Chloroform	0.158	ug/L	MW29-42 MW13-75 MW34-149	1.58 ug/L
L0711410	MW186-153-RD-EB	EB	1,1,2,2-Tetrachloroethane	0.430	ug/L	MW221-85	2.15 ug/L

TABLE 4
Blank Contamination: VOC
Memphis Depot Groundwater Sampling 2007

SDG	Sample ID	Sample Type	Parameter	Lab Result	Units	Samples Affected	Flag Concentrations less than the value listed below
L0711410	MW186-153-RD-EB	EB	Trichloroethene	0.819	ug/L	MW175-77 MW186-153 MW75-87 MW75-87-D MW172-77 MW59-81 MW60-77 MW61-74 MW12-83 MW4-78 MW221-85 MW178-84.85 MW228-78 MW56-69	4.095 ug/L

Flags were applied to the analyte in the associated samples in the following manner:

When the analyte was detected in the equipment blank or method blank, the detected compounds, that were less than 10 times the concentration detected for the common laboratory contaminant or 5 times the concentration for all other laboratory contaminant, the analyte listed, were flagged "U" due to possible laboratory contamination with a validation note of "BL".

The positive results for benzene and trichloroethene in the samples listed below should be considered quantitative estimates. The laboratory noted that the presence of these analytes may be attributed to carry-over contamination from previous analyses. The positive results for benzene and trichloroethene in the specified samples have been "J" qualified on the data summary tables with a validation note of "CO" to indicate that they are quantitative estimates.

Compound	Affected Samples
Benzene	MW176-85
Trichloroethene	MW127-64, MW42-57, MW128-69.5 and MW128-69.5-D

Dilutions

The samples presented below in table 5 were analyzed at a dilution for the analysis indicated. These dilutions were required to prevent saturation of the instrument, to allow quantitation of the compounds within the linear range of the calibration curve, and/or to reduce the effects of the matrix on the target compounds. Positive results for compounds reported above the calibration range in the initial analysis have been reported from the diluted analyses. When possible, results and quantitation limits for all other compounds were reported from the initial analysis.

TABLE 5
Dilutions: VOC
Memphis Depot Groundwater Sampling 2007

Sample ID	Analysis	Dilution Factor
MW189-86	VOC	50X
MW190-86	VOC	20X
MW195-79	VOC	20X
MW195-79-D	VOC	20X
MW193-80	VOC	20X
MW191-77	VOC	50X
MW222-84	VOC	20X
MW227-78	VOC	20X

Data Rejected during the Data Validation Process

Some samples may be analyzed multiple times by the laboratory because of dilution requirements or because spike recoveries are outside the method target acceptance limits. The laboratory reports all analyses; therefore, it is possible that several sample results may exist for a specific sample and analysis. During the data validation, all the sample results are evaluated and the "best answer" for each sample and analysis is chosen, and the other results are rejected.

The initial results for 1,1,2,2-tetrachloroethane, trichloroethene, cis-1,2-dichloroethene, and chloroform for the samples listed above in table 5 were rejected because the samples required a dilution in order to obtain results within the method target acceptance limits.

Holding Time

Trip Blank sample TB-1-1010 was received at the laboratory outside the technical holding time. Since it is a field QC sample, no qualifiers were applied to the trip blank sample results.

Field Duplicate Sample Results

Field duplicate analyses measure both field and laboratory precision and can also be affected by the homogeneity of the samples. Therefore the results may have more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples are not spiked; therefore, evaluation of duplicate sample results can only be performed on the comparison of positive sample results. Sample results are not qualified based on duplicate sample results; instead, the information is used to support the overall assessment of precision. According to the EPA *National Functional Guidelines*, there are no qualification criteria for field duplicate precision.

Six field duplicate samples were submitted for the volatile organic analyses.

A control limit of ± 20 percent for the RPD was used for original and duplicate aqueous sample values greater than or equal to five times the RL. A control limit of ± the RL was used if either the sample for the duplicate value was less than five times the RL. In the cases where only one result is more than five times the RL level and the other is below, the ± RL

All of the precision data were within criteria indicating that the sample matrix did not interfere with the overall analytical process.

Conclusion

A review of the analytical data submitted regarding the investigation of Memphis Depot, Groundwater Sampling 2007, by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The validation review demonstrated that the analytical systems were generally in control and the data results can be used as qualified in the decision making process.

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709256
Report Date : September 20, 2007

Sample Number: L0709256-03
Client ID: MW231 192
Matrix: Water
Workgroup Number: WG250008
Collect Date: 09/12/2007 11:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/13/2007 17:56
Cal Date: 09/05/2007 19:51
Run Date: 09/13/2007 17:56
File ID: 11M45441

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	90.8	86	118	
1,2-Dichloroethane-d4	93.0	80	120	
Toluene-d8	94.5	88	110	
4-Bromofluorobenzene	97.2	86	115	

U Not detected at or above adjusted sample detection limit

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-01
Client ID: MW231-177-190-0929-1
Matrix: Water
Workgroup Number: WG252187
Collect Date: 09/29/2007 22:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS6
Prep Date: 10/08/2007 18:17
Cal Date: 09/12/2007 17:13
Run Date: 10/08/2007 18:17
File ID: 6M69749

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	99.2	86	118	
1,2-Dichloroethane-d4	99.5	80	120	
Toluene-d8	99.6	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit

CA

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-02
Client ID: MW231-177-190-0930-1
Matrix: Water
Workgroup Number: WG252187
Collect Date: 09/30/2007 15:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS6
Prep Date: 10/08/2007 18:49
Cal Date: 09/12/2007 17:13
Run Date: 10/08/2007 18:49
File ID: 6M69750

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	98.9	86	118	
1,2-Dichloroethane-d4	99.6	80	120	
Toluene-d8	99.1	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit

C-2

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-03
Client ID: MW231-177-190-0930-2
Matrix: Water
Workgroup Number: WG252312
Collect Date: 09/30/2007 22:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MRS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/09/2007 20:07
Cal Date: 09/25/2007 17:05
Run Date: 10/09/2007 20:07
File ID: 10M59481

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	116	86	118	
1,2-Dichloroethane-d4	134	80	120	*
Toluene-d8	98.7	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
* Surrogate or spike compound out of range

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-04
Client ID: MW231-177-190-1001-1
Matrix: Water
Workgroup Number: WG252312
Collect Date: 10/01/2007 10:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/09/2007 20:38
Cal Date: 09/25/2007 17:05
Run Date: 10/09/2007 20:38
File ID: 10M59482

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.264	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	114	86	118	
1,2-Dichloroethane-d4	138	80	120	*
Toluene-d8	97.9	88	110	
4-Bromofluorobenzene	104	86	115	

SSH

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-05
Client ID: MW231-177-190-1001-2
Matrix: Water
Workgroup Number: WG252402
Collect Date: 10/01/2007 22:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 10/10/2007 06:02
Cal Date: 10/01/2007 15:48
Run Date: 10/10/2007 06:02
File ID: 11M46432

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.340	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.8	86	118	
1,2-Dichloroethane-d4	101	80	120	
Toluene-d8	90.0	88	110	
4-Bromofluorobenzene	94.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-06
Client ID: MW231-177-190-1002-1
Matrix: Water
Workgroup Number: WG252402
Collect Date: 10/02/2007 10:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 10/10/2007 06:32
Cal Date: 10/01/2007 15:48
Run Date: 10/10/2007 06:32
File ID: 11M46433

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.276	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

UJ-SSL

SSL

UJ-SSL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.6	86	118	
1,2-Dichloroethane-d4	96.7	80	120	
Toluene-d8	87.4	88	110	*
4-Bromofluorobenzene	91.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

Report Number: L0710087
Report Date : October 18, 2007

Sample Number: L0710087-07
Client ID: TB-1-1002
Matrix: Water
Workgroup Number: WG252402
Collect Date: 10/02/2007 14:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 10/09/2007 22:59
Cal Date: 10/01/2007 15:48
Run Date: 10/09/2007 22:59
File ID: 11M46418

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	87.7	86	118	
1,2-Dichloroethane-d4	90.1	80	120	
Toluene-d8	87.4	88	110	*
4-Bromofluorobenzene	89.4	86	115	

U Not detected at or above adjusted sample detection limit
* Surrogate or spike compound out of range

9531587

Report Number: L0710324
Report Date : October 24, 2007

Sample Number: L0710324-01
Client ID: MW232-169-1003-1
Matrix: Water
Workgroup Number: MG252675
Collect Date: 10/03/2007 22:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/12/2007 20:14
Cal Date: 09/25/2007 17:05
Run Date: 10/12/2007 20:14
File ID: 10M59569

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1	4.11	J	5.00	2.50	J-SSH
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	0.616	J	1.00	0.125	J-SSH
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3	0.567	J	1.00	0.125	J-SSH
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4	2.84		1.00	0.500	J-SSH
cis-1,2-Dichloroethene	156-59-2	5.16		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	0.908	J	1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5	0.672	J	1.00	0.125	J-SSH
1,1,2,2-Tetrachloroethane	79-34-5	0.725	J	1.00	0.125	
Tetrachloroethene	127-18-4	0.709	J	1.00	0.250	
Toluene	108-88-3	0.545	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6	0.730	J	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	2.13		1.00	0.250	
Trichloroethene	79-01-6	74.1		1.00	0.250	
Vinyl chloride	75-01-4	0.645	J	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	114	86	118	
1,2-Dichloroethane-d4	132	80	120	*
Toluene-d8	101	88	110	
4-Bromofluorobenzene	104	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit
* Surrogate or spike compound out of range

C.L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0710324
Report Date : October 24, 2007

Sample Number: L0710324-02
Client ID: MW232-169-1004-1
Matrix: Water
Workgroup Number: WG252675
Collect Date: 10/04/2007 10:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/12/2007 20:46
Cal Date: 09/25/2007 17:05
Run Date: 10/12/2007 20:46
File ID: 10M59570

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	0.452	J	1.00	0.125	J-SSH
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3	0.502	J	1.00	0.125	J-SSH
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4	2.77		1.00	0.500	J-SSH
cis-1,2-Dichloroethene	156-59-2	1.51		1.00	0.250	↓
trans-1,2-Dichloroethene	156-60-5	0.310	J	1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5	0.621	J	1.00	0.125	J-SSH
1,1,2,2-Tetrachloroethane	79-34-5	0.279	J	1.00	0.125	↓
Tetrachloroethene	127-18-4	0.732	J	1.00	0.250	
Toluene	108-88-3		U	1.00	0.250	
1,1,1-Trichloroethane	71-55-6	0.732	J	1.00	0.250	J-SSH
1,1,2-Trichloroethane	79-00-5	0.700	J	1.00	0.250	↓
Trichloroethene	79-01-6	29.1		1.00	0.250	
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	111	86	118	
1,2-Dichloroethane-d4	129	80	120	*
Toluene-d8	99.4	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

Report Number: L0710324

Report Date : October 24, 2007

Sample Number: L0710324-03
Client ID: MW232-169-1004-1-AB
Matrix: Water
Workgroup Number: WG252768
Collect Date: 10/04/2007 10:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/13/2007 14:33
Cal Date: 09/25/2007 17:05
Run Date: 10/13/2007 14:33
File ID: 10MS9582

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2	0.595	J	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	113	80	120	
Toluene-d8	99.3	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0710324
Report Date : October 24, 2007

Sample Number: L0710324-04
Client ID: TB-1-1010
Matrix: Water
Workgroup Number: WG252768
Collect Date: 09/07/2007 14:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 10/13/2007 14:01
Cal Date: 09/25/2007 17:05
Run Date: 10/13/2007 14:01
File ID: 10MS9581

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	100	86	118	
1,2-Dichloroethane-d4	109	80	120	
Toluene-d8	99.7	88	110	
4-Bromofluorobenzene	99.3	86	115	

U Not detected at or above adjusted sample detection limit

O.K

Report Number: L0711164
Report Date : November 19, 2007

Sample Number: L0711164-01
Client ID: MW232-161
Matrix: Water
Workgroup Number: WG255426
Collect Date: 11/05/2007 17:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/11/2007 21:09
Cal Date: 10/18/2007 16:51
Run Date: 11/11/2007 21:09
File ID: 10M60348

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2	0.212	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0	1.15		1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.297	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3	0.257	J	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	1.82		1.00	0.500
cis-1,2-Dichloroethene	156-59-2	3.11		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.357	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5	0.573	J	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.45		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	0.938	J	1.00	0.250
Trichloroethene	79-01-6	23.3		1.00	0.250
Vinyl chloride	75-01-4	0.327	J	1.00	0.250
o-Xylene	95-47-6	0.263	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.802	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	99.6	86	118	
1,2-Dichloroethane-d4	99.5	80	120	
Toluene-d8	98.5	88	110	
4-Bromofluorobenzene	97.6	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

Sample Number: L0711164-02
Client ID: MW239-169
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 12:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 16:55
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 16:55
File ID: 10M60369

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	4.35	J	5.00	2.50
Benzene	71-43-2	0.198	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0	1.71		1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	26.4		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	108	86	118	
1,2-Dichloroethane-d4	112	80	120	
Toluene-d8	100	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Report Number: L0711164
Report Date : November 19, 2007

Sample Number: L0711164-03
Client ID: MW237-172
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 11:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 17:27
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 17:27
File ID: 10M60370

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2	0.162	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.276	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3	0.322	J	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	1.97		1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.281	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.258	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	110	86	118	
1,2-Dichloroethane-d4	119	80	120	
Toluene-d8	98.0	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711164
Report Date : November 19, 2007

Sample Number: L0711164-04
Client ID: MW-238-190
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 13:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 17:59
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 17:59
File ID: 10M60371

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	4.37	J	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0	2.61		1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	2.87		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.17		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	86	118	
1,2-Dichloroethane-d4	117	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Sample Number: L0711164-05
Client ID: MW234-170
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 15:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 18:31
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 18:31
File ID: 10M60372

Analyte	CAS Number	Result	Qual	RL	MDL
Acetone	67-64-1	5.47		5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0	0.586	J	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	2.44		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.514	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	108	86	118	
1,2-Dichloroethane-d4	115	80	120	
Toluene-d8	98.4	88	110	
4-Bromofluorobenzene	97.4	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711164
Report Date : November 19, 2007

Sample Number: L0711164-06
Client ID: MW231-181
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 15:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 19:03
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 19:03
File ID: 10M60373

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.00		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	86	118	
1,2-Dichloroethane-d4	119	80	120	
Toluene-d8	99.9	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit

Report Number: L0711164

Report Date : November 19, 2007

Sample Number: L0711164-07
Client ID: MW23S-59
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 16:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 19:35
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 19:35
File ID: 10M60374

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	0.519	J	1.00	0.125	SSH
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250	
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125	
Tetrachloroethene	127-18-4		U	1.00	0.250	
Toluene	108-88-3	0.475	J	1.00	0.250	SSH
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250	
Trichloroethene	79-01-6		U	1.00	0.250	
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	113	86	118	
1,2-Dichloroethane-d4	124	80	120	*
Toluene-d8	100	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711164
Report Date : November 19, 2007

Sample Number: L0711164-08
Client ID: MW236-34
Matrix: Water
Workgroup Number: WG255483
Collect Date: 11/06/2007 16:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/12/2007 20:07
Cal Date: 10/18/2007 16:51
Run Date: 11/12/2007 20:07
File ID: 10M60375

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.275	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	86	118	
1,2-Dichloroethane-d4	124	80	120	*
Toluene-d8	99.4	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

SSH

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-01
Client ID: MW14-77.5
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 09:07
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 15:38
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 15:38
File ID: 11M47749

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.17		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.776	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.2	86	118	
1,2-Dichloroethane-d4	93.3	80	120	
Toluene-d8	97.8	88	110	
4-Bromofluorobenzene	98.1	86	115	

U-25H,CCH

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-04
Client ID: MW3-71
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 09:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 13:35
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 13:35
File ID: 11M47745

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	3.07		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	2.89		1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	2.63		1.00	0.250
Toluene	108-88-3	0.284	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	2.18		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.2	86	118	
1,2-Dichloroethane-d4	94.0	80	120	
Toluene-d8	98.0	88	110	
4-Bromofluorobenzene	98.7	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCl

C

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-05
Client ID: MW15-75
Matrix: Water
Workgroup Number: WG256233
Collect Date: 11/07/2007 10:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/18/2007 07:43
Cal Date: 11/16/2007 16:59
Run Date: 11/18/2007 07:43
File ID: 14M01428

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	25.0		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	186		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	1.20		1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	10.6		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	3.67		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	2.47		1.00	0.125
Tetrachloroethene	127-18-4	6.32		1.00	0.250
Toluene	108-88-3	0.524	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	145		1.00	0.250
Vinyl chloride	75-01-4	0.313	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.558	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	89.2	80	120	
Toluene-d8	104	88	110	
4-Bromofluorobenzene	106	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

C-2

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-06
Client ID: MW6-69
Matrix: Water
Workgroup Number: WG256233
Collect Date: 11/07/2007 11:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/18/2007 08:13
Cal Date: 11/16/2007 16:59
Run Date: 11/18/2007 08:13
File ID: 14M01429

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	13.8		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	8.55		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	0.387	J	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	150		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	6.33		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	18.4		1.00	0.125
Tetrachloroethene	127-18-4	1.14		1.00	0.250
Toluene	108-88-3	0.316	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	2.32		1.00	0.250
Trichloroethene	79-01-6	78.1		1.00	0.250
Vinyl chloride	75-01-4	0.484	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	103	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	106	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

Report Number: L0711408

Report Date : December 4, 2007

Sample Number: L0711408-07
Client ID: MW6-69-D
Matrix: Water
Workgroup Number: WG256233
Collect Date: 11/07/2007 11:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/18/2007 08:50
Cal Date: 11/16/2007 16:59
Run Date: 11/18/2007 08:50
File ID: 14M01430

Analyte	CAS Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	13.8		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	8.36		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	0.371	J	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	147		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	6.38		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	17.5		1.00	0.125
Tetrachloroethene	127-18-4	1.08		1.00	0.250
Toluene	108-88-3	0.314	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	2.15		1.00	0.250
Trichloroethene	79-01-6	78.1		1.00	0.250
Vinyl chloride	75-01-4	0.506	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	104	86	118	
1,2-Dichloroethane-d4	96.6	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	106	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-08
Client ID: MW29-42
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 12:15
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 17:09
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 17:09
File ID: 11M47752

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.229	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3	0.868	J	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	16.0		1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.549	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	13.6		1.00	0.250
Toluene	108-88-3	0.610	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6	1.71		1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	22.3		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	93.0	86	118	
1,2-Dichloroethane-d4	91.0	80	120	
Toluene-d8	99.0	88	110	
4-Bromofluorobenzene	97.8	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCT

1.04-BL

C.L

Report Number: L0711408

Report Date : December 4, 2007

Sample Number: L0711408-09
Client ID: MW13-75
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 12:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 17:39
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 17:39
File ID: 11M47753

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.127	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.571	J	1.00	0.250
Toluene	108-88-3	0.366	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	93.6	86	118	
1,2-Dichloroethane-d4	91.6	80	120	
Toluene-d8	97.9	88	110	
4-Bromofluorobenzene	97.9	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

US-25H, CCH

1.0U-BL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-10
Client ID: MW34-149
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 13:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 18:09
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 18:09
File ID: 11M47754

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	0.479	J	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.371	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.340	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	1.39		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	93.7	86	118	
1,2-Dichloroethane-d4	91.6	80	120	
Toluene-d8	98.8	88	110	
4-Bromofluorobenzene	96.1	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCV

1.0U-BL

cL

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-11
Client ID: MW8-RD-EB
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 13:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 15:07
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 15:07
File ID: 11M47748

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	6.76		5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.158	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.7	86	118	
1,2-Dichloroethane-d4	92.4	80	120	
Toluene-d8	97.9	88	110	
4-Bromofluorobenzene	98.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-12
Client ID: MW91-69
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 14:15
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 18:39
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 18:39
File ID: 11M47755

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		UJ	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	3.29		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	25.6		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.594	J	1.00	0.250
Toluene	108-88-3	0.391	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	13.8		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	96.2	86	118	
1,2-Dichloroethane-d4	92.9	80	120	
Toluene-d8	98.2	88	110	
4-Bromofluorobenzene	96.7	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCl

C-L

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-13
Client ID: MW35-84
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 15:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 19:09
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 19:09
File ID: 11M47756

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.485	J	1.00	0.250
Toluene	108-88-3	0.460	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	93.7	86	118	
1,2-Dichloroethane-d4	91.2	80	120	
Toluene-d8	97.8	88	110	
4-Bromofluorobenzene	98.4	86	115	

UJ-25H, CCH

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-14
Client ID: MW126-24.5
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 15:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 19:39
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 19:39
File ID: 11M47757

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.381	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	94.8	86	118	
1,2-Dichloroethane-d4	91.1	80	120	
Toluene-d8	97.3	88	110	
4-Bromofluorobenzene	97.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCI

C-L

Report Number: L0711408

Report Date : December 4, 2007

Sample Number: L0711408-15
Client ID: MW30-54
Matrix: Water
Workgroup Number: WG256247
Collect Date: 11/07/2007 16:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/18/2007 20:09
Cal Date: 11/12/2007 17:09
Run Date: 11/18/2007 20:09
File ID: 11M47758

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2	0.919	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.98		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.733	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.2	86	118	
1,2-Dichloroethane-d4	90.0	80	120	
Toluene-d8	97.9	88	110	
4-Bromofluorobenzene	98.4	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-25H, CCl

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-16
Client ID: MW240-90
Matrix: Water
Workgroup Number: WG256255
Collect Date: 11/07/2007 16:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/18/2007 21:43
Cal Date: 11/16/2007 16:59
Run Date: 11/18/2007 21:43
File ID: 14M01458

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	1.85		1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.707	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	2.42		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.307	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.733	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	104	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

CK

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-17
Client ID: MW127-64
Matrix: Water
Workgroup Number: WG256278
Collect Date: 11/08/2007 08:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/19/2007 07:14
Cal Date: 11/12/2007 17:09
Run Date: 11/19/2007 07:14
File ID: 11M47781

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.170	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.708	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.900	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.262	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.502	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	92.7	86	118	
1,2-Dichloroethane-d4	90.9	80	120	
Toluene-d8	99.5	88	110	
4-Bromofluorobenzene	99.2	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-25H, CCI

CO

C-L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-18
Client ID: MW42-57
Matrix: Water
Workgroup Number: WG256278
Collect Date: 11/08/2007 09:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/19/2007 07:44
Cal Date: 11/12/2007 17:09
Run Date: 11/19/2007 07:44
File ID: 11M47782

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	5.10		5.00	2.50
Benzene	71-43-2	0.166	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.173	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4	0.336	J	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	2.12		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.689	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.450	J	1.00	0.250
m-,p-Xylene	136777-61-2	1.00		1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	91.5	86	118	
1,2-Dichloroethane-d4	89.2	80	120	
Toluene-d8	96.9	88	110	
4-Bromofluorobenzene	99.4	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-19
Client ID: MW12B-69.5
Matrix: Water
Workgroup Number: WG256278
Collect Date: 11/08/2007 09:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/19/2007 08:14
Cal Date: 11/12/2007 17:09
Run Date: 11/19/2007 08:14
File ID: 11M47783

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		UJ	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	0.795	J	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.883	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	90.8	86	118	
1,2-Dichloroethane-d4	89.2	80	120	
Toluene-d8	95.2	88	110	
4-Bromofluorobenzene	97.2	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-20
Client ID: MW128-69.5-D
Matrix: Water
Workgroup Number: WG256278
Collect Date: 11/08/2007 09:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/19/2007 08:44
Cal Date: 11/12/2007 17:09
Run Date: 11/19/2007 08:44
File ID: 11M47784

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	0.774	J	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.813	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	94.2	86	118	
1,2-Dichloroethane-d4	93.5	80	120	
Toluene-d8	97.3	88	110	
4-Bromofluorobenzene	96.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCH

CO

C-L

Report Number: L0711408

Report Date : December 4, 2007

Sample Number: L0711408-21
Client ID: MW182-70
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 10:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 04:51
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 04:51
File ID: 14M01472

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	97.3	86	118	
1,2-Dichloroethane-d4	84.8	80	120	
Toluene-d8	103	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-22
Client ID: MW129-74.5
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 10:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 05:22
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 05:22
File ID: 14M01473

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3	2.78		1.00	0.125
1,2-Dichloroethane	107-06-2	0.335	J	1.00	0.250
1,1-Dichloroethene	75-35-4	32.7		1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.360	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	30.2		1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6	2.15		1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	19.1		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	100	86	118	
1,2-Dichloroethane-d4	87.1	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Q. L

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-23
Client ID: MW185-90.5
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 11:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 05:52
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 05:52
File ID: 14M01474

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.570	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.448	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	102	86	118	
1,2-Dichloroethane-d4	92.9	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-24
Client ID: MW51-61
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 11:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 06:23
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 06:23
File ID: 14M01475

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.186	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	17.6		1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	1.65		1.00	0.250
Toluene	108-88-3	0.450	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	7.71		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	97.0	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C L

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-25
Client ID: MW183-168
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 12:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 06:54
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 06:54
File ID: 14M01476

Analyte	CAS Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.196	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.588	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.520	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	104	86	118	
1,2-Dichloroethane-d4	97.8	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C.L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-26
Client ID: MW78-59
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 13:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 07:24
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 07:24
File ID: 14M01477

Analyte	CAS Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.944	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.716	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	97.5	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

O.K

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-27
Client ID: MW134-84
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 14:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 07:55
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 07:55
File ID: 14M01478

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	4.47		1.00	0.125
Tetrachloroethene	127-18-4	0.420	J	1.00	0.250
Toluene	108-88-3	0.446	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	1.03		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	91.2	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

O.K

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-28
Client ID: MW180-81
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 14:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 08:25
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 08:25
File ID: 14M01479

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.373	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	100	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

c-t

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-29
Client ID: MW80-71
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 14:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 08:56
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 08:56
File ID: 14M01480

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.303	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	104	86	118	
1,2-Dichloroethane-d4	99.5	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-30
Client ID: MW134-84-RD-EB
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 14:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 09:27
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 09:27
File ID: 14M01481

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	102	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-31
Client ID: MW132-82
Matrix: Water
Workgroup Number: MG256280
Collect Date: 11/08/2007 15:15
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 09:58
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 09:58
File ID: 14M01482

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	1.11		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.281	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	92.4		1.00	0.125
Tetrachloroethene	127-18-4	0.424	J	1.00	0.250
Toluene	108-88-3	0.902	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	1.67		1.00	0.250
Trichloroethene	79-01-6	8.87		1.00	0.250
Vinyl chloride	75-01-4	1.93		1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.529	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	90.4	80	120	
Toluene-d8	102	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

O.K

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-32
Client ID: MW179-86
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 15:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 10:29
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 10:29
File ID: 14M01483

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	0.326	J	1.00	0.125
Tetrachloroethene	127-18-4	0.905	J	1.00	0.250
Toluene	108-88-3	0.270	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	2.11		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	104	80	120	
Toluene-d8	101	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-L

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-33
Client ID: MW187-81
Matrix: Water
Workgroup Number: WG256280
Collect Date: 11/08/2007 16:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/19/2007 11:00
Cal Date: 11/16/2007 16:59
Run Date: 11/19/2007 11:00
File ID: 14M01484

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1;1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	0.141	J	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.663	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.568	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	101	80	120	
Toluene-d8	100	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

c.1

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-34
Client ID: MW176-85
Matrix: Water
Workgroup Number: WG256403
Collect Date: 11/08/2007 16:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/20/2007 13:08
Cal Date: 11/15/2007 16:17
Run Date: 11/20/2007 13:08
File ID: 10M60646

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2	0.153	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	0.415	J	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.246	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.287	J	1.00	0.250
Toluene	108-88-3	0.333	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	3.07		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	102	86	118	
1,2-Dichloroethane-d4	97.7	80	120	
Toluene-d8	97.4	88	110	
4-Bromofluorobenzene	92.8	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

CO

UJ-25H

34 of 36

CH

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-35
Client ID: MW176-85-D
Matrix: Water
Workgroup Number: WG256403
Collect Date: 11/08/2007 16:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/20/2007 13:40
Cal Date: 11/15/2007 16:17
Run Date: 11/20/2007 13:40
File ID: 10M60647

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	0.392	J	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.267	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.256	J	1.00	0.250
Toluene	108-88-3	0.329	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	3.00		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	96.7	80	120	
Toluene-d8	95.2	88	110	
4-Bromofluorobenzene	90.8	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711408
Report Date : December 4, 2007

Sample Number: L0711408-36
Client ID: MW58-66.5
Matrix: Water
Workgroup Number: WG256403
Collect Date: 11/08/2007 16:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/20/2007 14:11
Cal Date: 11/15/2007 16:17
Run Date: 11/20/2007 14:11
File ID: 10M60648

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	3.34	J	5.00	2.50
Benzene	71-43-2	0.211	J	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	8.89		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4	0.322	J	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.82		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.321	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.531	J	1.00	0.250
m-,p-Xylene	136777-61-2	1.10		1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	99.6	80	120	
Toluene-d8	97.7	88	110	
4-Bromofluorobenzene	93.2	86	115	

U-2SH

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-01
Client ID: MW87-68
Matrix: Water
Workgroup Number: WG256398
Collect Date: 11/09/2007 08:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/20/2007 15:58
Cal Date: 11/12/2007 17:09
Run Date: 11/20/2007 15:58
File ID: 11M47836

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		UJ	1.00	0.500
2-Butanone	78-93-3		UJ	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	7.16		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	6.25		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2	0.370	J	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	91.2		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	4.60		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	180		1.00	0.125
Tetrachloroethene	127-18-4	0.676	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	6.67		1.00	0.250
Trichloroethene	79-01-6	91.4		1.00	0.250
Vinyl chloride	75-01-4	0.272	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	98.7	80	120	
Toluene-d8	99.0	88	110	
4-Bromofluorobenzene	105	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

UJ-25H, CCH
UJ-CCH

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-02
Client ID: MW175-77
Matrix: Water
Workgroup Number: WGZ56398
Collect Date: 11/09/2007 08:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/20/2007 16:28
Cal Date: 11/12/2007 17:09
Run Date: 11/20/2007 16:28
File ID: 11M47837

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	0.361	J	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	2.55		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	1.52		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	98.6	86	118	
1,2-Dichloroethane-d4	97.0	80	120	
Toluene-d8	98.9	88	110	
4-Bromofluorobenzene	99.2	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

9531635

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-03
Client ID: MW186-153
Matrix: Water
Workgroup Number: WG256398
Collect Date: 11/09/2007 08:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 11/20/2007 16:58
Cal Date: 11/12/2007 17:09
Run Date: 11/20/2007 16:58
File ID: 11M47838

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		~~U~~	1.00	0.500
2-Butanone	78-93-3		~~U~~	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5	0.584	J	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	1.55		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.482	~~J~~	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.734	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	101	80	120	
Toluene-d8	95.8	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH, CCH
UJ-CCH

1.04-BL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-04
Client ID: MW186-153-RD-EB
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 09:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 21:26
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 21:26
File ID: 8M341934

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	0.430	J	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.819	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	104	86	118	
1,2-Dichloroethane-d4	103	80	120	
Toluene-d8	108	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-05
Client ID: MW189-86
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 09:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 21:55
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 21:55
File ID: 8M341935

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2	0.201	J	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	2.32		1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	3.98		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2	0.326	J	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	80.4		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	10.5		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	2030	~~I~~	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	6.75		1.00	0.250	
Toluene	108-88-3	0.946	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	10.3		1.00	0.250	
Trichloroethene	79-01-6	1030	~~I~~	1.00	0.250	R-DL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2	0.697	J	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	106	80	120	
Toluene-d8	107	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

AEMKON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-05
Client ID: MW189-86
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 09:50
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 50
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 16:16
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 16:16
File ID: 11M47884

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	250	125
Benzene	71-43-2		U	50.0	6.25
Bromodichloromethane	75-27-4		U	50.0	12.5
Bromoform	75-25-2		U	50.0	25.0
Bromomethane	74-83-9		U	50.0	25.0
2-Butanone	78-93-3		U	250	125
Carbon disulfide	75-15-0		U	50.0	25.0
Carbon tetrachloride	56-23-5		U	50.0	12.5
Chlorobenzene	108-90-7		U	50.0	6.25
Chlorodibromomethane	124-48-1		U	50.0	12.5
Chloroethane	75-00-3		U	50.0	25.0
Chloroform	67-66-3		U	50.0	6.25
Chloromethane	74-87-3		U	50.0	12.5
1,1-Dichloroethane	75-34-3		U	50.0	6.25
1,2-Dichloroethane	107-06-2		U	50.0	12.5
1,1-Dichloroethene	75-35-4		U	50.0	25.0
cis-1,2-Dichloroethene	156-59-2	56.3		50.0	12.5
trans-1,2-Dichloroethene	156-60-5		U	50.0	12.5
1,2-Dichloropropane	78-87-5		U	50.0	10.0
cis-1,3-Dichloropropene	10061-01-5		U	50.0	12.5
trans-1,3-Dichloropropene	10061-02-6		U	50.0	25.0
Ethylbenzene	100-41-4		U	50.0	12.5
2-Hexanone	591-78-6		U	250	125
4-Methyl-2-pentanone	108-10-1		U	250	125
Methylene chloride	75-09-2		U	50.0	12.5
Styrene	100-42-5		U	50.0	6.25
1,1,2,2-Tetrachloroethane	79-34-5	3240		50.0	6.25
Tetrachloroethene	127-18-4		U	50.0	12.5
Toluene	108-88-3		U	50.0	12.5
1,1,1-Trichloroethane	71-55-6		U	50.0	12.5
1,1,2-Trichloroethane	79-00-5		U	50.0	12.5
Trichloroethene	79-01-6	1940		50.0	12.5
Vinyl chloride	75-01-4		U	50.0	12.5
o-Xylene	95-47-6		U	50.0	12.5
m-,p-Xylene	136777-61-2		U	50.0	25.0

R-DL = R-DL = R-DL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	98.0	86	118	
1,2-Dichloroethane-d4	97.9	80	120	
Toluene-d8	96.8	88	110	
4-Bromofluorobenzene	101	86	115	

U Not detected at or above adjusted sample detection limit

a.-L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-06
Client ID: MW74-85
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 09:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 22:25
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 22:25
File ID: 8M341936

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.196	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	4.98		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.456	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	95.8		1.00	0.125
Tetrachloroethene	127-18-4	0.810	J	1.00	0.250
Toluene	108-88-3	0.496	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	1.15		1.00	0.250
Trichloroethene	79-01-6	61.8		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	106	80	120	
Toluene-d8	108	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-07
Client ID: MW75-87
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 10:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 22:55
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 22:55
File ID: 8M341937

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	7.01		1.00	0.125
Tetrachloroethene	127-18-4	0.623	J	1.00	0.250
Toluene	108-88-3	0.331	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	1.71		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

1.00-BL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	105	80	120	
Toluene-d8	105	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-08
Client ID: MW7S-87-D
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 10:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 23:25
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 23:25
File ID: 8M341938

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	7.28		1.00	0.125
Tetrachloroethene	127-18-4	0.648	J	1.00	0.250
Toluene	108-88-3	0.351	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	1.54		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

1.00-BL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	107	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C. L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-09
Client ID: MW190-86
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 11:08
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 19:56
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 19:56
File ID: 8M341931

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	1.17		1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	1.32		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	33.3		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	1.56		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	1040	I	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	6.01		1.00	0.250	
Toluene	108-88-3	0.746	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	3.38		1.00	0.250	
Trichloroethene	79-01-6	705	I	1.00	0.250	R-DL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2	0.586	J	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	104	86	118	
1,2-Dichloroethane-d4	102	80	120	
Toluene-d8	108	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-09
Client ID: MW190-86
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 11:08
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 20
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 15:46
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 15:46
File ID: 11M47883

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5		U	20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3		U	20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2		U	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	24.1		20.0	5.00
trans-1,2-Dichloroethene	156-60-5		U	20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	1500		20.0	2.50
Tetrachloroethene	127-18-4		U	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5		U	20.0	5.00
Trichloroethene	79-01-6	1050		20.0	5.00
Vinyl chloride	75-01-4		U	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

R-DL

R-DL

R-DL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	98.9	86	118	
1,2-Dichloroethane-d4	98.0	80	120	
Toluene-d8	98.6	88	110	
4-Bromofluorobenzene	105	86	115	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-12
Client ID: MW172-77
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 11:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/20/2007 23:55
Cal Date: 11/17/2007 19:02
Run Date: 11/20/2007 23:55
File ID: 8M341939

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.375	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.565	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.383	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.503	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	112	80	120	
Toluene-d8	104	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

1.0U-BL

C.A

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-13
Client ID: MW59-81
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 11:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 00:26
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 00:26
File ID: 8M341940

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.161	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	4.93		1.00	0.250
Toluene	108-88-3	0.334	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.336	~~J~~	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

1.00-BL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	108	86	118	
1,2-Dichloroethane-d4	110	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C.A.R

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-14
Client ID: MW174-76
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 12:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 00:56
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 00:56
File ID: BM341941

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	2.93		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	30.6		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	0.550	J	1.00	0.250
Toluene	108-88-3	0.337	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	11.8		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	110	86	118	
1,2-Dichloroethane-d4	110	80	120	
Toluene-d8	108	88	110	
4-Bromofluorobenzene	104	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Q-1L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-15
Client ID: MW60-77
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 12:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 01:26
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 01:26
File ID: 8M341942

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.177	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	1.26		1.00	0.250
Toluene	108-88-3	0.299	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.319	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	112	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

1.04-BL

C.R

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-16
Client ID: MW195-79
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 13:19
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 01:56
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 01:56
File ID: 8M341943

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2	0.305	J	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	1.67		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2	0.587	J	1.00	0.250	
1,1-Dichloroethene	75-35-4	1.32		1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	292	I	1.00	0.250	R-DL
trans-1,2-Dichloroethene	156-60-5	81.9		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	1270	I	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	6.64		1.00	0.250	
Toluene	108-88-3	0.437	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	11.6		1.00	0.250	
Trichloroethene	79-01-6	747	I	1.00	0.250	R-DL
Vinyl chloride	75-01-4	5.32		1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	86	118	
1,2-Dichloroethane-d4	116	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	107	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

C-L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-16
Client ID: MW195-79
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 13:19
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 20
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 16:46
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 16:46
File ID: 11M47885

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5		U	20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3		U	20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2		U	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	261		20.0	5.00
trans-1,2-Dichloroethene	156-60-5	60.2		20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	1680		20.0	2.50
Tetrachloroethene	127-18-4		U	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5	10.1	J	20.0	5.00
Trichloroethene	79-01-6	983		20.0	5.00
Vinyl chloride	75-01-4	5.40	J	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	99.2	86	118	
1,2-Dichloroethane-d4	98.6	80	120	
Toluene-d8	97.3	88	110	
4-Bromofluorobenzene	108	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-17
Client ID: MW195-79-D
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 13:19
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 02:26
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 02:26
File ID: 8M341944

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2	0.336	J	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	1.88		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2	0.615	J	1.00	0.250	
1,1-Dichloroethene	75-35-4	1.41		1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	300	I	1.00	0.250	R-DL
trans-1,2-Dichloroethene	156-60-5	83.5		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	1300	I	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	6.98		1.00	0.250	
Toluene	108-88-3	0.446	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	12.0		1.00	0.250	
Trichloroethene	79-01-6	815	I	1.00	0.250	R-DL
Vinyl chloride	75-01-4	5.48		1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	113	86	118	
1,2-Dichloroethane-d4	115	80	120	
Toluene-d8	104	88	110	
4-Bromofluorobenzene	106	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

C. L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-17
Client ID: MW195-79-D
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 13:19
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 20
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 17:17
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 17:17
File ID: 11M47886

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5		U	20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3		U	20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2		U	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	256		20.0	5.00
trans-1,2-Dichloroethene	156-60-5	60.3		20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	1650		20.0	2.50
Tetrachloroethene	127-18-4		U	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5	9.13	J	20.0	5.00
Trichloroethene	79-01-6	1050		20.0	5.00
Vinyl chloride	75-01-4		U	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	98.9	80	120	
Toluene-d8	99.0	88	110	
4-Bromofluorobenzene	109	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-18
Client ID: MW61-74
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 13:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 02:56
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 02:56
File ID: 8M341945

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.547	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3	0.257	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	0.896	J	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

1.0U-BL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	110	86	118	
1,2-Dichloroethane-d4	116	80	120	
Toluene-d8	105	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

c.c.L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-19
Client ID: MW193-80
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 14:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 03:26
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 03:26
File ID: 8M341946

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	1.19		1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	1.42		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	37.6		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	1.49		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	1200	X	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	8.16		1.00	0.250	
Toluene	108-88-3		U	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	2.93		1.00	0.250	
Trichloroethene	79-01-6	938	X	1.00	0.250	R-DL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	111	86	118	
1,2-Dichloroethane-d4	115	80	120	
Toluene-d8	105	88	110	
4-Bromofluorobenzene	106	86	115	

U Not detected at or above adjusted sample detection limit
I Semiquantitative result (out of instrument calibration range)

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-19
Client ID: MW193-80
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 14:40
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 20
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 17:47
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 17:47
File ID: 11M47887

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5		U	20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3		U	20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2		U	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	247		20.0	5.00
trans-1,2-Dichloroethene	156-60-5		U	20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	1510		20.0	2.50
Tetrachloroethene	127-18-4		U	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5		U	20.0	5.00
Trichloroethene	79-01-6	1270		20.0	5.00
Vinyl chloride	75-01-4		U	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	100	86	118	
1,2-Dichloroethane-d4	98.1	80	120	
Toluene-d8	98.7	88	110	
4-Bromofluorobenzene	109	86	115	

U Not detected at or above adjusted sample detection limit

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-20
Client ID: MW220-75
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 14:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 03:56
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 03:56
File ID: 8M341947

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4	7.93		1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	7.67		1.00	0.250
Toluene	108-88-3	0.367	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	6.73		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	110	86	118	
1,2-Dichloroethane-d4	117	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-21
Client ID: MW225-88
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 15:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 04:27
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 04:27
File ID: 8M341948

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.517	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	11.2		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	1.21		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	75.9		1.00	0.125
Tetrachloroethene	127-18-4	1.19		1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	2.34		1.00	0.250
Trichloroethene	79-01-6	140		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	111	86	118	
1,2-Dichloroethane-d4	114	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-22
Client ID: MW184-68
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 15:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 04:56
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 04:56
File ID: 8M341949

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	4.19		1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	7.79		1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	1.20		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.270	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	9.47		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	86	118	
1,2-Dichloroethane-d4	117	80	120	
Toluene-d8	106	88	110	
4-Bromofluorobenzene	99.3	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-23
Client ID: MW191-77
Matrix: Water
Workgroup Number: WG256534
Collect Date: 11/09/2007 16:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 11/21/2007 05:26
Cal Date: 11/17/2007 19:02
Run Date: 11/21/2007 05:26
File ID: 8M341950

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	
2-Butanone	78-93-3		U	5.00	2.50	
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	2.68		1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	2.99		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	63.9		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	7.24		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	1790	~~I~~	1.00	0.125	R-DL
Tetrachloroethene	127-18-4	13.9		1.00	0.250	
Toluene	108-88-3		U	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	6.08		1.00	0.250	
Trichloroethene	79-01-6	1320	~~I~~	1.00	0.250	R-DL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	114	86	118	
1,2-Dichloroethane-d4	118	80	120	
Toluene-d8	105	88	110	
4-Bromofluorobenzene	108	86	115	

U Not detected at or above adjusted sample detection limit
I Semiquantitative result (out of instrument calibration range)

C.L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-23
Client ID: MW191-77
Matrix: Water
Workgroup Number: WG256561
Collect Date: 11/09/2007 16:00
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 50
Units: ug/L

Instrument: HPMS11
Prep Date: 11/21/2007 18:17
Cal Date: 11/12/2007 17:09
Run Date: 11/21/2007 18:17
File ID: 11M47888

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	250	125
Benzene	71-43-2		U	50.0	6.25
Bromodichloromethane	75-27-4		U	50.0	12.5
Bromoform	75-25-2		U	50.0	25.0
Bromomethane	74-83-9		U	50.0	25.0
2-Butanone	78-93-3		U	250	125
Carbon disulfide	75-15-0		U	50.0	25.0
Carbon tetrachloride	56-23-5		U	50.0	12.5
Chlorobenzene	108-90-7		U	50.0	6.25
Chlorodibromomethane	124-48-1		U	50.0	12.5
Chloroethane	75-00-3		U	50.0	25.0
Chloroform	67-66-3		U	50.0	6.25
Chloromethane	74-87-3		U	50.0	12.5
1,1-Dichloroethane	75-34-3		U	50.0	6.25
1,2-Dichloroethane	107-06-2		U	50.0	12.5
1,1-Dichloroethene	75-35-4		U	50.0	25.0
cis-1,2-Dichloroethene	156-59-2	34>5	J	50.0	12.5
trans-1,2-Dichloroethene	156-60-5		U	50.0	12.5
1,2-Dichloropropane	78-87-5		U	50.0	10.0
cis-1,3-Dichloropropene	10061-01-5		U	50.0	12.5
trans-1,3-Dichloropropene	10061-02-6		U	50.0	25.0
Ethylbenzene	100-41-4		U	50.0	12.5
2-Hexanone	591-78-6		U	250	125
4-Methyl-2-pentanone	108-10-1		U	250	125
Methylene chloride	75-09-2		U	50.0	12.5
Styrene	100-42-5		U	50.0	6.25
1,1,2,2-Tetrachloroethane	79-34-5	2270		50.0	6.25
Tetrachloroethene	127-18-4		U	50.0	12.5
Toluene	108-88-3		U	50.0	12.5
1,1,1-Trichloroethane	71-55-6		U	50.0	12.5
1,1,2-Trichloroethane	79-00-5		U	50.0	12.5
Trichloroethene	79-01-6	1820		50.0	12.5
Vinyl chloride	75-01-4		U	50.0	12.5
o-Xylene	95-47-6		U	50.0	12.5
m-,p-Xylene	136777-61-2		U	50.0	25.0

R-DL
R-DL
R-DL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	99.1	86	118	
1,2-Dichloroethane-d4	99.1	80	120	
Toluene-d8	98.5	88	110	
4-Bromofluorobenzene	107	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-24
Client ID: MW226-83
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 16:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 03:26
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 03:26
File ID: 10M60673

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.156	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	2.57		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.486	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	9.56		1.00	0.125
Tetrachloroethene	127-18-4	0.559	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	1.09		1.00	0.250
Trichloroethene	79-01-6	24.7		1.00	0.250
Vinyl chloride	75-01-4	1.24		1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	107	80	120	
Toluene-d8	96.7	88	110	
4-Bromofluorobenzene	94.5	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-25
Client ID: MW12-83
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 17:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 03:58
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 03:58
File ID: 10M60674

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	5.17		5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.732	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	4.58		1.00	0.125
Tetrachloroethene	127-18-4	0.518	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	3.27		1.00	0.250
Vinyl chloride	75-01-4	0.490	J	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	107	80	120	
Toluene-d8	96.3	88	110	
4-Bromofluorobenzene	94.4	86	115	

J The analyte was positively identified, but the quantitation was below the RL
U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-26
Client ID: MW4-78
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 17:45
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 04:30
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 04:30
File ID: 10M60675

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.160	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	23.4		1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	~~1.11~~		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	109	80	120	
Toluene-d8	95.9	88	110	
4-Bromofluorobenzene	93.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-25H

1.04-BL

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-27
Client ID: MW226-83-D
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 16:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 05:03
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 05:03
File ID: 10M60676

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		UJ	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.169	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	2.44		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	0.459	J	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	8.99		1.00	0.125
Tetrachloroethene	127-18-4	0.614	J	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	1.06		1.00	0.250
Trichloroethene	79-01-6	23.8		1.00	0.250
Vinyl chloride	75-01-4	1.43		1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	106	86	118	
1,2-Dichloroethane-d4	107	80	120	
Toluene-d8	95.6	88	110	
4-Bromofluorobenzene	92.4	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-28
Client ID: MW222-84
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 18:55
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 05:35
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 05:35
File ID: 10M60677

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		UJ	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.358	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	25.4		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	5.20		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	1130	I	1.00	0.125
Tetrachloroethene	127-18-4	1.23		1.00	0.250
Toluene	108-88-3	0.681	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	8.97		1.00	0.250
Trichloroethene	79-01-6	351	I	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.253	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.668	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	108	80	120	
Toluene-d8	96.5	88	110	
4-Bromofluorobenzene	99.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

UJ-2SH

R-DL

R-DL

C L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-28
Client ID: MW222-84
Matrix: Water
Workgroup Number: WG256560
Collect Date: 11/09/2007 18:55
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 20
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 12:02
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 12:02
File ID: 10M60688

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5		U	20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3		U	20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2		U	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	19.2	J	20.0	5.00
trans-1,2-Dichloroethene	156-60-5		U	20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	1090		20.0	2.50
Tetrachloroethene	127-18-4		U	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5	5.85	J	20.0	5.00
Trichloroethene	79-01-6	308		20.0	5.00
Vinyl chloride	75-01-4		U	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.2	86	118	
1,2-Dichloroethane-d4	89.8	80	120	
Toluene-d8	99.3	88	110	
4-Bromofluorobenzene	95.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-29
Client ID: MW223-84
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 20:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 06:08
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 06:08
File ID: 10M60678

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5	0.283	J	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.838	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	5.56		1.00	0.250
trans-1,2-Dichloroethene	156-60-5	1.21		1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	30.3		1.00	0.125
Tetrachloroethene	127-18-4	0.944	J	1.00	0.250
Toluene	108-88-3	0.915	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5	2.81		1.00	0.250
Trichloroethene	79-01-6	144		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.285	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.765	J	1.00	0.500

UJ-25H

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	108	86	118	
1,2-Dichloroethane-d4	110	80	120	
Toluene-d8	96.4	88	110	
4-Bromofluorobenzene	95.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C L

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-30
Client ID: MW221-85
Matrix: Water
Workgroup Number: WG256560
Collect Date: 11/09/2007 20:42
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 12:33
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 12:33
File ID: 10M60689

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.368	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2	0.268	J	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4	0.300	J	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5	0.692	J	1.00	0.125
Tetrachloroethene	127-18-4	1.09		1.00	0.250
Toluene	108-88-3	1.31		1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	2.31		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6	0.325	J	1.00	0.250
m-,p-Xylene	136777-61-2	0.886	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.1	86	118	
1,2-Dichloroethane-d4	90.5	80	120	
Toluene-d8	98.6	88	110	
4-Bromofluorobenzene	94.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-31
Client ID: MW178-84.85
Matrix: Water
Workgroup Number: WG256560
Collect Date: 11/09/2007 10:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 13:04
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 13:04
File ID: 10M60690

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	2.31		1.00	0.250
Toluene	108-88-3	0.255	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	~~2.11~~		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.4	86	118	
1,2-Dichloroethane-d4	90.9	80	120	
Toluene-d8	99.3	88	110	
4-Bromofluorobenzene	96.1	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-2SH

1.0U-BL

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-32
Client ID: MW224-84.5
Matrix: Water
Workgroup Number: WG256560
Collect Date: 11/10/2007 08:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 16:41
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 16:41
File ID: 10M60697

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3	0.170	J	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4	2.23		1.00	0.250
Toluene	108-88-3	0.584	J	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6	13.4		1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2	0.594	J	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.3	86	118	
1,2-Dichloroethane-d4	92.9	80	120	
Toluene-d8	96.2	88	110	
4-Bromofluorobenzene	94.8	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

UJ-25H

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-33
Client ID: MW227-78
Matrix: Water
Workgroup Number: WG256560
Collect Date: 11/10/2007 09:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 17:12
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 17:12
File ID: 10M60698

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	UJ-CCH
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4	1.01		1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	UJ-2SH
2-Butanone	78-93-3		U	5.00	2.50	UJ-CCH
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	33.7		1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	1080	I	1.00	0.125	R-DL
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2	8.70		1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2	58.5		1.00	0.250	
trans-1,2-Dichloroethene	156-60-5	10.9		1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	UJ-CCH
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	118		1.00	0.125	
Tetrachloroethene	127-18-4	13.5		1.00	0.250	
Toluene	108-88-3	0.275	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5	7.33		1.00	0.250	
Trichloroethene	79-01-6	347	I	1.00	0.250	R-DL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	101	86	118	
1,2-Dichloroethane-d4	98.0	80	120	
Toluene-d8	96.9	88	110	
4-Bromofluorobenzene	99.2	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
I Semiquantitative result (out of instrument calibration range)

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-33
Client ID: MW227-78
Matrix: Water
Workgroup Number: WG256661
Collect Date: 11/10/2007 09:30
Sample Tag: DL01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: TMB
Dilution: 20
Units: ug/L

Instrument: HPMS10
Prep Date: 11/23/2007 13:43
Cal Date: 11/15/2007 16:17
Run Date: 11/23/2007 13:43
File ID: 10M60714

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	100	50.0
Benzene	71-43-2		U	20.0	2.50
Bromodichloromethane	75-27-4		U	20.0	5.00
Bromoform	75-25-2		U	20.0	10.0
Bromomethane	74-83-9		U	20.0	10.0
2-Butanone	78-93-3		U	100	50.0
Carbon disulfide	75-15-0		U	20.0	10.0
Carbon tetrachloride	56-23-5	27.2		20.0	5.00
Chlorobenzene	108-90-7		U	20.0	2.50
Chlorodibromomethane	124-48-1		U	20.0	5.00
Chloroethane	75-00-3		U	20.0	10.0
Chloroform	67-66-3	1150		20.0	2.50
Chloromethane	74-87-3		U	20.0	5.00
1,1-Dichloroethane	75-34-3		U	20.0	2.50
1,2-Dichloroethane	107-06-2	6.99	J	20.0	5.00
1,1-Dichloroethene	75-35-4		U	20.0	10.0
cis-1,2-Dichloroethene	156-59-2	52.9		20.0	5.00
trans-1,2-Dichloroethene	156-60-5	8.75	J	20.0	5.00
1,2-Dichloropropane	78-87-5		U	20.0	4.00
cis-1,3-Dichloropropene	10061-01-5		U	20.0	5.00
trans-1,3-Dichloropropene	10061-02-6		U	20.0	10.0
Ethylbenzene	100-41-4		U	20.0	5.00
2-Hexanone	591-78-6		U	100	50.0
4-Methyl-2-pentanone	108-10-1		U	100	50.0
Methylene chloride	75-09-2		U	20.0	5.00
Styrene	100-42-5		U	20.0	2.50
1,1,2,2-Tetrachloroethane	79-34-5	97.7		20.0	2.50
Tetrachloroethene	127-18-4	12.2	J	20.0	5.00
Toluene	108-88-3		U	20.0	5.00
1,1,1-Trichloroethane	71-55-6		U	20.0	5.00
1,1,2-Trichloroethane	79-00-5	5.68	J	20.0	5.00
Trichloroethene	79-01-6	374		20.0	5.00
Vinyl chloride	75-01-4		U	20.0	5.00
o-Xylene	95-47-6		U	20.0	5.00
m-,p-Xylene	136777-61-2		U	20.0	10.0

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	98.9	86	118	
1,2-Dichloroethane-d4	89.0	80	120	
Toluene-d8	99.6	88	110	
4-Bromofluorobenzene	93.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-34
Client ID: MW228-78
Matrix: Water
Workgroup Number: WG256661
Collect Date: 11/10/2007 10:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: TMB
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/23/2007 14:14
Cal Date: 11/15/2007 16:17
Run Date: 11/23/2007 14:14
File ID: 10M60715

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	UJ-CCH
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	UJ-ASH
2-Butanone	78-93-3		U	5.00	2.50	UJ-CCH
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5		U	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	4.51		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250	
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	UJ-CCH
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5	5.07		1.00	0.125	
Tetrachloroethene	127-18-4		U	1.00	0.250	
Toluene	108-88-3	0.284	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250	
Trichloroethene	79-01-6	0.974	J	1.00	0.250	1.0U-BL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	97.6	86	118	
1,2-Dichloroethane-d4	90.7	80	120	
Toluene-d8	98.3	88	110	
4-Bromofluorobenzene	93.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

CL

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-35
Client ID: MW56-69
Matrix: Water
Workgroup Number: WG256661
Collect Date: 11/10/2007 10:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: TMB
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/23/2007 14:45
Cal Date: 11/15/2007 16:17
Run Date: 11/23/2007 14:45
File ID: 10M60716

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1		U	5.00	2.50	UJ-CCH
Benzene	71-43-2		U	1.00	0.125	
Bromodichloromethane	75-27-4		U	1.00	0.250	
Bromoform	75-25-2		U	1.00	0.500	
Bromomethane	74-83-9		U	1.00	0.500	UJ-2SH
2-Butanone	78-93-3		U	5.00	2.50	UJ-CCH
Carbon disulfide	75-15-0		U	1.00	0.500	
Carbon tetrachloride	56-23-5	0.303	J	1.00	0.250	
Chlorobenzene	108-90-7		U	1.00	0.125	
Chlorodibromomethane	124-48-1		U	1.00	0.250	
Chloroethane	75-00-3		U	1.00	0.500	
Chloroform	67-66-3	7.53		1.00	0.125	
Chloromethane	74-87-3		U	1.00	0.250	
1,1-Dichloroethane	75-34-3		U	1.00	0.125	
1,2-Dichloroethane	107-06-2		U	1.00	0.250	
1,1-Dichloroethene	75-35-4		U	1.00	0.500	
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250	
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250	
1,2-Dichloropropane	78-87-5		U	1.00	0.200	
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250	
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500	
Ethylbenzene	100-41-4		U	1.00	0.250	
2-Hexanone	591-78-6		U	5.00	2.50	UJ-CCH
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50	
Methylene chloride	75-09-2		U	1.00	0.250	
Styrene	100-42-5		U	1.00	0.125	
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125	
Tetrachloroethene	127-18-4	0.305	J	1.00	0.250	
Toluene	108-88-3	0.291	J	1.00	0.250	
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250	
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250	
Trichloroethene	79-01-6	0.295	J	1.00	0.250	1.0U-BL
Vinyl chloride	75-01-4		U	1.00	0.250	
o-Xylene	95-47-6		U	1.00	0.250	
m-,p-Xylene	136777-61-2		U	1.00	0.500	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	96.8	86	118	
1,2-Dichloroethane-d4	89.5	80	120	
Toluene-d8	96.6	88	110	
4-Bromofluorobenzene	91.0	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-L

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-36
Client ID: MW174-76-SB
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 12:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 02:23
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 02:23
File ID: 10M60671

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	86	118	
1,2-Dichloroethane-d4	102	80	120	
Toluene-d8	94.8	88	110	
4-Bromofluorobenzene	92.5	86	115	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-37
Client ID: MW225-88-SB
Matrix: Water
Workgroup Number: WG256536
Collect Date: 11/09/2007 15:40
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS10
Prep Date: 11/21/2007 02:55
Cal Date: 11/15/2007 16:17
Run Date: 11/21/2007 02:55
File ID: 10M60672

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	104	80	120	
Toluene-d8	95.8	88	110	
4-Bromofluorobenzene	92.7	86	115	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-38
Client ID: TB-1-1113
Matrix: Water
Workgroup Number: WG255910
Collect Date: 11/02/2007 14:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/15/2007 14:33
Cal Date: 11/07/2007 13:09
Run Date: 11/15/2007 14:33
File ID: 14M01308

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	86	118	
1,2-Dichloroethane-d4	102	80	120	
Toluene-d8	110	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit

Report Number: L0711410
Report Date : December 11, 2007

Sample Number: L0711410-39
Client ID: TB-2-1113
Matrix: Water
Workgroup Number: WG255910
Collect Date: 11/02/2007 14:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS14
Prep Date: 11/15/2007 15:04
Cal Date: 11/07/2007 13:09
Run Date: 11/15/2007 15:04
File ID: 14M01309

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	86	118	
1,2-Dichloroethane-d4	108	80	120	
Toluene-d8	108	88	110	
4-Bromofluorobenzene	103	86	115	

U Not detected at or above adjusted sample detection limit

C. L

COC No. A 71614

156 Starlite Drive
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD / *24 HOUR | Location: Memphis, TN

Project #: 334469.5A.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B (GW)	BTEX/5035A (Soil)	% Solids	TOC (Plug)	ADDITIONAL REQUIREMENTS
*MW231_192		X	9/12/07	1120		X	3		X				*24 HOUR TAT*
MW237_55		X	9/12/07	1350		X	5			X	X	X	
TB-1_0912		X	9/7/07	1930		X	2		X				Trip Blank - Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/12/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
			Erin Cedar	9-13-07	11:15	3	

*Homogenize all composite samples prior to analysis

Page 1 of 1

95316781

COC No. A 71606

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531679

Company Name: CH2M Hill

Project Contact: David Nelson

Contact Phone #: 678 530 4250

Turn Around Requirements: STD

Location: Memphis, TN

Project #: 334469.SA.HS

Project Name: Memphis Depot

Sampler (print): DEREK MILLER

Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	326	ADDITIONAL REQUIREMENTS
MW231_177-190_0929-1		X	9/29/07	2205		X	3		X	
MW231_177-190-0930-1		X	9/30/07	1500		X	3		X	
MW231_177-190-0936-2		X	9/30/07	2200		X	3		X	
MW231_177-190_1001-1		X	10/1/07	1000		X	3		X	
MW231_177-190_1001-2		X	10/1/07	2200		X	3		X	
MW231_177-190_1002-1		X	10/2/07	1000		X	3		X	
TB-1_1002		X	9/7/07	1445		X	2		X	Trip Blank - Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	10/2/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
				10-3-07	1116	2	

*Homogenize all composite samples prior to analysis

COC No. 71613

156 Starlite Drive
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B
MW232_169_1003-1		X	10/3/07	2200		X	3		X
MW232_169_1004-1		X	10/4/07	1000		X	3		X
MW232_169_1004-1-AB		X	10/4/07	1005		X	3		X
TB-1_1010		X	9/7/07	1445		X	2		X

ADDITIONAL REQUIREMENTS

Ambient Blank
Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	10/10/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
			Erin Elder	10-11-07	1010	1	

*Homogenize all composite samples prior to analysis

9531680

COC No. A 77355

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531681

Company Name: CH2M Hill

Project Contact: David Nelson

Contact Phone #: 770 604 9182

Turn Around Requirements: * 3-DAY *

Location: Memphis Dept

Project ID: 334469, SA, HS

Sampler (print): DEREK MILLER

Signature:

3-DAY TAT

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	8260	TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS
MW232-161		X	11/5/07	1705	W	3		X		
MW239-169		X	11/6/07	1240		3		X		
MW237-172		X		1100		3		X		
MW238-190		X		1320		3		X		
MW234-170		X		1500		3		X		
MW231-181		X		1525		3		X		
MW235-59		X		1630		3		X		Containers ID wrong
MW-236-34		X		1640		3		X		
TB-1-1106		X	11/2/07	1425		2		X		Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/6/07	1830					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:
			Lindal Medley	11-07-07	10:29	0

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

COC No 77356

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis Depot

Project ID: 334469.SA.HS

Sampler (print): DEREK MILLER | Signature:

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	8260B	TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS
MW14-77.5		X	11/7/07	0907	W	9		X		MS/MSD
MW3-71		X		0945		3		X		
MW15-75		X		1045		3		X		
MW6-69		X		1105		3		X		
MW6-69-D		X		1105		3		X		
MW29-42		X		1215		3		X		
MW13-75		X		1235		3		X		
MW34-149		X		1345		3		X		
MW8-RD-EB		X		1355		3		X		Equipment Blank
MW91-69		X		1415		3		X		
MW35-84		X		1500		3		X		
MW126-24.5		X		1530		3		X		
MW30-54		X		1625		3		X		
MW240-90		X		1655		3		X		
MW127-64		X	11/8/07	0830		3		X		
MW42-57		X		0930		3		X		
MW128-69.5		X		0930		3		X		
MW128-69.5-D		X		0930		3		X		
MW182-70		X		1030		3		X		
MW129-74.5		X		1030		3		X		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/13/07	1930	FEDEX				

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:
			Linda Hedge	11-14-07	10.21	9531682

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

COC No. A 77357

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531683

Company Name:

Project Contact: SEE PAGE 1 Contact Phone #:

Turn Around Requirements: Location:

Project ID: ONE

Sampler (print): Signature:

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	826(8)	TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS
MW185-90.5		X	11/8/07	1135	W	3		X		
MW51-61		X		1155		3		X		
MW183-168		X		1225		3		X		
MW78-59		X		1325		3		X		
MW134-84		X		1405		3		X		
MW180-81		X		1410		3		X		
MW80-71		X		1440		3		X		
MW134-84-RD-EB		X		1440		3		X		Equipment Blank
MW132-82		X		1515		3		X		
MW179-86		X		1520		3		X		
MW187-81		X		1610		3		X		
MW176-85		X		1630		3		X		
MW176-85-D		X		1630		3		X		
MW58-66.5		X		1645		3		X		
MW87-68		X	11/9/07	0820		3		X		
MW175-77		X		0850		3		X		
MW186-153		X		0840		3		X		
MW186-153-RD-EB		X		0900		3		X		Equipment Blank
MW189-86		X		0950		3		X		
MW74-85		X		0950		3		X		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/13/07	1930	FEDEX				

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:
				11-14-07	10:21	

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

COC No. 77357

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:

Project Contact: SEE PAGE 1 | Contact Phone #:

Turn Around Requirements: ONE | Location:

Project ID:

Sampler (print): | Signature:

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	8260B	TOTAL #(UAB USE)	ADDITIONAL REQUIREMENTS
MW185-90.5		X	11/8/07	1135	W	3		X		
MW51-61		X		1155		3		X		
MW183-168		X		1225		3		X		
MW78-59		X		1325		3		X		
MW134-84		X		1405		3		X		
MW180-81		X		1410		3		X		
MW80-71		X		1440		3		X		
MW134-84-RD-EB		X		1440		3		X		Equipment Blank
MW132-82		X		1515		3		X		
MW179-86		X		1520		3		X		
MW187-81		X		1610		3		X		
MW176-85		X		1630		3		X		
MW176-85-D		X		1630		3		X		
MW58-66.5		X		1645		3		X		
MW87-68		X	11/9/07	0820		3		X		
MW175-77		X		0850		3		X		
MW186-153		X		0840		3		X		
MW186-153-RD-EB		X		0900		3		X		Equipment Blank
MW189-86		X		0950		3		X		
MW74-85		X		0958		3		X		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/13/07	1930	FEDEX				
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	
				11-14-07	10:21		

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

95316844

COC No. A 77358

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

95316B5

Company Name:

Project Contact: SEE PAGE 1 Contact Phone #:

Turn Around Requirements: Location:

Project ID: ONE

Sampler (print): Signature:

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	8260B	TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS
MW75-87		X	11/9/07	1045	W	3		X		
MW75-87-D		X		1045		3		X		
MW190-86		X		1108		9		X		MS/MSD
MW172-77		X		1110		3		X		
MW59-81		X		1135		3		X		
MW174-76		X		1235		3		X		
MW60-77		X		1250		3		X		
MW195-79		X		1319		3		X		
MW195-79-D		X		1319		3		X		
MW61-74		X		1355		3		X		
MW193-80		X		1440		3		X		
MW220-75		X		1455		3		X		
MW225-88		X		1510		3		X		
MW184-68		X		1545		3		X		Bailed
MW191-77		X		1600		3		X		Bailed
MW226-83		X		1630		3		X		Containers labeled wrong
MW12-83		X		1700		3		X		Bailed
MW4-78		X		1745		3		X		Bailed
MW226-83-D		X		1630		3		X		
MW222-84		X		1855		3		X		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/13/07	1930	FEDEX
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)

Date	Time	Remarks.
11-14-07	10:24	

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

COC No. 77359

156 Starlite Drive
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: SEE PAGE 1

Project Contact: | Contact Phone #:

Turn Around Requirements: ONE | Location:

Project ID:

Sampler (print): | Signature:

Program: ☐ CWA ☐ RCRA ☐ DOD ☐ AFCEE ☐ Other

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold	8260B		TOTAL # (LAB USE)	ADDITIONAL REQUIREMENTS
MW223-84		X	11/9/07	2030	W	3		X	X		
MW221-85		X	↓	2043	↓	3		X			
MW178-84.85		X	↓	1020	↓	3		X			
MW224-84.5		X	11/10/07	0810	↓	3		X			
MW227-78		X	↓	0930	↓	3		X			
MW228-78		X	↓	1020	↓	3		X			
MW56-69		X	↓	1030	↓	3		X			Bailed
MW174-76-SB		X	11/9/07	1235	↓	1		X			Ambient Blank
MW225-88-SB		X	11/9/07	1540	↓	1		X			Ambient Blank
TB-1_1113		X	11/2/07	1425	↓	3		X			Trip Blank
TB-2_1113		X	11/2/07	1425	↓	3		X			Trip Blank

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	11/13/07	1930	FEDEX				

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

9531686

MEMORANDUM CH2MHILL

Data Validation Summary – Memphis Depot, Soil Sampling 2007

TO: David Nelson/CH2M HILL/ATL

FROM: Camden Robinson/CH2M HILL/ATL
Kaye Walker/CH2M HILL/MGM

DATE: March 12, 2008

The purpose of this memorandum is to present the results of the data validation process for the samples collected for Memphis Depot, Soil Sampling 2007. The samples were collected on September 1st, 2007 thru September 17th, 2007.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were reviewed and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA *National Functional Guidelines for Organic Data Review (EPA 1999)*. Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to Kemron Environmental Services, in Marietta, Ohio for the following analyses: SW-846 8260B Volatile Organic Compounds (VOC), and Lloyd Kahn method Total Organic Carbon (TOC).

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the one, two/three-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

[=] Detected. The analyte was analyzed for and detected at the concentration shown.

[J] Estimated. The analyte was present but the reported value may not be accurate or precise.

[U] Undetected. The analyte was analyzed for but not detected above the method detection limit.

[UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.

[R] Rejected. The data is not useable.

Secondary Qualifier Codes

Code	Definition
2SH	Second Source Accuracy High
2SL	Second Source Accuracy Low
BD	Blank Spike/Blank Spike Duplicate (LCS/LCSD) Precision
BL	Blank
BSH	Blank Spike/LCS Recovery High
BSL	Blank Spike/LCS Recovery Low
CCH	Continuing Calibration Verification Accuracy High
CCL	Continuing Calibration Verification Accuracy Low
DL	Dilution
FD	Field Duplicate
HT	Holding Time
ICH	Initial Calibration High
ICL	Initial Calibration Low
ISH	Internal Standard Area Response High
ISL	Internal Standard Area Response Low
LR	Linear Range (Exceeded calibration range)
MD	Matrix Spike/Matrix Spike Duplicate Precision
MSH	Matrix Spike and/or Matrix Spike Duplicate Recovery High
MSL	Matrix Spike and/or Matrix Spike Duplicate Recovery Low
OT	Other
RE	Re-extraction
SSH	Spiked Surrogate Recovery High
SSL	Spiked Surrogate Recovery Low
TN	Tune
P	Primary/Confirmatory Column Criteria greater than 40%
M	Matrix Interference with quantitation of analytes
LD	Laboratory Duplicate
ST	Sample Temperature

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

SDG	Sample ID	Lab Sample ID	Matrix	Sample Type	Date Collected	Analyses Performed
L0709016	MW233-SS-80	L0709016-01	S	N	09/01/2007	[1], [2]
L0709016	MW231-SS-96	L0709016-02	S	N	09/01/2007	[2]
L0709016	TB-1-0901	L0709016-03	WQ	TB	09/01/2007	[1]
L0709038	MW235-SS-65	L0709038-01	S	N	09/04/2007	[1], [2]
L0709038	TB-1-0904	L0709038-02	WQ	TB	09/04/2007	[1]
L0709056	MW236-SS-38	L0709056-01	S	N	09/05/2007	[1], [2]
L0709056	TB-1-0905	L0709056-01	WQ	TB	09/05/2007	[1]
L0709098	MW234-SS-81	L0709098-01	S	N	09/06/2007	[1], [2]
L0709098	TB-1-0906	L0709098-02	WQ	TB	09/06/2007	[1]
L0709257	MW237-SS	L0709257-01	S	N	09/12/2007	[1], [2]
L0709257	TB-1-0912	L0709257-02	WQ	TB	09/12/2007	[1]
L0709319	MW238-SS-90	L0709319-01	S	N	09/13/2007	[1], [2]
L0709319	TB-1-0913	L0709319-02	WQ	TB	09/13/2007	[1]
L0709351	MW239-SS-104	L0709351-01	S	N	09/14/2007	[1], [2]
L0709351	TB-1-0914	L0709351-02	WQ	TB	09/14/2007	[1]
L0709398	MW232-SS-127	L0709398-01	S	N	09/17/2007	[1], [2]
L0709398	MW232-SS-127-D	L0709398-02	S	FD	09/17/2007	[1], [2]
L0709398	TB-1-0917	L0709398-03	WQ	TB	09/17/2007	[1]

MATRIX CODE

S – Soil/Solid
WQ – Water Quality Control

SAMPLE TYPE CODE

N - Native Sample
FD – Field Duplicate
TB – Trip Blank

ANALYSIS CODE

[1] – VOC –Volatile Organic Compounds by SW-846 method 8260B
[2] – TOC – Total Organic Carbon by method Lloyd Kahn

Organic Parameters

Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for organic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks and trip blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Surrogate Recoveries** – Surrogate Compounds are added to each sample and the recoveries are used to monitor lab performance and possible matrix interference.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and it's duplicate. This information can only be determined when target compounds are detected.
- **GC/MS Tuning** – The mass spectrum of the tuning compound is evaluated for method compliance. The criteria are established to verify the proper mass assignment and mass resolution.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.
- **Internal Standards** – The internal standards (retention time and response) are evaluated for method compliance. The internal standards are used in quantitation of the target parameters and monitor the instrument sensitivity and response for stability during each analysis.

Volatile Organic Compounds (VOC) Analyses

The QA/QC parameters for the VOC analyses for all of the samples were within acceptable control limits, except as noted below:

Continuing Calibration

All continuing calibration criteria were met, except as listed in Table 1.

TABLE 1
Exceptions to Continuing Calibration: VOC
Memphis Depot Soil Sampling 2007

Instrument/Calibration Date	Analyte	%Relative Standard Deviation or R^2 (ICAL)/ %Difference (CCAL)	Associated Samples
CCV-HPMS9 / 09/10/07, 10:03	Acetone	30.0% high	MW233-SS-80
CCV-HPMS9 / 09/11/07, 09:43	Bromoform	26.2% high	MW235-SS-65 MW236-SS-38
CCV – Continuing Calibration			

Flags were applied to the compounds in the associated samples in the following manner:

- When the percent difference (%D) was outside acceptance criteria in the continuing calibration, detected compounds were flagged "J" and non-detected compounds were flagged "UJ", as estimated with a validation note of "CCH" for high percent recoveries.

Recoveries - Surrogates

All Surrogate recoveries were within acceptable quality control limits, except as noted in Table 2 below.

TABLE 2
Surrogate Recoveries Out of QC Limits: VOC
Memphis Depot Soil Sampling 2007

SDG	Sample	Parameter	Recovery	Recovery Limits	Associated Samples	Flag
L0709038	MW235-SS-65	Toluene-d8	128%	81-117	MW235-SS-65	Detects-J
L0709056	MW236-SS-38	Toluene-d8	138%	81-117	MW236-SS-38	Detects-J
		4-Bromofluorobenzene	134%	74-121		

The volatile sample results for acetone and carbon disulfide for the samples listed above were qualified with a "J" as estimated due to surrogate recoveries were outside the acceptable limits that are listed in Table 2 with a validation note of "SSH". Please note that the samples were re-analyzed and yielded similar results.

Internal Standards

The quantitation limits reported for volatile organic compounds benzene, bromodichloromethane, bromoform, carbon tetrachloride, chlorodibromomethane, 1,2-dichloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 1,1,1-trichloroethane , and 1,1,2-trichloroethane for samples MW235-SS-65 and MW236-SS-38 should be considered quantitative estimates due to the biased low response reported for internal standard 1,4-dichlorobenzene-d4 during the sample analyses. Low internal standard recoveries are indicative of matrix interferences with the associated compounds; therefore a "UJ" qualifier was appended to the analytes listed above for samples MW235-SS-65 and MW236-SS-38 to indicate that the reported values are quantitative estimates with a validation note of "ISL". Please note that the samples were re-analyzed and yielded similar results.

Holding Time

Sample MW233-SS-80 was analyzed outside the 48 hour technical preservation holding time for terracore samples for the volatile organic compounds analysis. The volatile organic compound results for sample MW233-SS-80 have been qualified as estimated with a "UJ" qualifier for non-detects and a validation note of "HT" to indicate that the results for this sample should be considered estimated due to holding time exceedances.

Sample Temperature

Samples MW233-SS-80 and MW235-SS-65 were received at the laboratory outside the temperature requirements of $4^{\circ} \pm 2^{\circ}C$ for the volatile organic compounds analysis. The volatile organic compound results for samples MW233-SS-80 and MW235-SS-65 have been qualified as estimated with a "UJ" qualifier for non-detects or a "J" qualifier for detects, and a validation note of "ST" to indicate that the results for these samples should be considered estimated due to sample temperature exceedances.

Data Rejected during the Data Validation Process

Some samples may be analyzed multiple times by the laboratory because of dilution requirements or because spike recoveries are outside the method target acceptance limits. The laboratory reports all analyses; therefore, it is possible that several sample results may exist for a specific sample and analysis. During the data validation, all the sample results are evaluated and the "best answer" for each sample and analysis is chosen, and the other results are rejected.

The initial results for samples MW235-SS-65 and MW236-SS-38 were rejected because the samples required a re-analysis in order to confirm surrogate and internal standard failures that were caused by matrix interferences.

Field Duplicate Sample Results

Field duplicate analyses measure both field and laboratory precision and can also be affected by the homogeneity of the samples. Therefore the results may have more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples are not spiked; therefore, evaluation of duplicate sample results can only be performed on the comparison of positive sample results. Sample results are not qualified based on duplicate sample results; instead, the information is used to support the overall assessment of precision. According to the EPA *National Functional Guidelines*, there are no qualification criteria for field duplicate precision.

One field duplicate samples were submitted for the volatile organic analyses.

A control limit of ± 20 percent for the RPD was used for original and duplicate aqueous sample values greater than or equal to five times the RL. A control limit of ± the RL was used if either the sample for the duplicate value was less than five times the RL. In the cases where only one result is more than five times the RL level and the other is below, the ± RL

All of the precision data were within criteria indicating that the sample matrix did not interfere with the overall analytical process.

Inorganic Parameters

Quality Control Review

The following list represents the QA/QC measures that were reviewed during the data quality evaluation procedure for inorganic data.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Method blanks, initial calibration, and continuing calibration blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", either laboratory reagent water or Ottawa sand, in which target compounds have been added prior to extraction/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and it's duplicate. This information can only be determined when target compounds are detected.
- **Initial Calibration** – The initial calibration ensures that the instrument is capable of producing acceptable qualitative and quantitative data for the compounds of interest.
- **Continuing Calibration** – The continuing calibration checks satisfactory performance of the instrument and its predicted response to the target compounds.

Total Organic Carbon (TOC) Analysis

The QA/QC parameters for the Total Organic Carbon (TOC) analysis for all of the samples were within acceptable control limits, except as noted below:

Sample Temperature

Samples MW233-SS-80, MW231-SS-96, and MW235-SS-65 were received at the laboratory outside the temperature requirements of $4^{\circ} \pm 2^{\circ}C$ for the total organic carbon (TOC) analysis. The total organic carbon results for samples MW233-SS-80, MW231-SS-96, and MW235-SS-65 have been qualified as estimated with a "J" qualifier for detects and a validation note of "ST" to indicate that the results for these samples should be considered estimated due to sample temperature exceedances.

Field Duplicate Sample Results

Field duplicate analyses measure both field and laboratory precision and can also be affected by the homogeneity of the samples. Therefore the results may have more variability than laboratory duplicates, which measure only laboratory performance. Duplicate samples are not spiked; therefore, evaluation of duplicate sample results can only be performed on the comparison of positive sample results. Sample results are not qualified based on duplicate sample results; instead, the information is used to support the overall assessment of precision. According to the EPA *National Functional Guidelines*, there are no qualification criteria for field duplicate precision.

One field duplicate samples were submitted for the total organic carbon analyses.

A control limit of ± 20 percent for the RPD was used for original and duplicate aqueous sample values greater than or equal to five times the RL. A control limit of ± the RL was used if either the sample for the duplicate value was less than five times the RL. In the cases where only one result is more than five times the RL level and the other is below, the ± RL

The precision was outside criteria for total organic carbon indicating that the sample matrix possibly did interfere with the overall analytical process.

Rejected Data

No data were rejected based upon the validation process for this sampling event.

Conclusion

A review of the analytical data submitted regarding the investigation of Memphis Depot, Soil Sampling 2007, by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

The validation review demonstrated that the analytical systems were generally in control and the data results can be used as qualified in the decision making process.

Report Number: L0709016
Report Date : September 19, 2007

Sample Number: L0709016-01
Client ID: MW233-SS-80
Matrix: Soil
Workgroup Number: WG249681
Collect Date: 09/01/2007 11:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/10/2007 17:39
Cal Date: 08/14/2007 16:27
Run Date: 09/10/2007 17:39
File ID: 9M566S1
Percent Solid: 77.0

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	9.89	4.94
Benzene	71-43-2		U	0.989	0.494
Bromodichloromethane	75-27-4		U	1.98	0.494
Bromoform	75-25-2		U	4.94	0.494
Bromomethane	74-83-9		U	4.94	0.989
2-Butanone	78-93-3		U	4.94	2.47
Carbon disulfide	75-15-0		U	4.94	0.494
Carbon tetrachloride	56-23-5		U	4.94	0.494
Chlorobenzene	108-90-7		U	4.94	0.494
Chlorodibromomethane	124-48-1		U	1.98	0.494
Chloroethane	75-00-3		U	4.94	0.989
Chloroform	67-66-3		U	1.98	0.494
Chloromethane	74-87-3		U	4.94	1.98
1,1-Dichloroethane	75-34-3		U	1.98	0.989
1,2-Dichloroethane	107-06-2		U	1.98	0.494
1,1-Dichloroethene	75-35-4		U	4.94	0.494
cis-1,2-Dichloroethene	156-59-2		U	4.94	0.494
trans-1,2-Dichloroethene	156-60-5		U	1.98	0.494
1,2-Dichloropropane	78-87-5		U	1.98	0.494
cis-1,3-Dichloropropene	10061-01-5		U	1.98	0.494
trans-1,3-Dichloropropene	10061-02-6		U	1.98	0.494
Ethylbenzene	100-41-4		U	0.989	0.494
2-Hexanone	591-78-6		U	4.94	2.47
Methylene chloride	75-09-2		U	4.94	0.989
MIBK (methyl isobutyl ketone)	108-10-1		U	4.94	2.47
Styrene	100-42-5		U	1.98	0.494
1,1,2,2-Tetrachloroethane	79-34-5		U	1.98	0.494
Tetrachloroethene	127-18-4		U	4.94	0.494
Toluene	108-88-3		U	0.989	0.494
1,1,1-Trichloroethane	71-55-6		U	1.98	0.494
1,1,2-Trichloroethane	79-00-5		U	4.94	0.494
Trichloroethene	79-01-6		U	4.94	0.494
Vinyl chloride	75-01-4		U	1.98	0.989
o-Xylene	95-47-6		U	0.989	0.494
m-,p-Xylene	136777-61-2		U	0.989	0.494

UJ-HT,ST,CC
UJ-HT,ST

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	105	80	120	
1,2-Dichloroethane-d4	100	80	120	
Toluene-d8	101	81	117	
4-Bromofluorobenzene	100	74	121	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709016
Report Date : September 19, 2007

Sample Number: L0709016-03
Client ID: TB-1 0901
Matrix: Water
Workgroup Number: WG249650
Collect Date: 09/01/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/08/2007 20:13
Cal Date: 09/05/2007 19:51
Run Date: 09/08/2007 20:13
File ID: 11M45299

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	0.343	J	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	88.8	86	118	
1,2-Dichloroethane-d4	89.0	80	120	
Toluene-d8	94.3	88	110	
4-Bromofluorobenzene	95.4	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-P

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709016
Report Date : September 19, 2007

Sample Number: L0709016-01
Client ID: MW233-SS-80
Matrix: Soil
Workgroup Number: WG249529
Collect Date: 09/01/2007 11:00
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/06/2007 21:26
Cal Date: 02/26/2007 11:40
Run Date: 09/06/2007 21:26
File ID: TC09-06-2007.35
Percent Solid: 77.0

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		4230	J	1300	650

ST

9531700

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709016
Report Date : September 19, 2007

Sample Number: L0709016-02
Client ID: MW231_SS_96
Matrix: Soil
Workgroup Number: WG249529
Collect Date: 09/01/2007 11:15
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/06/2007 21:30
Cal Date: 02/26/2007 11:40
Run Date: 09/06/2007 21:30
File ID: TC09-06-2007.36
Percent Solid: 74.9

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		2770	J	1340	668

ST

a-L

Report Number: L0709038
Report Date : September 19, 2007

Sample Number: L0709038-01
Client ID: MW235 SS 65
Matrix: Soil
Workgroup Number: WG249773
Collect Date: 09/04/2007 14:30
Sample Tag: A1

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/11/2007 18:55
Cal Date: 08/14/2007 16:27
Run Date: 09/11/2007 18:55
File ID: 9M56682
Percent Solid: 74.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	65.3	J	12.5	6.23
Benzene	71-43-2		U	1.25	0.623
Bromodichloromethane	75-27-4		U	2.49	0.623
Bromoform	75-25-2		U	6.23	0.623
Bromomethane	74-83-9		U	6.23	1.25
2-Butanone	78-93-3		U	6.23	3.12
Carbon disulfide	75-15-0	1.35	J	6.23	0.623
Carbon tetrachloride	56-23-5		U	6.23	0.623
Chlorobenzene	108-90-7		U	6.23	0.623
Chlorodibromomethane	124-48-1		U	2.49	0.623
Chloroethane	75-00-3		U	6.23	1.25
Chloroform	67-66-3		U	2.49	0.623
Chloromethane	74-87-3		U	6.23	2.49
1,1-Dichloroethane	75-34-3		U	2.49	1.25
1,2-Dichloroethane	107-06-2		U	2.49	0.623
1,1-Dichloroethene	75-35-4		U	6.23	0.623
cis-1,2-Dichloroethene	156-59-2		U	6.23	0.623
trans-1,2-Dichloroethene	156-60-5		U	2.49	0.623
1,2-Dichloropropane	78-87-5		U	2.49	0.623
cis-1,3-Dichloropropene	10061-01-5		U	2.49	0.623
trans-1,3-Dichloropropene	10061-02-6		U	2.49	0.623
Ethylbenzene	100-41-4		U	1.25	0.623
2-Hexanone	591-78-6		U	6.23	3.12
Methylene chloride	75-09-2		U	6.23	1.25
MIBK (methyl isobutyl ketone)	108-10-1		U	6.23	3.12
Styrene	100-42-5		U	2.49	0.623
1,1,2,2-Tetrachloroethane	79-34-5		U	2.49	0.623
Tetrachloroethene	127-18-4		U	6.23	0.623
Toluene	108-88-3		U	1.25	0.623
1,1,1-Trichloroethane	71-55-6		U	2.49	0.623
1,1,2-Trichloroethane	79-00-5		U	6.23	0.623
Trichloroethene	79-01-6		U	6.23	0.623
Vinyl chloride	75-01-4		U	2.49	1.25
o-Xylene	95-47-6		U	1.25	0.623
m-,p-Xylene	136777-61-2		U	1.25	0.623

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	112	80	120	
1,2-Dichloroethane-d4	98.5	80	120	
Toluene-d8	128	81	117	*
4-Bromofluorobenzene	117	74	121	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

SSH, ST
UJ-ST, ISL
UJ-ST
UJ-ST
SSH, ST
UJ-ST, ISL
UJ-ST
UJ-ST, ISL
UJ-ST
UJ-ST, ISL
UJ-ST
UJ-ST, ISL
UJ-ST
UJ-ST, CCH
UJ-ST

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709038
Report Date : September 19, 2007

Sample Number: L0709038-01
Client ID: MW235_SS_65
Matrix: Soil
Workgroup Number: WG249681
Collect Date: 09/04/2007 14:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/10/2007 18:10
Cal Date: 08/14/2007 16:27
Run Date: 09/10/2007 18:10
File ID: 9M56652
Percent Solid: 74.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	71.3		12.7	6.37
Benzene	71-43-2		U	1.27	0.637
Bromodichloromethane	75-27-4		U	2.55	0.637
Bromoform	75-25-2		U	6.37	0.637
Bromomethane	74-83-9		U	6.37	1.27
2-Butanone	78-93-3		U	6.37	3.19
Carbon disulfide	75-15-0	1.47	J	6.37	0.637
Carbon tetrachloride	56-23-5		U	6.37	0.637
Chlorobenzene	108-90-7		U	6.37	0.637
Chlorodibromomethane	124-48-1		U	2.55	0.637
Chloroethane	75-00-3		U	6.37	1.27
Chloroform	67-66-3		U	2.55	0.637
Chloromethane	74-87-3		U	6.37	2.55
1,1-Dichloroethane	75-34-3		U	2.55	1.27
1,2-Dichloroethane	107-06-2		U	2.55	0.637
1,1-Dichloroethene	75-35-4		U	6.37	0.637
cis-1,2-Dichloroethene	156-59-2		U	6.37	0.637
trans-1,2-Dichloroethene	156-60-5		U	2.55	0.637
1,2-Dichloropropane	78-87-5		U	2.55	0.637
cis-1,3-Dichloropropene	10061-01-5		U	2.55	0.637
trans-1,3-Dichloropropene	10061-02-6		U	2.55	0.637
Ethylbenzene	100-41-4		U	1.27	0.637
2-Hexanone	591-78-6		U	6.37	3.19
Methylene chloride	75-09-2		U	6.37	1.27
MIBK (methyl isobutyl ketone)	108-10-1		U	6.37	3.19
Styrene	100-42-5		U	2.55	0.637
1,1,2,2-Tetrachloroethane	79-34-5		U	2.55	0.637
Tetrachloroethene	127-18-4		U	6.37	0.637
Toluene	108-88-3		U	1.27	0.637
1,1,1-Trichloroethane	71-55-6		U	2.55	0.637
1,1,2-Trichloroethane	79-00-5		U	6.37	0.637
Trichloroethene	79-01-6		U	6.37	0.637
Vinyl chloride	75-01-4		U	2.55	1.27
o-Xylene	95-47-6		U	1.27	0.637
m-,p-Xylene	136777-61-2		U	1.27	0.637

R-DL

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	120	80	120	
1,2-Dichloroethane-d4	106	80	120	
Toluene-d8	142	81	117	*
4-Bromofluorobenzene	126	74	121	*

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL
* Surrogate or spike compound out of range

C-4

Report Number: L0709038
Report Date : September 19, 2007

Sample Number: L0709038-02
Client ID: TB-1 0904
Matrix: Water
Workgroup Number: WG249650
Collect Date: 09/04/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MBS
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/08/2007 20:43
Cal Date: 09/05/2007 19:51
Run Date: 09/08/2007 20:43
File ID: 11M45300

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	0.446	J	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	88.9	86	118	
1,2-Dichloroethane-d4	89.6	80	120	
Toluene-d8	94.7	88	110	
4-Bromofluorobenzene	95.9	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

9531704

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709038
Report Date : September 19, 2007

Sample Number: L0709038-01
Client ID: MW235 SS 65
Matrix: Soil
Workgroup Number: WG249481
Collect Date: 09/04/2007 14:30
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/06/2007 20:19
Cal Date: 02/26/2007 11:40
Run Date: 09/06/2007 20:19
Pile ID: TC09-06-2007.29
Percent Solid: 74.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		58600	J	1340	672

ST

C-T

Report Number: L0709056
Report Date : September 19, 2007

Sample Number: L0709056-01
Client ID: MW236_SS_38
Matrix: Soil
Workgroup Number: WG249773
Collect Date: 09/05/2007 14:35
Sample Tag: A1

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/11/2007 19:26
Cal Date: 08/14/2007 16:27
Run Date: 09/11/2007 19:26
File ID: 9M56683
Percent Solid: 77.5

Analyte	CAS. Number	Result	Qual	RL	MDL	
Acetone	67-64-1	22.2	J	10.8	5.40	SSH
Benzene	71-43-2		U	1.08	0.540	UJ-ISL
Bromodichloromethane	75-27-4		U	2.16	0.540	↓
Bromoform	75-25-2		U	5.40	0.540	
Bromomethane	74-83-9		U	5.40	1.08	
2-Butanone	78-93-3		U	5.40	2.70	
Carbon disulfide	75-15-0		U	5.40	0.540	
Carbon tetrachloride	56-23-5		U	5.40	0.540	UJ-ISL
Chlorobenzene	108-90-7		U	5.40	0.540	
Chlorodibromomethane	124-48-1		U	2.16	0.540	UJ-ISL
Chloroethane	75-00-3		U	5.40	1.08	
Chloroform	67-66-3		U	2.16	0.540	
Chloromethane	74-87-3		U	5.40	2.16	
1,1-Dichloroethane	75-34-3		U	2.16	1.08	
1,2-Dichloroethane	107-06-2		U	2.16	0.540	
1,1-Dichloroethene	75-35-4		U	5.40	0.540	
cis-1,2-Dichloroethene	156-59-2		U	5.40	0.540	
trans-1,2-Dichloroethene	156-60-5		U	2.16	0.540	
1,2-Dichloropropane	78-87-5		U	2.16	0.540	UJ-ISL
cis-1,3-Dichloropropene	10061-01-5		U	2.16	0.540	↓
trans-1,3-Dichloropropene	10061-02-6		U	2.16	0.540	
Ethylbenzene	100-41-4		U	1.08	0.540	
2-Hexanone	591-78-6		U	5.40	2.70	
Methylene chloride	75-09-2		U	5.40	1.08	
MIBK (methyl isobutyl ketone)	108-10-1		U	5.40	2.70	
Styrene	100-42-5		U	2.16	0.540	
1,1,2,2-Tetrachloroethane	79-34-5		U	2.16	0.540	
Tetrachloroethene	127-18-4		U	5.40	0.540	
Toluene	108-88-3		U	1.08	0.540	
1,1,1-Trichloroethane	71-55-6		U	2.16	0.540	UJ-ISL
1,1,2-Trichloroethane	79-00-5		U	5.40	0.540	↓
Trichloroethene	79-01-6		U	5.40	0.540	
Vinyl chloride	75-01-4		U	2.16	1.08	UJ-CCH
o-Xylene	95-47-6		U	1.08	0.540	
m-,p-Xylene	136777-61-2		U	1.08	0.540	

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	119	80	120	
1,2-Dichloroethane-d4	107	80	120	
Toluene-d8	138	81	117	*
4-Bromofluorobenzene	134	74	121	*

U Not detected at or above adjusted sample detection limit
* Surrogate or spike compound out of range

C.T

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709056
Report Date : September 19, 2007

Sample Number: L0709056-01
Client ID: MW236 SS 38
Matrix: Soil
Workgroup Number: WG249681
Collect Date: 09/05/2007 14:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/10/2007 18:40
Cal Date: 08/14/2007 16:27
Run Date: 09/10/2007 18:40
File ID: 9M56653
Percent Solid: 77.5

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	19.0		11.1	5.56
Benzene	71-43-2		U	1.11	0.556
Bromodichloromethane	75-27-4		U	2.22	0.556
Bromoform	75-25-2		U	5.56	0.556
Bromomethane	74-83-9		U	5.56	1.11
2-Butanone	78-93-3		U	5.56	2.78
Carbon disulfide	75-15-0		U	5.56	0.556
Carbon tetrachloride	56-23-5		U	5.56	0.556
Chlorobenzene	108-90-7		U	5.56	0.556
Chlorodibromomethane	124-48-1		U	2.22	0.556
Chloroethane	75-00-3		U	5.56	1.11
Chloroform	67-66-3		U	2.22	0.556
Chloromethane	74-87-3		U	5.56	2.22
1,1-Dichloroethane	75-34-3		U	2.22	1.11
1,2-Dichloroethane	107-06-2		U	2.22	0.556
1,1-Dichloroethene	75-35-4		U	5.56	0.556
cis-1,2-Dichloroethene	156-59-2		U	5.56	0.556
trans-1,2-Dichloroethene	156-60-5		U	2.22	0.556
1,2-Dichloropropane	78-87-5		U	2.22	0.556
cis-1,3-Dichloropropene	10061-01-5		U	2.22	0.556
trans-1,3-Dichloropropene	10061-02-6		U	2.22	0.556
Ethylbenzene	100-41-4		U	1.11	0.556
2-Hexanone	591-78-6		U	5.56	2.78
Methylene chloride	75-09-2		U	5.56	1.11
MIBK (methyl isobutyl ketone)	108-10-1		U	5.56	2.78
Styrene	100-42-5		U	2.22	0.556
1,1,2,2-Tetrachloroethane	79-34-5		U	2.22	0.556
Tetrachloroethene	127-18-4		U	5.56	0.556
Toluene	108-88-3		U	1.11	0.556
1,1,1-Trichloroethane	71-55-6		U	2.22	0.556
1,1,2-Trichloroethane	79-00-5		U	5.56	0.556
Trichloroethene	79-01-6		U	5.56	0.556
Vinyl chloride	75-01-4		U	2.22	1.11
o-Xylene	95-47-6		U	1.11	0.556
m-,p-Xylene	136777-61-2		U	1.11	0.556

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	110	80	120	
1,2-Dichloroethane-d4	99.5	80	120	
Toluene-d8	132	81	117	*
4-Bromofluorobenzene	129	74	121	*

U Not detected at or above adjusted sample detection limit
* Surrogate or spike compound out of range

R-DL

Report Number: L0709056
Report Date : September 19, 2007

Sample Number: L0709056-02
Client ID: TB-1 0905
Matrix: Water
Workgroup Number: WG249650
Collect Date: 09/05/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/08/2007 22:13
Cal Date: 09/05/2007 19:51
Run Date: 09/08/2007 22:13
File ID: 11M45303

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	0.387	J	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	89.5	86	118	
1,2-Dichloroethane-d4	92.9	80	120	
Toluene-d8	95.9	88	110	
4-Bromofluorobenzene	95.7	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

9531708

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709056

Report Date : September 19, 2007

Sample Number: L0709056-01
Client ID: MW236 SS 38
Matrix: Soil
Workgroup Number: WG249529
Collect Date: 09/05/2007 14:35
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/06/2007 21:48
Cal Date: 02/26/2007 11:40
Run Date: 09/06/2007 21:48
File ID: TC09-06-2007.39
Percent Solid: 77.5

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		30000		1290	645

C-1

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709098
Report Date : September 27, 2007

Sample Number: L0709098-01
Client ID: MW234 SS-81
Matrix: Soil
Workgroup Number: WG250097
Collect Date: 09/06/2007 17:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/14/2007 19:46
Cal Date: 08/14/2007 16:27
Run Date: 09/14/2007 19:46
File ID: 9MS6771
Percent Solid: 82.7

Analyte	CAS Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	10.3	5.17
Benzene	71-43-2		U	1.03	0.517
Bromodichloromethane	75-27-4		U	2.07	0.517
Bromoform	75-25-2		U	5.17	0.517
Bromomethane	74-83-9		U	5.17	1.03
2-Butanone	78-93-3		U	5.17	2.58
Carbon disulfide	75-15-0		U	5.17	0.517
Carbon tetrachloride	56-23-5		U	5.17	0.517
Chlorobenzene	108-90-7		U	5.17	0.517
Chlorodibromomethane	124-48-1		U	2.07	0.517
Chloroethane	75-00-3		U	5.17	1.03
Chloroform	67-66-3		U	2.07	0.517
Chloromethane	74-87-3		U	5.17	2.07
1,1-Dichloroethane	75-34-3		U	2.07	1.03
1,2-Dichloroethane	107-06-2		U	2.07	0.517
1,1-Dichloroethene	75-35-4		U	5.17	0.517
cis-1,2-Dichloroethene	156-59-2		U	5.17	0.517
trans-1,2-Dichloroethene	156-60-5		U	2.07	0.517
1,2-Dichloropropane	78-87-5		U	2.07	0.517
cis-1,3-Dichloropropene	10061-01-5		U	2.07	0.517
trans-1,3-Dichloropropene	10061-02-6		U	2.07	0.517
Ethylbenzene	100-41-4		U	1.03	0.517
2-Hexanone	591-78-6		U	5.17	2.58
Methylene chloride	75-09-2		U	5.17	1.03
MIBK (methyl isobutyl ketone)	108-10-1		U	5.17	2.58
Styrene	100-42-5		U	2.07	0.517
1,1,2,2-Tetrachloroethane	79-34-5		U	2.07	0.517
Tetrachloroethene	127-18-4		U	5.17	0.517
Toluene	108-88-3		U	1.03	0.517
1,1,1-Trichloroethane	71-55-6		U	2.07	0.517
1,1,2-Trichloroethane	79-00-5		U	5.17	0.517
Trichloroethene	79-01-6		U	5.17	0.517
Vinyl chloride	75-01-4		U	2.07	1.03
o-Xylene	95-47-6		U	1.03	0.517
m-,p-Xylene	136777-61-2		U	1.03	0.517

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	102	80	120	
1,2-Dichloroethane-d4	86.2	80	120	
Toluene-d8	113	81	117	
4-Bromofluorobenzene	116	74	121	

U Not detected at or above adjusted sample detection limit

C-1

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709098
Report Date : September 27, 2007

Sample Number: L0709098-02
Client ID: TB-1 0906
Matrix: Water
Workgroup Number: WG249716
Collect Date: 09/06/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/10/2007 17:31
Cal Date: 09/05/2007 19:51
Run Date: 09/10/2007 17:31
File ID: 11M45330

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	0.376	J	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	89.5	86	118	
1,2-Dichloroethane-d4	91.5	80	120	
Toluene-d8	93.6	88	110	
4-Bromofluorobenzene	96.2	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

Report Number: L0709098
Report Date : September 27, 2007

Sample Number: L0709098-01
Client ID: MW234_SS-81
Matrix: Soil
Workgroup Number: WG250758
Collect Date: 09/06/2007 17:05
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 11:50
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 11:50
File ID: TC09-23-2007.06
Percent Solid: 82.7

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		3500		1210	605

C-2

Report Number: L0709257
Report Date : October 1, 2007

Sample Number: L0709257-01
Client ID: MW237 SS
Matrix: Soil
Workgroup Number: WG250340
Collect Date: 09/12/2007 13:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/18/2007 14:01
Cal Date: 08/14/2007 16:27
Run Date: 09/18/2007 14:01
File ID: 9MS6858
Percent Solid: 80.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	9.97	4.98
Benzene	71-43-2		U	0.997	0.498
Bromodichloromethane	75-27-4		U	1.99	0.498
Bromoform	75-25-2		U	4.98	0.498
Bromomethane	74-83-9		U	4.98	0.997
2-Butanone	78-93-3		U	4.98	2.49
Carbon disulfide	75-15-0		U	4.98	0.498
Carbon tetrachloride	56-23-5		U	4.98	0.498
Chlorobenzene	108-90-7		U	4.98	0.498
Chlorodibromomethane	124-48-1		U	1.99	0.498
Chloroethane	75-00-3		U	4.98	0.997
Chloroform	67-66-3		U	1.99	0.498
Chloromethane	74-87-3		U	4.98	1.99
1,1-Dichloroethane	75-34-3		U	1.99	0.997
1,2-Dichloroethane	107-06-2		U	1.99	0.498
1,1-Dichloroethene	75-35-4		U	4.98	0.498
cis-1,2-Dichloroethene	156-59-2	3.37	J	4.98	0.498
trans-1,2-Dichloroethene	156-60-5	0.592	J	1.99	0.498
1,2-Dichloropropane	78-87-5		U	1.99	0.498
cis-1,3-Dichloropropene	10061-01-5		U	1.99	0.498
trans-1,3-Dichloropropene	10061-02-6		U	1.99	0.498
Ethylbenzene	100-41-4		U	0.997	0.498
2-Hexanone	591-78-6		U	4.98	2.49
Methylene chloride	75-09-2		U	4.98	0.997
MIBK (methyl isobutyl ketone)	108-10-1		U	4.98	2.49
Styrene	100-42-5		U	1.99	0.498
1,1,2,2-Tetrachloroethane	79-34-5		U	1.99	0.498
Tetrachloroethene	127-18-4		U	4.98	0.498
Toluene	108-88-3		U	0.997	0.498
1,1,1-Trichloroethane	71-55-6		U	1.99	0.498
1,1,2-Trichloroethane	79-00-5		U	4.98	0.498
Trichloroethene	79-01-6	2.53	J	4.98	0.498
Vinyl chloride	75-01-4		U	1.99	0.997
o-Xylene	95-47-6		U	0.997	0.498
m-,p-Xylene	136777-61-2		U	0.997	0.498

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	109	80	120	
1,2-Dichloroethane-d4	96.3	80	120	
Toluene-d8	110	81	117	
4-Bromofluorobenzene	102	74	121	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709257
Report Date : October 1, 2007

Sample Number: L0709257-02
Client ID: TB-1 0912
Matrix: Water
Workgroup Number: WG250631
Collect Date: 09/12/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS6
Prep Date: 09/21/2007 11:13
Cal Date: 09/12/2007 17:13
Run Date: 09/21/2007 11:13
File ID: 6M69139

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	4.71	J	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.3	86	118	
1,2-Dichloroethane-d4	94.3	80	120	
Toluene-d8	99.8	88	110	
4-Bromofluorobenzene	102	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709257
Report Date : October 1, 2007

Sample Number: L0709257-01
Client ID: MW237 SS
Matrix: Soil
Workgroup Number: WG250758
Collect Date: 09/12/2007 13:50
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 12:53
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 12:53
File ID: TC09-23-2007.15
Percent Solid: 80.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		3850		1240	622

Report Number: L0709319
Report Date : September 28, 2007

Sample Number: L0709319-01
Client ID: MW238_SS_90
Matrix: Soil
Workgroup Number: WG250439
Collect Date: 09/13/2007 13:20
Sample Tag: 02

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/19/2007 12:30
Cal Date: 08/14/2007 16:27
Run Date: 09/19/2007 12:30
File ID: 9M56887
Percent Solid: 80.9

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	10.5	5.24
Benzene	71-43-2		U	1.05	0.524
Bromodichloromethane	75-27-4		U	2.09	0.524
Bromoform	75-25-2		U	5.24	0.524
Bromomethane	74-83-9		U	5.24	1.05
2-Butanone	78-93-3		U	5.24	2.62
Carbon disulfide	75-15-0		U	5.24	0.524
Carbon tetrachloride	56-23-5		U	5.24	0.524
Chlorobenzene	108-90-7		U	5.24	0.524
Chlorodibromomethane	124-48-1		U	2.09	0.524
Chloroethane	75-00-3		U	5.24	1.05
Chloroform	67-66-3		U	2.09	0.524
Chloromethane	74-87-3		U	5.24	2.09
1,1-Dichloroethane	75-34-3		U	2.09	1.05
1,2-Dichloroethane	107-06-2		U	2.09	0.524
1,1-Dichloroethene	75-35-4		U	5.24	0.524
cis-1,2-Dichloroethene	156-59-2		U	5.24	0.524
trans-1,2-Dichloroethene	156-60-5		U	2.09	0.524
1,2-Dichloropropane	78-87-5		U	2.09	0.524
cis-1,3-Dichloropropene	10061-01-5		U	2.09	0.524
trans-1,3-Dichloropropene	10061-02-6		U	2.09	0.524
Ethylbenzene	100-41-4		U	1.05	0.524
2-Hexanone	591-78-6		U	5.24	2.62
Methylene chloride	75-09-2		U	5.24	1.05
MIBK (methyl isobutyl ketone)	108-10-1		U	5.24	2.62
Styrene	100-42-5		U	2.09	0.524
1,1,2,2-Tetrachloroethane	79-34-5		U	2.09	0.524
Tetrachloroethene	127-18-4		U	5.24	0.524
Toluene	108-88-3		U	1.05	0.524
1,1,1-Trichloroethane	71-55-6		U	2.09	0.524
1,1,2-Trichloroethane	79-00-5		U	5.24	0.524
Trichloroethene	79-01-6		U	5.24	0.524
Vinyl chloride	75-01-4		U	2.09	1.05
o-Xylene	95-47-6		U	1.05	0.524
m-,p-Xylene	136777-61-2		U	1.05	0.524

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	107	80	120	
1,2-Dichloroethane-d4	98.2	80	120	
Toluene-d8	104	81	117	
4-Bromofluorobenzene	98.6	74	121	

U Not detected at or above adjusted sample detection limit

C-2

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709319
Report Date : September 28, 2007

Sample Number: L0709319-02
Client ID: TB-1 0913
Matrix: Water
Workgroup Number: WG250727
Collect Date: 09/13/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS6
Prep Date: 09/22/2007 13:11
Cal Date: 09/12/2007 17:13
Run Date: 09/22/2007 13:11
File ID: 6M69175

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	3.48	J	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	95.3	86	118	
1,2-Dichloroethane-d4	94.8	80	120	
Toluene-d8	99.9	88	110	
4-Bromofluorobenzene	100	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

ARMRON ENVIRONMENTAL SERVICES

Report Number: L0709319
Report Date : September 28, 2007

Sample Number: L0709319-01
Client ID: MW238 SS 90
Matrix: Soil
Workgroup Number: WG250758
Collect Date: 09/13/2007 13:20
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 12:59
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 12:59
File ID: TC09-23-2007.16
Percent Solid: 80.9

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		4140		1240	618

Report Number: L0709351
Report Date : October 2, 2007

Sample Number: L0709351-01
Client ID: MW239-SS-104
Matrix: Soil
Workgroup Number: WG250340
Collect Date: 09/14/2007 14:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/18/2007 17:33
Cal Date: 08/14/2007 16:27
Run Date: 09/18/2007 17:33
File ID: 9MS6865
Percent Solid: 82.1

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	9.69	4.84
Benzene	71-43-2		U	0.969	0.484
Bromodichloromethane	75-27-4		U	1.94	0.484
Bromoform	75-25-2		U	4.84	0.484
Bromomethane	74-83-9		U	4.84	0.969
2-Butanone	78-93-3		U	4.84	2.42
Carbon disulfide	75-15-0		U	4.84	0.484
Carbon tetrachloride	56-23-5		U	4.84	0.484
Chlorobenzene	108-90-7		U	4.84	0.484
Chlorodibromomethane	124-48-1		U	1.94	0.484
Chloroethane	75-00-3		U	4.84	0.969
Chloroform	67-66-3		U	1.94	0.484
Chloromethane	74-87-3		U	4.84	1.94
1,1-Dichloroethane	75-34-3		U	1.94	0.969
1,2-Dichloroethane	107-06-2		U	1.94	0.484
1,1-Dichloroethene	75-35-4		U	4.84	0.484
cis-1,2-Dichloroethene	156-59-2		U	4.84	0.484
trans-1,2-Dichloroethene	156-60-5		U	1.94	0.484
1,2-Dichloropropane	78-87-5		U	1.94	0.484
cis-1,3-Dichloropropene	10061-01-5		U	1.94	0.484
trans-1,3-Dichloropropene	10061-02-6		U	1.94	0.484
Ethylbenzene	100-41-4		U	0.969	0.484
2-Hexanone	591-78-6		U	4.84	2.42
Methylene chloride	75-09-2		U	4.84	0.969
MIBK (methyl isobutyl ketone)	108-10-1		U	4.84	2.42
Styrene	100-42-5		U	1.94	0.484
1,1,2,2-Tetrachloroethane	79-34-5		U	1.94	0.484
Tetrachloroethene	127-18-4		U	4.84	0.484
Toluene	108-88-3		U	0.969	0.484
1,1,1-Trichloroethane	71-55-6		U	1.94	0.484
1,1,2-Trichloroethane	79-00-5		U	4.84	0.484
Trichloroethene	79-01-6		U	4.84	0.484
Vinyl chloride	75-01-4		U	1.94	0.969
o-Xylene	95-47-6		U	0.969	0.484
m-,p-Xylene	136777-61-2		U	0.969	0.484

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	109	80	120	
1,2-Dichloroethane-d4	97.8	80	120	
Toluene-d8	106	81	117	
4-Bromofluorobenzene	99.6	74	121	

U Not detected at or above adjusted sample detection limit

Report Number: L0709351
Report Date : October 2, 2007

Sample Number: L0709351-02
Client ID: TB-1_0914
Matrix: Water
Workgroup Number: WG250896
Collect Date: 09/14/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/L

Instrument: HPMS11
Prep Date: 09/25/2007 00:51
Cal Date: 09/05/2007 19:51
Run Date: 09/25/2007 00:51
File ID: 11M45819

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1	4.46	J	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3		U	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	88.2	86	118	
1,2-Dichloroethane-d4	94.9	80	120	
Toluene-d8	94.3	88	110	
4-Bromofluorobenzene	94.9	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

C-2

Report Number: L0709351
Report Date : October 2, 2007

Sample Number: L0709351-01
Client ID: MW239-SS-104
Matrix: Soil
Workgroup Number: MG250758
Collect Date: 09/14/2007 14:25
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 13:05
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 13:05
File ID: TC09-23-2007.17
Percent Solid: 82.1

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		3860		1220	609

CT

Report Number: L0709398
Report Date : October 2, 2007

Sample Number: L0709398-01
Client ID: MW232 SS 127-
Matrix: Soil
Workgroup Number: WG250439
Collect Date: 09/17/2007 15:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/19/2007 13:01
Cal Date: 08/14/2007 16:27
Run Date: 09/19/2007 13:01
File ID: 9M56888
Percent Solid: 84.5

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	10.4	5.19
Benzene	71-43-2		U	1.04	0.519
Bromodichloromethane	75-27-4		U	2.08	0.519
Bromoform	75-25-2		U	5.19	0.519
Bromomethane	74-83-9		U	5.19	1.04
2-Butanone	78-93-3		U	5.19	2.60
Carbon disulfide	75-15-0		U	5.19	0.519
Carbon tetrachloride	56-23-5		U	5.19	0.519
Chlorobenzene	108-90-7		U	5.19	0.519
Chlorodibromomethane	124-48-1		U	2.08	0.519
Chloroethane	75-00-3		U	5.19	1.04
Chloroform	67-66-3		U	2.08	0.519
Chloromethane	74-87-3		U	5.19	2.08
1,1-Dichloroethane	75-34-3		U	2.08	1.04
1,2-Dichloroethane	107-06-2		U	2.08	0.519
1,1-Dichloroethene	75-35-4		U	5.19	0.519
cis-1,2-Dichloroethene	156-59-2		U	5.19	0.519
trans-1,2-Dichloroethene	156-60-5		U	2.08	0.519
1,2-Dichloropropane	78-87-5		U	2.08	0.519
cis-1,3-Dichloropropene	10061-01-5		U	2.08	0.519
trans-1,3-Dichloropropene	10061-02-6		U	2.08	0.519
Ethylbenzene	100-41-4		U	1.04	0.519
2-Hexanone	591-78-6		U	5.19	2.60
Methylene chloride	75-09-2		U	5.19	1.04
MIBK (methyl isobutyl ketone)	108-10-1		U	5.19	2.60
Styrene	100-42-5		U	2.08	0.519
1,1,2,2-Tetrachloroethane	79-34-5		U	2.08	0.519
Tetrachloroethene	127-18-4		U	5.19	0.519
Toluene	108-88-3		U	1.04	0.519
1,1,1-Trichloroethane	71-55-6		U	2.08	0.519
1,1,2-Trichloroethane	79-00-5		U	5.19	0.519
Trichloroethene	79-01-6		U	5.19	0.519
Vinyl chloride	75-01-4		U	2.08	1.04
o-Xylene	95-47-6		U	1.04	0.519
m-,p-Xylene	136777-61-2		U	1.04	0.519

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	103	80	120	
1,2-Dichloroethane-d4	92.0	80	120	
Toluene-d8	99.7	81	117	
4-Bromofluorobenzene	93.1	74	121	

U Not detected at or above adjusted sample detection limit

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709398
Report Date : October 2, 2007

Sample Number: L0709398-02
Client ID: MW232_SS_127-D
Matrix: Soil
Workgroup Number: WG250439
Collect Date: 09/17/2007 15:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: MES
Dilution: 1
Units: ug/kg

Instrument: HPMS9
Prep Date: 09/19/2007 13:32
Cal Date: 08/14/2007 16:27
Run Date: 09/19/2007 13:32
File ID: 9M56889
Percent Solid: 83.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	9.68	4.84
Benzene	71-43-2		U	0.968	0.484
Bromodichloromethane	75-27-4		U	1.94	0.484
Bromoform	75-25-2		U	4.84	0.484
Bromomethane	74-83-9		U	4.84	0.968
2-Butanone	78-93-3		U	4.84	2.42
Carbon disulfide	75-15-0		U	4.84	0.484
Carbon tetrachloride	56-23-5		U	4.84	0.484
Chlorobenzene	108-90-7		U	4.84	0.484
Chlorodibromomethane	124-48-1		U	1.94	0.484
Chloroethane	75-00-3		U	4.84	0.968
Chloroform	67-66-3		U	1.94	0.484
Chloromethane	74-87-3		U	4.84	1.94
1,1-Dichloroethane	75-34-3		U	1.94	0.968
1,2-Dichloroethane	107-06-2		U	1.94	0.484
1,1-Dichloroethene	75-35-4		U	4.84	0.484
cis-1,2-Dichloroethene	156-59-2		U	4.84	0.484
trans-1,2-Dichloroethene	156-60-5		U	1.94	0.484
1,2-Dichloropropane	78-87-5		U	1.94	0.484
cis-1,3-Dichloropropene	10061-01-5		U	1.94	0.484
trans-1,3-Dichloropropene	10061-02-6		U	1.94	0.484
Ethylbenzene	100-41-4		U	0.968	0.484
2-Hexanone	591-78-6		U	4.84	2.42
Methylene chloride	75-09-2		U	4.84	0.968
MIBK (methyl isobutyl ketone)	108-10-1		U	4.84	2.42
Styrene	100-42-5		U	1.94	0.484
1,1,2,2-Tetrachloroethane	79-34-5		U	1.94	0.484
Tetrachloroethene	127-18-4		U	4.84	0.484
Toluene	108-88-3		U	0.968	0.484
1,1,1-Trichloroethane	71-55-6		U	1.94	0.484
1,1,2-Trichloroethane	79-00-5		U	4.84	0.484
Trichloroethene	79-01-6		U	4.84	0.484
Vinyl chloride	75-01-4		U	1.94	0.968
o-Xylene	95-47-6		U	0.968	0.484
m-,p-Xylene	136777-61-2		U	0.968	0.484

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	108	80	120	
1,2-Dichloroethane-d4	96.5	80	120	
Toluene-d8	105	81	117	
4-Bromofluorobenzene	98.1	74	121	

U Not detected at or above adjusted sample detection limit

C.L

Report Number: L0709398
Report Date : October 2, 2007

Sample Number: L0709398-03
Client ID: TB-1 0917
Matrix: Water
Workgroup Number: WG251027
Collect Date: 09/17/2007 00:01
Sample Tag: 01

PrePrep Method: NONE
Prep Method: 5030B
Analytical Method: 8260B
Analyst: CMS
Dilution: 1
Units: ug/L

Instrument: HPMS8
Prep Date: 09/26/2007 14:46
Cal Date: 09/25/2007 21:35
Run Date: 09/26/2007 14:46
File ID: 8M339949

Analyte	CAS. Number	Result	Qual	RL	MDL
Acetone	67-64-1		U	5.00	2.50
Benzene	71-43-2		U	1.00	0.125
Bromodichloromethane	75-27-4		U	1.00	0.250
Bromoform	75-25-2		U	1.00	0.500
Bromomethane	74-83-9		U	1.00	0.500
2-Butanone	78-93-3		U	5.00	2.50
Carbon disulfide	75-15-0		U	1.00	0.500
Carbon tetrachloride	56-23-5		U	1.00	0.250
Chlorobenzene	108-90-7		U	1.00	0.125
Chlorodibromomethane	124-48-1		U	1.00	0.250
Chloroethane	75-00-3		U	1.00	0.500
Chloroform	67-66-3		U	1.00	0.125
Chloromethane	74-87-3	0.667	J	1.00	0.250
1,1-Dichloroethane	75-34-3		U	1.00	0.125
1,2-Dichloroethane	107-06-2		U	1.00	0.250
1,1-Dichloroethene	75-35-4		U	1.00	0.500
cis-1,2-Dichloroethene	156-59-2		U	1.00	0.250
trans-1,2-Dichloroethene	156-60-5		U	1.00	0.250
1,2-Dichloropropane	78-87-5		U	1.00	0.200
cis-1,3-Dichloropropene	10061-01-5		U	1.00	0.250
trans-1,3-Dichloropropene	10061-02-6		U	1.00	0.500
Ethylbenzene	100-41-4		U	1.00	0.250
2-Hexanone	591-78-6		U	5.00	2.50
4-Methyl-2-pentanone	108-10-1		U	5.00	2.50
Methylene chloride	75-09-2		U	1.00	0.250
Styrene	100-42-5		U	1.00	0.125
1,1,2,2-Tetrachloroethane	79-34-5		U	1.00	0.125
Tetrachloroethene	127-18-4		U	1.00	0.250
Toluene	108-88-3		U	1.00	0.250
1,1,1-Trichloroethane	71-55-6		U	1.00	0.250
1,1,2-Trichloroethane	79-00-5		U	1.00	0.250
Trichloroethene	79-01-6		U	1.00	0.250
Vinyl chloride	75-01-4		U	1.00	0.250
o-Xylene	95-47-6		U	1.00	0.250
m-,p-Xylene	136777-61-2		U	1.00	0.500

Surrogate	% Recovery	Lower	Upper	Qual
Dibromofluoromethane	96.0	86	118	
1,2-Dichloroethane-d4	87.3	80	120	
Toluene-d8	103	88	110	
4-Bromofluorobenzene	93.6	86	115	

U Not detected at or above adjusted sample detection limit
J The analyte was positively identified, but the quantitation was below the RL

KEMRON ENVIRONMENTAL SERVICES

9531724

Report Number: L0709398
Report Date : October 2, 2007

Sample Number: L0709398-01
Client ID: MW232 SS 127
Matrix: Soil
Workgroup Number: WG250758
Collect Date: 09/17/2007 15:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 13:11
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 13:11
File ID: TC09-23-2007.18
Percent Solid: 84.5

Analyte	CAS: Number	Result	Qual	RL	MDL
Total Organic Carbon		3180		1180	592

C-4

KEMRON ENVIRONMENTAL SERVICES

Report Number: L0709398
Report Date : October 2, 2007

Sample Number: L0709398-02
Client ID: MW232 SS 127-D
Matrix: Soil
Workgroup Number: WG250758
Collect Date: 09/17/2007 15:10
Sample Tag: 01

PrePrep Method: NONE
Prep Method: LYDKHN
Analytical Method: LYDKHN
Analyst: DIH
Dilution: 1
Units: mg/kg

Instrument: TOC-VWP
Prep Date: 09/23/2007 13:17
Cal Date: 02/28/2007 09:24
Run Date: 09/23/2007 13:17
File ID: TC09-23-2007.19
Percent Solid: 83.4

Analyte	CAS. Number	Result	Qual	RL	MDL
Total Organic Carbon		20600		1200	599

C-2

COC No. A 74043

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

Phone: 740-373-4071
Fax: 740-373-4835

CHAIN-OF-CUSTODY RECORD

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	% Solids	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW233-55-80		X	9/1/07	1100		X	5		X	X	X	
MW231_55_96		X	9/1/07	1115		X	1				X	
TB-1_0901		X	8/28/07	1537		X	2		X			Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/1/07	1300					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
				9-4-07	1010	23	

*Homogenize all composite samples prior to analysis

Page 1 of 1

9531726

COC No. A 74044

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531727

Company Name: CH2M Hill

Project Contact: David Nelson

Contact Phone #: 678 530 4250

Turn Around Requirements: STD

Location: Memphis TN

Project #: 334469.SA.HS

Project Name: Memphis Depot

Sampler (print): DEREK MILLER

Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	% Solids	TOC (445.1)	ADDITIONAL REQUIREMENTS
MW235_55_65		X	9/4/07	1430		X	5		X	X	X	
TB-1_0904		X	8/29/07	1537		X	2		X			Trip Blank-Laboratory Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/4/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
				9-6-07	1210	8	

*Homogenize all composite samples prior to analysis

COC No. 74045

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	% Solids	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW236_55_38		X	9/5/07	1435		X	5		X	X	X	
TB-1_0905		X	8/28/07	1537			2		X			Trip Blank - Lab provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/5/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
				9-6-07	1045	2	9531728

*Homogenize all composite samples prior to analysis

COC No. A 74046

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531729

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	PCT-5	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW234_55-81		X	9/6/07	1705		X	5		X	X	X	
TB-1-0906		X	8/28/07	1537		X	2		X			Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/6/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
			Kelli Klingel	9-7-07	1040	4	

*Homogenize all composite samples prior to analysis

COC No. A 71614

156 Starlite Drive
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill	
Project Contact: David Nelson	Contact Phone #: 678 530 4250
Turn Around Requirements: STD / *24 HOUR	Location: Memphis, TN
Project #: 334469.5A.HS	Project Name: Memphis Dept
Sampler (print): DEREK MILLER	Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B (GW)	8260B/5035A (Soil)	% Solids	TOC (Lloyd Kahn)	ADDITIONAL REQUIREMENTS
*MW231_192		X	9/12/07	1120		X	3		X				*24 HOUR TAT*
MW237_55		X	9/12/07	1350		X	5			X	X	X	
TB-L_0912		X	9/7/07	1930 1445		X	2		X				Trip Blank - Lab Provided

Relinquished by: (Signature)	Date 9/12/07	Time 1930	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature) Erin Elder	Date 9-13-07	Time 1115	Cooler Temp in °C 3	Remarks:	

*Homogenize all composite samples prior to analysis

Page 1 of 1

9531730

COC No. A 71615

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531731

Company Name: CH2M Hill

Project Contact: David Nelson

Contact Phone #: 678 530 4250

Turn Around Requirements: STD

Location: Memphis, TN

Project #: 334469.SA.HS

Project Name: Memphis Depot

Sampler (print): DEREK MILLER

Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	PCT-S	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW238_SS_90		X	9/13/07	1320		X	5		X	X	X	
TB-1_0913		X	9/7/07	1445		X	2		X			Trip Blank - Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/13/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
			Erin Elder	9-14-07	1220	4	

*Homogenize all composite samples prior to analysis

COC No. A 71604

156 Starlite Drive
Marietta, OH 45750

KEMRON ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): DEREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	8260B/5035A	% Solids	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW239_55_104		X	9/14/07	1425		X	2		X	X	X	
TB-1-0914		X	9/7/07	1445		X	2		X			Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/14/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
				9-15-07	0918		

*Homogenize all composite samples prior to analysis

95317732

COC No. A 71605

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

9531733

Company Name: CH2M Hill

Project Contact: David Nelson | Contact Phone #: 678 530 4250

Turn Around Requirements: STD | Location: Memphis, TN

Project #: 334469.SA.HS | Project Name: Memphis Depot

Sampler (print): EREK MILLER | Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USAGE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA	Protocol SW846	NUMBER OF CONTAINERS	Hold	BTEX 8260B/5035A	PCT-S	TOC (415.1)	ADDITIONAL REQUIREMENTS
MW232_SS_127		X	9/17/07	1510		X	9		X	X	X	
MW232_SS_127-D		X	9/17/07	1510		X	9		X	X	X	
TB-1_0917		X	8/28/07	1537		X	2		X			Trip Blank-Lab Provided

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	9/17/07	1930					

Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
			Erin Elder	9-18-07	1215	4	

*Homogenize all composite samples prior to analysis

ATTACHMENT E

Geotechnical Laboratory Report

KEMRON
ENVIRONMENTAL SERVICES

1359-A Ellsworth Industrial Blvd • Atlanta, GA 30318 • TEL 404-636-0928 • FAX 404-636-7162

November 7, 2007

David Nelson
CH2MHill
North Park 400
1000 Abernathy Road
Suite 1600
Atlanta, GA 30328

Re: Final Letter Report
MEMPHIS DEPOT
KEMRON ATG Project #SE-0234

Dear Mr. Nelson:

Enclosed, please find the testing results for the MEMPHIS DEPOT Project. The following samples were received on 2 October 2007 for Geotechnical testing:

MW231-ST-93-94.5
MW232-ST-136-138
MW237-ST-112-114
MW239-ST-107-109
MW238-ST-96-98
MW234-ST-82-84
MW233-ST-88-90
MW236-ST-47-49

This letter report includes a summary of the testing results, supporting laboratory data and the sample chain of custody. The following tests were completed for the samples referenced above: Hydraulic Conductivity - ASTM D5084 and Particle Size Analysis - ASTM D422.

KEMRON Environmental Services, Inc. appreciates this opportunity to provide laboratory services to CH2MHILL. If you have any questions, or require additional information, please contact me at (404) 636-0928.

Sincerely,

KEMRON Environmental Services, Inc.

Kelly M. Clemons
Program Manager

Attachments

9531736

SUMMARY DATA TABLE

KEMRON
ENVIRONMENTAL SERVICES

CH2MHILL
MEMPHIS DEPOT
TABLE 1
SUMMARY OF TESTING
MOISTURE CONTENT - ASTM D2216
PARTICLE SIZE ANALYSIS - ASTM D422

SAMPLE ID	RESULTS				
	Moisture Content (%)	Particle Size Analyses			
		Gravel (%)	Sand (%)	Silt (%)	Clay (%)
MW231-ST-93-94.5	23.68	0.0	16.0	52.4	31.6
MW232-ST-136-138	5.30	8.8	39.0	31.1	21.1
MW237-ST-112-114	21.31	0.0	19.7	56.7	23.6
MW239-ST-107-109	20.87	0.0	19.4	53.2	27.4
MW238-ST-96-98	23.08	0.0	6.6	60.9	32.5
MW234-ST-82-84	22.62	0.0	6.5	58.4	35.1
MW233-ST-88-90	24.09	0.0	45.5	36.7	17.8
MW236-ST-47-49	31.64	0.0	1.4	41.1	57.5

9531737

KEMRON
ENVIRONMENTAL SERVICES

95317738

CH2MHILL
MEMPHIS DEPOT
TABLE 2
SUMMARY OF TESTING
FALLING HEAD PERMEABILITY RESULTS - ASTM D 5084

SAMPLE ID	HYDRAULIC CONDUCTIVITY			
	Initial Moisture Content (%)	Initial Bulk Density (lbs/ft^3)	Dry Density (lbs/ft^3)	Permeability (k) (cm/sec) (1)
MW231-ST-93-94.5	25.0	126.4	101.1	**3.60E-07**
MW232-ST-136-138	CND	CND	CND	*
MW237-ST-112-114	21.0	127.8	105.6	**8.30E-09**
MW239-ST-107-109	20.9	125.2	103.6	**1.80E-07**
MW238-ST-96-98	22.8	123.5	100.6	**2.00E-08**
MW234-ST-82-84	23.9	125.9	101.6	**1.80E-08**
MW233-ST-88-90	21.9	130.8	107.3	**7.90E-09**
MW236-ST-47-49	29.5	120.0	92.7	**1.60E-08**

9531739

CHAIN OF CUSTODY

COC No. A 67263

156 Starlite Drive
Marietta, OH 45750

KEMRON
ENVIRONMENTAL SERVICES

Phone: 740-373-4071
Fax: 740-373-4835

CHAIN-OF-CUSTODY RECORD

Company Name: CH2M Hill

Project Contact: David Nelson

Contact Phone #: 678 530 4250

Turn Around Requirements: STD

Location: Memphis, TN

Project #: 334469.SA.HS

Project Name: Memphis Depot

Sampler (print): DEREK MILLER

Signature:

Program: ☐ NPDES ☐ AFCEE ☐ RCRA ☐ USACE ☐ Other

Sample I.D. No.	Comp*	Grab	Date	Time	Protocol CWA SW846	NUMBER OF CONTAINERS	Hold (ASTM D 5084)	Vertical Permeability	Grain size Analysis (W/hydrometer) (ASTM D 422)
MW231_ST_93-95		X	8/28/07	1430	ASTM	1		X	X
MW233_ST_88-90		X	9/1/07	1110	"	1		X	X
MW236_ST_47-49		X	9/5/07	1440	"	1		X	X
MW234_ST_82-84		X	9/6/07	1700	"	1		X	X
MW237_ST_112-114		X	9/12/07	1345	"	1		X	X
MW238_ST_96-98		X	9/13/07	1400	"	1		X	X
MW239_ST_107-109		X	9/14/07	1600	"	1		X	X
MW232_ST_136-138		X	9/17/07	1530	"	1		X	X

ADDITIONAL REQUIREMENTS

*All samples are 30" Shelby tubes. All analyses on tubes request grain size w/o hydrometer, please change to analyze WITH hydrometer.

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	10/1/07	1300	10-2-07				
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Cooler Temp in °C	Remarks:
							9531740

*Homogenize all composite samples prior to analysis

Page 1 of 1

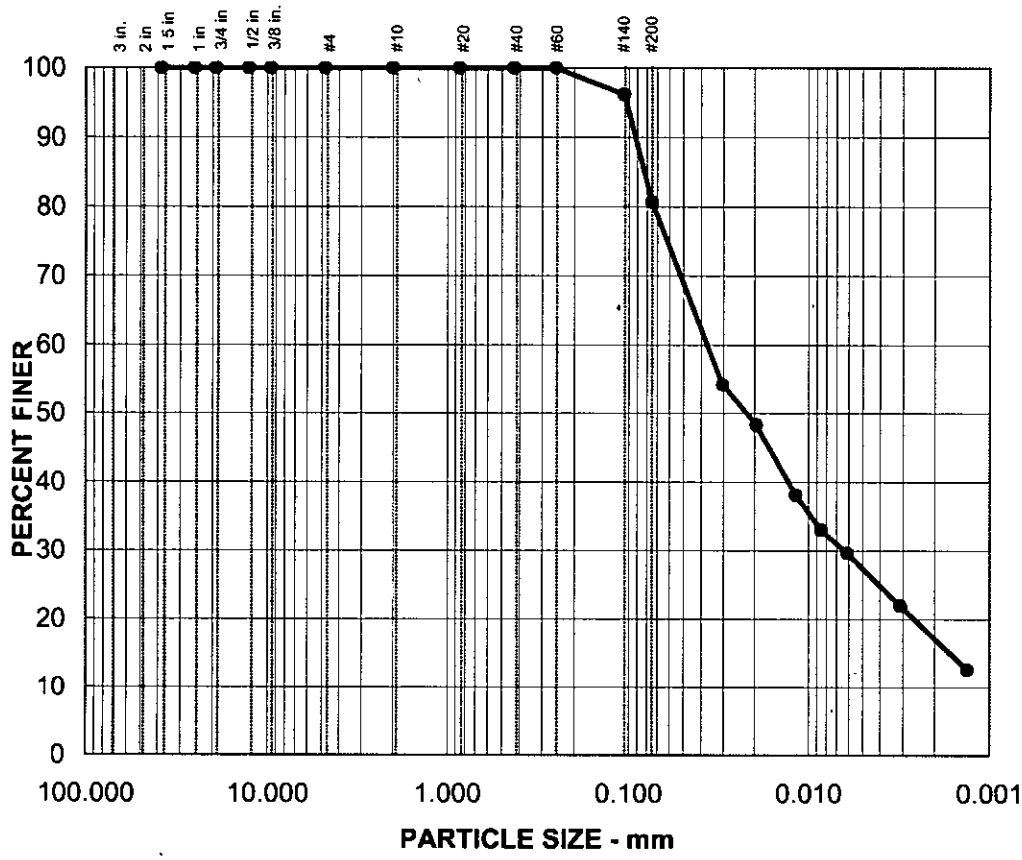
Memphis Depot - CH2MHill Page 6 of 71

9531741

PHYSICAL PROPERTY DATA

9531742

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	19.4	53.2	27.4

SAMPLE INFORMATION	
Project Name:	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-239-ST-107-109
Sample Description:	Silty Clay
Testing Date:	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Sandy Silty Clay	

KEMRON ENVIRONMENTAL SERVICES

PARTICLE SIZE DISTRIBUTION TEST REPORT PAGE 1 OF 2

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No.:	SE-0234
SAMPLE No.:	MW-239-ST-107-109
SAMPLE DESCRIPT:	Silty Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4503_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	255.50 g
WT WET SOIL + TARE	325.36 g
WT DRY SOIL + TARE	313 30 g
WT WATER, Ww	12.06 g
WT DRY SOIL, Ws	57 80 g
ASTM MOISTURE	20.87 %
EPA MOISTURE	17.26 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1 0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100 0 %
#4	100.0 %
#10	100.0 %
#20	100 0 %
#40	100.0 %
#60	100.0 %
#140	96.1 %
#200	80 6 %

HYDROMETER ANALYSIS	
HYDROMETER No.	14
Wt OF DRY SOIL, Ws	46.61
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:41:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	37.5	32 0	0.0301	54.2
5	34.0	28.5	0.0196	48.3
15	28.0	22.5	0.0118	38.1
30	25 0	19.5	0.0085	33.0
60	23.0	17.5	0 0061	29 6
250	18 5	13.0	0.0031	22.0
1440	13 0	7.5	0.0013	12.6

KEMRON
ENVIRONMENTAL SERVICES

9531744

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW239-ST-107-109	MW239-ST-107-109
2. WT MOISTURE TIN (tare weight)	0.00 *g*	227.70 *g*
3. WT WET SOIL + TARE	625.30 *g*	864.20 *g*
4. WT DRY SOIL + TARE	517.20 *g*	744.90 *g*
5. WT WATER, Ww	108.10 g	119.30 g
6. WT DRY SOIL, Ws	517.20 g	517.20 g
7. MOISTURE CONTENT, W	20.90 %	23.07 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.90 in.*	*2.90 in.*	*2.89 in.*	*2.90 in.*
No. 2	*2.90 in.*	*2.90 in.*	*2.89 in.*	*2.89 in.*
No. 3	*2.88 in.*	*2.89 in.*	*2.90 in.*	*2.88 in.*
Average	2.89 in.	2.90 in.	2.89 in.	2.89 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*625.30 g*	*636.90 g*
Area, Ao	6.57 in^2	6.59 in^2
Volume, Vo	19.02 in^3	19.05 in^3
Bulk Unit Weight	125.2 lb/ft^3	127.4 lb/ft^3
Dry Unit Weight	103.6 lb/ft^3	103.5 lb/ft^3

9531745

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		

TEST	TIME	TESTED	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
DATE	(military)	BY	CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/04/07	14 : 30	RRB	7.0	5.0	5.8				
10/04/07	15 : 46	RRB	17.0	15.0	15.8	12.2	10.0	6.4	0.64
10/04/07	17 : 30	RRB	27.0	25.0	25.8	24.4	10.0	8.6	0.86
10/04/07	9 : 41	RRB	37.0	35.0	35.9	34.9	10.0	9.1	0.91
10/04/07	11 : 25	RRB	47.0	45.0	45.8	45.3	10.0	9.4	0.94
10/08/07	13 : 16	RRB	57.0	55.0	*	55.8	10.0	10.0	1.00
10/08/07	8 : 15	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531746

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4503
SAMPLE No.:	MW239-ST-107-109	1
TEST DATE:	4 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	TESTED BY	TIME (Military)	ELAPSED TIME (minutes)	TOTAL TIME (minutes)	TOTAL TIME (Log)	SPECIMEN CONSOLIDATION (ML)		
						READING		ACTUAL
						BOTTOM	TOP	TOTAL (Ct)
10 / 8 / 7	RRB	8 : 17				25.0	25.0	0.0
10 / 8 / 7	RRB	8 : 18	1	1	0.00	24.0	24.0	2.0
10 / 8 / 7	RRB	8 : 19	1	2	0.30	23.9	23.9	2.2
10 / 8 / 7	RRB	9 : 50	91	93	1.97	22.5	22.6	4.9
10 / 8 / 7	RRB	10 : 35	45	138	2.14	22.2	22.5	5.3
10 / 8 / 7	RRB	11 : 57	82	220	2.34	22.0	22.2	5.8
10 / 8 / 7	RRB	13 : 42	105	325	2.51	21.9	22.2	5.9
10 / 8 / 7	RRB	14 : 59	77	402	2.60	21.9	22.1	6.0
10 / 9 / 7	RRB	13 : 7	1328	1730	3.24	21.9	22.1	6.0

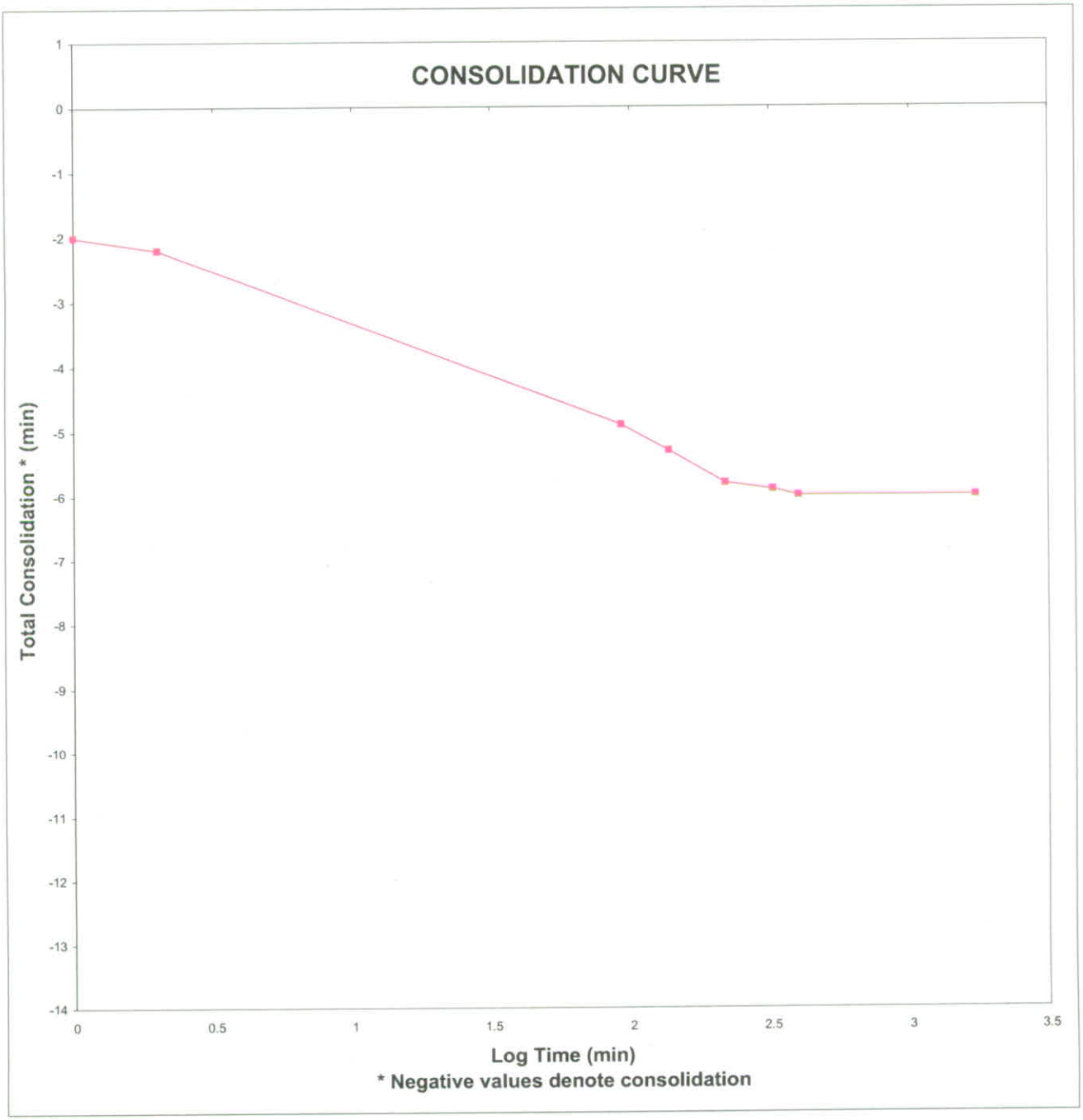
9531747

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		



9531748

PERMEABILITY ASTM D5084

TEST DATA

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP. C°	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT		CELL	INFLUENT	EFFLUENT
10 / 9 / 7	RRB	15 : 3		0.0	25.0	20.0	55.0	47.0	45.0
10 / 9 / 7	RRB	15 : 50	47	0.5	24.5	20.0	55.0	47.0	45.0
10 / 10 / 7	RRB	11 : 50	RESET	0.0	25.0	20.0	55.0	50.0	45.0
10 / 10 / 7	RRB	12 : 33	43	1.0	24.0	20.0	55.0	50.0	45.0
10 / 10 / 7	RRB	13 : 44	RESET	0.0	25.0	20.0	55.0	50.0	45.0
10 / 10 / 7	RRB	14 : 49	65	1.2	23.8	20.0	55.0	50.0	45.0
10 / 10 / 7	RRB	15 : 55	66	3.1	21.9	20.0	55.0	50.0	45.0

9531749

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		

ELAPSED TIME	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT*	*HYDRAULIC GRADIENT*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
(minutes)	*INFLUENT*	*EFFLUENT*	*RATIO*	*(cm/cm)*	*@ Temp.*	*@ 20° C*
RESET				22.544		
47	0.5	0.5	1.00	22.408	1.86E-07	1.87E-07
RESET				51.258		
43	1.0	1.0	1.00	50.986	1.79E-07	1.80E-07
RESET				51.258		
65	1.2	1.2	1.00	50.932	1.42E-07	1.43E-07
66	1.9	1.9	1.00	50.415	2.23E-07	2.24E-07

9531750

PERMEABILITY ASTM D5084

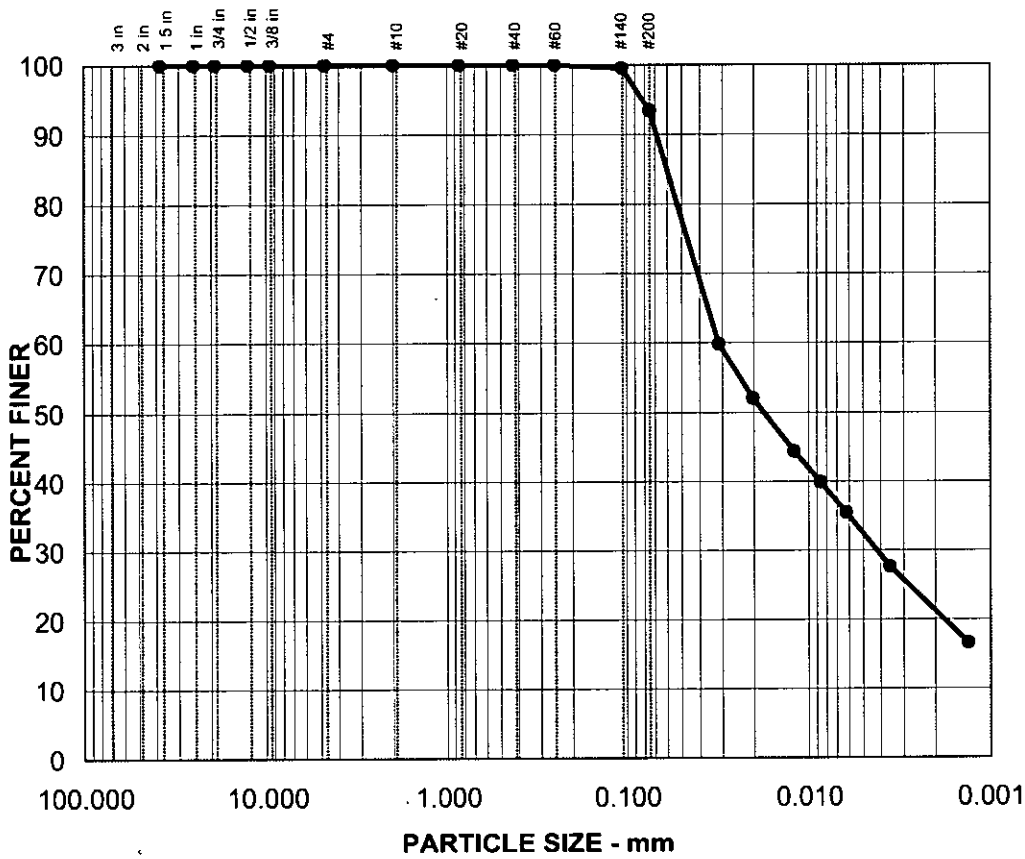
SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4503
SAMPLE No.:	MW239-ST-107-109	EQUIPMENT No.:	1
TEST DATE:	4 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	125.2 lb/ft³	127.4 lb/ft³
DRY UNIT WEIGHT	103.6 lb/ft³	103.5 lb/ft³
MOISTURE CONTENT	20.9 %	23.1 %
PERMEABILITY @ 20°C	1.8E-07 cm/sec	

9531751

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	6.6	60.9	32.5

SAMPLE INFORMATION	
Project Name:	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-238-ST-96-98
Sample Description:	Clay
Testing Date:	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Lean Clay	

KEMRON
ENVIRONMENTAL SERVICES

9531752

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No.:	SE-0234
SAMPLE No.:	MW-238-ST-96-98
SAMPLE DESCRIPT:	Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4514_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	231 97 g
WT WET SOIL + TARE	286.32 g
WT DRY SOIL + TARE	276.13 g
WT WATER, Ww	10 19 g
WT DRY SOIL, Ws	44.16 g
ASTM MOISTURE	23.08 %
EPA MOISTURE	18 75 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	100.0 %
#40	100.0 %
#60	100.0 %
#140	99.5 %
#200	93.4 %

HYDROMETER ANALYSIS	
HYDROMETER No.	2
Wt OF DRY SOIL, Ws	41 25
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:31:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	32.5	27.0	0.0313	59.8
5	29.0	23.5	0.0203	52 1
15	25.5	20.0	0.0120	44.3
30	23.5	18.0	0.0086	39.9
60	21.5	16.0	0.0062	35 4
190	18 0	12.5	0.0035	27 6
1450	13.0	7.5	0.0013	16.6

KEMRON
ENVIRONMENTAL SERVICES

9531753

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW238-ST-96-98	MW238-ST-96-98
2. WT MOISTURE TIN (tare weight)	0.00 *g*	223.99 *g*
3. WT WET SOIL + TARE	527.51 *g*	757.20 *g*
4. WT DRY SOIL + TARE	429.71 *g*	653.70 *g*
5. WT WATER, Ww	97.80 g	103.50 g
6. WT DRY SOIL, Ws	429.71 g	429.71 g
7. MOISTURE CONTENT, W	22.76 %	24.09 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.86 in.*	*2.88 in.*	*2.50 in.*	*2.51 in.*
No. 2	*2.88 in.*	*2.88 in.*	*2.50 in.*	*2.51 in.*
No. 3	*2.89 in.*	*2.87 in.*	*2.51 in.*	*2.50 in.*
Average	2.88 in.	2.88 in.	2.50 in.	2.51 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*527.51 g*	*533.41 g*
Area, Ao	6.50 in^2	6.50 in^2
Volume, Vo	16.27 in^3	16.29 in^3
Bulk Unit Weight	123.5 lb/ft^3	124.7 lb/ft^3
Dry Unit Weight	100.6 lb/ft^3	100.5 lb/ft^3

9531754

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		

TEST	TIME	TESTED	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
DATE	(military)	BY	CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/05/07	12 : 21	RRB	7.0	5.0	6.2				
10/05/07	12 : 29	RRB	17.0	15.0	16.3	10.9	10.0	4.7	0.47
10/05/07	13 50	RRB	27.0	25.0	26.2	22.6	10.0	6.3	0.63
10/05/07	8 : 21	RRB	37.0	35.0	36.3	35.6	10.0	9.4	0.94
10/08/07	9 : 48	RRB	47.0	45.0	46.3	45.9	10.0	9.6	0.96
10/08/07	12 : 5	RRB	57.0	55.0	*	56.0	10.0	9.7	0.97
10/08/07	12 : 6	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531755

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

Page 3 of 6

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4515
SAMPLE No.:	MW238-ST-96-98	7
TEST DATE:	5 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	*TESTED BY*	*TIME (Military)*	*ELAPSED TIME (minutes)*	*TOTAL TIME (minutes)*	*TOTAL TIME (Log)*	*SPECIMEN CONSOLIDATION (ML)*		
						READING		*ACTUAL*
						BOTTOM	*TOP*	*TOTAL (Ct)*
10 / 8 / 7	RRB	12 : 9				25.0	25.0	0.0
10 / 8 / 7	RRB	12 : 10	1	1	0.00	24.4	24.4	1.2
10 / 8 / 7	RRB	12 : 11	1	2	0.30	24.3	24.3	1.4
10 / 8 / 7	RRB	13 : 38	87	89	1.95	23.3	23.7	3.0
10 / 8 / 7	RRB	15 : 13	95	184	2.26	23.0	23.5	3.5
10 / 9 / 7	RRB	13 : 11	1318	1502	3.18	22.7	23.3	4.0
10 / 10 / 7	RRB	8 : 45	1174	2676	3.43	22.7	23.4	3.9

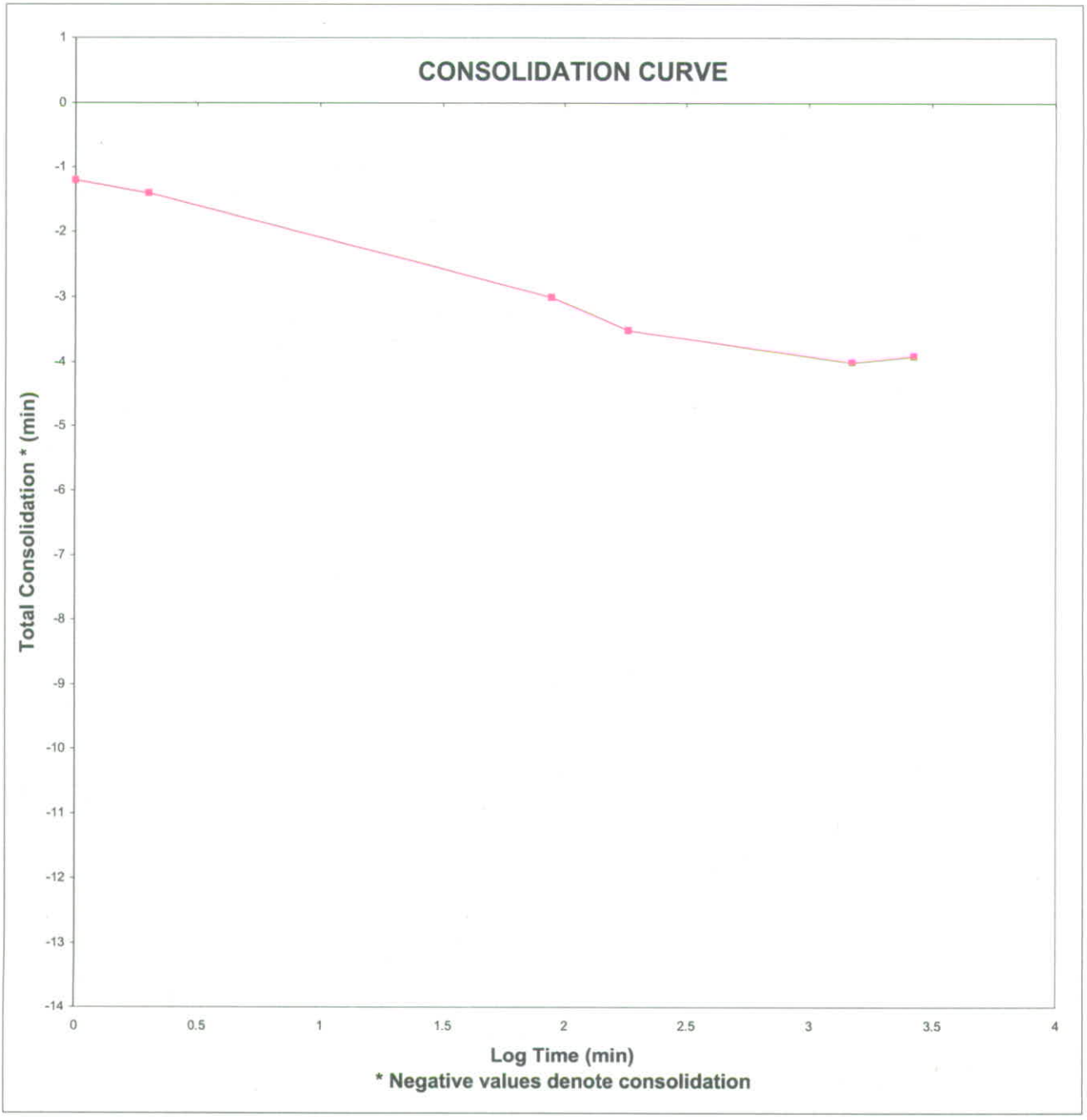
9531756

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		



9531757

PERMEABILITY ASTM D5084

TEST DATA

Page 5 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP. C°	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT		CELL	INFLUENT	EFFLUENT
10 / 10 / 7	RRB	8 : 47		0.0	25.0	20.0	55.0	45.0	45.0
10 / 10 / 7	RRB	11 : 52	RESET	0.0	25.0	20.0	55.0	51.0	45.0
10 / 10 / 7	RRB	14 : 8	136	0.6	24.6	20.0	55.0	51.0	45.0
10 / 11 / 7	RRB	8 : 38	RESET	0.0	25.0	20.0	55.0	51.0	45.0
10 / 11 / 7	RRB	11 : 42	184	0.7	24.3	20.0	55.0	51.0	45.0
10 / 11 / 7	RRB	14 : 6	144	1.2	23.8	20.0	55.0	51.0	45.0
10 / 12 / 7	RRB	8 : 7	1081	4.6	20.4	20.0	55.0	51.0	45.0
10 / 12 / 7	RRB	10 : 34	147	5.1	19.9	20.0	55.0	51.0	45.0

9531758

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		

ELAPSED TIME	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT*	*HYDRAULIC GRADIENT*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
(minutes)	*INFLUENT*	*EFFLUENT*	*RATIO*	*(cm/cm)*	*@ Temp.*	*@ 20° C*
RESET				3.932		
RESET				70.306		
136	0.6	0.4	0.67	70.149	2.08E-08	2.09E-08
RESET				70.306		
184	0.7	0.7	1.00	70.086	2.15E-08	2.16E-08
144	0.5	0.5	1.00	69.929	1.97E-08	1.98E-08
1081	3.4	3.4	1.00	68.859	1.80E-08	1.81E-08
147	0.5	0.5	1.00	68.702	1.97E-08	1.97E-08

9531759

PERMEABILITY ASTM D5084

SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4515
SAMPLE No.:	MW238-ST-96-98	EQUIPMENT No.:	7
TEST DATE:	5 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	123.5 lb/ft³	124.7 lb/ft³
DRY UNIT WEIGHT	100.6 lb/ft³	100.5 lb/ft³
MOISTURE CONTENT	22.8 %	24.1 %
PERMEABILITY @ 20°C	2.0E-08 cm/sec	

9531760

SIEVE AND HYDROMETER ANALYSIS

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No :	SE-0234
SAMPLE No.:	MW-231-ST-93-94
SAMPLE DESCRIPT·	Clay
TESTING DATE·	10/25/2007
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4523_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	229 62 g
WT WET SOIL + TARE	298 40 g
WT DRY SOIL + TARE	285 23 g
WT WATER, Ww	13 17 g
WT DRY SOIL, Ws	55 61 g
ASTM MOISTURE	23 68 %
EPA MOISTURE	19 15 %

SIEVE NUMBER	CUMULATIVE WEIGHT RETAINED
1 5	0 00 g
1 0	0 00 g
0.75	0 00 g
0 5	0 00 g
0 375	0.00 g
#4	0.00 g
#10	0.00 g
#20	0.00 g
#40	0.00 g
#60	0.00 g
#140	2 89 g
#200	8 88 g

HYDROMETER ANALYSIS	
HYDROMETER No	12
Wt OF DRY SOIL, Ws	46 73
DATE TESTING INITIATED	10/29/2007
TIME TESTING INITIATED	10 39

DATE	TIME	ELAPSED TIME (minutes)	TEMP. (oC)	HYDROMETER READINGS
10/29/2007	10 41	2	20 0	38 0
10/29/2007	10 44	5	20.0	35.0
10/29/2007	10·54	15	20 0	31 0
10/29/2007	11 09	30	20 0	27 5
10/29/2007	11 39	60	20 0	25 0
10/29/2007	13 49	190	20.0	20 5
10/30/2007	10 50	1450	20 0	15 0

9531761

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT	Memphis Depot	TESTED BY:	RRB
PROJECT No..	SE-0234	TRACKING CODE	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No	6A
TEST DATE.	5 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW231-ST-93-94	MW231-ST-93-94
2. WT MOISTURE TIN (tare weight)	0.00 *g*	228.28 *g*
3. WT WET SOIL + TARE	665.00 *g*	893.10 *g*
4. WT DRY SOIL + TARE	531.82 *g*	760.10 *g*
5 WT WATER, Ww	133.18 g	133.00 g
6 WT DRY SOIL, Ws	531.82 g	531 82 g
7. MOISTURE CONTENT, W	25 04 %	25.01 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.88 in.*	*2.89 in.*	*3.11 in.*	*3.11 in.*
No. 2	*2.85 in.*	*2.87 in.*	*3.12 in.*	*3.11 in.*
No. 3	*2.86 in.*	*2.84 in.*	*3.11 in.*	*3.11 in.*
Average	2.86 in.	2.87 in.	3 11 in.	3.11 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*665.00 g*	*668.00 g*
Area, Ao	6.44 in^2	6.45 in^2
Volume, Vo	20.05 in^3	20 07 in^3
Bulk Unit Weight	126 4 lb/ft^3	126.8 lb/ft^3
Dry Unit Weight	101 1 lb/ft^3	101.4 lb/ft^3

9531762

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

Page 2 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No.:	6A
TEST DATE:	5 October 2007		

TEST	TIME	TESTED	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
DATE	(military)	BY	CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/08/07	9 : 45	RRB	7.0	5.0	5.7				
10/08/07	11 : 21	RRB	17.0	15.0	15.9	13.9	10.0	8.2	0.82
10/08/07	12 : 13	RRB	27.0	25.0	25.9	25.0	10.0	9.1	0.91
10/08/07	15 : 12	RRB	37.0	35.0	36.0	35.4	10.0	9.5	0.95
10/10/07	8 : 45	RRB	47.0	45.0	45.8	45.5	10.0	9.5	0.95
10/10/07	12 : 12	RRB	57.0	55.0	*	55.5	10.0	9.7	0.97
10/10/07	12 : 13	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531763

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

Page 3 of 6

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4523
SAMPLE No.:	MW231-ST-93-94	6A
TEST DATE:	5 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	*TESTED BY*	*TIME (Military)*	*ELAPSED TIME (minutes)*	*TOTAL TIME (minutes)*	*TOTAL TIME (Log)*	*SPECIMEN CONSOLIDATION (ML)*		
						READING		*ACTUAL*
						BOTTOM	*TOP*	*TOTAL (Ct)*
10 / 10 / 7	RRB	12 : 17				25.0	25.0	0.0
10 / 10 / 7	RRB	12 : 18	1	1	0.00	23.8	24.0	2.2
10 / 10 / 7	RRB	12 : 19	1	2	0.30	23.5	23.8	2.7
10 / 10 / 7	RRB	16 : 46	267	269	2.43	22.4	23.0	4.6
10 / 11 / 7	RRB	8 : 36	950	1219	3.09	22.4	22.8	4.8
10 / 12 / 7	RRB	8 : 5	1409	2628	3.42	22.5	22.7	4.8

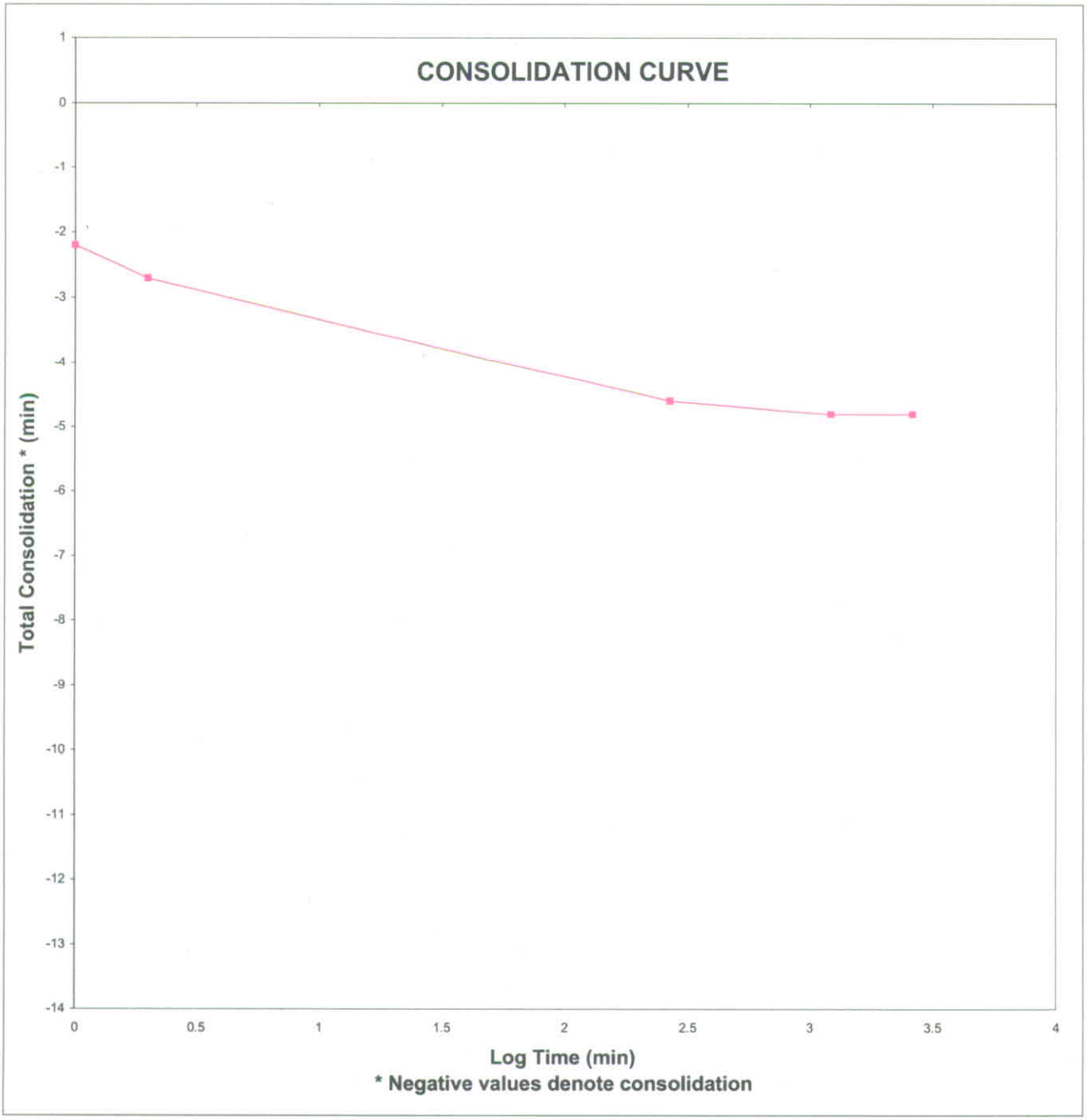
This page was intentionally left blank

9531765

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No.:	6A
TEST DATE:	5 October 2007		



9531766

PERMEABILITY ASTM D5084

TEST DATA

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No.:	6A
TEST DATE:	5 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP.	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT	C°	CELL	INFLUENT	EFFLUENT
10 / 12 / 7	RRB	9 : 36		0.0	25.0	20.0	55.0	47.0	45.0
10 / 12 / 7	RRB	10 : 52	76	1.6	23.5	20.0	55.0	47.0	45.0
10 / 12 / 7	RRB	14 : 24	212	5.3	19.7	20.0	55.0	47.0	45.0
10 / 12 / 7	RRB	15 : 18	54	6.2	18.8	20.0	55.0	47.0	45.0
10 / 12 / 7	RRB	16 : 12	54	7.1	17.9	20.0	55.0	47.0	45.0

9531767

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No.:	6A
TEST DATE:	5 October 2007		

ELAPSED TIME	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT*	*HYDRAULIC GRADIENT*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
(minutes)	*INFLUENT*	*EFFLUENT*	*RATIO*	*(cm/cm)*	*@ Temp.*	*@ 20° C*
RESET				20.951		
76	1.6	1.5	0.94	20.559	3.94E-07	3.96E-07
212	3.7	3.8	1.03	19.611	3.53E-07	3.55E-07
54	0.9	0.9	1.00	19.383	3.43E-07	3.45E-07
54	0.9	0.9	1.00	19.156	3.47E-07	3.49E-07

9531768

PERMEABILITY ASTM D5084

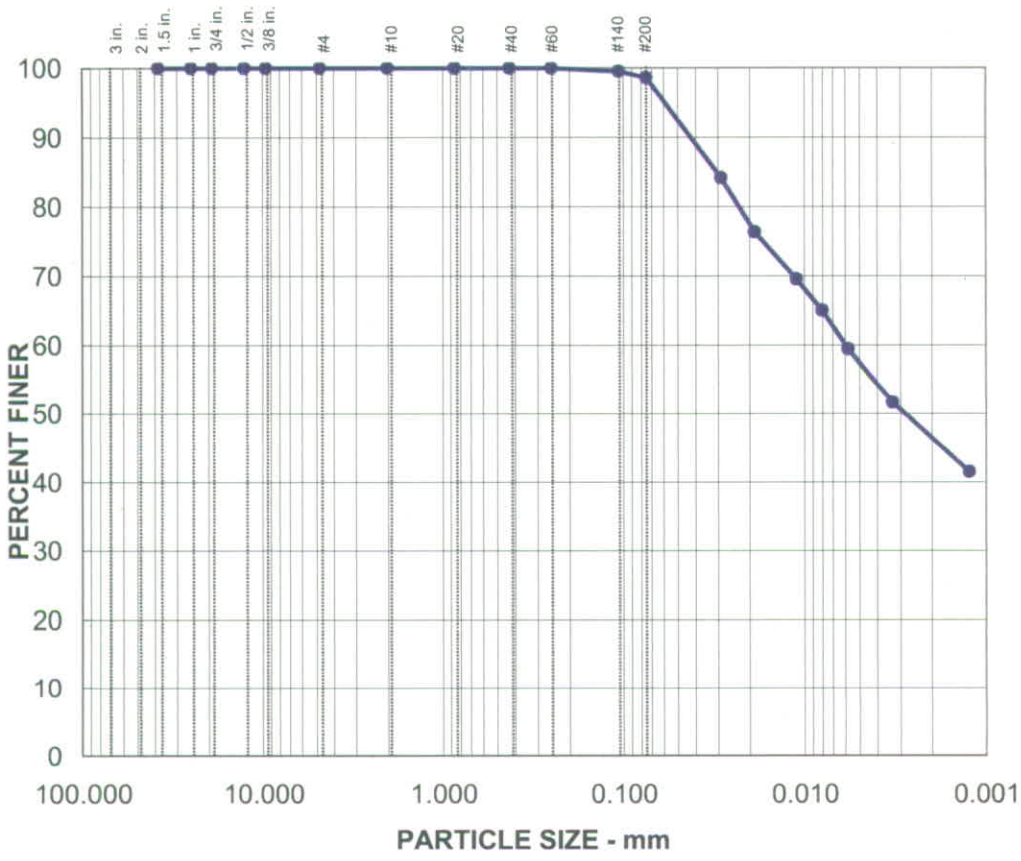
SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4523
SAMPLE No.:	MW231-ST-93-94	EQUIPMENT No.:	6A
TEST DATE:	5 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	126.4 lb/ft³	126.8 lb/ft³
DRY UNIT WEIGHT	101.1 lb/ft³	101.4 lb/ft³
MOISTURE CONTENT	25.0 %	25.0 %
PERMEABILITY @ 20°C	3.6E-07 cm/sec	

9531769

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.4	41.1	57.5

SAMPLE INFORMATION	
Project Name:	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-236-ST-47-49
Sample Description:	Clay
Testing Date:	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Silty Clay	

KEMRON ENVIRONMENTAL SERVICES

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No.:	SE-0234
SAMPLE No.:	MW-236-ST-47-49
SAMPLE DESCRIPT:	Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4540_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	230.19 g
WT WET SOIL + TARE	287.60 g
WT DRY SOIL + TARE	273.80 g
WT WATER, Ww	13.80 g
WT DRY SOIL, Ws	43.61 g
ASTM MOISTURE	31.64 %
EPA MOISTURE	24.04 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	100.0 %
#40	100.0 %
#60	100.0 %
#140	99.5 %
#200	98.6 %

HYDROMETER ANALYSIS	
HYDROMETER No.	3
Wt OF DRY SOIL, Ws	43.00
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:32:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	43.0	37.5	0.0287	84.2
5	39.5	34.0	0.0187	76.3
15	36.5	31.0	0.0111	69.6
30	34.5	29.0	0.0080	65.1
60	32.0	26.5	0.0057	59.5
190	28.5	23.0	0.0033	51.6
1450	24.0	18.5	0.0012	41.5

KEMRON
ENVIRONMENTAL SERVICES

9531771

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No.:	4
TEST DATE:	4 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW236-ST-47-49	MW236-ST-47-49
2. WT MOISTURE TIN (tare weight)	0.00 ***g***	239.47 ***g***
3. WT WET SOIL + TARE	597.04 ***g***	846.50 ***g***
4. WT DRY SOIL + TARE	460.93 ***g***	700.40 ***g***
5. WT WATER, Ww	136.11 g	146.10 g
6. WT DRY SOIL, Ws	460.93 g	460.93 g
7. MOISTURE CONTENT, W	29.53 %	31.70 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	***2.85 in.***	***2.85 in.***	***2.97 in.***	***2.99 in.***
No. 2	***2.85 in.***	***2.86 in.***	***2.96 in.***	***2.99 in.***
No. 3	***2.86 in.***	***2.86 in.***	***2.96 in.***	***2.99 in.***
Average	2.85 in.	2.86 in.	2.96 in.	2.99 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	***597.04 g***	***607.52 g***
Area, Ao	6.39 in^2	6.41 in^2
Volume, Vo	18.95 in^3	19.16 in^3
Bulk Unit Weight	120.0 lb/ft^3	120.8 lb/ft^3
Dry Unit Weight	92.7 lb/ft^3	91.7 lb/ft^3

9531772

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

Page 2 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No.:	4
TEST DATE:	4 October 2007		

TEST DATE	TIME (military)	TESTED BY	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
			CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/04/07	15 : 45	RRB	7.0	5.0	6.2				
10/04/07	17 : 30	RRB	17.0	15.0	16.2	11.6	10.0	5.4	0.54
10/05/07	9 : 40	RRB	27.0	25.0	26.1	24.1	10.0	7.9	0.79
10/05/07	13 : 17	RRB	37.0	35.0	36.2	35.3	10.0	9.2	0.92
10/08/07	8 : 14	RRB	47.0	45.0	46.2	46.0	10.0	9.8	0.98
10/08/07	9 : 51	RRB	57.0	55.0	*	56.1	10.0	9.9	0.99
10/08/07	9 : 52	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531773

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

Page 3 of 6

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4540
SAMPLE No.:	MW236-ST-47-49	4
TEST DATE:	4 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	*TESTED BY*	*TIME (Military)*	*ELAPSED TIME (minutes)*	*TOTAL TIME (minutes)*	*TOTAL TIME (Log)*	*SPECIMEN CONSOLIDATION (ML)*		
						READING		*ACTUAL*
						BOTTOM	*TOP*	*TOTAL (Ct)*
10 / 8 / 7	RRB	9 : 54				25.0	25.0	0.0
10 / 8 / 7	RRB	9 : 55	1	1	0.00	24.4	24.2	1.4
10 / 8 / 7	RRB	9 : 56	1	2	0.30	24.4	24.1	1.5
10 / 8 / 7	RRB	10 : 40	44	46	1.66	23.7	23.0	3.3
10 / 8 / 7	RRB	11 : 58	78	124	2.09	23.3	22.2	4.5
10 / 8 / 7	RRB	13 : 43	105	229	2.36	22.9	21.7	5.4
10 / 8 / 7	RRB	14 : 59	76	305	2.48	22.8	21.5	5.7
10 / 9 / 7	RRB	13 : 10	1331	1636	3.21	22.4	21.0	6.6
10 / 10 / 7	RRB	8 : 42	1172	2808	3.45	22.2	20.8	7.0
10 / 10 / 7	RRB	12 : 34	232	3040	3.48	22.2	20.9	6.9

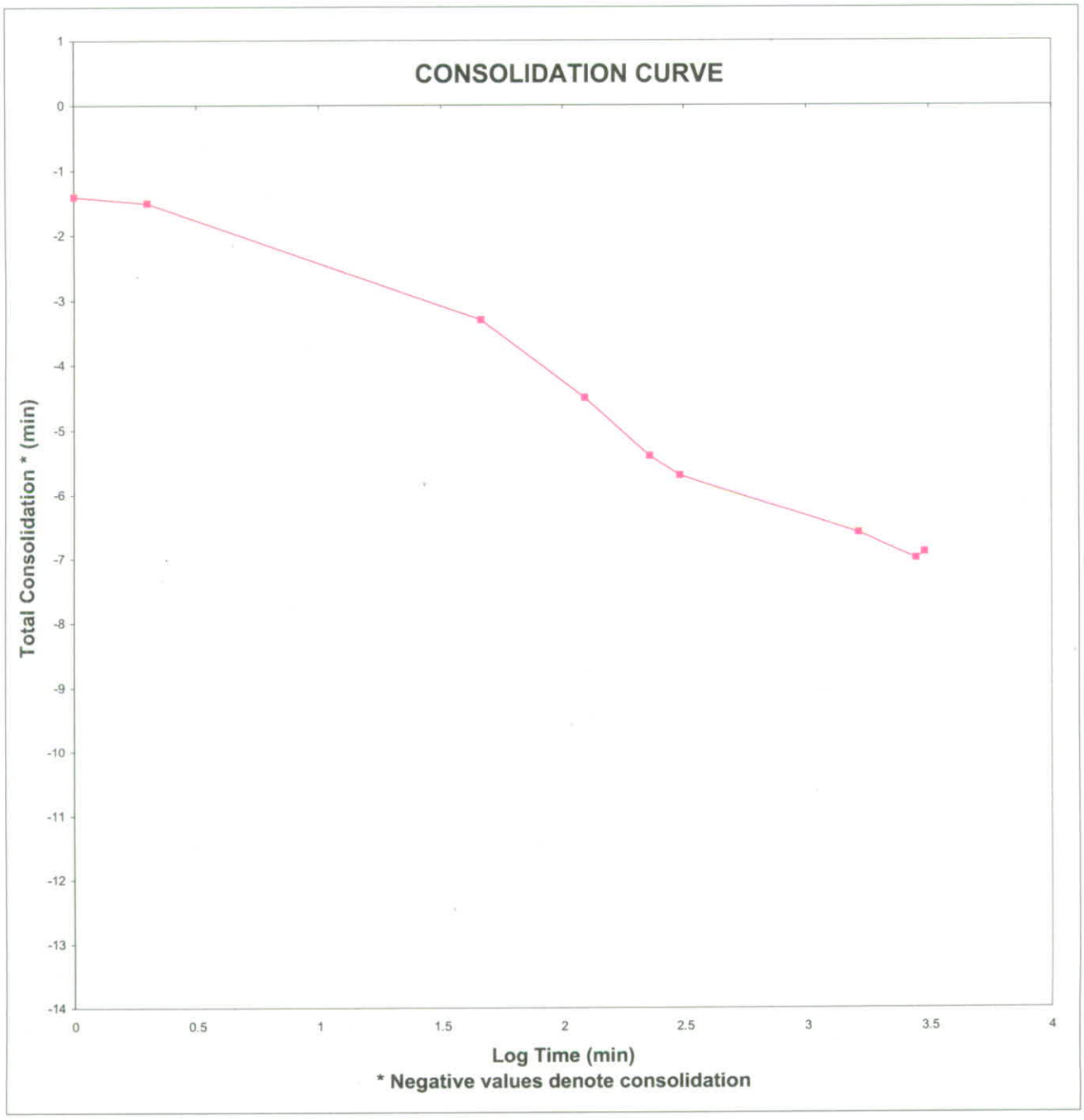
9531774

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No.:	4
TEST DATE:	4 October 2007		



9531775

PERMEABILITY ASTM D5084

TEST DATA

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No.:	4
TEST DATE:	4 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP.	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT	C°	CELL	INFLUENT	EFFLUENT
10 / 16 / 7	RRB	8 : 56		0.0	25.0	20.0	55.0	50.0	45.0
10 / 16 / 7	RRB	14 : 21	325	0.5	24.5	20.0	55.0	50.0	45.0
10 / 17 / 7	RRB	13 : 19	RESET	0.0	25.0	20.0	55.0	52.0	45.0
10 / 18 / 7	RRB	8 : 37	1158	3.2	21.8	20.0	55.0	52.0	45.0
10 / 18 / 7	RRB	11 : 37	180	3.7	21.3	20.0	55.0	52.0	45.0
10 / 18 / 7	RRB	16 : 28	291	4.5	20.5	20.0	55.0	52.0	45.0

9531776

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No.:	4
TEST DATE:	4 October 2007		

ELAPSED TIME	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT*	*HYDRAULIC GRADIENT*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
(minutes)	*INFLUENT*	*EFFLUENT*	*RATIO*	*(cm/cm)*	*@ Temp.*	*@ 20° C*
RESET				50.047		
325	0.5	0.5	1.00	49.915	1.24E-08	1.25E-08
RESET				68.738		
1158	3.2	3.2	1.00	67.887	1.63E-08	1.64E-08
180	0.5	0.5	1.00	67.755	1.65E-08	1.66E-08
291	0.8	0.8	1.00	67.542	1.64E-08	1.65E-08

9531777

PERMEABILITY ASTM D5084

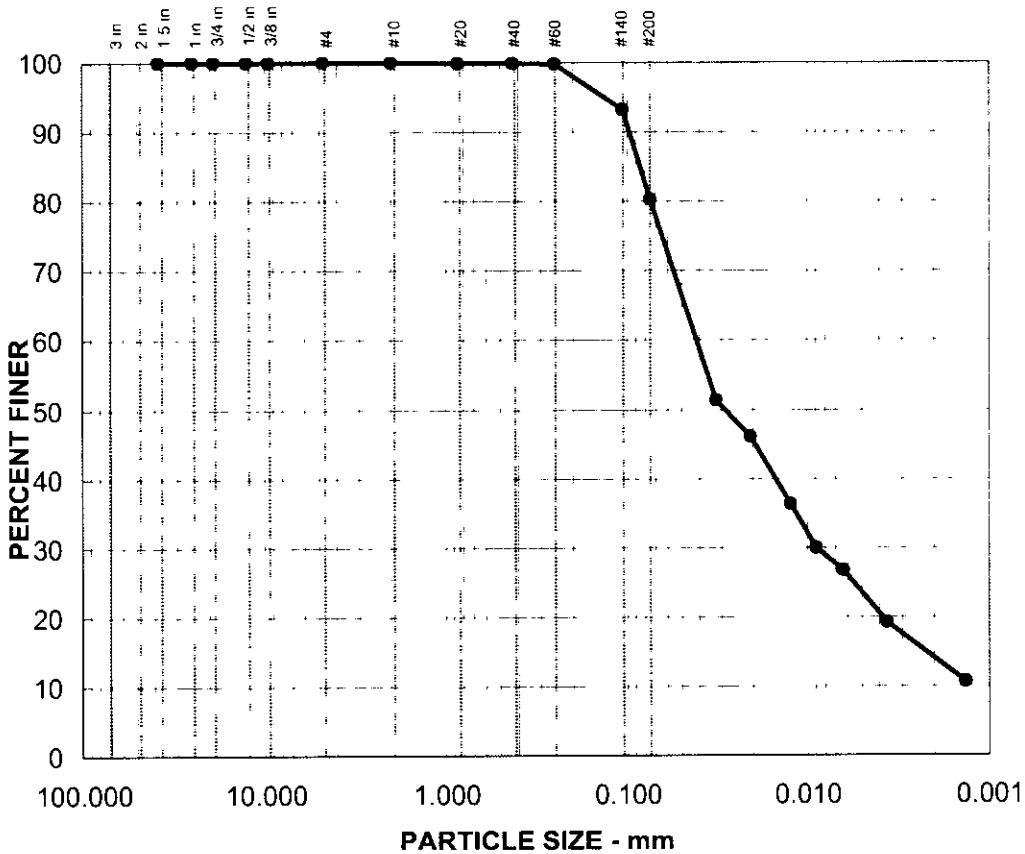
SUMMARY OF RESULTS

PROJECT.	Memphis Depot	TESTED BY.	RRB
PROJECT No..	SE-0234	TRACKING CODE:	4540
SAMPLE No.:	MW236-ST-47-49	EQUIPMENT No	4
TEST DATE.	4 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	120.0 lb/ft³	120.8 lb/ft³
DRY UNIT WEIGHT	92.7 lb/ft³	91.7 lb/ft³
MOISTURE CONTENT	29.5 %	31.7 %
PERMEABILITY @ 20°C	1.6E-08 cm/sec	

9531778

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0 0	19 7	56.7	23 6

SAMPLE INFORMATION	
Project Name	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-237-ST-112-114
Sample Description	Silty Clay
Testing Date	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit	
Plastic Limit	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Sandy Silty Clay	

KEMRON
ENVIRONMENTAL SERVICES

9531779

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No..	SE-0234
SAMPLE No.:	MW-237-ST-112-114
SAMPLE DESCRIPT:	Silty Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4541_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	251.15 g
WT WET SOIL + TARE	306.55 g
WT DRY SOIL + TARE	296.82 g
WT WATER, Ww	9 73 g
WT DRY SOIL, Ws	45 67 g
ASTM MOISTURE	21 31 %
EPA MOISTURE	17 56 %

SIEVE NUMBER	PERCENT PASSING
1 5	100 0 %
1 0	100 0 %
0 75	100.0 %
0 5	100 0 %
0.375	100.0 %
#4	100.0 %
#10	100 0 %
#20	99 9 %
#40	99 9 %
#60	99 8 %
#140	93 2 %
#200	80 3 %

HYDROMETER ANALYSIS	
HYDROMETER No.	1
Wt OF DRY SOIL, Ws	36 67
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10 30 00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	29 5	24 0	0 0320	51 4
5	27 0	21 5	0 0206	46.0
15	22.5	17 0	0 0123	36.4
30	19 5	14 0	0 0088	30.0
60	18 0	12 5	0 0063	26.7
190	14 5	9 0	0 0036	19 2
1450	10.5	5.0	0 0013	10 6

KEMRON
ENVIRONMENTAL SERVICES

9531780

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT.	Memphis Depot	TESTED BY	RRB
PROJECT No	SE-0234	TRACKING CODE.	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No :	2
TEST DATE:	4 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW237-ST-112-114	MW237-ST-112-114
2. WT MOISTURE TIN (tare weight)	0.00 *g*	233 50 *g*
3. WT WET SOIL + TARE	649.70 *g*	893 00 *g*
4. WT DRY SOIL + TARE	537.10 *g*	770 60 *g*
5. WT WATER, Ww	112 60 g	122 40 g
6 WT DRY SOIL, Ws	537.10 g	537.10 g
7. MOISTURE CONTENT, W	20.96 %	22.79 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.89 in.*	*2.89 in.*	*2.98 in.*	*3.00 in.*
No. 2	*2.87 in.*	*2.88 in.*	*2.98 in.*	*3.00 in.*
No. 3	*2.87 in.*	*2.88 in.*	*2.98 in.*	*2.99 in.*
Average	2.88 in.	2.88 in	2.98 in	3.00 in

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*649.70 g*	*659.50 g*
Area, Ao	6 50 in^2	6.53 in^2
Volume, Vo	19.37 in^3	19 57 in^3
Bulk Unit Weight	127.8 lb/ft^3	128.4 lb/ft^3
Dry Unit Weight	105.6 lb/ft^3	104.6 lb/ft^3

9531781

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

Page 2 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No.:	2
TEST DATE:	4 October 2007		

TEST	TIME	TESTED	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
DATE	(military)	BY	CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/05/07	11 : 50	RRB	7.0	5.0	5.7				
10/05/07	13 : 16	RRB	17.0	15.0	15.7	10.9	10.0	5.2	0.52
10/08/07	8 : 20	RRB	27.0	25.0	25.6	23.7	10.0	8.0	0.80
10/08/07	9 : 50	RRB	37.0	35.0	35.7	34.6	10.0	9.0	0.90
10/08/07	11 : 20	RRB	47.0	45.0	45.6	45.0	10.0	9.3	0.93
10/08/07	15 : 2	RRB	57.0	55.0	*	55.4	10.0	9.8	0.98
10/08/07	15 : 3	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531782

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

Page 3 of 6

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4541
SAMPLE No.:	MW237-ST-112-114	2
TEST DATE:	4 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	*TESTED BY*	*TIME (Military)*	*ELAPSED TIME (minutes)*	*TOTAL TIME (minutes)*	*TOTAL TIME (Log)*	*SPECIMEN CONSOLIDATION (ML)*		
						READING		*ACTUAL*
						BOTTOM	*TOP*	*TOTAL (Ct)*
10 / 8 / 7	RRB	15 : 5				24.0	24.0	0.0
10 / 8 / 7	RRB	15 : 6	1	1	0.00	23.5	23.4	1.1
10 / 8 / 7	RRB	15 : 7	1	2	0.30	23.3	23.3	1.4
10 / 9 / 7	RRB	13 : 6	1319	1321	3.12	19.7	21.5	6.8
10 / 10 / 7	RRB	8 : 43	1177	2498	3.40	19.5	21.3	7.2
10 / 10 / 7	RRB	12 : 22	219	2717	3.43	19.5	21.3	7.2

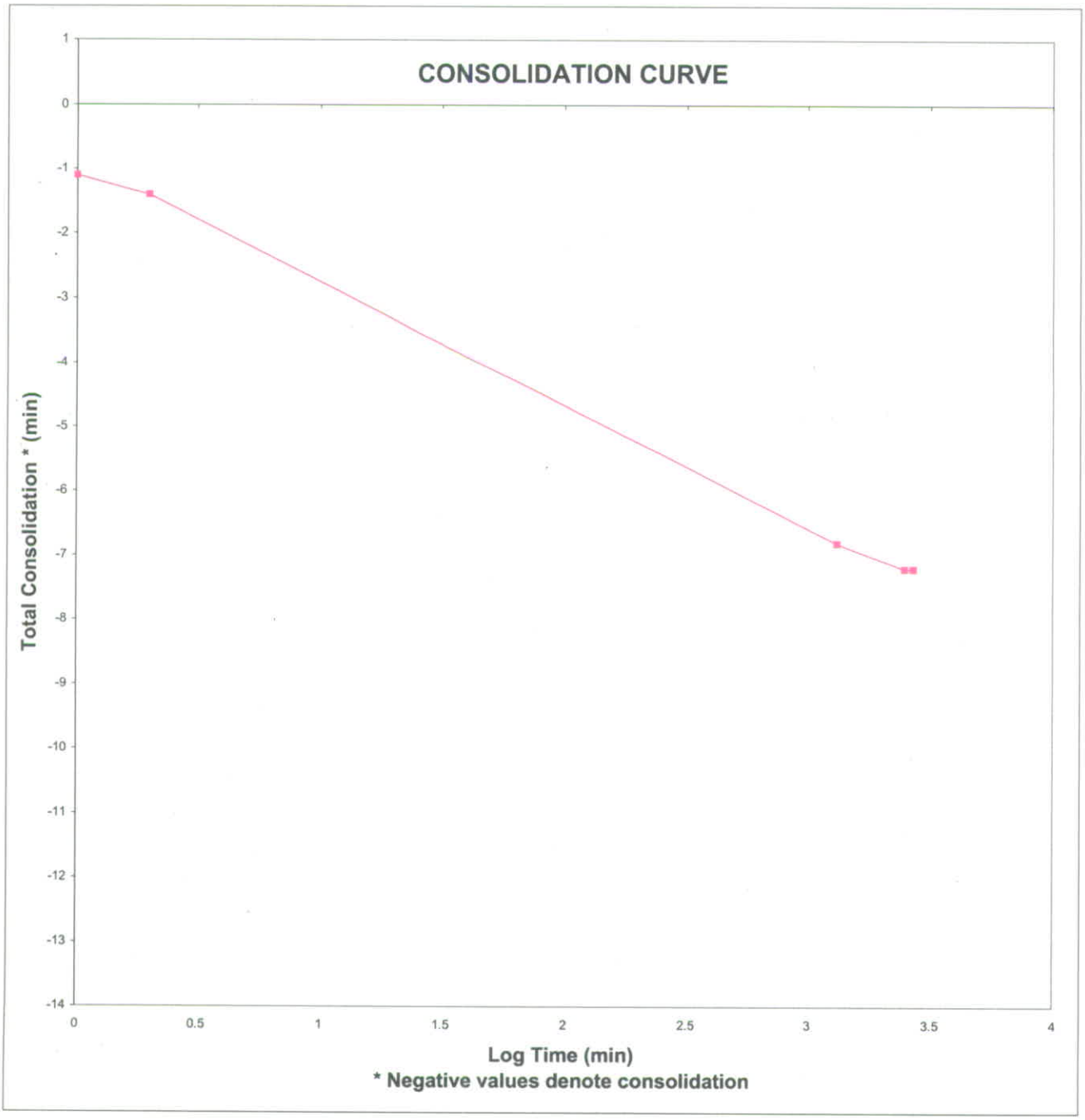
9531783

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No.:	2
TEST DATE:	4 October 2007		



PERMEABILITY ASTM D5084

TEST DATA

Page 5 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No.:	2
TEST DATE:	4 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP. C°	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT		CELL	INFLUENT	EFFLUENT
10 / 17 / 7	RRB	8 : 21		0.0	24.0	20.0	55.0	52.0	45.0
10 / 17 / 7	RRB	13 : 22	301	0.5	23.5	20.0	55.0	52.0	45.0
10 / 18 / 7	RRB	8 : 35	1153	1.9	22.1	20.0	55.0	52.0	45.0
10 / 18 / 7	RRB	13 : 45	310	2.4	21.6	20.0	55.0	52.0	45.0
10 / 19 / 7	RRB	9 : 30	1185	3.8	20.2	20.0	55.0	52.0	45.0

9531785

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No.:	2
TEST DATE:	4 October 2007		

ELAPSED TIME (minutes)	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT RATIO*	*HYDRAULIC GRADIENT (cm/cm)*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
	INFLUENT	*EFFLUENT*			*@ Temp.*	*@ 20° C*
RESET				68.221		
301	0.5	0.5	1.00	68.089	9.69E-09	9.73E-09
1153	1.4	1.4	1.00	67.719	7.11E-09	7.14E-09
310	0.5	0.5	1.00	67.587	9.48E-09	9.52E-09
1185	1.4	1.4	1.00	67.217	6.97E-09	7.00E-09

9531786

PERMEABILITY ASTM D5084

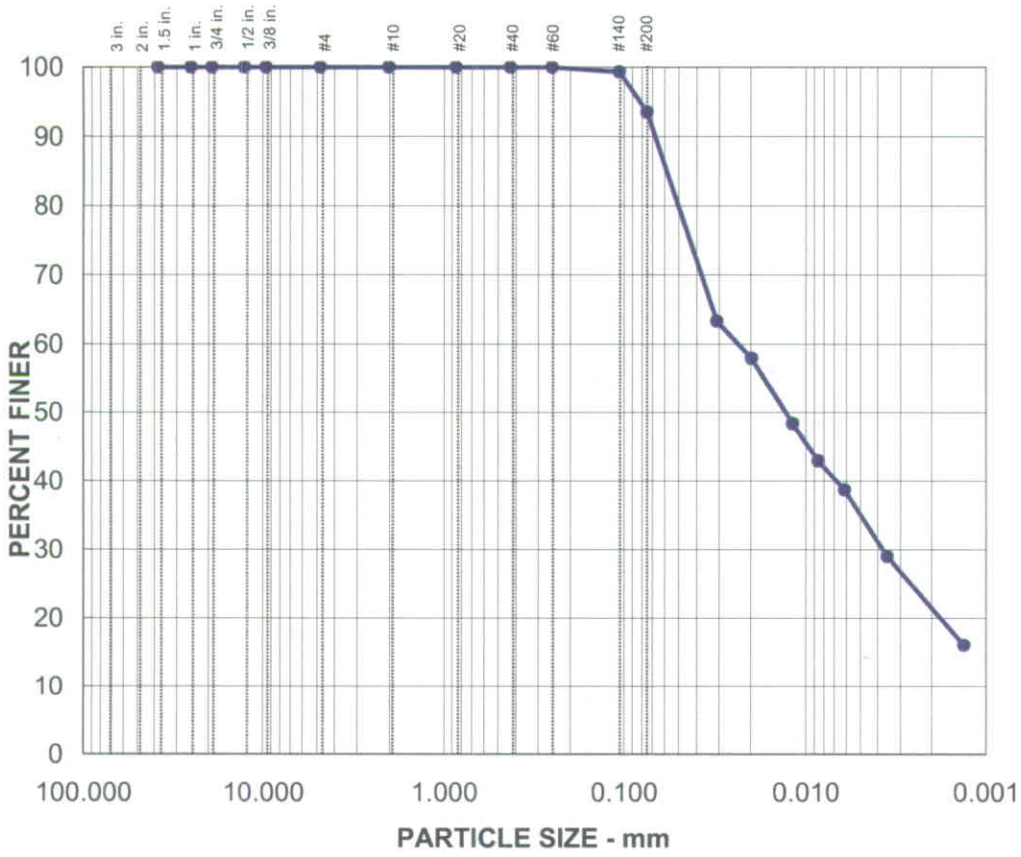
SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4541
SAMPLE No.:	MW237-ST-112-114	EQUIPMENT No.:	2
TEST DATE:	4 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	127.8 lb/ft³	128.4 lb/ft³
DRY UNIT WEIGHT	105.6 lb/ft³	104.6 lb/ft³
MOISTURE CONTENT	21.0 %	22.8 %
PERMEABILITY @ 20°C	8.3E-09 cm/sec	

9531787

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	6.5	58.4	35.1

SAMPLE INFORMATION	
Project Name:	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-234-ST-82-84
Sample Description:	Clay
Testing Date:	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Lean Clay	

KEMRON ENVIRONMENTAL SERVICES

9531788

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No.:	SE-0234
SAMPLE No.:	MW-234-ST-82-84
SAMPLE DESCRIPT:	Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4543_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	240.12 g
WT WET SOIL + TARE	296.01 g
WT DRY SOIL + TARE	285.70 g
WT WATER, Ww	10.31 g
WT DRY SOIL, Ws	45.58 g
ASTM MOISTURE	22.62 %
EPA MOISTURE	18.45 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	100.0 %
#40	100.0 %
#60	100.0 %
#140	99.3 %
#200	93.5 %

HYDROMETER ANALYSIS	
HYDROMETER No.	10
Wt OF DRY SOIL, Ws	42.61
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:37:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	35.0	29.5	0.0307	63.3
5	32.5	27.0	0.0198	58.0
15	28.0	22.5	0.0118	48.3
30	25.5	20.0	0.0085	42.9
60	23.5	18.0	0.0061	38.6
190	19.0	13.5	0.0035	28.9
1451	13.0	7.5	0.0013	16.0

kemron
ENVIRONMENTAL SERVICES

9531789

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW234-ST-82-84	MW234-ST-82-84
2. WT MOISTURE TIN (tare weight)	0.00 *g*	231.17 *g*
3. WT WET SOIL + TARE	562.76 *g*	803.10 *g*
4. WT DRY SOIL + TARE	454.33 *g*	685.50 *g*
5. WT WATER, Ww	108.43 g	117.60 g
6. WT DRY SOIL, Ws	454.33 g	454.33 g
7. MOISTURE CONTENT, W	23.87 %	25.88 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.87 in.*	*2.87 in.*	*2.62 in.*	*2.64 in.*
No. 2	*2.92 in.*	*2.91 in.*	*2.62 in.*	*2.64 in.*
No. 3	*2.84 in.*	*2.83 in.*	*2.62 in.*	*2.63 in.*
Average	2.88 in.	2.87 in.	2.62 in.	2.64 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*562.76 g*	*572.11 g*
Area, Ao	6.50 in^2	6.47 in^2
Volume, Vo	17.03 in^3	17.06 in^3
Bulk Unit Weight	125.9 lb/ft^3	127.8 lb/ft^3
Dry Unit Weight	101.6 lb/ft^3	101.5 lb/ft^3

9531790

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

Page 2 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		

TEST DATE	TIME (military)	TESTED BY	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
			CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/08/07	11 : 26	RRB	7.0	5.0	5.7				
10/08/07	11 : 57	RRB	17.0	15.0	15.8	10.0	10.0	4.3	0.43
10/08/07	13 : 42	RRB	27.0	25.0	25.8	22.2	10.0	6.4	0.64
10/08/07	15 : 0	RRB	37.0	35.0	35.7	33.4	10.0	7.6	0.76
10/09/07	13 : 7	RRB	47.0	45.0	45.7	44.9	10.0	9.2	0.92
10/09/07	15 : 5	RRB	57.0	55.0	*	55.3	10.0	9.6	0.96
10/09/07	15 : 6	RRB	47.0	45.0	*	*	*	*	*

* Saturation check - no data available.

9531791

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4543
SAMPLE No.:	MW234-ST-82-84	3
TEST DATE:	8 October 2007	

CELL PRESSURE: 55 psi **BACK PRESSURE:** 45 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	TESTED BY	TIME (Military)	ELAPSED TIME (minutes)	TOTAL TIME (minutes)	TOTAL TIME (Log)	SPECIMEN CONSOLIDATION (ML) READING BOTTOM	READING TOP	ACTUAL TOTAL (Ct)
10 / 12 / 7	RRB	9 : 27				24.0	24.0	0.0
10 / 12 / 7	RRB	9 : 28	1	1	0.00	23.7	23.5	0.8
10 / 12 / 7	RRB	9 : 29	1	2	0.30	23.7	23.5	0.8
10 / 12 / 7	RRB	10 : 52	83	85	1.93	22.9	22.2	2.9
10 / 12 / 7	RRB	16 : 13	321	406	2.61	22.4	20.5	5.1
10 / 16 / 7	RRB	9 : 0	5327	5733	3.76	22.3	18.5	7.2
10 / 16 / 7	RRB	13 : 12	252	5985	3.78	22.3	18.5	7.2

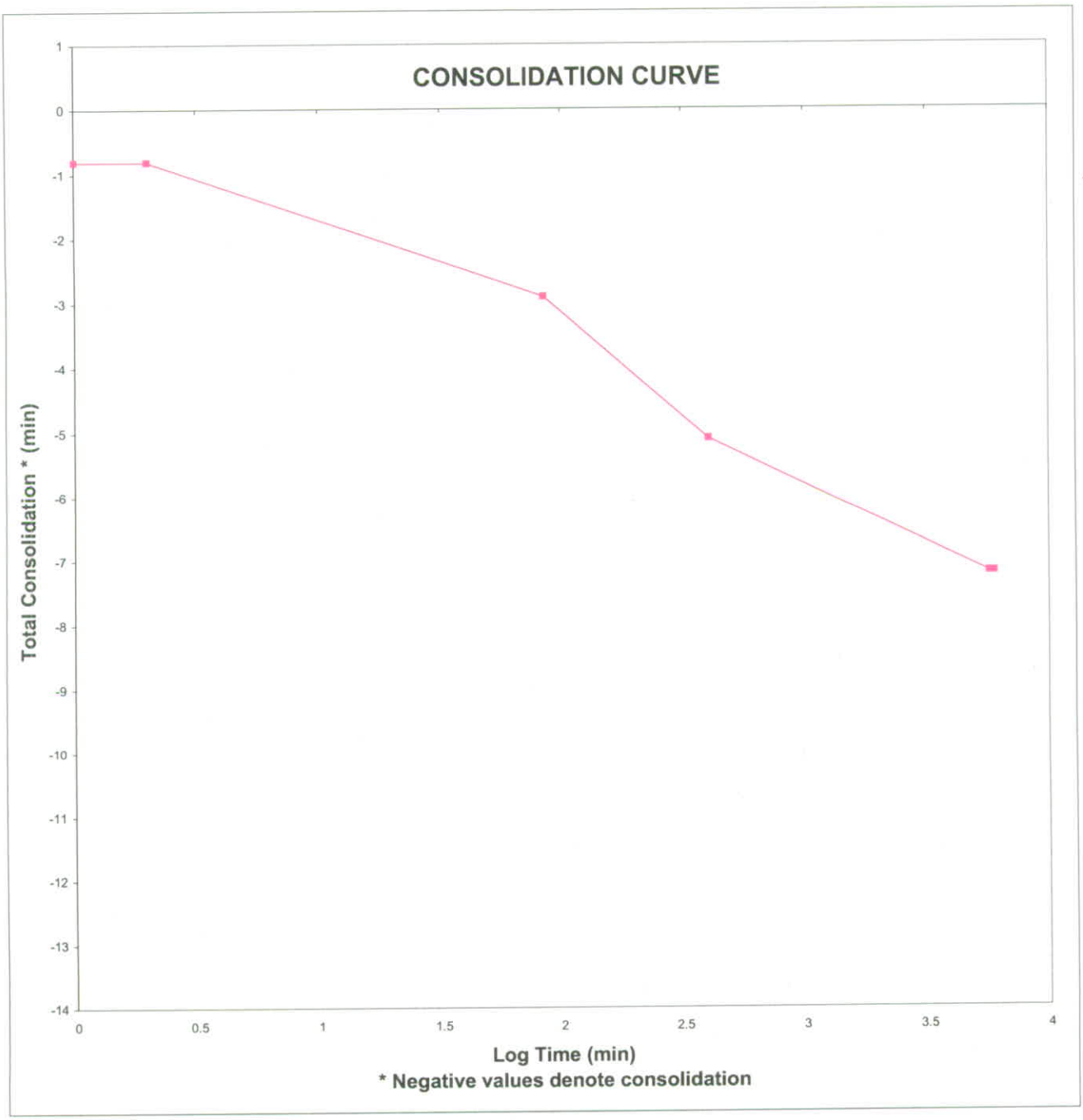
9531792

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		



9531793

PERMEABILITY ASTM D5084

TEST DATA

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP. C°	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT		CELL	INFLUENT	EFFLUENT
10 / 16 / 7	RRB	15 : 14		0.0	24.0	20.0	55.0	45.0	45.0
10 / 17 / 7	RRB	13 : 22	RESET	0.0	24.0	20.0	55.0	53.0	45.0
10 / 18 / 7	RRB	8 : 36	1154	2.5	21.5	20.0	55.0	53.0	45.0
10 / 18 / 7	RRB	11 : 38	182	3.0	21.0	20.0	55.0	53.0	45.0
10 / 18 / 7	RRB	16 : 27	289	3.6	20.4	20.0	55.0	53.0	45.0
10 / 19 / 7	RRB	8 : 27	960	5.6	18.4	20.0	55.0	53.0	45.0

9531794

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		

ELAPSED TIME	*HYDRAULIC HEAD DIFFERENCE (cm)*		*EFFLUENT - INFLUENT*	*HYDRAULIC GRADIENT*	*HYDRAULIC CONDUCTIVITY (cm/sec)*	
(minutes)	*INFLUENT*	*EFFLUENT*	*RATIO*	*(cm/cm)*	*@ Temp.*	*@ 20° C*
RESET				3.606		
RESET				88.165		
1154	2.5	2.5	1.00	87.414	9.81E-09	9.85E-09
182	0.5	0.5	1.00	87.263	1.25E-08	1.26E-08
289	0.6	0.6	1.00	87.083	9.47E-09	9.51E-09
960	2.0	2.0	1.00	86.482	9.54E-09	9.59E-09

9531795

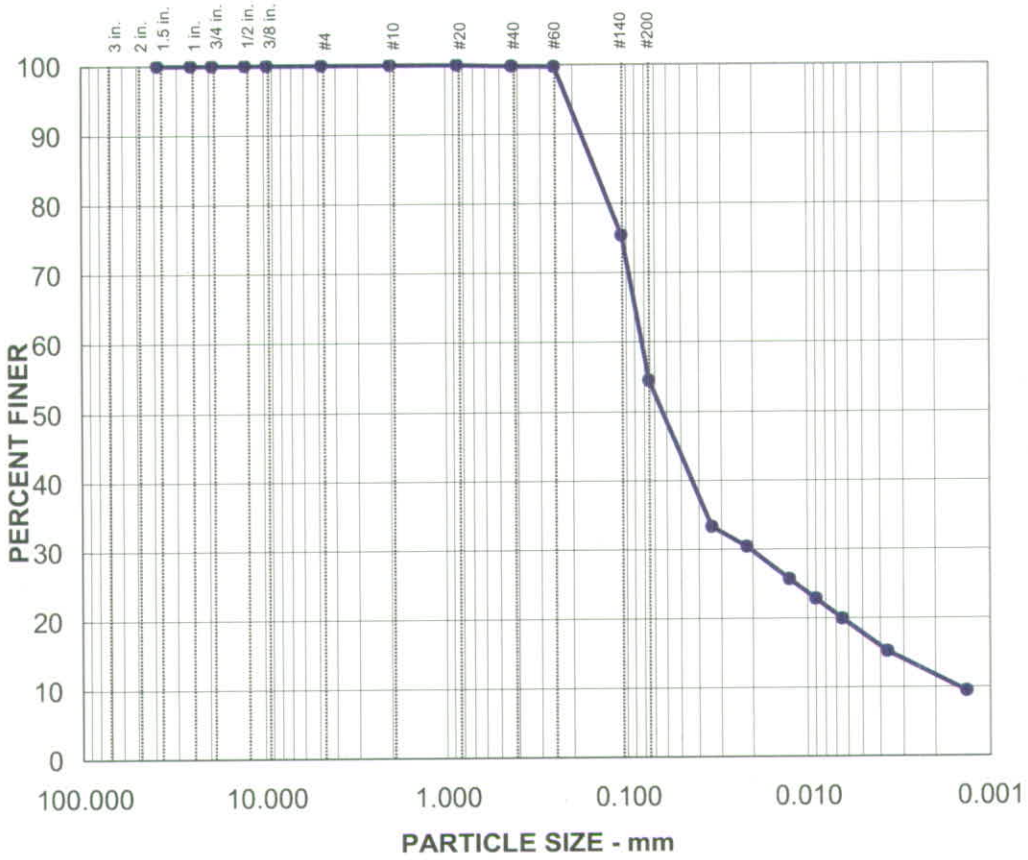
PERMEABILITY ASTM D5084

SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4543
SAMPLE No.:	MW234-ST-82-84	EQUIPMENT No.:	3
TEST DATE:	8 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	125.9 lb/ft³	127.8 lb/ft³
DRY UNIT WEIGHT	101.6 lb/ft³	101.5 lb/ft³
MOISTURE CONTENT	23.9 %	25.9 %
PERMEABILITY @ 20°C	1.0E-08 cm/sec	

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	45.5	36.7	17.8

SAMPLE INFORMATION	
Project Name:	Memphis Depot
Project Number:	SE-0234
Sample ID:	MW-233-ST-88-90
Sample Description:	Sandy Clay
Testing Date:	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Sandy Silty Clay	

KEMRON
ENVIRONMENTAL SERVICES

9531797

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No.:	SE-0234
SAMPLE No.:	MW-233-ST-88-90
SAMPLE DESCRIPT:	Sandy Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4556_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	256.17 g
WT WET SOIL + TARE	320.04 g
WT DRY SOIL + TARE	307.64 g
WT WATER, Ww	12.40 g
WT DRY SOIL, Ws	51.47 g
ASTM MOISTURE	24.09 %
EPA MOISTURE	19.41 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	100.0 %
#40	99.8 %
#60	99.7 %
#140	75.4 %
#200	54.5 %

HYDROMETER ANALYSIS	
HYDROMETER No.	13
Wt OF DRY SOIL, Ws	28.05
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:40:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	23.0	17.5	0.0334	33.2
5	21.5	16.0	0.0214	30.4
15	19.0	13.5	0.0125	25.6
30	17.5	12.0	0.0089	22.8
60	16.0	10.5	0.0064	19.9
190	13.5	8.0	0.0036	15.2
1451	10.5	5.0	0.0013	9.4

KEMRON
ENVIRONMENTAL SERVICES

9531798

PERMEABILITY ASTM D5084

SPECIMEN CONDITIONS

Page 1 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		

MOISTURE CONTENT (Dry Basis)	*INITIAL*	*FINAL*
1. MOISTURE TIN NO.	MW233-ST-88-90	MW233-ST-88-90
2. WT MOISTURE TIN (tare weight)	0.00 *g*	231.10 *g*
3. WT WET SOIL + TARE	587.73 *g*	832.90 *g*
4. WT DRY SOIL + TARE	482.10 *g*	713.20 *g*
5. WT WATER, Ww	105.63 g	119.70 g
6. WT DRY SOIL, Ws	482.10 g	482.10 g
7. MOISTURE CONTENT, W	21.91 %	24.83 %

SOIL SPECIMEN DIMENSIONS				
TRIPLICATE	*DIAMETER*		*HEIGHT*	
ANALYSES	*INITIAL*	*FINAL*	*INITIAL*	*FINAL*
No. 1	*2.82 in.*	*2.86 in.*	*2.68 in.*	*2.70 in.*
No. 2	*2.86 in.*	*2.88 in.*	*2.67 in.*	*2.70 in.*
No. 3	*2.88 in.*	*2.80 in.*	*2.68 in.*	*2.71 in.*
Average	2.85 in.	2.85 in.	2.68 in.	2.70 in.

SPECIMEN CONDITIONS	*INITIAL*	*FINAL*
Specimen WT, Wo	*587.73 g*	*601.95 g*
Area, Ao	6.39 in^2	6.36 in^2
Volume, Vo	17.12 in^3	17.21 in^3
Bulk Unit Weight	130.8 lb/ft^3	133.3 lb/ft^3
Dry Unit Weight	107.3 lb/ft^3	106.8 lb/ft^3

9531799

PERMEABILITY ASTM D5084

BACK-PRESSURE SATURATION

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		

TEST DATE	TIME (military)	TESTED BY	TEST PRESSURES (psi)						
			APPLIED		PORE		PRESSURE CHANGE		
			CELL	BACK	SAT.	TEST	CELL	PORE	B-Value
10/11/07	15 : 42	RRB	7.0	5.0	5.5				
10/11/07	16 : 12	RRB	17.0	15.0	15.8	11.2	10.0	5.7	0.57
10/12/07	8 : 8	RRB	27.0	25.0	25.9	22.8	10.0	7.0	0.70
10/12/07	9 : 32	RRB	37.0	35.0	35.8	33.9	10.0	8.0	0.80
10/12/07	14 : 26	RRB	47.0	45.0	45.7	44.6	10.0	8.8	0.88
10/12/07	16 : 15	RRB	57.0	55.0	55.9	54.6	10.0	8.9	0.89
10/16/07	9 : 5	RRB	67.0	65.0	*	65.3	10.0	9.4	0.94
10/16/07	9 : 6	RRB	57.0	55.0	*	*	*	*	*

* Saturation check - no data available.

9531800

PERMEABILITY ASTM D5084

SPECIMEN CONSOLIDATION

Page 3 of 6

PROJECT:	Memphis Depot	RRB
PROJECT No.:	SE-0234	4556
SAMPLE No.:	MW233-ST-88-90	6B
TEST DATE:	11 October 2007	

CELL PRESSURE: 65 psi **BACK PRESSURE:** 55 psi **EFFECTIVE STRESS:** 10 psi

TEST DATE	TESTED BY	TIME (Military)	ELAPSED TIME (minutes)	TOTAL TIME (minutes)	TOTAL TIME (Log)	SPECIMEN CONSOLIDATION (ML) READING BOTTOM	READING TOP	ACTUAL TOTAL (Ct)
10 / 16 / 7	RRB	9 : 10				25.0	25.0	0.0
10 / 16 / 7	RRB	9 : 11	1	1	0.00	24.8	24.7	0.5
10 / 16 / 7	RRB	9 : 12	1	2	0.30	24.7	24.7	0.6
10 / 16 / 7	RRB	15 : 14	362	364	2.56	23.2	23.7	3.1
10 / 17 / 7	RRB	9 : 21	1087	1451	3.16	22.3	23.1	4.6
10 / 17 / 7	RRB	13 : 22	241	1692	3.23	22.3	23.1	4.6

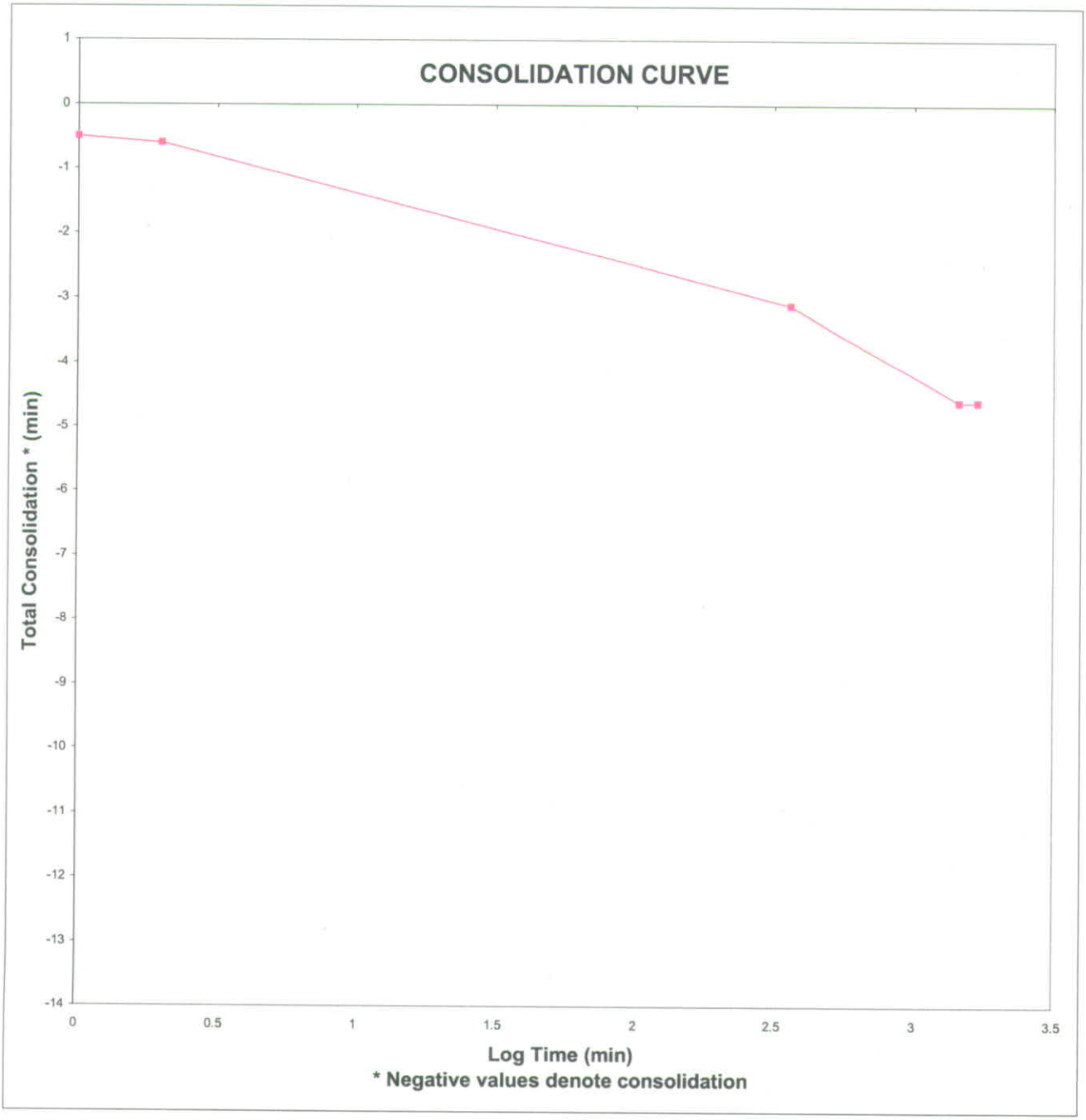
9531801

PERMEABILITY ASTM D5084

CONSOLIDATION CURVE

Page 4 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		



9531802

PERMEABILITY ASTM D5084

TEST DATA

Page 5 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		

DATE	TESTED BY	TIME (military)	ELAPSED TIME (minutes)	HYDRAULIC HEAD (cm)		TEMP. C°	GAUGE PRESSURE (psi)		
				INFLUENT	EFFLUENT		CELL	INFLUENT	EFFLUENT
10 / 17 / 7	RRB	13 : 27		0.0	25.0	20.0	65.0	58.0	55.0
10 / 18 / 7	RRB	8 : 30	1143	1.0	24.0	20.0	65.0	58.0	55.0
10 / 22 / 7	RRB	9 : 5	RESET	0.0	25.0	20.0	65.0	61.0	55.0
10 / 22 / 7	RRB	15 : 25	380	0.5	24.5	20.0	65.0	61.0	55.0
10 / 23 / 7	RRB	8 : 58	1053	1.8	23.2	20.0	65.0	61.0	55.0
10 / 24 / 7	RRB	9 : 43	1485	3.6	21.4	20.0	65.0	61.0	55.0
10 / 24 / 7	RRB	16 : 59	436	4.2	20.8	20.0	65.0	61.0	55.0
10 / 25 / 7	RRB	8 : 32	933	5.3	19.7	20.0	65.0	61.0	55.0

9531803

PERMEABILITY ASTM D5084

TEST DATA (continued)

Page 6 of 6

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		

ELAPSED TIME (minutes)	HYDRAULIC HEAD DIFFERENCE (cm)		EFFLUENT - INFLUENT RATIO	HYDRAULIC GRADIENT (cm/cm)	HYDRAULIC CONDUCTIVITY (cm/sec)	
	INFLUENT	EFFLUENT			@ Temp.	@ 20° C
RESET				34.715		
1143	1.0	1.0	1.00	34.421	1.02E-08	1.03E-08
RESET				65.753		
380	0.5	0.5	1.00	65.606	8.09E-09	8.13E-09
1053	1.3	1.3	1.00	65.224	7.62E-09	7.66E-09
1485	1.8	1.8	1.00	64.694	7.54E-09	7.57E-09
436	0.6	0.6	1.00	64.518	8.61E-09	8.65E-09
933	1.1	1.1	1.00	64.194	7.40E-09	7.44E-09

9531804

PERMEABILITY ASTM D5084

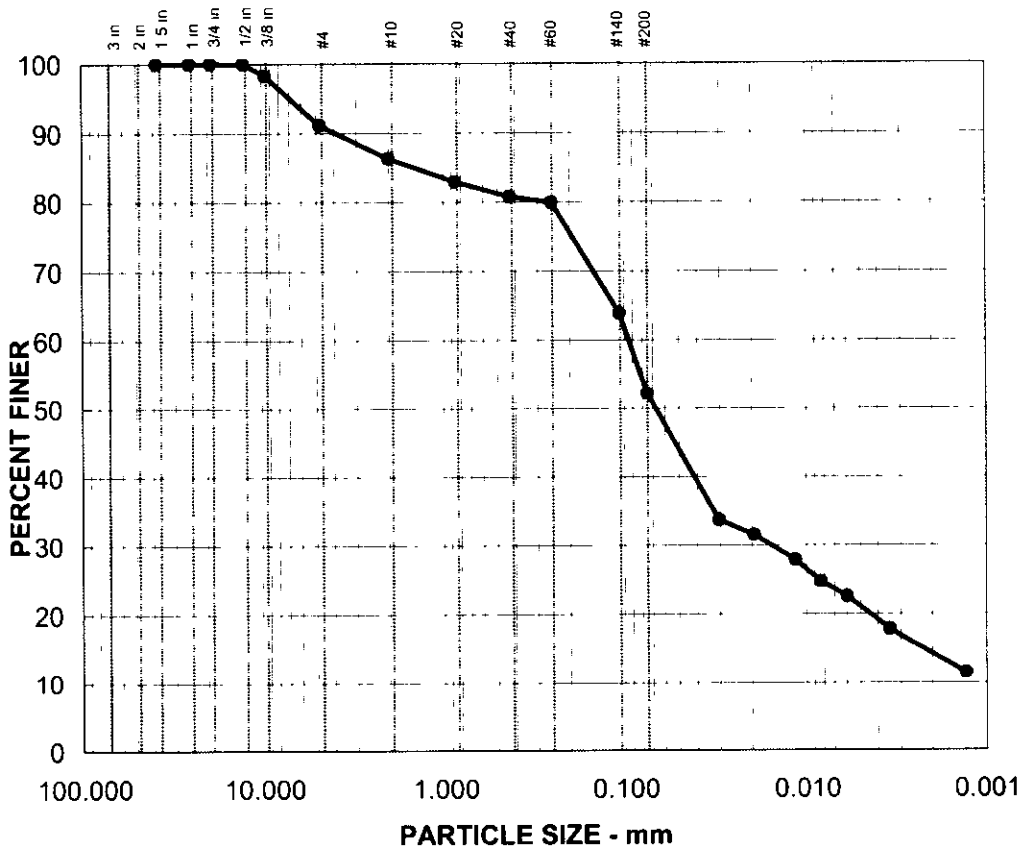
SUMMARY OF RESULTS

PROJECT:	Memphis Depot	TESTED BY:	RRB
PROJECT No.:	SE-0234	TRACKING CODE:	4556
SAMPLE No.:	MW233-ST-88-90	EQUIPMENT No.:	6B
TEST DATE:	11 October 2007		

TESTING PARAMETER	INITIAL	FINAL
BULK UNIT WEIGHT	130.8 lb/ft³	133.3 lb/ft³
DRY UNIT WEIGHT	107.3 lb/ft³	106.8 lb/ft³
MOISTURE CONTENT	21.9 %	24.8 %
PERMEABILITY @ 20°C	7.9E-09 cm/sec	

9531805

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
8 8	39.0	31.1	21 1

SAMPLE INFORMATION	
Project Name	Memphis Depot
Project Number	SE-0234
Sample ID:	MW-232-136-138
Sample Description:	Sandy Clay
Testing Date	10/25/07

SAMPLE CLASSIFICATION	
Liquid Limit	
Plastic Limit	
Plasticity Index	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION: Sandy Silty Clay	

KEMRON
ENVIRONMENTAL SERVICES

9531806

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT:	Memphis Depot
PROJECT No :	SE-0234
SAMPLE No.:	MW-232-136-138
SAMPLE DESCRIPT:	Sandy Clay
TESTING DATE:	10/25/07
TESTED BY:	SEM/TKE/RRB
TRACKING CODE:	4566_GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	252 44 g
WT WET SOIL + TARE	350 58 g
WT DRY SOIL + TARE	345 64 g
WT WATER, Ww	4 94 g
WT DRY SOIL, Ws	93 20 g
ASTM MOISTURE	5 30 %
EPA MOISTURE	5 03 %

SIEVE NUMBER	PERCENT PASSING
1 5	100 0 %
1 0	100 0 %
0 75	100 0 %
0 5	100 0 %
0 375	98 3 %
#4	91 2 %
#10	86.3 %
#20	83 0 %
#40	80 8 %
#60	79 9 %
#140	63 9 %
#200	52 2 %

HYDROMETER ANALYSIS	
HYDROMETER No	11
Wt OF DRY SOIL, Ws	48 61
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10 38 00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	37 5	32.0	0 0301	33 6
5	35 5	30.0	0 0193	31 5
15	32 0	26.5	0 0115	27 8
30	29 0	23 5	0 0083	24 7
60	27 0	21 5	0 0059	22 6
190	22 5	17 0	0 0034	17 8
1450	16 5	11 0	0 0013	11 5

KEMRON
ENVIRONMENTAL SERVICES

9531807

ATTACHMENT F

Report on MW-232 Confirmation Sampling

Solutions Today for a Sustainable Tomorrow

Memorandum

To: Brian Renaghan, CIV AFCEE/EXA
Mike Dobbs, DES-DDC-EE

From: Tom Holmes
Kevin Sedlak

Date: 8 January 2008

Re: **MW-232 Confirmation Sampling**
Off Depot Intermediate Aquifer Study
Dunn Field – Defense Depot Memphis, Tennessee
FA8903-04-D-8722, TO 0019

CH2M HILL has conducted an Intermediate Aquifer Investigation as part of the Off Depot Remedial Design. The objectives of the investigation included an improved conceptual site model with respect to groundwater flow, hydraulic interconnectivity of the fluvial and deeper aquifers, and an assessment of the vertical hydraulic connections between the aquifers. The field work included installation of several wells in the intermediate aquifer for groundwater sampling and conducting aquifer tests. Three intermediate aquifer wells (MW-232, MW-237 and MW-239) were installed near the downgradient edge of the high-concentration portion of the Off Depot fluvial aquifer plume. The wells are located near the intersection of Menager Road and Ragan Street.

Analytical results for initial groundwater samples collected from the new wells prior to the aquifer test indicated chlorinated volatile organic compounds (CVOCs) were not present in the new wells; however, low-flow sampling procedures were not used for these initial samples. Additional samples from existing and new wells were collected by CH2M HILL in November 2007 using low-flow sampling procedures. CVOCs were detected in MW-232 with trichloroethene having the highest concentration at 23.3 micrograms per liter (µg/L). The results were discussed at the BCT meeting on 15 November and it was decided that MW-232 would be re-sampled due to the discrepancy with the initial sample and higher concentrations compared to the other newly installed intermediate aquifer wells. e^2M was directed to collect the samples during the previously scheduled sampling event in December. The number and location of samples were discussed at the BCT meeting and finalized in later discussions between e^2M, Noblis and CH2M HILL.

The well completion diagram states MW-232 was completed on 17 September 2007; the boring was drilled to 181 feet below ground surface with the well screen at a depth of 150.5 to 170.5 feet, bgs. The water level was measured by CH2M HILL on 24 September at 132.92 feet below top of casing (btoc). e^2M personnel measured the water level and total well depth on 30 November 2007 at 125.70 and 168.7 feet, btoc, respectively. Based on the two total depth measurements, approximately 2 feet of silt was in the well. The water level increase is probably due to increased rainfall and recharge since the previous measurement.

Three groundwater samples (CH2-Test-1, CH2-Test-2, and CH2-Test-3) were collected at MW-232 by e^2M personnel on 4 December. The field measurements recorded during sampling are shown on Table 1.

The initial sample, CH2-Test-1, was collected at 08:00 with the sample pump at a depth of 151 feet, btoc, approximately 0.5 feet below the top of the well screen. The well was purged of approximately 1.1 liters of groundwater to remove a volume approximately equal to the discharge line volume. One set of field measurements was recorded and the sample was collected. The sample pump and tubing was then removed from the well.

A clean pump with new sample tubing was lowered to a depth of 165.8 feet, btoc, approximately 4 feet above the bottom of the well screen and 2 feet above the silt at the bottom of the well. The well was purged at a rate of 200 to 300 milliliters per minute (mL/min) for approximately two hours until the field measurements stabilized. The second sample, CH2-Test-2, was collected at 10:05.

The pump was left at the same depth and purging continued at 300 ml/min for 6 hours. Field measurements were recorded hourly. Three final field measurements were collected at 5-minute intervals. Since the measurements were stable, the third sample, CH2-Test 3, was collected at 16:46.

The pump and tubing were removed from the well and two passive diffusion bag samplers were placed in the well at depths of 151.5 and 165.7 feet, btoc respectively.

The samples were kept cool and shipped to Kemron Analytical Laboratory in Marietta, Ohio for volatile organic compounds (VOCs) analysis by method 8260B.

The analytical results are shown on Table 2. The reported concentrations were similar to those reported for the November 2007 sample. TCE was detected in all three samples at concentrations of 26.9 µg/L, 20.1 µg/L and 14.2 µg/L, respectively. cis-1,2-Dichloroethene was detected at 5.74 µg/L, 10.7 µg/L and 7.8 µg/L, respectively. Carbon disulfide, 1,1-dichloroethene, toluene and 1,1,2-trichloethane were also detected above reporting limits in one or more samples.

E 1

FIELD MEASUREMENTS
MW-232 CONFIRMATION SAMPLES
OFF DEPOT INTERMEDIATE AQUIFER STUDY
Dunn Field - Defense Depot Memphis, Tennessee

Well ID	Date	Time Reading	Pump Depth ft (btoc)	Depth to Water ft (btoc)	Purge Rate mL/min	Volume Purged Liters	pH	Temp °C	Specific Conductivity mS/cm	Dissolved Oxygen mg/L	Oxidation Reduction Potential mV	Turbidity NTUs
MW-232/CH2-Test-1	12/4/2007	7:57	151.0	125 7	360	1 08	6 73	15 32	0.328	8.59	18 7	14.4
MW-232/CH2-Test-2	12/4/2007	8:12	165 8	126 9	300	Initial	6 91	13 58	0.327	13 58	-7.2	145.0
	12/4/2007	8:17	165 8	126.9	300	1 30	6 77	14 24	0 331	11 65	-62 9	64.4
	12/4/2007	8:22	165.8	127 0	300	2 00	6 77	14 45	0.331	10 80	-75 1	53.8
	12/4/2007	8:27	165.8	127 0	300	3.08	6 78	14 72	0 330	10 23	-82 7	45 8
	12/4/2007	8 32	165 8	127.0	300	4 30	6.79	14.63	0 330	9 72	-89.2	46 1
	12/4/2007	8:37	165 8	127.0	300	5 22	6 79	14.58	0 330	8 96	-93.4	40 8
	12/4/2007	8:42	165 8	127.0	300	6 00	6 79	14 75	0 330	8 50	-98 0	38.9
	12/4/2007	8:47	165 8	127.0	300	7 20	6 78	14 97	0.330	7 88	-100 6	36.7
	12/4/2007	8:52	165 8	127 0	300	8.00	6 80	14 75	0.330	7 46	-103 1	34 6
	12/4/2007	8 57	165.8	127.0	300	9.22	6.79	14 63	0 329	6.86	-104 5	32 4
	12/4/2007	9 02	165.8	127 0	300	10 00	6 79	14 82	0 330	6.60	-106 2	29 5
	12/4/2007	9 07	165.8	127 0	300	11.06	6.81	14.86	0.331	6.08	-107 1	28 1
	12/4/2007	9.12	165.8	127 0	300	12.00	6.81	14 72	0.331	5.76	-107 5	28 5
	12/4/2007	9:17	165 8	127.0	200	13 06	6 80	14 69	0.334	2 04	-100.0	30.7
	12/4/2007	9 22	165.8	127.0	200	14 00	6 81	14.89	0 335	1 87	-102.0	24 1
	12/4/2007	9.27	165.8	127 0	200	15 22	6.81	14.65	0 335	1.85	-102.4	25 2
	12/4/2007	9:32	165.8	127 0	200	16.00	6 81	14 71	0 336	2.08	-101 8	23 7
	12/4/2007	9:37	165.8	127.0	200	17.20	6.82	14 86	0 336	1.79	-101 3	22 7
	12/4/2007	9:42	165.8	127 0	200	18.14	6 82	14 80	0 337	1.92	-101 5	25.0
	12/4/2007	9:47	165 8	127.0	200	19.22	6.83	14 79	0.337	1 86	-101 5	21 6
	12/4/2007	9:52	165.8	127 0	200	20 46	6 84	14 90	0 337	1.90	-101 4	21.6
	12/4/2007	9:57	165 8	127 0	200	21.24	6 83	14 82	0.338	1 81	-101 6	20.7
	12/4/2007	10:02	165 8	127.0	200	22 14	6 82	14 96	0.338	1 77	-101.8	19.0
MW-232/CH2-Test-3	12/4/2007	10 32	165 8	127 4	300	Initial	6.87	15.40	0 341	2.03	-75 1	24 1
	12/4/2007	11:32	165 8	127 4	300	18.00	6.88	15.72	0 341	1.57	-105 8	9 4
	12/4/2007	12:32	165 8	127 4	300	36.00	6 90	16 04	0.343	1.93	-107 5	6 6
	12/4/2007	13 32	165 8	127.4	300	54 00	6 94	16.32	0.350	1 53	-103 7	3.1
	12/4/2007	14.32	165.8	127 4	300	72.00	6.94	16.51	0 352	1.58	-72.0	-19 1
	12/4/2007	15 32	165 8	127.3	300	90 00	6 93	16.41	0.351	1 32	-90.4	-19.8
	12/4/2007	16 32	165.8	127.3	300	108 00	6 96	16.10	0 357	1 60	-89.1	-11.8
	12/4/2007	16 37	165.8	127.3	300	109 80	6 94	16.15	0 355	1 31	-88 1	-10.9
	12/4/2007	16:42	165 8	127 3	300	111.52	6 93	16 16	0 353	1 33	-86 4	-11 7

9531810

TABLE 2
ANALYTICAL RESULTS
MW-232 CONFIRMATION SAMPLING
OFF DEPOT INTERMEDIATE AQUIFER STUDY
Dunn Field - Defense Depot Memphis, Tennessee

	Sample ID	MW-232 CH2-TEST 1	MW-232 CH2-TEST 2	MW-232 CH2-TEST 3
	Date	12/4/2007	12/4/2007	12/4/2007
	Time	8:00	10:05	16:46
Analyte	**units**			
1,1,1,2-Tetrachloroethane	ug/L	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	ug/L	<1	<1	<1
1,1,2,2-Tetrachloroethane	ug/L	0.157 F	0.163 F	<0.5
1,1,2-Trichloroethane	ug/L	1.06	1.08	0.783 F
1,1-Dichloroethane	ug/L	0.233 F	0.259 F	0.341 F
1,1-Dichloroethene	ug/L	1.36	1.43	1.6
1,1-Dichloropropene	ug/L	<1	<1	<1
1,2,3-Trichlorobenzene	ug/L	<1	<1	<1
1,2,3-Trichloropropane	ug/L	<1	<1	<1
1,2,4-Trichlorobenzene	ug/L	<1	<1	<1
1,2,4-Trimethylbenzene	ug/L	<1	<1	<1
1,2-Dibromo-3-chloropropane	ug/L	<2	<2	<2
1,2-Dibromoethane	ug/L	<1	<1	<1
1,2-Dichlorobenzene	ug/L	<1	<1	<1
1,2-Dichloroethane	ug/L	<0.5	<0.5	<0.5
1,2-Dichloropropane	ug/L	<1	<1	<1
1,3,5-Trimethylbenzene	ug/L	<1	<1	<1
1,3-Dichlorobenzene	ug/L	<1	<1	<1
1,3-Dichloropropane	ug/L	<0.4	<0.4	<0.4
1,4-Dichlorobenzene	ug/L	0.144 F	0.141 F	0.135 F
1-Chlorohexane	ug/L	<1	<1	<1
2,2-Dichloropropane	ug/L	<1	<1	<1
2-Chlorotoluene	ug/L	<1	<1	<1
2-Hexanone	ug/L	<10	<10	<10
4-Chlorotoluene	ug/L	<1	<1	<1
Acetone	ug/L	3.33 F	<10	<10
Benzene	ug/L	0.212 F	0.398 F	0.349 F
Bromobenzene	ug/L	<1	<1	<1
Bromochloromethane	ug/L	<1	<1	<1
Bromodichloromethane	ug/L	<0.5	<0.5	<0.5
Bromoform	ug/L	<1	<1	<1
Bromomethane	ug/L	<1	<1	<1
Carbon disulfide	ug/L	4.58	4.36	2.76
Carbon tetrachloride	ug/L	<1	<1	<1
Chlorobenzene	ug/L	<0.5	<0.5	<0.5
Chloroethane	ug/L	<1	<1	<1
Chloroform	ug/L	0.18 F	0.185 F	0.184 F
Chloromethane	ug/L	<1	<1	<1
cis-1,2-Dichloroethene	ug/L	5.74	10.7	7.8
cis-1,3-Dichloropropene	ug/L	<0.5	<0.5	<0.5
Dibromochloromethane	ug/L	<0.5	<0.5	<0.5
Dibromomethane	ug/L	<1	<1	<1
Dichlorodifluoromethane	ug/L	<1	<1	<1
Ethylbenzene	ug/L	<1	<1	<1
Hexachlorobutadiene	ug/L	<0.6	<0.6	<0.6
Isopropylbenzene	ug/L	<1	<1	<1
m-,p-Xylene	ug/L	<2	<2	0.548 F
MEK (2-Butanone)	ug/L	<10	<10	<10

TABLE 2
ANALYTICAL RESULTS
MW-232 CONFIRMATION SAMPLING
OFF DEPOT INTERMEDIATE AQUIFER STUDY
Dunn Field - Defense Depot Memphis, Tennessee

	Sample ID	**MW-232 CH2-TEST 1**	**MW-232 CH2-TEST 2**	**MW-232 CH2-TEST 3**
	Date	12/4/2007	12/4/2007	12/4/2007
	Time	8.00	10:05	16:46
Methyl t-butyl ether (MTBE)	ug/L	<5	<5	<5
Methylene chloride	ug/L	<1	<1	<1
MIBK (methyl isobutyl ketone)	ug/L	<10	<10	<10
Naphthalene	ug/L	<1	<1	<1
n-Butylbenzene	ug/L	<1	<1	<1
n-Propylbenzene	ug/L	<1	<1	<1
o-Xylene	ug/L	<1	<1	<1
p-Isopropyltoluene	ug/L	<1	<1	<1
sec-Butylbenzene	ug/L	<1	<1	<1
Styrene	ug/L	0.159 F	0.367 F	0 31 F
tert-Butylbenzene	ug/L	<1	<1	<1
Tetrachloroethene	ug/L	0.334 F	<1	<1
Toluene	ug/L	1.06	1.09	0.804 F
trans-1,2-Dichloroethene	ug/L	0.38 F	0.447 F	<1
trans-1,3-Dichloropropene	ug/L	<1	<1	<1
Trichloroethene	ug/L	26.9	20.1	14.2
Trichlorofluoromethane	ug/L	<1	<1	<1
Vinyl acetate	ug/L	<5	<5	<5
Vinyl chloride	ug/L	<1	<1	<1

<: Not detected above Reporting Limit (RL)
F: Concentration below RL

9531813

APPENDIX E

Microcosm Study Results

Laboratory Microcosm Study Results

PREPARED FOR: USACE-Huntsville Center

PREPARED BY: CH2M HILL/ATL

COPIES: Defense Logistics Agency (DLA)
U.S. Environmental Protection Agency, Region 4 (EPA)
Tennesee Department of Environment and Conservation (TDEC)
e^2M
Noblis

DATE: February 14, 2008

In 2006, enhanced reductive dechlorination (ERD) was selected by the Memphis Depot Base Realignment and Closure (BRAC) Cleanup Team (BCT) as the preferred remedy for the Off-Depot chlorinated volatile organic compound (CVOC) plume. This selection was based on hydrogeologic and chlorinated volatile organic compound (CVOC) data collected since the *Memphis Depot Dunn Field Record of Decision* (ROD) (CH2M HILL, 2004) was signed and the challenges associated with the installation of a full-scale zero-valent iron permeable reactive barrier (ZVI PRB) (CH2M HILL, 2007).

Though the biodegradation pathways for TeCA were known and understood, a literature review conducted in fall 2006 showed few sites with field-scale enhanced bioremediation applications for this constituent. Much of the research had been conducted at sites where natural attenuation processes facilitated the reductive dechlorination of 1,1,2,2-PCA. As such, prior to completing the Off-Depot Groundwater Remedial Design (RD) and then implementing the full-scale remedy, CH2M HILL and the BCT decided that microcosm and pilot-scale studies were needed to evaluate whether 1,1,2,2-tetrachloroethane (TeCA) and trichloroethene (TCE) could be effectively reduced to site-specific remedial goals using ERD. This document presents the results of the microcosm study that was conducted from December 2006 to January 2008.

Approach and Methods

SiREM was contracted to perform the microcosm study to evaluate TeCA and TCE degradation rates using five carbon substrates (in two phases), site-specific soil and groundwater, and the WBC-2™, a newly developed, dehalorespiring microbial consortia that is reportedly capable of completely dechlorinating TeCA. The key questions that the study was intended to answer included the following:

- *Can target compounds be biodegraded under current site conditions?*
- *What site amendments will increase degradation rates?*
- *What are the expected degradation rates of target compounds?*
- *What are the degradation by-products?*
- *What are the maximum concentrations that can be degraded?*
- *What are the synergies/inhibitions?*

SiREM constructed 21 anaerobic treatment microcosms on January 3, 2007 to assess the rate and extent of reductive dechlorination that can be achieved by the indigenous microbial populations under natural in situ conditions (intrinsic controls) and through the addition of Wilclear (a commercially-available sodium lactate product), EOS™ (a commercially-available emulsified vegetable oil product), and Chitorem™ (a commercially available chitin product). SiREM constructed another six microcosms on August 21, 2007 to assess high fructose corn syrup (HFCS) and HRC-Advanced® (now marketed as 3-D Microemulsion [3DMe™]). Microcosm construction and sampling and analysis are detailed in the *Laboratory Biotreatability Study to Assess Biodegradation of Chlorinated VOCs* Report (SiREM, 2008) included as Attachment A.

Results

The *Laboratory Biotreatability Study to Assess Biodegradation of Chlorinated VOCs* Report (Attachment A) also presents and discusses the results of the microcosm study. The report includes analyses of the sterile and active control microcosms, the lactate- and EOS™-amended microcosms, and the lactate-, EOS™-, chitin-, HFCS-, and 3DMe™-amended microcosms that were also bioaugmented with WBC-2. It also includes a discussion of denatured gradient gel electrophoresis (DGEE), a molecular genetic method that provides information on both the diversity and composition of mixed microbial communities, as well as relevant data tables and figures.

In summary, the results indicate the following:

- The rate and extent of intrinsic degradation of TeCA and TCE in site groundwater may be limited by a deficiency of available electron donor and the absence of specific bacteria capable of mediating complete reductive dechlorination.
- Indigenous bacteria appear to be capable of the partial dechlorination of TCE to *cis*-1,2-dichloroethene (DCE) and TeCA to 1,1,2-trichloethane (TCA) with lactate, chitin, or HFCS as electron donor. Complete dechlorination of both parent compounds was achieved with the addition of WBC-2 to the lactate- and chitin-amended microcosms. The HFCS with WBC-2 bioaugmented microcosms resulted in complete TCE dechlorination but only partial dechlorination of TeCA to *trans*-1,2-DCE. However, based on the lactate microcosm results, which showed *trans*-1,2-DCE degradation following the addition of sodium bicarbonate to raise the pH from 6.5 to above 7, complete dechlorination of TeCA may be possible with the addition of a buffer to a HFCS application.
- Complete dechlorination of TeCA and TCE to ethene was not achieved with the slow-release electron donors (EOS™ and 3DMe™) even when bioaugmented with WBC-2. These results suggest that the WBC-2 culture may have electron donor preferences.
- The dominant pathway for TeCA degradation was via a dihaloelimination pathway to *trans*-1,2-DCE, which was further dechlorinated via reductive dechlorination to ethene. The rate of *trans*-1,2-DCE degradation in the bioaugmented microcosms appears to be sensitive to pH; therefore, buffering may be required depending upon data for a field-scale application.
- DGGE analysis conducted on the initial microcosm suggests that microcosms amended with chitin or lactate had a higher concentration of dechlorinating *Dehalococcoides*

bacteria than the EOS™-amended. This finding corresponds to the increased TCE/TeCA dechlorination rates in the lactate- and chitin-amended microcosms and supports the observation that the WBC-2 culture has electron donor preferences.

Based on the results of this study, the data suggests that the use of lactate or HFCS as an electron donor combined with bioaugmentation using the WBC-2 culture may be an effective remedial approach to stimulate complete reductive dechlorination of TCE and TECA to ethene in site groundwater. For both substrates, buffering (for example, with sodium bicarbonate) will likely be required to raise the pH and optimize dechlorination rates. Though chitin was highly effective, it is not applicable for Dunn Field because it is can not be readily injected into the fluvial aquifer.

References

CH2M HILL. 2004. *Final Memphis Depot Dunn Field ROD*. Prepared for the CEHNC. March.

CH2M HILL. 2007. *Summary of the Memphis Depot Dunn Field ZVI PRB Implementation Study*. February.

ATTACHMENT A

SiREM Report

9531818

Prepared for:

CH2M HILL
Northpark 400
1000 Abernathy Road, Suite 1600
Atlanta, GA, 30328

LABORATORY BIOTREATABILITY STUDY TO ASSESS BIODEGRADATION OF CHLORINATED VOC'S

Former Defense Depot, Memphis, Tennessee

Prepared by:

SiREM
Site Recovery & Management
130 Research Lane, Suite 2
Guelph, Ontario N1G 5G3

SiREM Ref: TL0082

13 February 2008

TABLE OF CONTENTS

Page

1. INTRODUCTION 1

2. APPROACH AND METHODS 2

2.1 Microcosm Construction and Incubation 2

2.1.1 Additional Electron Donor Testing (Phase 2) 4

2.2 Microcosm Sampling and Analysis 5

2.2.1 Microcosm Sampling 5

2.2.2 Analysis of cVOCs and Dissolved Hydrocarbon Gases 5

2.2.3 Analysis of Anions and Total Volatile Fatty Acids 6

2.2.4 Analysis of Volatile Fatty Acids 7

2.2.5 DGGE Analysis 7

3. RESULTS AND DISCUSSION 8

3.1 Sterile and Active Controls 9

3.2 Lactate Amended and Lactate Amended/WBC-2 Bioaugmented Microcosms 9

3.3 EOS™ Amended and EOS™ Amended/WBC-2 Bioaugmented Microcosms 11

3.4 Chitin Amended/WBC-2 Bioaugmented Microcosms 12

3.5 Corn Syrup Amended/WBC-2 Bioaugmented Microcosms 13

3.6 HRC-Advanced ® Amended/WBC-2 Bioaugmented Microcosms 14

3.7 DGGE Analysis Results 15

4. CONCLUSIONS 16

5. REFERENCES 18

LIST OF TABLES

Table 1: Summary of Microcosm Controls and Treatments
Table 2A: Summary of Phase 1 Microcosm cVOCs, Ethene, Ethane, and Methane Results
Table 2B: Summary of Phase 1 Microcosm Anion Results
Table 2C: Summary of Phase 1 Microcosm VFA Results
Table 2D Summary of Phase 1 Microcosm pH Results
Table 3A: Summary of Phase 2 Microcosm cVOCs, Ethene, Ethane, and Methane Results
Table 3B: Summary of Phase 2 Microcosm Anion Results
Table 3C: Summary of Phase 2 Microcosm VFA Results
Table 3D Summary of Phase 2 Microcosm pH Results

LIST OF FIGURES

Figure 1: Degradation pathways for TECA and TCE
Figure 2: cVOC, Ethene, Ethane, and Anion Concentration Trends in anaerobic Sterile Control Microcosms
Figure 3: cVOC, Ethene, Ethane, and Anion Concentration Trends in anaerobic Active Control Microcosms
Figure 4: cVOC, Ethene, Ethane, and Anion Concentration Trends in Lactate Amended Microcosms
Figure 5A: cVOC, Ethene, Ethane, and Anion Concentration Trends in Lactate Amended/WBC-2 Bioaugmented Microcosms
Figure 5B: cVOC, Ethene, Ethane, and Anion Concentration Trends in Re-Spiked Lactate Amended/WBC-2 Bioaugmented Microcosms
Figure 6: cVOC, Ethene, Ethane, and Anion Concentration Trends in EOS™Amended Microcosms
Figure 7A: cVOC, Ethene, Ethane, and Anion Concentration Trends in EOS™ Amended/WBC-2 Bioaugmented Microcosms
Figure 7B: cVOC, Ethene, Ethane, and Anion Concentration Trends in Re-Spiked EOS™ Amended/WBC-2 Bioaugmented Microcosms

Figure 8A: cVOC, Ethene, Ethane, and Anion Concentration Trends in Chitin Amended/WBC-2 Bioaugmented Microcosms
Figure 8B: cVOC, Ethene, Ethane, and Anion Concentration Trends in Re-Spiked Chitin Amended/WBC-2 Bioaugmented Microcosms
Figure 9: cVOC, Ethene, Ethane, and Anion Concentration Trends in Corn Syrup Amended/WBC-2 Bioaugmented Microcosms
Figure 10: cVOC, Ethene, Ethane, and Anion Concentration Trends in HRC-Advanced® Amended/WBC-2 Bioaugmented Microcosms
Figure 11: DGGE Gel Image Highlighting Bacterial Banding Patterns for Electron Donors Used in Phase One of the Microcosm Study

APPENDIX A: Henry's Law Calculation

APPENDIX B: DGGE Analysis Report

LIST OF ABBREVIATIONS

12DCA	1,2-dichloroethane
112TCA	1,1,2-trichloroethane
TECA	1,1,2,2-tetrachloroethane
CA	chloroethane
cis-1,2-DCE	*cis*-1,2-dichloroethene
cVOC	chlorinated volatile organic compound
°C	degrees Celsius
°C/min	degrees Celsius per minute
DGGE	denatured gradient gel electrophoresis
DHG	dissolved hydrocarbon gases
GC	gas chromatograph
G	grams
IC	ion chromatograph
µg/L	micrograms per liter
µL	microliters
min	minutes
mg/L	milligrams per liter
mL	milliliters
mL/L	milliliters per liter
mL/min	milliliters per minute
mM	millimolar
mmol/bottle	millimole per bottle
%	per cent
QL	quantitation limit
SiREM	SiREM Laboratories
TCE	trichloroethene
Trans-1,2-DCE	*trans*-1,2-dichloroethene
VC	vinyl chloride
VFA	volatile fatty acid

1. INTRODUCTION

CH2M HILL retained SiREM Laboratories (SiREM) to perform a laboratory biotreatability study to assess bioremediation options for chlorinated volatile organic compounds (cVOCs) in groundwater at the Former Defense Depot Site, Memphis, Tennessee (the Site). The primary contaminants of concern are 1,1,2,2-tetrachloroethane (TECA) and trichloroethene (TCE). The purpose of the study was to assess natural attenuation, enhanced bioremediation, and bioaugmentation processes for the remediation of the target cVOCs and their breakdown products. Biological reductive dechlorination breakdown products of TECA include 1,1,2-trichloroethane (112TCA), 1,2-dichlorethane (12DCA), and chloroethane (CA). The more common pathways for TECA degradation observed are the elimination reaction of TECA to TCE and the dihaloelimination reaction of TECA to *trans*-1,2-dichloroethene (*trans*-1,2-DCE). TCE (via *cis*-1,2-dichloroethene [*cis*-1,2-DCE) and vinyl chloride [VC]) and *trans*-1,2-DCE follow the reductive dechlorination pathway to ethene. Figure 1 illustrates the degradation pathways for TECA and TCE.

Natural biodegradation processes can occur *in situ* and are often mediated by indigenous microbial populations present at contaminated sites. Enhanced anaerobic bioremediation can, in certain cases, be achieved by stimulating the indigenous microbial populations through the addition of electron donors (biostimulation). Bioaugmentation is the process in which a microbial population known to promote complete reductive dechlorination is introduced to groundwater to enhance the rate and/or extent of biodegradation. WBC-2 is a novel consortium that has a broad substrate range and appears capable of completely biodegrading TECA, 112TCA, 12DCA and chlorinated ethenes to ethene[1].

Groundwater used in this study was collected by CH2M HILL personnel from location MW-77-86 on 18 December 2006 and was received by SiREM on 21 December 2006. Soil cores collected on 19 December 2006 from locations SB-5/74-76 and SB-5/76-78 between depths of 74 and 78 feet below ground surface were received by SiREM on 21 December 2006. Microcosms were prepared under anaerobic conditions in an effort to simulate *in situ* conditions in the laboratory to the extent practicable.

The remainder of this report is divided into three sections. Section 2 presents the experimental approach and methods, section 3 presents the results and discussion and section 4 presents conclusions of the microcosm study.

2. APPROACH AND METHODS

The following sections describe the approach and methods used for microcosm construction and incubation (Section 2.1), and microcosm sampling and analysis (Section 2.2).

2.1 Microcosm Construction and Incubation

A total of 27 microcosms were constructed on 3 January 2007 (21 for Phase 1 of the microcosm study and 6 for additional electron donor testing [Phase 2]). Site soil and groundwater were placed in a disposable anaerobic glove bag with the materials required to construct the various treatment and control microcosms. The glove bag was purged with a carbon dioxide/nitrogen (20:80) gas mixture in order to create an anaerobic environment. The soil from the different cores was combined and manually mixed to improve reproducibility between replicates. Microcosms were constructed by filling sterile 250 milliliter (mL) (nominal volume) screw cap Boston round clear glass bottles (Systems Plus, New Hamburg, ON) with 60 grams (g) of homogenized soil and 200 mL of Site groundwater. The bottles were capped with Mininert™ closures to allow repetitive sampling of the bottle with minimal cVOC loss, and to allow nutrient amendment, as needed, throughout the incubation period. All controls and treatments were constructed in triplicate. Six of these prepared microcosm bottles were designated as spare microcosms and were stored in the cold room at 4 degrees Celsius (°C) for future use in Phase 2 of the microcosm study. Table 1 summarizes the details of microcosm construction and amendments for the various treatment and control microcosms.

Anaerobic sterile control microcosms were constructed to quantify potential abiotic and experimental cVOC losses from the microcosms. The sterile controls were constructed by autoclaving the Site soil at 121 °C and 15 pounds per square inch pressure for 45 to 60 minutes (min). After autoclaving, the control microcosms were returned to the anaerobic chamber, filled with 200 mL of Site groundwater and amended with 2.8 mL of 2.7 per cent (%) mercuric chloride (equal to a final liquid concentration of 0.05%) and 0.5 mL of 5% sodium azide (equal to a final liquid concentration of 0.017%) to inhibit microbial activity.

All microcosms were sampled and incubated in an anaerobic chamber (Coy Laboratory Products, Grass Lake, MI) filled with an atmosphere of approximately 80% nitrogen, 10% carbon dioxide, and 10% hydrogen (BOC gases, Guelph, ON). Hydrogen was added to scavenge low levels of oxygen via a palladium catalyst, and anaerobic conditions were verified using resazurin-containing mineral medium, which turns pink if oxygen is present. During quiescent incubation, all microcosms were covered to

minimize photodegradation, and stored horizontally to minimize VOC losses via the (submerged) Mininert™ closure. Microcosms were incubated for a period of up to 224 days at 22°C (room temperature).

Treatment microcosms were amended with either soluble or slow release electron donors on 8 January 2007 (Day 0). The soluble electron donor tested was Wilclear (a commercially available sodium lactate product), while the slow release electron donors tested were EOS™ (a commercially available emulsified vegetable oil product), and chitorem™ (a commercially available chitin product). The lactate treatment microcosms were amended with sodium lactate at approximately 10 times the stoichiometric demand of the cVOCs and selected inorganic compounds (i.e., nitrate and sulfate). The lactate microcosms were amended with 100 microliters (µL) of Wilclear (60 % sodium lactate solution) corresponding to target concentrations of 299 milligrams per liter (mg/L). The EOS™ microcosms were amended with 334 µL of EOS™ corresponding to a target concentration of 0.1 % EOS™ as oil (EOS™ is 59.8 % soy bean oil). The amount of EOS™ added (a percentage of what is typically applied in the field) was based on experience with prior laboratory studies. The chitin microcosms were amended with 0.5 g of Chitorem™. The amount of chitin added was based on experience with prior laboratory studies. Electron donor treatments were reamended with electron donor as necessary throughout the incubation period (refer to Table 2A for amendment dates).

To assess the ability of bioaugmentation to improve the rate and extent of TECA and TCE dechlorination to ethene, one set of each lactate treatment, EOS™ treatment and the chitin treatment microcosms were bioaugmented with WBC-2 culture on 9 February 2007 (Day 32). Microcosms were not bioaugmented at time zero to allow for development of reducing conditions required by the WBC-2 culture. Suitable reducing conditions in these microcosms developed after the addition of the electron donor. Reducing conditions in the microcosms were confirmed by the evidence of sulfate reduction and darkening of the microcosm sediment.

CH2M HILL requested that the lactate amended and chitin amended bioaugmented treatment microcosms be spiked with higher concentrations of TECA and TCE to represent higher concentration areas at the site. On 12 March 2007 (Day 63), the lactate amended and chitin amended bioaugmented treatment microcosms were amended with 1.26 µL of neat TECA (Sigma, St Louis, Missouri) and 1.2 mL of a saturated TCE water stock (concentration of 1,100 mg/L) (Sigma) to reach the target concentrations of 10 mg/L and 6 mg/L respectively. A laboratory error occurred during spiking which resulted in the addition 1.26 µL of neat 112TCA to all three lactate amended bioaugmented treatments and replicate one of the chitin amended treatment.

The corresponding 112TCA concentration achieved in the microcosms was approximately 9.0 mg/L.

CH2M HILL also requested that the EOS amended/WBC-2 bioaugmented treatment microcosms be spiked with higher concentrations of TECA and TCE. On 20 April 2007 (Day 102) the EOS amended bioaugmented treatment microcosms were amended with 1.26 µL of neat TECA and 1.2 mL of a saturated TCE water stock (concentration of 1,100 mg/L) to reach the target concentrations of 10 mg/L and 6 mg/L respectively. It was decided in agreement with CH2M Hill at this time, not to re-spike microcosm three of the EOS™ amended bioaugmented treatments and to discontinue the sampling and maintenance of this microcosm due to slower activity in this microcosm relative to the other two microcosms.

On 19 June 2007 (Day 162), in consultation with CH2M HILL, it was decided to adjust pH levels of the lactate amended and EOS™ amended microcosms closer to neutral (pH 7 +/- 0.2) using a saturated sodium bicarbonate solution. The optimal range for dehalorespiring bacteria is known to be 6.8 to 7.8[2]. The pH was subsequently monitored throughout the study and was adjusted as necessary to maintain the neutral pH. Refer to Table 2D for amendment dates.

2.1.1 Additional Electron Donor Testing (Phase 2)

On 15 August 2007, the six spare microcosms were removed from the cold room and placed in the anaerobic chamber and allowed to equilibrate to room temperature. On 20 August 2007 the spare microcosms were sampled for cVOC analysis. Analysis showed that the concentration of TECA and TCE were less then the target concentration. On 21 August 2007 the spare microcosms were amended with 544 µL of saturated TECA water stock (concentration of 2,962 mg/L) and 957 µL of a saturated TCE water stock (concentration of 1,100 mg/L) to reach the target concentrations of 10 mg/L and 6 mg/L respectively.

The additional electron donors tested were corn syrup and HRC-Advanced® (now marketed as 3-D Microemulsion [3DMe™]). The corn syrup amended treatment microcosms were amended with corn syrup at approximately 10 times the stoichiometric demand of the cVOCs and selected inorganic compounds (i.e., nitrate and sulfate). The corn syrup amended microcosms were amended with 352 µL of a 1:10 corn syrup (BeeHive brand, ACH Food Company Inc., Memphis, TN) and water solution corresponding to a target concentration of 160 mg/L. The HRC-Advanced® microcosms were amended with 2.2 mL of a 1:10 HRC-Advanced® (Regenesis, San Clemente, CA) and water solution corresponding to a target concentration of 0.1 % HRC-Advanced® in the microcosm bottles as recommended by Regenesis. Electron

donor treatments were re-amended with electron donor as necessary throughout the incubation period (refer to Table 3A for amendment dates).

To assess the ability of bioaugmentation to improve the rate and extent of TECA and TCE dechlorination to ethene the corn syrup and HRC-Advanced® treatment microcosms were bioaugmented with WBC-2 culture on 1 October 2007 (Day 41). Microcosms were not bioaugmented at time zero to allow for development of reducing conditions required by the WBC-2 culture. Suitable reducing conditions in the corn syrup microcosms were obtained after the addition of the electron donor confirmed by the evidence of sulfate reduction and darkening of the microcosm sediment. Only replicate three of the HRC-Advanced® microcosms showed similar signs of reducing conditions at the time of bioaugmentation.

2.2 Microcosm Sampling and Analysis

2.2.1 Microcosm Sampling

Aqueous samples were collected from the control and treatment microcosms on a weekly, biweekly (i.e., every two weeks), or monthly basis for analysis of cVOCs (TECA, 112TCA, 12DCA, CA, TCE, *trans*-1,2-DCE, *cis*-1,2-DCE, and VC), dissolved hydrocarbon gases (DHGs) (ethene, ethane, and methane), anions (sulfate, nitrate, nitrite, chloride, phosphate, bromide), and total volatile fatty acids (VFAs) (lactate, acetate, propionate, formate, butyrate, and pyruvate). Microcosms were sampled using gas-tight 1 mL Hamilton glass syringes. Separate sets of syringes were used for the bioaugmented and non-bioaugmented treatments to minimize the potential for transfer of WBC-2 microorganisms from bioaugmented to non-bioaugmented treatments. Syringes were cleaned with acidified water (pH ~2) and rinsed 10 times with deionized water between samples, to ensure that VOCs and microorganisms were not transferred between different samples or treatments. The analytical methods employed by SiREM are described below.

2.2.2 Analysis of cVOCs and Dissolved Hydrocarbon Gases

This section describes the methods used to quantify cVOCs and DHGs. The quantitation limits (QL) for the cVOCs and DHGs were typically 5 to 10 micrograms per liter (µg/L) in the microcosms based on the lowest concentration standards that were included in the linear calibration trend.

Aqueous cVOC (excluding TECA) concentrations in the microcosms were measured using a Hewlett-Packard (Hewlett Packard 5890 series II Plus) gas chromatograph (GC) equipped with an auto sampler (Hewlett Packard 7684) programmed to heat each

sample vial to 75°C for 45 min prior to headspace injection into a GSQ Plot column (0.53 millimeters x 30 meters, J&W) and a flame ionization detector. Sample vials were heated to ensure that all VOCs in the aqueous sample would partition into the headspace. The injector temperature was 200°C, and the detector temperature was 250°C. The oven temperature was programmed as follows: 35°C for 2 min, increased to 100°C at 50 degrees Celsius per minute (°C/min), then increased to 185°C at 25°C/min and held at 185°C for 5.80 min. The carrier gas was helium at a flow rate of 11 milliliters per minute (mL/min). TECA concentrations were measured using the same GC, auto sampler, and detector but a DB624 column (0.53 millimeters x 30 meters, J&W) was used with the following temperature program: 40°C for 5 min, increased to 150°C at 10°C/min, then increased to 185°C at 50°C/min and held at 185°C for 3.0 min.

After withdrawing a 1.0 mL sample (as described in section 2.2.1), the sample was injected into a 10 mL auto sampler vial containing 5.0 mL of acidified deionized water (pH ~2). The water was acidified to inhibit microbial activity between microcosm sampling and GC analysis. The vial was sealed with an inert Teflon™-coated septum and aluminum crimp cap for automated injection of 3 mL of headspace onto the GC. One cVOC standard was analyzed with each set of samples to verify the instrument five-point calibration curve using methanolic stock solutions containing known concentrations of the target analytes. Calibration was performed using external standards purchased as standard solutions (Sigma), where known volumes of standard solutions were added to acidified water in auto sampler vials and analyzed as described above for microcosm samples. Data were integrated using Peak Simple Chromatography Data System Software (SRI, Inc., Torrance, California), where concentrations were converted from mg/L to total millimoles per bottle (mmol/bottle) (Figures 1 to 10, Table 2A, and Table 3A) using Henry's Law as demonstrated in Appendix A.

2.2.3 Analysis of Anions and Total Volatile Fatty Acids

This section describes the methods to quantify anions and lactate (as a measure of total volatile fatty acids.

Analysis was performed on a Dionex DX-600 ion chromatograph (IC) equipped with a Dionex AS-40 auto sampler and an AS18 column, the sample loop volume was 25 µL. An isocratic separation was performed using 33 millimolar (mM) sodium hydroxide (reagent grade, Fisher Scientific, Ottawa, Ontario) eluent for 13 minutes. One standard was analysed with each set of samples to verify the yearly seven-point calibration using external standards of known concentrations. External standards were prepared

gravimetrically using chemicals of the highest purity available (Sigma or Bioshop, Burlington, Ontario). Data were integrated using Peaknet Chromatography software (Dionex, Oakville, Ontario). The QLs were as follows: 0.25 mg/L lactate, 0.03 mg/L chloride, 0.28 mg/L nitrite, 0.10 mg/L nitrate, 0.03 mg/L sulfate, 0.57 mg/L phosphate and 0.14 mg/L bromide. The VFA value included not only lactate but other VFAs, such as formate, acetate, propionate, pyruvate, and butyrate (valerate has not been tested), as this particular analytical method does not resolve these compounds.

A 0.5 mL sample was withdrawn (as described in section 2.2.1), after which the sample was placed in a 1.5 mL micro-centrifuge tube. Samples were centrifuged for five minutes to remove solids. The supernatant was removed, diluted 10-fold in deionized water and placed in a Dionex auto sampler vial with a cap that filters the sample during automated injection onto the IC.

2.2.4 Analysis of Volatile Fatty Acids

This section describes the methods to quantify VFAs. Analysis was performed on a Dionex DX-600 IC equipped with a Dionex AS-40 auto sampler and an AS11-HC column, the sample loop volume was 25 µL. A gradient separation was performed using the following eluent profile; 1.0 mM sodium hydroxide for 8.0 min to 15 mM at 18.0 min and proceeding to 30 mM at 28.0 min. with a flow rate of 1.5 mL/min. Calibration was performed using external standards of known concentrations. One standard was analysed with each set of samples to verify the yearly seven-point calibration using external standards of known concentrations. External standards were prepared gravimetrically using chemicals of the highest purity available (Sigma or Bioshop). Data were integrated using Dionex's Peaknet chromatography software. The QLs were as follows: lactate 0.40 mg/L, acetate 0.54 mg/L , propionate 0.31 mg/L, formate 0.23 mg/L, butyrate 0.41 mg/L, and pyruvate 0.69 mg/L.

A 0.5 mL sample was withdrawn (as described in section 2.2.1), after which the sample was placed in a 1.5 mL micro-centrifuge tube. Samples were centrifuged for five minutes to remove solids. The supernatant was removed, diluted 50-fold in deionized water and placed in a Dionex auto sampler vial with a cap that filters the sample during automated injection onto the IC.

2.2.5 DGGE Analysis

Samples from selected Phase 1 microcosms were submitted for Denatured Gradient Gel Electrophoresis (DGGE) analysis. A 40 mL sample was withdrawn from each of the lactate amended/WBC-2 bioaugmented (lactate/WBC-2) and chitin amended/WBC-

2 bioaugmented (Chitin/WBC-2) microcosms on 4 September 2007 (Day 239). The 40 mL samples from the triplicate microcosms were combined in a sterile bottle and submitted for DGGE analysis. A 120 mL sample was withdrawn on Day 239 from microcosms one and two of the EOS™ amended/WBC-2 bioaugmented microcosms (EOS-1/WBC-2 and EOS-2/WBC-2). The 120 mL samples from the individual microcosms were transferred to a sterile bottle and submitted for DGGE analysis. The method for the DGGE analysis is referenced in appendix B.

3. RESULTS AND DISCUSSION

The following section presents and discusses the results of the biotreatability study;

- Section 3.1 discusses the results for the sterile and active control microcosms,
- Section 3.2 discusses the results for the lactate amended and lactate amended/WBC-2 bioaugmented treatment microcosms,
- Section 3.3 discusses the results for the EOS™ amended and EOS™ amended/WBC-2 bioaugmented treatment microcosms,
- Section 3.4 discusses the results of the Chitin amended/WBC-2 bioaugmented treatment microcosms,
- Section 3.5 discusses the results of the corn syrup amended/WBC-2 bioaugmented microcosms,
- Section 3.6 discusses the results of the HRC-Advanced® amended/WBC-2 bioaugmented microcosms, and,
- Section 3.7 discusses the results for the DGGE analysis.

Tables 2A, 2B, 2C, 2D, 3A, 3B, 3C, and 3D provide cVOC, DHG, anion, VFA, and pH data from the control and treatment microcosms over the incubation period for the study. All cVOC and DHG concentrations are presented both in concentration units of mg/L and millimoles per microcosm bottle (mmol/bottle) to demonstrate mass balances on a molar basis. Figures 1 through 10 present trends in the concentrations of cVOCs, ethene, ethane, and anions in the control and treatment microcosms over the incubation period for the study.

3.1 Sterile and Active Controls

TECA concentrations decreased slightly with a concomitant increase in TCE concentrations in sterile control microcosms two and three (Figure 2). This observed activity may be due to abiotic degradation (dehydrochlorination) of TECA to TCE, which is known to occur at measurable rates at room temperature and higher. The TECA also decreased similarly in microcosm one, but the increase in TCE concentration was greater than that what could expected from abiotic TECA degradation alone (Figure 2). No increases in TECA and TCE degradation products were observed in these three microcosms. The reason for the greater increase in TCE in microcosm one could possibly be due to desorption of TECA from the aquifer material followed by abiotic transformation to TCE. Sulfate and nitrate concentrations remained stable throughout the incubation period. These results indicate abiotic conversion of TECA to TCE is possible in the treatment microcosms, but there was little or no mass loss of cVOCs in the various treatment microcosms resulting from experimental losses (e.g., sorption or loss through microcosm closures).

TECA and TCE concentrations remained relatively stable in the anaerobic active control microcosms. TECA decreased slightly in all microcosms with low levels of 112TCA present throughout the incubation period. TCE increased slightly in all three microcosms along with slight increases in *cis*-1,2-DCE in microcosms two and three (Figure 3). Similar to the sterile controls, the TECA decreases and increases in TCE may be attributed to abiotic degradation (dehydrochlorination). Nitrate was reduced in all three replicates, but sulfate concentrations remained stable. These data suggest that the rate and extent of intrinsic biodegradation activity at the Site may be limited, likely due to a lack of available nutrients (e.g., electron donors or cometabolites) and/or appropriate microorganisms to promote degradation.

The sterile and active controls were sampled and analysed over a 168 day period, while the treatment microcosms were monitored for up to 224 days.

3.2 Lactate Amended and Lactate Amended/WBC-2 Bioaugmented Microcosms

The addition of lactate alone promoted dechlorination of TCE to *cis*-1,2-DCE in all three microcosms. TECA concentrations decreased over the incubation period and low levels of 112TCA persisted throughout (Figure 4). The observed decreases in TECA may be via a dihaloelimination reaction to *cis*-1,2-DCE as *trans*-1,2-DCE concentrations did not increase and *cis*-1,2-DCE concentrations increased to more than the the starting molar concentration of TCE. Another possibility for the decrease in TECA accompanied by increased *cis*-1,2-DCE would be abiotic degradation to TCE (via an dehydrochlorinatoin reaction) and reductive dechlorination to *cis*-1,2-DCE.

Nitrate and sulfate reductions were observed with nitrate reduction complete by day 14 and sulfate reduction essentially complete by day 56. Methane concentrations did not increase throughout the incubation period.

Prior to bioaugmentation of the lactate amended/WBC-2 bioaugmented microcosms, TCE dechlorination to *cis*-1,2-DCE was observed in microcosms one and three, while TCE concentrations remained stable in microcosm two. TECA concentrations remained stable in all three microcosms (Figure 5A). Nitrate and sulfate reductions were observed similar to the lactate amended microcosms. Following bioaugmentation with WBC-2 on day 32 TECA, 112TCA, and TCE concentrations decreased with corresponding increases in *cis*-1,2-DCE, *trans*-1,2-DCE, VC, and ethene. TECA, 112TCA, and TCE were completely dechlorinated by day 42. 112TCA and 12DCA concentrations did not increase indicating that the TECA degradation was via the dihaloelimination pathway to *trans*-1,2-DCE (often observed with this culture). After day 42 *cis*-1,2-DCE decreased rapidly in all three microcosms with corresponding increases in VC and ethene. VC was dechlorinated to ethene in microcosms two and three and partially to ethene in microcosm one. *trans*-1,2-DCE decreased more slowly with some remaining in all three replicates at day 63.

All three microcosms were re-spiked with TECA, 112TCA, and TCE on day 64. TECA, 112TCA, and TCE began to decrease immediately with increases in 12DCA, *cis*-1,2-DCE, trans-1,2-DCE, and VC (Figure 5B). *cis*-1,2-DCE and VC began to decrease after day 99 and were essentially at non-detect by day 140 with corresponding increases in ethene. 12DCA decreased more slowly but was completely degraded by day 196 in all microcosms with further increases in ethene. *trans*-1,2-DCE remained stable up to day 168, after which concentrations decreased to non-detect by day 196 in microcosm one, and by day 224 in microcosms two and three. Following the re-spike the pH in these microcosms was observed to be consistently around a pH of 6.5 (Table 2D) prior to buffering with sodium bicarbonate on day 162. pH values greater than 7 were achieved in all three microcosms on day 176 (Table 2D). It appears that increasing the pH in these microcosms increased the rate of *trans*-1,2-DCE dechlorination. The TECA degradation was likely via the dihaloelimination pathway to *trans*-1,2-DCE, while 112TCA followed reductive dechlorination to 12DCA followed by dihaloelimination to ethene. Methane concentrations increased slightly in all three replicates indicating that a portion of the electron donor may have been consumed by methanogens. Chloride concentrations increased throughout the incubation period as expected during the dechlorination process.

These data indicate that indigenous microorganisms present at the Site are capable of partial dechlorination of TCE to *cis*-1,2-DCE and TECA to 112TCA and that

bioaugmentation with WBC-2 can promote complete dechlorination of TECA and TCE to ethene with lactate as an electron donor.

3.3 EOS™ Amended and EOS™ Amended/WBC-2 Bioaugmented Microcosms

The addition of EOS™ alone did not promote dechlorination of TECA or TCE over the incubation period (Figure 6). TECA concentrations decreased slightly over the incubation period and low levels of 112TCA persisted throughout. Nitrate reduction was observed in all three microcosms and was complete by day 14. Sulfate concentrations remained stable in microcosm two, but were reduced in microcosms one and three by day 56. The concentration of methane did not increase in microcosms one or two, but an increase was observed in microcosm three near the end of the incubation period indicating that a portion of the electron donor was being consumed by methanogens.

Prior to bioaugmentation of the EOS™ amended/WBC-2 bioaugmented microcosms TCE dechlorination to *cis*-1,2-DCE had begun, while TECA and 112TCA concentrations increased slightly (Figure 7A). Microcosm three was removed from the data set because of the difference in activity to the other replicates (data for microcosm three is not shown). Nitrate and sulfate reductions were observed similar to the EOS™ amended microcosms. Following bioaugmentation with WBC-2 on day 32 TECA, 112TCA, and TCE concentrations decreased and were essentially at non-detect by day 42 with corresponding increases in *cis*-1,2-DCE, *trans*-1,2-DCE, VC, and ethene. TECA and 112TCA degradation likely occurred via dihaloelimination reactions to *trans*-1,2-DCE and VC respectively. *cis*-1,2-DCE concentrations decreased to day 84 with increases in VC followed by ethene. VC dechlorination was complete by day 99 in microcosm one, but low levels remained in microcosm two. *trans*-1,2-DCE persisted up to day 99 of the incubation period.

Microcosms one and two were re-spiked with TECA and TCE on day 102. In microcosms one, TCE decreased to non-detect by day 112 with a corresponding increase in *cis*-1,2-DCE (Figure 7B). TECA decreases followed reaching non-detect by day 154 with corresponding increases in *trans*-1,2-DCE. Again TECA degradation was via the dihaloelimination pathway to *trans*-1,2-DCE. After day 112 *cis*-1,2-DCE decreased reaching near non-detect levels by day 224 with corresponding increases in VC and ethene. *trans*-1,2-DCE concentrations remained stable to the end of the incubation period on day 224. In microcosm two TCE to *cis*-1,2-DCE dechlorination was similar to microcosm one, but *cis*-1,2-DCE remained stable to the end of the incubation period without increases in VC and ethene. Dechlorination of TECA was not observed in replicate two. Following the re-spike, the pH in these microcosms was measured and was consistently below pH 6.5 (Table 2D) prior to buffering with sodium

bicarbonate on day 162. pH values greater than 7 were achieved in both microcosms on day 176. Unlike the Lactate amended microcosms, the pH buffering did not appear to have an effect on *trans*-1,2-DCE dechlorination. However, other chlorinated compounds were still present in these microcosms and more time may have been needed to observe the effect of pH buffering on *trans*-1,2-DCE dechlorination. The concentration of methane increased in both microcosms indicating that a portion of the electron donor was being consumed by methanogens. Chloride concentrations increased throughout the incubation period as expected during the dechlorination process.

These data indicate that indigenous microorganisms present at the Site are not capable of TECA or TCE dechlorination with EOS™ as an electron donor. Bioaugmentation with WBC-2 can promote complete dechlorination of TCE to ethene, but only partial dechlorination of TECA to *trans*-1,2-DCE with EOS™ as an electron donor. These data suggest that the WBC-2 culture may have electron donor preferences.

3.4 Chitin Amended/WBC-2 Bioaugmented Microcosms

Prior to bioaugmentation of the chitin amended/WBC-2 bioaugmented microcosms TCE dechlorination to *cis*-1,2-DCE had begun in microcosms one and two, but TCE remained stable microcosm three. TECA concentrations decreased slightly in microcosms one and two with low levels of 112TCA present, while TECA decreased by more than 50 % in microcosm three with a corresponding increase in 112TCA (Figure 8A). Nitrate and sulfate reduction was observed in all microcosms and was essentially complete by day 14. Following bioaugmentation with WBC-2 on day 32 TECA, 112TCA, TCE, and *cis*-1,2-DCE concentrations decreased with increases in *trans*-1,2-DCE, VC, and ethene, and were essentially at non-detect by day 56 in all three microcosms. *trans*-1,2-DCE concentrations decreased after day 49 reaching near non-detect levels by day 63 with further increase in ethene. Unlike microcosms one and two, an increase in 12DCA was observed following the decrease in TECA and 112TCA in microcosm three. The concentration of 12DCA increased to day 42, followed by a slow decrease over the remainder of the incubation period. TECA degradation appeared to follow both reductive dechlorination and dihaloelimination pathways in replicate three, but was via dihaloelimination only in replicates one and two.

Microcosm one was re-spiked with TECA, 112TCA and TCE on day 64, and microcosms two and three were spiked with TECA and TCE. In microcosm one TECA, 112TCA, and TCE dechlorination began immediately with corresponding increases 12DCA, *cis*-1,2-DCE, *trans*-1,-2DCE, VC, and ethene. Concentrations of *cis*-1,2-DCE

and VC began to decrease after day 71, while *trans*-1,2-DCE and 12DCA decreased after day 77 and essentially all mass was converted to ethene by day 99. In microcosms two and three TECA and TCE dechlorination began immediately with corresponding increases *cis*-1,2-DCE, *trans*-1,-2DCE, VC, and ethene. Concentrations of *cis*-1,2-DCE and VC began to decrease after day 71, while *trans*-1,2-DCE decreased after day 77 and essentially all mass was converted to ethene by day 99 in microcosm two and by day 112 in microcosm three. Interestingly, following the re-spike, microcosm one appeared to follow both reductive dechlorination and dihaloelimination pathways for TECA, while microcosm three was via dihaloelimination only.

The pH of these microcosms was consistently above 6.5 (Table 2D) and buffering was not required for complete dechlorination to occur. Chitin is extracted from crustacean exoskeletons and contains calcium carbonate, which would have provided pH buffering in these microcosms. The concentration of methane increased in all three microcosms indicating that a portion of the electron donor was being consumed by methanogens. Chloride concentrations increased throughout the incubation period as expected during the dechlorination process.

These data indicate that indigenous microorganisms present at the Site are capable of partial dechlorination of TCE to *cis*-1,2-DCE and TECA to 112TCA and that bioaugmentation with WBC-2 can promote complete dechlorination of TECA and TCE to ethene with chitin as an electron donor.

3.5 Corn Syrup Amended/WBC-2 Bioaugmented Microcosms

Prior to bioaugmentation of the corn syrup amended/WBC-2 bioaugmented microcosms TCE dechlorination to *cis*-1,2-DCE had begun in all three microcosms (Figure 9). Nitrate and sulfate reduction was observed with nitrate reduction complete by day 14 and sulfate reduction underway by day 34. Following bioaugmentation with WBC-2 on day 42, TECA and *cis*-1,2-DCE concentrations decreased in microcosm one with corresponding increases in *trans*-1,2-DCE and VC. VC dechlorination to ethene followed and *cis*-1,2-DCE and VC were essentially at non-detect by day 97. *trans*-1,2-DCE persisted to the end of the incubation period on day 134. Similar results were observed in microcosm two with the exception that *cis*-1,2-DCE and VC dechlorination was slower, reaching near non-detect levels by day 134. In microcosm three, TECA dechlorination to *trans*-1,2-DCE occurred between day 69 and day 83 with *trans*-12,-DCE persisting throughout the remainder of the incubation period. *cis*-1,2-DCE remained stable to day 97 after which *cis*-1,2-DCE was dechlorinated to VC with a slight increase in ethene. In all three microcosms the primary reaction mechanisms for TECA was dihaloelimination to *trans*-12,-DCE. The pH in these microcosms was

typically between 6.4 and 6.8 (Table 3D). These microcosms were not buffered to increase the pH. It is possible that with a longer incubation period and pH buffering dechlorination of *trans*-1,2-DCE may have occurred similar to the lactate treatments. Further research would be required to verify this. Methane concentrations did not increase in any of these microcosms.

These data indicate that indigenous microorganisms present at the Site are capable of partial dechlorination of TCE to *cis*-1,2-DCE and that bioaugmentation with WBC-2 can promote complete dechlorination of TCE to ethene, but only partial dechlorination of TECA to *trans*-1,2-DCE using corn syrup as an electron donor.

3.6 HRC-Advanced® Amended/WBC-2 Bioaugmented Microcosms

Prior to bioaugmentation of the HRC-Advanced® amended/WBC-2 bioaugmented microcosms TECA and TCE concentrations remained stable in all three microcosms with no increases in breakdown products (Figure 10). Nitrate reduction was observed and was complete by day 14. Sulfate reduction was observed in replicate three, but sulfate remained stable in replicates one and two. Following bioaugmentation with WBC-2 on day 42, sulfate reduction was observed by the first sampling point on day 55 in all three microcosms. TECA and TCE concentrations remained stable through day 69 followed by dechlorination of TCE to *cis*-1,2-DCE by day 97 in microcosm one. TECA and *cis*-1,2-DCE concentrations persisted to the end of the incubation period with no further increases in degradation products. In microcosm two, TECA and TCE concentrations remained stable throughout the entire incubation period with no observed increases in degradation products. It should be noted that the TECA concentration in microcosm two was measured at time zero to be about two times higher (~18 mg/L) then the target concentration due to a laboratory error. In microcosm three dechlorination of TCE to *cis*-1,2-DCE occurred by day 69. TECA and *cis*-1,2-DCE concentrations persisted to the end of the incubation period with no increases in degradation products. The pH in these microcosms were typically measured below a pH of 6.5 (Table 3D). The lack of microbial activity in these microcosms may have been partially due to the low pH levels as compared to the other treatments. It is possible that with a longer incubation period and pH buffering that dechlorination of the contaminants may have been possible. A longer incubation period would be required to verify this. Methane concentrations did not increase in all three microcosms throughout the incubation period.

These data indicate that indigenous microorganisms present at the Site are not capable of TECA or TCE dechlorination and that bioaugmentation with WBC-2 does

not promote complete dechlorination of TECA and TCE to ethene with HRC-Advanced® as an electron donor.

3.7 DGGE Analysis Results

DGGE is a molecular genetic method that provides information on both the diversity and composition of mixed microbial communities. Each band in the DGGE analysis represents a distinct microbial species that can be identified, in some cases, by sequencing the DNA of the individual bands (See Figure 11 for the DGGE gel image and Appendix B [DGGE report] for more details regarding this analysis).

DGGE was performed on liquid samples taken from the selected microcosms on Day 239. Samples tested were a composite of the Chitin/WBC-2 microcosms, a composite of the Lactate/WBC-2 microcosms, and non composite samples from EOS-1/WBC-2, and EOS-2/WBC-2 microcosms. DGGE analysis of the WBC-2 culture was performed in an adjacent lane to determine if bands in common with those in WBC-2 were present in the microcosm samples.

Based on differing banding patterns (Figure 11) the DGGE analysis indicates that the microbial communities between the microcosms vary in terms of total diversity (more bands) and in the composition (different bands at specific locations). EOS-2/WBC-2 appeared to have the greatest microbial diversity followed by Chitin/WBC-2 and EOS-1/WBC-2, while Lactate/WBC-2 exhibited the lowest microbial diversity. The high diversity in the EOS amended microcosms is possibly due to the fact that EOS is a complex electron donor (composed of lactate, soybean oil, emulsifiers, and nutrients) and therefore may support the metabolism of a larger variety of different microorganisms. This may also be true for chitin which is extracted from crustacean exoskeletons, contains nitrogen, and is frequently supplemented with nutrients. Lactate on the other hand is a simple VFA with reduced potential to support the growth of a diverse microbial community.

Band F in the EOS-1/WBC-2 lane was common at high intensity to both EOS-1/WBC-2, and EOS-2 /WBC-2 as well as but to a lesser extent in lactate/WBC-2 and chitin /WBC-2. This band was identified as corresponding to a bacterium belonging to the family Spirochaetales. This microbial group is frequently associated with dechlorinating cultures and sites exhibiting reductive dechlorination.

The analysis suggests that several of the microorganisms present in the WBC-2 culture are also present in the bioaugmented microcosms. Specifically bands A and B in the WBC-2 culture also appear in the EOS-2/WBC-2 lane, the microbes corresponding to these bands were identified as belonging to the genus *Propionispora*. Bands

corresponding to *Propionispora* were also visible in the Lactate/WBC-2 lane but not readily apparent in lanes corresponding to the other microcosms. Another microorganism, most likely a *Dehalococcoides* species, is represented by band D in the WBC-2 lane. This band was also present in lanes corresponding to Lactate/WBC-2 (Band B), EOS -1/WBC-2 (Band A), as well as at high density in Chitin/WBC-2 (Band B). Band B in EOS-1/WBC-2 was also identified as a *Dehalococcoides* species. Intriguingly neither of these bands were detected at high density in E0S-2/WBC-2 which exhibited lagging dechlorination when compared to the other treatments.

It appears the *Dehalococcoides* species (specifically band B in chitin/WBC-2, band B in lactate/WBC-2 and band A in EOS-1/WBC-2) were at their highest concentration in the chitin/WBC-2 lane followed by lactate/WBC-2 and then EOS-1/WBC-2 and not detectable in EOS-2/WBC-2. This observation corresponds with the relative dechlorination activity observed in these treatments/microcosms, suggesting that the relative *Dehalococcoides* concentration correlates to the dechlorination of the target compounds.

4. CONCLUSIONS

The laboratory biotreatability study results indicated the following:

1. The rate and extent of intrinsic degradation of TECA and TCE in Site groundwater may be limited by a deficiency of available nutrients (e.g., electron donor) and the absence of specific bacteria capable of mediating complete reductive dechlorination of TECA and TCE to ethene.

2. Indigenous bacteria present at the Site appear to be capable of the partial dechlorination of TCE to *cis*-1,2-DCE and TECA to 112TCA with lactate or chitin as electron donor.

3. Complete dechlorination of TECA and TCE (at concentrations representative of higher concentration areas at the site) to ethene in Site groundwater may be achieved with the addition of either lactate or chitin as electron donor combined with bioaugmentation with WBC-2.

4. Complete dechlorination of TCE to ethene and partial dechlorination of TECA to *trans*-1,2-DCE in Site groundwater may be achieved with the addition of either EOS™ or corn syrup as electron donor combined with bioaugmentation with WBC-2.

5. Partial dechlorination of TCE to *cis*-1,2-DCE in Site groundwater may be achieved with the HRC-Advanced® electron donor combined with bioaugmentation with WBC-2.

6. The dominant pathway for TECA degradation was via a dihaloelimination pathway to *trans*-1,2-DCE which was further dechlorinated via reductive dechlorination to ethene.

7. Slow release, oil based electron donors (EOS and HRC-Advanced®), combined with bioaugmentation with WBC-2 did not promote complete degradation of both TECA and TCE to ethene in this microcosm study.

8. The relationship between pH and dechlorination appears to be important, especially for *trans*-1,2-DCE dechlorination.

9. DGGE analysis suggests that microcosms amended with chitin or lactate had a higher concentration of dechlorinating *Dehalococcoides* bacteria, which corresponded to the increased TCE/TECA dechlorination versus EOS amended microcosms.

Based on the results of this study, the data suggests that the use of chitin, lactate, or corn syrup as an electron donor combined with bioaugmentation using the WBC-2 culture may be an effective remedial approach to stimulate complete reductive dechlorination of TCE and TECA to ethene in Site groundwater. Although complete dechlorination of *trans*-1,2-DCE did not occur in the corn syrup amended microcosms over the incubation period of this study, the data from the lactate microcosms indicates that with a longer incubation period and pH buffering, dechlorination of *trans*-1,2-DCE may have occurred.

5. REFERENCES

1. Lorah, M.M., Majcher, E., Jones, E., Voytek, M., Dworatzek, S., Graves, D. 2007. Degradation of Chlorinated Methanes Developed for Chlorinated Alkanes and Alkenes. Battelle Press, Columbia, Ohio.

2. Adamson, D.T., Mcdade, J.M., Hughes, J.B. 2003. Inoculation of a DNAPL Source Zone to initiate Reductive Dechloriantion of PCE. Environmental Science and Technology 37: 2525-2533.

TABLES

TABLE 1: SUMMARY OF MICROCOSM CONTROLS AND TREATMENTS
Former Defense Depot, Memphis, Tennessee

SiREM

Microcosm Name	Electron Donor/Acceptor Treatment	Description
ANSC	Anaerobic Sterile Control	Autoclaved and amended with mercuric chloride and sodium azide.
ANAC	Anaerobic Active Control	Unamended.
Lactate	Lactate Amended	Initial electron donor concentration of 299 mg/L sodium lactate.
EOS	EOS Amended	Initial electron donor concentration of 0.1% as oil.
Lac + WBC-2	Lactate Amended/ WBC-2 Bioaugmented	Initial electron donor concentration of 299 mg/L sodium lactate. Bioaugmented with WBC-2 on day 32.
EOS + WBC-2	EOS Amended/ WBC-2 Bioaugmented	Initial electron donor concentration of 0.1% as oil. Bioaugmented with WBC-2 on day 32.
Chitin + WBC-2	Chitin Amended/ WBC-2 Bioaugmented	Initial electron donor concentration of 5 g/L Chitin. Bioaugmented with WBC-2 on day 32.
Corn Syrup + WBC-2	Corn Syrup Amended/ WBC-2 Bioaugmented	Initial electron donor concentration of 160 mg/L corn syrup. Bioaugmented with WBC-2 on day 42.
HRC-Advanced® + WBC-2	3-D Microemulsion (HRC-Advanced®) Amended/ WBC-2 Bioaugmented	Initial electron donor concentration of 0.1% as oil. Bioaugmented with WBC-2 on day 42.

Notes:

EOS – emulsified oil substrate
g/L – grams per liter
mg/L - milligrams per liter
% - percent

9531842

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Anaerobic Sterile Control	03-Jan-07	-5														Amended first replicate with 100 µL of resazurin Poisoned with 2 8 mL mercuric chloride and 0 5 mL sodium azide
	08-Jan-07	0	ANSC-1	1 6	0 04	<0 010	<0 010	--	2 5	0 23	<0 010	<0 010	<0 010	<0 010	0 08	
			ANSC-2	1 5	0 05	<0 010	<0 010	--	2 5	0 25	<0 010	<0 010	<0 010	<0 010	0 11	
			ANSC-3	1 1	0 04	<0 010	<0 010	--	2 2	0 19	<0 010	<0 010	<0 010	<0 010	0 10	
			Average Concentration (mg/L)	1 4	0 04	ND	ND	--	2 4	0 22	ND	ND	ND	ND	0 095	
			Standard Deviation (mmoles)	4 3E-04	1 0E-05	0 0E+00	0 0E+00	--	2 2E-04	4 7E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 9E-04	
			Average Total mmoles	**0 0022**	**0.000093**	**ND**	**ND**	**2.3E-03**	**0.0031**	**0.00034**	**ND**	**ND**	**ND**	**ND**	**0.0044**	
	22-Jan-07	14	ANSC-1	2 5	0 04	<0 010	<0 010	--	--	0 04	<0 010	<0 010	<0 010	<0 010	0 07	
			ANSC-2	1 3	0 04	<0 010	<0 010	--	--	0 03	<0 010	<0 010	<0 010	<0 010	0 09	
			ANSC-3	0 91	0 04	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 06	
			Average Concentration (mg/L)	1 6	0 04	ND	ND	--	--	0 02	ND	ND	ND	ND	0 07	
			Standard Deviation (mmoles)	1 3E-03	7 0E-06	0 0E+00	0 0E+00	--	--	3 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 7E-04	
			Average Total mmoles	**0.0025**	**0.000082**	**ND**	**ND**	**2 6E-03**	**--**	**0 000034**	**ND**	**ND**	**ND**	**ND**	**0.0033**	
	05-Feb-07	28	ANSC-1	3 4	0 04	<0 010	<0 010	--	2 6	0 20	<0 010	<0 010	<0 010	<0 010	0 07	
			ANSC-2	1 5	0 04	<0 010	<0 010	--	2 6	0 18	<0 010	<0 010	<0 010	<0 010	0 09	
			ANSC-3	1 3	0 05	<0 010	<0 010	--	2 5	0 16	<0 010	<0 010	<0 010	<0 010	0 09	
			Average Concentration (mg/L)	2 1	0 04	ND	ND	--	2 5	0 18	ND	ND	ND	ND	0 08	
			Standard Deviation (mmoles)	1 8E-03	5 3E-06	0 0E+00	0 0E+00	--	8 3E-05	3 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 3E-04	
			Average Total mmoles	**0 0033**	**0.000094**	**ND**	**ND**	**3 4E-03**	**0.0033**	**0 00027**	**ND**	**ND**	**ND**	**ND**	**0.0038**	
	05-Mar-07	56	ANSC-1	4 4	0 04	<0 010	<0 010	--	1 9	0 19	<0 010	<0 010	0 02	<0 010	0 07	
			ANSC-2	1 7	0 05	<0 010	<0 010	--	2 0	0 17	<0 010	<0 010	<0 010	<0 010	0 08	
			ANSC-3	1 4	0 05	<0 010	<0 010	--	1 9	0 16	<0 010	<0 010	<0 010	<0 010	0 08	
			Average Concentration (mg/L)	2 5	0 05	ND	ND	--	1 9	0 17	ND	ND	<0 010	ND	0 08	
			Standard Deviation (mmoles)	2 7E-03	7 3E-06	0 0E+00	0 0E+00	--	8 4E-05	2 2E-05	0 0E+00	0 0E+00	1 5E-04	0 0E+00	3 9E-04	
			Average Total mmoles	**0.0039**	**0.000096**	**ND**	**ND**	**4 1E-03**	**0 0025**	**0.00026**	**ND**	**ND**	**0.000088**	**ND**	**0.0035**	
	02-Apr-07	84	ANSC-1	5 1	0 04	<0 010	<0 010	--	2 2	0 14	<0 010	<0 010	<0 010	<0 010	0 06	
			ANSC-2	1 8	0 05	<0 010	<0 010	--	2 2	0 12	<0 010	<0 010	<0 010	<0 010	0 08	
			ANSC-3	1 5	0 05	<0 010	<0 010	--	2 0	0 11	<0 010	<0 010	<0 010	<0 010	0 07	
			Average Concentration (mg/L)	2 8	0 05	ND	ND	--	2 1	0 13	ND	ND	ND	ND	0 07	
			Standard Deviation (mmoles)	3 2E-03	7 6E-06	0 0E+00	0 0E+00	--	1 5E-04	2 3E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 1E-04	
			Average Total mmoles	**0.0044**	**0.000097**	**ND**	**ND**	**4 5E-03**	**0.0028**	**0 00019**	**ND**	**ND**	**ND**	**ND**	**0.0032**	
	30-Apr-07	112	ANSC-1	5 9	0 04	<0 010	<0 010	--	2 1	0 28	<0 010	<0 010	<0 010	<0 010	0 06	
			ANSC-2	2 0	0 04	<0 010	<0 010	--	2 1	0 28	<0 010	<0 010	<0 010	<0 010	0 07	
			ANSC-3	1 6	0 05	<0 010	<0 010	--	1 9	0 25	<0 010	<0 010	<0 010	<0 010	0 07	
			Average Concentration (mg/L)	3 2	0 05	ND	ND	--	2 0	0 27	ND	ND	ND	ND	0 07	
			Standard Deviation (mmoles)	3 8E-03	7 1E-06	0 0E+00	0 0E+00	--	1 1E-04	2 7E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 2E-04	
			Average Total mmoles	**0 0051**	**0.000095**	**ND**	**ND**	**5.2E-03**	**0 0026**	**0.0004**	**ND**	**ND**	**ND**	**ND**	**0.0031**	
	28-May-07	140	ANSC-1	6 2	0 05	<0 010	<0 010	--	1 8	0 21	<0 010	<0 010	<0 010	<0 010	0 06	
			ANSC-2	2 0	0 04	<0 010	<0 010	--	1 8	0 18	<0 010	<0 010	<0 010	<0 010	0 07	
			ANSC-3	1 7	0 05	<0 010	<0 010	--	1 7	0 15	<0 010	<0 010	<0 010	<0 010	0 06	
			Average Concentration (mg/L)	3 3	0 05	ND	ND	--	1 8	0 18	ND	ND	ND	ND	0 06	
			Standard Deviation (mmoles)	4 0E-03	8 1E-06	0 0E+00	0 0E+00	--	8 7E-05	4 5E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 7E-04	
			Average Total mmoles	**0.0053**	**0.000099**	**ND**	**ND**	**5 4E-03**	**0.0023**	**0 00027**	**ND**	**ND**	**ND**	**ND**	**0.0029**	
	25-Jun-07	168	ANSC-1	6 6	0 04	<0 010	<0 010	--	1 7	0 23	<0 010	<0 010	<0 010	<0 010	0 06	
			ANSC-2	2 3	0 04	<0 010	<0 010	--	1 7	0 19	<0 010	<0 010	<0 010	<0 010	0 07	
			ANSC-3	1 8	0 05	<0 010	<0 010	--	1 6	0 15	<0 010	<0 010	<0 010	<0 010	0 06	
			Average Concentration (mg/L)	3 6	0 05	ND	ND	--	1 7	0 19	ND	ND	ND	ND	0 06	
			Standard Deviation (mmoles)	4 2E-03	9 7E-06	0 0E+00	0 0E+00	--	5 2E-05	5 9E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 0E-04	
			Average Total mmoles	**0.0057**	**0 000096**	**ND**	**ND**	**5 8E-03**	**0.0022**	**0.00029**	**ND**	**ND**	**ND**	**ND**	**0.0029**	
Anaerobic Active Control	03-Jan-07	-5														Amended the first replicate with 100 µL of resazurin
	08-Jan-07	0	ANAC-1	1 0	0 04	<0 010	<0 010	--	2 1	0 16	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	0 99	0 04	<0 010	<0 010	--	2 0	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	0 93	0 03	<0 010	<0 010	--	1 9	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 98	0 04	ND	ND	--	2 0	0 15	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	8 3E-05	3 9E-06	0 0E+00	0 0E+00	--	1 0E-04	1 1E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	5 1E-05	
			Average Total mmoles	**0 0016**	**0 000076**	**ND**	**ND**	**1.7E-03**	**0 0026**	**0.00023**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	ANAC-1	1 0	0 04	<0 010	<0 010	--	--	0 03	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 0	0 06	<0 010	<0 010	--	--	0 02	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	0 98	0 04	<0 010	<0 010	--	--	0 02	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 0	0 05	ND	ND	--	--	0 02	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	5 6E-05	2 2E-05	0 0E+00	0 0E+00	--	--	4 4E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 9E-05	
			Average Total mmoles	**0 0016**	**0.000096**	**ND**	**ND**	**1.7E-03**	**--**	**0 000033**	**ND**	**ND**	**ND**	**ND**	**0 0012**	
	05-Feb-07	28	ANAC-1	1 2	0 05	<0 010	<0 010	--	2 4	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 1	0 08	<0 010	<0 010	--	2 3	0 21	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 0	0 04	<0 010	<0 010	--	2 2	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 1	0 06	ND	ND	--	2 3	0 14	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 5E-04	3 9E-05	0 0E+00	0 0E+00	--	1 3E-04	9 2E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 0E-05	
			Average Total mmoles	**0.0018**	**0.00012**	**ND**	**ND**	**1 9E-03**	**0.003**	**0.00021**	**ND**	**ND**	**ND**	**ND**	**0.0012**	
	05-Mar-07	56	ANAC-1	1 2	0 05	<0 010	<0 010	--	1 7	0 14	<0 010	<0 010	<0 010	<0 010	0 04	
			ANAC-2	1 1	0 12	<0 010	<0 010	--	1 6	0 20	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 1	0 06	<0 010	<0 010	--	1 5	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 1	0 08	ND	ND	--	1 6	0 14	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 1E-04	7 7E-05	0 0E+00	0 0E+00	--	1 3E-04	8 9E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 7E-04	
			Average Total mmoles	**0.0018**	**0 00017**	**ND**	**ND**	**2.0E-03**	**0.0021**	**0.00021**	**ND**	**ND**	**ND**	**ND**	**0 0015**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Anaerobic Active Control Continued	02-Apr-07	84	ANAC-1	1 4	0 06	<0 010	<0 010	--	1 8	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 2	0 16	<0 010	<0 010	--	1 6	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 1	0 07	<0 010	<0 010	--	1 5	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 2	0 10	ND	ND	--	1 6	0 11	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	2 0E-04	1 2E-04	0 0E+00	0 0E+00	--	1 8E-04	1 2E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 2E-05	
			Average Total mmoles	**0.002**	**0.0002**	**ND**	**ND**	**2.2E-03**	**0.0021**	**0.00017**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	30-Apr-07	112	ANAC-1	1 5	0 06	<0 010	<0 010	--	1 7	0 21	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 4	0 20	<0 010	<0 010	--	1 5	0 19	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 3	0 09	<0 010	<0 010	--	1 4	0 18	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 4	0 11	ND	ND	--	1 6	0 19	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 7E-04	1 5E-04	0 0E+00	0 0E+00	--	2 0E-04	2 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 6E-05	
			Average Total mmoles	**0.0022**	**0.00024**	**ND**	**ND**	**2.4E-03**	**0.002**	**0 00029**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	28-May-07	140	ANAC-1	1 5	0 05	<0 010	<0 010	--	1 5	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 4	0 23	<0 010	<0 010	--	1 3	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 2	0 18	<0 010	<0 010	--	1 3	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 4	0 16	ND	ND	--	1 3	0 11	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	2 8E-04	2 0E-04	0 0E+00	0 0E+00	--	1 7E-04	2 2E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 1E-06	
			Average Total mmoles	**0.0022**	**0 00033**	**ND**	**ND**	**2 5E-03**	**0 0018**	**0.00017**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	25-Jun-07	168	ANAC-1	1 6	0 06	<0 010	<0 010	--	1 4	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-2	1 3	0 25	<0 010	<0 010	--	1 2	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			ANAC-3	1 2	0 21	<0 010	<0 010	--	1 2	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 4	0 17	ND	ND	--	1 3	0 11	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	3 7E-04	2 1E-04	0 0E+00	0 0E+00	--	1 9E-04	2 5E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 1E-06	
			Average Total mmoles	**0 0022**	**0.00037**	**ND**	**ND**	**2.6E-03**	**0.0017**	**0.00017**	**ND**	**ND**	**ND**	**ND**	**0.0012**	
Lactate Amended	03-Jan-07	-5														Amended the first replicate with 100 µL of resazurin
	08-Jan-07	0														Amended with lactate to a target concentration of 299 mg/L
	08-Jan-07	0	Lac-1	1 1	0 04	<0 010	<0 010	--	1 9	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	1 0	0 04	<0 010	<0 010	--	1 9	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	0 93	0 04	<0 010	<0 010	--	1 9	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 0	0 04	ND	ND	--	1 9	0 12	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 1E-04	6 0E-06	0 0E+00	0 0E+00	--	6 1E-05	6 6E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 7E-05	
			Average Total mmoles	**0 0016**	**0 000079**	**ND**	**ND**	**1 7E-03**	**0 0025**	**0.00018**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	Lac-1	0 03	0 91	0 01	<0 010	--	--	0 03	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	1 1	0 05	<0 010	<0 010	--	--	0 05	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	0 99	0 05	<0 010	<0 010	--	--	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 70	0 34	<0 010	ND	--	--	0 05	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	9 3E-04	1 1E-03	1 3E-05	0 0E+00	--	--	2 7E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 4E-05	
			Average Total mmoles	**0.0011**	**0 00072**	**0 0000073**	**ND**	**1.8E-03**	**--**	**0.000072**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	05-Feb-07	28	Lac-1	0 07	1 1	0 02	<0 010	--	2 1	0 16	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	1 1	0 09	<0 010	<0 010	--	2 2	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	0 95	0 08	0 01	<0 010	--	2 1	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 69	0 41	0 01	ND	--	2 1	0 13	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	8 7E-04	1 2E-03	1 8E-05	0 0E+00	--	1 2E-04	2 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 4E-05	
			Average Total mmoles	**0.0011**	**0 00088**	**0 000019**	**ND**	**2 0E-03**	**0.0028**	**0 0002**	**ND**	**ND**	**ND**	**ND**	**0 0014**	
	19-Feb-07	42	Lac-1	<0 010	1 2	0 02	<0 010	--	1 4	0 20	<0 010	<0 010	<0 010	<0 010	0 04	
			Lac-2	0 10	0 96	0 02	<0 010	--	1 6	0 28	<0 010	<0 010	<0 010	<0 010	0 04	
			Lac-3	0 28	0 75	0 01	<0 010	--	1 6	0 30	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 13	0 98	0 02	ND	--	1 5	0 26	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	2 3E-04	5 3E-04	6 0E-06	0 0E+00	--	1 2E-04	8 1E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 6E-04	
			Average Total mmoles	**0 0002**	**0.0021**	**0 000037**	**ND**	**2.3E-03**	**0 002**	**0.00039**	**ND**	**ND**	**ND**	**ND**	**0.0016**	
	05-Mar-07	56	Lac-1	<0 010	1 4	0 02	<0 010	--	1 3	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	0 18	0 94	0 01	<0 010	--	1 4	0 06	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	0 13	0 92	0 02	<0 010	--	1 2	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 10	1 1	0 02	ND	--	1 3	0 07	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 5E-04	5 9E-04	9 5E-06	0 0E+00	--	1 0E-04	2 3E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 6E-05	
			Average Total mmoles	**0 00017**	**0.0023**	**0.000034**	**ND**	**2 5E-03**	**0 0017**	**0 00011**	**ND**	**ND**	**ND**	**ND**	**0.0015**	
	20-Mar-07	71	Lac-1	<0 010	1 5	0 02	<0 010	--	--	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	0 08	1 1	0 01	<0 010	--	--	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	0 13	0 99	0 02	<0 010	--	--	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 072	1 2	0 02	ND	--	--	0 08	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 1E-04	6 0E-04	8 2E-06	0 0E+00	--	--	7 2E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 9E-05	
			Average Total mmoles	**0.00012**	**0 0026**	**0 000037**	**ND**	**2.8E-03**	**--**	**0.00011**	**ND**	**ND**	**ND**	**ND**	**0.0015**	
	26-Mar-07	77	Lac-1	<0 010	1 6	0 03	<0 010	--	--	0 23	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	<0 010	1 1	0 01	<0 010	--	--	0 29	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	<0 010	1 1	0 02	<0 010	--	--	0 29	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	ND	1 3	0 02	ND	--	--	0 27	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	0 0E+00	6 0E-04	1 5E-05	0 0E+00	--	--	5 5E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 3E-05	
			Average Total mmoles	**ND**	**0.0027**	**0.000044**	**ND**	**2 7E-03**	**--**	**0.0004**	**ND**	**ND**	**ND**	**ND**	**0.0015**	
	02-Apr-07	84	Lac-1	<0 010	1 6	0 03	<0 010	--	1 1	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	<0 010	1 2	0 02	<0 010	--	1 2	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	<0 010	1 2	0 02	<0 010	--	0 99	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	ND	1 3	0 02	ND	--	1 1	0 12	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	0 0E+00	4 8E-04	1 0E-05	0 0E+00	--	1 6E-04	6 0E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	5 4E-06	
			Average Total mmoles	**ND**	**0.0028**	**0 000049**	**ND**	**2 8E-03**	**0 0014**	**0 00017**	**ND**	**ND**	**ND**	**ND**	**0 0014**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Lactate Amended Continued	20-Apr-07	102														Amended with lactate to a target concentration of 75 mg/L
	30-Apr-07	112	Lac-1	<0 010	1 9	0 02	<0 010	--	1 0	0 19	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	<0 010	1 3	0 01	<0 010	--	1 1	0 19	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	<0 010	1 1	0 01	<0 010	--	0 91	0 22	<0 010	<0 010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	ND	1 4	0 02	ND	--	1 0	0 20	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	0 0E+00	9 4E-04	1 3E-05	0 0E+00	--	1 3E-04	2 4E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 1E-04	
			Average Total mmoles	**ND**	**0.003**	**0 000036**	**ND**	**3.0E-03**	**0.0013**	**0.0003**	**ND**	**ND**	**ND**	**ND**	**0.0015**	
	28-May-07	140	Lac-1	<0 010	2 0	0 03	<0 010	--	0 80	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	<0 010	1 4	0 02	<0 010	--	0 93	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	<0 010	1 0	0 02	<0 010	--	0 64	0 10	<0 010	<0 010	<0 010	<0 010	0 07	
			Average Concentration (mg/L)	ND	1 5	0 02	ND	--	0 79	0 11	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	0 0E+00	9 8E-04	1 1E-05	0 0E+00	--	1 9E-04	2 2E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	9 4E-04	
			Average Total mmoles	**ND**	**0.0031**	**0 000043**	**ND**	**3.1E-03**	**0.001**	**0.00017**	**ND**	**ND**	**ND**	**ND**	**0.002**	
	25-Jun-07	168	Lac-1	<0 010	2 0	0 03	<0 010	--	0 70	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-2	<0 010	1 4	0 02	<0 010	--	0 82	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac-3	<0 010	0 88	0 02	<0 010	--	0 49	0 09	<0 010	<0 010	<0 010	<0 010	0 09	
			Average Concentration (mg/L)	ND	1 4	0 02	ND	--	0 67	0 11	ND	ND	ND	ND	0 05	
			Standard Deviation (mmoles)	0 0E+00	1 2E-03	1 1E-05	0 0E+00	--	2 2E-04	3 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 6E-03	
			Average Total mmoles	**ND**	**0.003**	**0.000048**	**ND**	**3.0E-03**	**0.00087**	**0 00017**	**ND**	**ND**	**ND**	**ND**	**0.0023**	
	05-Jul-07	178														Amended with lactate to a target concentration of 75 mg/L
EOS™ Amended	03-Jan-07	-5														Amended the first replicate with 100 µL of resazurin
	08-Jan-07	0														Amended with EOS™ to a target concentration of 0 1% as oil
	08-Jan-07	0	EOS-1	0 74	0 03	<0 010	<0 010	--	1 3	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 79	0 04	<0 010	<0 010	--	1 5	0 06	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 69	0 03	<0 010	<0 010	--	1 3	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 74	0 03	ND	ND	--	1 4	0 08	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	8 2E-05	3 2E-06	0 0E+00	0 0E+00	--	9 5E-05	2 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 4E-05	
			Average Total mmoles	**0.0012**	**0.000072**	**ND**	**ND**	**1.3E-03**	**0.0018**	**0.00011**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	EOS-1	0 71	0 03	<0 010	<0 010	--	--	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 75	0 03	<0 010	<0 010	--	--	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 71	0 03	<0 010	<0 010	--	--	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 72	0 03	ND	ND	--	--	0 08	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	3 0E-05	7 5E-07	0 0E+00	0 0E+00	--	--	4 0E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 8E-05	
			Average Total mmoles	**0.0012**	**0.000071**	**ND**	**ND**	**1.3E-03**	--	**0.00012**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	05-Feb-07	28	EOS-1	0 74	0 04	<0 010	<0 010	--	1 7	0 17	<0 010	<0 010	<0 010	<0 010	0 04	
			EOS-2	0 69	0 03	<0 010	<0 010	--	1 7	0 16	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 71	0 04	<0 010	<0 010	--	1 7	0 17	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 72	0 04	ND	ND	--	1 7	0 17	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	4 2E-05	5 7E-06	0 0E+00	0 0E+00	--	4 8E-05	1 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 0E-04	
			Average Total mmoles	**0.0011**	**0.000076**	**ND**	**ND**	**1.2E-03**	**0.0022**	**0.00025**	**ND**	**ND**	**ND**	**ND**	**0.0015**	
	19-Feb-07	42	EOS-1	0 75	0 06	<0 010	<0 010	--	1 4	0 27	<0 010	<0 010	<0 010	<0 010	0 04	
			EOS-2	0 73	0 04	<0 010	<0 010	--	1 3	0 25	<0 010	<0 010	<0 010	<0 010	0 04	
			EOS-3	0 77	0 04	<0 010	<0 010	--	1 3	0 24	<0 010	<0 010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	0 75	0 04	ND	ND	--	1 3	0 25	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	3 7E-05	2 3E-05	0 0E+00	0 0E+00	--	7 9E-05	2 9E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	6 4E-05	
			Average Total mmoles	**0.0012**	**0.000093**	**ND**	**ND**	**1.3E-03**	**0 0017**	**0.00038**	**ND**	**ND**	**ND**	**ND**	**0.0017**	
	05-Mar-07	56	EOS-1	0 89	0 04	<0 010	<0 010	--	1 2	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 69	0 03	<0 010	<0 010	--	1 2	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 78	0 04	<0 010	<0 010	--	1 2	0 11	<0 010	<0 010	<0 010	<0 010	0 05	
			Average Concentration (mg/L)	0 79	0 04	ND	ND	--	1 2	0 09	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	1 6E-04	8 3E-06	0 0E+00	0 0E+00	--	2 9E-05	2 3E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 4E-04	
			Average Total mmoles	**0.0013**	**0.000082**	**ND**	**ND**	**1.4E-03**	**0.0015**	**0.00013**	**ND**	**ND**	**ND**	**ND**	**0.0017**	
	20-Mar-07	71	EOS-1	0 71	0 04	<0 010	<0 010	--	--	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 75	0 04	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 80	0 05	<0 010	<0 010	--	--	0 08	<0 010	<0 010	<0 010	<0 010	0 13	
			Average Concentration (mg/L)	0 76	0 04	ND	ND	--	--	0 06	ND	ND	ND	ND	0 07	
			Standard Deviation (mmoles)	7 3E-05	1 6E-05	0 0E+00	0 0E+00	--	--	7 2E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 6E-03	
			Average Total mmoles	**0.0012**	**0.00009**	**ND**	**ND**	**1 3E-03**	--	**0.000082**	**ND**	**ND**	**ND**	**ND**	**0.003**	
	26-Mar-07	77	EOS-1	0 74	0 04	<0 010	<0 010	--	--	0 26	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 75	0 03	<0 010	<0 010	--	--	0 24	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 74	0 04	<0 010	<0 010	--	--	0 35	<0 010	<0 010	<0 010	<0 010	0 20	
			Average Concentration (mg/L)	0 74	0 04	ND	ND	--	--	0 28	ND	ND	ND	ND	0 09	
			Standard Deviation (mmoles)	7 9E-06	1 1E-05	0 0E+00	0 0E+00	--	--	9 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 4E-03	
			Average Total mmoles	**0 0012**	**0 000085**	**ND**	**ND**	**1 3E-03**	--	**0 00043**	**ND**	**ND**	**ND**	**ND**	**0 004**	
	02-Apr-07	84	EOS-1	0 82	0 05	<0 010	<0 010	--	1 2	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 77	0 03	<0 010	<0 010	--	1 2	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 82	0 04	<0 010	<0 010	--	1 1	0 11	<0 010	<0 010	<0 010	<0 010	0 31	
			Average Concentration (mg/L)	0 80	0 04	ND	ND	--	1 2	0 11	ND	ND	ND	ND	0 12	
			Standard Deviation (mmoles)	4 9E-05	1 4E-05	0 0E+00	0 0E+00	--	5 1E-05	3 1E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 5E-03	
			Average Total mmoles	**0.0013**	**0 000087**	**ND**	**ND**	**1.4E-03**	**0.0015**	**0.00017**	**ND**	**ND**	**ND**	**ND**	**0.0058**	
	20-Apr-07	102														Amended with EOS™ to a target concentration of 0 1% as oil
	30-Apr-07	112	EOS-1	0 68	0 04	<0 010	<0 010	--	0 86	0 20	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 63	0 03	<0 010	<0 010	--	1 0	0 19	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 72	0 05	<0 010	0 02	--	0 89	0 19	<0 010	<0 010	<0 010	<0 010	1 7	
			Average Concentration (mg/L)	0 68	0 04	ND	0 01	--	0 92	0 19	ND	ND	ND	ND	0 58	
			Standard Deviation (mmoles)	7 0E-05	1 7E-05	0 0E+00	3 8E-05	--	1 0E-04	1 4E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 4E-02	
			Average Total mmoles	**0 0011**	**0 000086**	**ND**	**0.000022**	**1 2E-03**	**0.0012**	**0.00029**	**ND**	**ND**	**ND**	**ND**	**0 027**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

SiREM

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
EOS™ Amended Continued	28-May-07	140	EOS-1	0 70	0 06	<0 010	<0 010	--	0 88	0 15	0 02	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 62	0 04	<0 010	<0 010	--	0 91	0 14	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 65	0 06	0 01	<0 010	--	0 82	0 15	0 01	<0 010	<0 010	<0 010	3 2	
			Average Concentration (mg/L)	0 66	0 05	<0 010	ND	--	0 87	0 15	0 01	ND	ND	ND	1 1	
			Standard Deviation (mmoles)	6 1E-05	2 8E-05	1 3E-05	0 0E+00	--	5 7E-05	1 1E-05	2 0E-05	0 0E+00	0 0E+00	0 0E+00	8 4E-02	
			Average Total mmoles	**0.0011**	**0.00011**	**0.0000076**	**ND**	**1.2E-03**	**0 0011**	**0.00022**	**0 000022**	**ND**	**ND**	**ND**	**0.05**	
	25-Jun-07	168	EOS-1	0 69	0 05	<0 010	<0 010	--	0 94	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-2	0 62	0 03	<0 010	<0 010	--	1 0	0 14	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS-3	0 68	0 06	0 01	<0 010	--	0 82	0 15	0 02	<0 010	<0 010	<0 010	3 3	
			Average Concentration (mg/L)	0 66	0 05	<0 010	ND	--	0 93	0 15	<0 010	ND	ND	ND	1 1	
			Standard Deviation (mmoles)	6 3E-05	3 2E-05	1 7E-05	0 0E+00	--	1 3E-04	1 1E-05	1 7E-05	0 0E+00	0 0E+00	0 0E+00	8 8E-02	
			Average Total mmoles	**0.0011**	**0.0001**	**0.00001**	**ND**	**1.2E-03**	**0 0012**	**0.00022**	**0.0000098**	**ND**	**ND**	**ND**	**0.052**	
	05-Jul-07	178														Amended with EOS™ to a target concentration of 0 1% as oil
Lactate Amended/WBC-2 Bioaugmented	03-Jan-07	-5														Amended the first replicate with 100 µL of resazurin
	08-Jan-07	0														Amended with lactate to a target concentration of 299 mg/L
	08-Jan-07	0	Lac + WBC-2- 1	0 99	0 04	<0 010	<0 010	--	1 9	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac + WBC-2- 2	1 2	0 04	<0 010	<0 010	--	1 8	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac + WBC-2- 3	1 1	0 04	<0 010	<0 010	--	1 8	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 1	0 04	ND	ND	--	1 8	0 09	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 8E-04	3 2E-06	0 0E+00	0 0E+00	--	6 6E-05	3 4E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 3E-05	
			Average Total mmoles	**0.0018**	**0.000085**	**ND**	**ND**	**1.9E-03**	**0 0024**	**0.00014**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	Lac + WBC-2- 1	0 90	0 14	<0 010	<0 010	--	--	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac + WBC-2- 2	0 98	0 04	<0 010	<0 010	--	--	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac + WBC-2- 3	0 02	0 89	<0 010	<0 010	--	--	0 09	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 63	0 35	ND	ND	--	--	0 08	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	8 6E-04	9 8E-04	0 0E+00	0 0E+00	--	--	1 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	5 3E-05	
			Average Total mmoles	**0 001**	**0 00075**	**ND**	**ND**	**1.8E-03**	**--**	**0 00013**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	05-Feb-07	28	Lac + WBC-2- 1	0 22	0 84	0 01	<0 010	--	2 2	0 14	<0 010	<0 010	<0 010	<0 010	0 04	
			Lac + WBC-2- 2	1 2	0 05	<0 010	<0 010	--	2 1	0 13	<0 010	<0 010	<0 010	<0 010	0 03	
			Lac + WBC-2- 3	0 08	0 95	<0 010	<0 010	--	2 1	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 49	0 62	<0 010	ND	--	2 1	0 14	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	9 5E-04	1 0E-03	1 7E-05	0 0E+00	--	7 6E-05	1 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 0E-04	
			Average Total mmoles	**0 00079**	**0.0013**	**0.0000097**	**ND**	**2.1E-03**	**0 0028**	**0 00022**	**ND**	**ND**	**ND**	**ND**	**0.0016**	
	09-Feb-07	32														Bioaugmented with WBC-2
	12-Feb-07	35	Lac + WBC-2- 1	<0 010	0 99	0 22	0 04	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 08	
			Lac + WBC-2- 2	1 1	0 11	0 23	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 08	
			Lac + WBC-2- 3	<0 010	0 89	0 26	0 09	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 09	
			Average Concentration (mg/L)	0 38	0 66	0 24	0 04	--	--	ND	ND	ND	ND	ND	0 08	
			Standard Deviation (mmoles)	1 0E-03	1 0E-03	4 6E-05	1 5E-04	--	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 4E-04	
			Average Total mmoles	**0.0006**	**0.0014**	**0 0005**	**0.00014**	**2.6E-03**	**--**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0038**	
	19-Feb-07	42	Lac + WBC-2- 1	<0 010	0 88	0 92	0 24	--	<0 010	<0 010	<0 010	<0 010	<0 010	<0 010	0 08	
			Lac + WBC-2- 2	<0 010	0 81	0 91	0 16	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 01	0 08	
			Lac + WBC-2- 3	<0 010	0 45	0 98	0 25	--	<0 010	<0 010	<0 010	<0 010	0 079	<0 010	0 17	
			Average Concentration (mg/L)	ND	0 71	0 93	0 22	--	ND	ND	ND	ND	ND	ND	0 11	
			Standard Deviation (mmoles)	0 0E+00	5 0E-04	8 5E-05	1 7E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 4E-03	
			Average Total mmoles	**ND**	**0.0015**	**0.002**	**0.00076**	**4.6E-03**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0052**	
	26-Feb-07	49	Lac + WBC-2- 1	<0 010	0 04	0 87	0 62	--	--	<0 010	<0 010	<0 010	0 05	<0 010	0 07	
			Lac + WBC-2- 2	<0 010	0 03	0 83	0 30	--	--	<0 010	<0 010	<0 010	0 10	<0 010	0 09	
			Lac + WBC-2- 3	<0 010	0 02	0 95	0 02	--	--	<0 010	<0 010	<0 010	0 16	<0 010	0 10	
			Average Concentration (mg/L)	ND	0 03	0 88	0 31	--	--	ND	ND	ND	0 10	ND	0 09	
			Standard Deviation (mmoles)	0 0E+00	2 8E-05	1 3E-04	1 0E-03	--	--	0 0E+00	0 0E+00	0 0E+00	7 4E-04	0 0E+00	5 1E-04	
			Average Total mmoles	**ND**	**0 000062**	**0.0019**	**0.0011**	**4.5E-03**	**--**	**ND**	**ND**	**ND**	**0.0014**	**ND**	**0.004**	
	05-Mar-07	56	Lac + WBC-2- 1	<0 010	0 01	0 71	0 32	--	<0 010	<0 010	<0 010	<0 010	0 13	<0 010	0 12	
			Lac + WBC-2- 2	<0 010	0 01	0 62	0 02	--	<0 010	<0 010	<0 010	<0 010	0 19	<0 010	0 12	
			Lac + WBC-2- 3	<0 010	0 01	0 78	<0 010	--	<0 010	<0 010	<0 010	<0 010	0 19	<0 010	0 17	
			Average Concentration (mg/L)	ND	0 01	0 71	0 11	--	ND	ND	ND	ND	0 17	ND	0 13	
			Standard Deviation (mmoles)	0 0E+00	1 7E-06	1 7E-04	6 2E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 3E-04	0 0E+00	1 3E-03	
			Average Total mmoles	**ND**	**0.000023**	**0.0015**	**0.00039**	**4.1E-03**	**ND**	**ND**	**ND**	**ND**	**0 0022**	**ND**	**0.0062**	
	12-Mar-07	63														Spiked with TeCA and 1,1,2-TCA to a target concentration of 10 mg/L and TCE to a target concentration of 6 mg/L
	12-Mar-07	63	Lac + WBC-2- 1	<0 010	0 01	0 55	0 15	--	--	<0 010	<0 010	<0 010	0 17	<0 010	0 13	
			Lac + WBC-2- 2	<0 010	<0 010	0 35	<0 010	--	--	<0 010	<0 010	<0 010	0 22	<0 010	0 14	
			Lac + WBC-2- 3	<0 010	<0 010	0 62	<0 010	--	--	<0 010	<0 010	<0 010	0 20	<0 010	0 15	
			Average Concentration (mg/L)	ND	<0 010	0 51	0 05	--	--	ND	ND	ND	0 20	ND	0 14	
			Standard Deviation (mmoles)	0 0E+00	1 2E-05	2 9E-04	3 0E-04	--	--	0 0E+00	0 0E+00	0 0E+00	3 6E-04	0 0E+00	6 3E-04	
			Average Total mmoles	**ND**	**0.0000072**	**0.0011**	**0.00017**	**3.9E-03**	**--**	**ND**	**ND**	**ND**	**0 0026**	**ND**	**0.0065**	
	13-Mar-07	64	Lac + WBC-2- 1	7 2	0 08	0 56	0 17	--	11	11	0 05	<0 010	0 18	<0 010	0 13	
			Lac + WBC-2- 2	7 2	0 10	0 32	0 03	--	9 6	9 2	0 04	<0 010	0 22	<0 010	0 14	
			Lac + WBC-2- 3	7 3	0 06	0 59	0 02	--	11	11	0 04	<0 010	0 19	<0 010	0 15	
			Average Concentration (mg/L)	7 2	0 08	0 49	0 07	--	11	11	0 04	ND	0 20	ND	0 14	
			Standard Deviation (mmoles)	9 1E-05	4 3E-05	3 1E-04	2 9E-04	--	1 1E-03	1 9E-03	1 1E-05	0 0E+00	2 6E-04	0 0E+00	5 8E-04	
			Average Total mmoles	**0 012**	**0 00017**	**0.001**	**0.00026**	**1.6E-02**	**0.014**	**0.016**	**0.000084**	**ND**	**0.0026**	**ND**	**0 0064**	
	20-Mar-07	71	Lac + WBC-2- 1	6 3	0 50	1 4	1 3	--	--	6 6	1 3	<0 010	0 18	<0 010	0 11	
			Lac + WBC-2- 2	6 6	0 52	0 95	0 80	--	--	6 3	0 85	<0 010	0 24	<0 010	0 12	
			Lac + WBC-2- 3	6 6	0 38	1 6	1 3	--	--	5 4	1 5	<0 010	0 18	<0 010	0 13	
			Average Concentration (mg/L)	6 5	0 47	1 3	1 1	--	--	6 1	1 2	ND	0 20	ND	0 12	
			Standard Deviation (mmoles)	3 1E-04	1 6E-04	6 5E-04	1 0E-03	--	--	9 4E-04	6 7E-04	0 0E+00	4 7E-04	0 0E+00	5 3E-04	
			Average Total mmoles	**0 01**	**0 00099**	**0 0027**	**0.004**	**2.0E-02**	**--**	**0 0092**	**0 0025**	**ND**	**0 0026**	**ND**	**0 0056**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Lactate Amended/WBC-2 Bioaugmented Continued	26-Mar-07	77	Lac + WBC-2- 1	6 6	0 76	2 3	2 2	--	8 4	3 6	2 2	<0 010	0 20	<0 010	0 11	
			Lac + WBC-2- 2	6 7	0 72	2 0	1 8	--	7 5	3 3	1 8	<0 010	0 26	<0 010	0 11	
			Lac + WBC-2- 3	5 9	1 2	2 0	1 8	--	7 9	4 4	1 9	<0 010	0 19	<0 010	0 12	
			Average Concentration (mg/L)	6 4	0 89	2 1	1 9	--	7 9	3 8	2 0	ND	0 22	ND	0 12	
			Standard Deviation (mmoles)	7 2E-04	5 3E-04	3 2E-04	8 9E-04	--	6 0E-04	7 9E-04	3 9E-04	0 0E+00	5 1E-04	0 0E+00	3 3E-04	
			Average Total mmoles	**0.01**	**0.0019**	**0.0044**	**0 0057**	**2 6E-02**	**0.01**	**0.0057**	**0.004**	**ND**	**0.0028**	**ND**	**0.0054**	
	02-Apr-07	84	Lac + WBC-2- 1	5 3	1 7	2 8	2 4	--	6 2	1 3	2 7	<0 010	0 21	<0 010	0 1	
			Lac + WBC-2- 2	5 2	1 8	2 5	2 0	--	5 6	0 75	2 2	<0 010	0 29	<0 010	0 1	
			Lac + WBC-2- 3	2 8	3 8	2 2	2 0	--	6 7	3 0	2 1	<0 010	0 22	<0 010	0 13	
			Average Concentration (mg/L)	4 4	2 4	2 5	2 1	--	6 2	1 7	2 3	ND	0 24	ND	0 11	
			Standard Deviation (mmoles)	2 3E-03	2 5E-03	6 8E-04	8 5E-04	--	7 7E-04	1 8E-03	6 2E-04	0 0E+00	5 7E-04	0 0E+00	7 9E-04	
			Average Total mmoles	**0.0071**	**0.0051**	**0.0053**	**0.0075**	**2 8E-02**	**0.0081**	**0.0026**	**0.0047**	**ND**	**0.0031**	**ND**	**0.0052**	
	17-Apr-07	99	Lac + WBC-2- 1	0 56	4 6	3 6	2 4	--	4 5	0 22	3 0	<0 010	0 37	<0 010	0 1	
			Lac + WBC-2- 2	1 3	4 3	3 1	2 1	--	4 4	0 28	2 4	<0 010	0 44	<0 010	0 1	
			Lac + WBC-2- 3	0 87	4 5	2 6	2 3	--	5 9	1 8	2 5	<0 010	0 37	<0 010	0 12	
			Average Concentration (mg/L)	0 91	4 4	3 1	2 3	--	4 9	0 75	2 6	ND	0 39	ND	0 11	
			Standard Deviation (mmoles)	5 9E-04	3 5E-04	1 0E-03	6 4E-04	--	1 1E-03	1 3E-03	6 6E-04	0 0E+00	5 2E-04	0 0E+00	5 6E-04	
			Average Total mmoles	**0.0014**	**0.0094**	**0.0066**	**0.008**	**3 1E-02**	**0 0084**	**0.0011**	**0.0053**	**ND**	**0.0052**	**ND**	**0.0051**	
	20-Apr-07	102														Amended with lactate to a target concentration of 75 mg/L
	30-Apr-07	112	Lac + WBC-2- 1	<0 010	1 4	5 0	1 6	--	0 16	0 18	3 0	0 01	1 0	<0 010	0 12	
			Lac + WBC-2- 2	<0 010	0 88	4 3	0 85	--	1 9	0 18	2 4	<0 010	1 4	<0 010	0 12	
			Lac + WBC-2- 3	<0 010	1 4	4 7	1 3	--	0 88	0 26	2 9	<0 010	1 1	<0 010	0 13	
			Average Concentration (mg/L)	ND	1 2	4 7	1 2	--	0 98	0 21	2 7	<0 010	1 1	ND	0 13	
			Standard Deviation (mmoles)	0 0E+00	6 5E-04	7 8E-04	1 3E-03	--	1 1E-03	7 0E-05	5 6E-04	2 1E-05	2 4E-03	0 0E+00	3 6E-04	
			Average Total mmoles	**ND**	**0.0026**	**0.0099**	**0.0043**	**3.2E-02**	**0.0013**	**0.00031**	**0.0056**	**0.000012**	**0.015**	**ND**	**0.0058**	
	15-May-07	127	Lac + WBC-2- 1	<0 010	0 07	4 8	0 16	--	0 51	<0 010	2 6	0 01	1 3	<0 010	0 14	
			Lac + WBC-2- 2	<0 010	0 05	4 5	<0 010	--	0 67	<0 010	2 3	<0 010	1 4	<0 010	0 12	
			Lac + WBC-2- 3	<0 010	0 07	4 8	<0 010	--	0 41	<0 010	2 7	<0 010	1 4	<0 010	0 17	
			Average Concentration (mg/L)	ND	0 06	4 7	0 06	--	0 53	ND	2 5	<0 010	1 4	ND	0 14	
			Standard Deviation (mmoles)	0 0E+00	2 1E-05	4 2E-04	3 3E-04	--	1 7E-04	0 0E+00	4 6E-04	2 6E-05	1 2E-03	0 0E+00	1 1E-03	
			Average Total mmoles	**ND**	**0.00013**	**0.0099**	**0.00019**	**2.8E-02**	**0 00069**	**ND**	**0.0052**	**0.000015**	**0 018**	**ND**	**0.0065**	
	28-May-07	140	Lac + WBC-2- 1	<0 010	0 07	5 0	0 06	--	<0 010	<0 010	2 2	0 02	1 3	<0 010	0 17	
			Lac + WBC-2- 2	<0 010	0 06	4 6	<0 010	--	<0 010	<0 010	2 0	<0 010	1 4	<0 010	0 14	
			Lac + WBC-2- 3	<0 010	0 05	4 3	<0 010	--	<0 010	<0 010	2 1	<0 010	1 3	<0 010	0 12	
			Average Concentration (mg/L)	ND	0 06	4 6	0 02	--	ND	ND	2 1	<0 010	1 3	ND	0 14	
			Standard Deviation (mmoles)	0 0E+00	1 9E-05	7 4E-04	1 1E-04	--	0 0E+00	0 0E+00	1 7E-04	2 7E-05	3 3E-04	0 0E+00	1 1E-03	
			Average Total mmoles	**ND**	**0.00012**	**0.0097**	**0.000066**	**2.8E-02**	**ND**	**ND**	**0.0043**	**0 000016**	**0 018**	**ND**	**0.0066**	
	11-Jun-07	154	Lac + WBC-2- 1	<0 010	0 11	4 8	0 05	--	<0 010	<0 010	1 5	0 01	1 4	<0 010	0 24	
			Lac + WBC-2- 2	<0 010	0 08	4 4	<0 010	--	<0 010	<0 010	1 5	<0 010	1 5	<0 010	0 20	
			Lac + WBC-2- 3	<0 010	0 14	4 5	<0 010	--	<0 010	<0 010	1 4	<0 010	1 5	<0 010	0 33	
			Average Concentration (mg/L)	ND	0 11	4 6	0 02	--	ND	ND	1 4	<0 010	1 5	ND	0 26	
			Standard Deviation (mmoles)	0 0E+00	6 0E-05	4 0E-04	9 4E-05	--	0 0E+00	0 0E+00	8 6E-05	2 7E-05	5 8E-04	0 0E+00	2 9E-03	
			Average Total mmoles	**ND**	**0.00023**	**0.0097**	**0.000054**	**2.9E-02**	**ND**	**ND**	**0 0029**	**0.000015**	**0 019**	**ND**	**0.012**	
	20-Jun-07	163	Lac + WBC-2- 1	<0 010	0 07	4 7	0 05	--	--	<0 010	1 1	0 01	1 2	<0 010	0 24	
			Lac + WBC-2- 2	<0 010	0 06	4 3	<0 010	--	--	<0 010	1 1	<0 010	1 3	<0 010	0 22	
			Lac + WBC-2- 3	<0 010	0 05	4 4	<0 010	--	--	<0 010	0 83	<0 010	1 3	<0 010	0 34	
			Average Concentration (mg/L)	ND	0 06	4 5	0 02	--	--	ND	1 0	<0 010	1 3	ND	0 27	
			Standard Deviation (mmoles)	0 0E+00	1 8E-05	4 1E-04	9 3E-05	--	--	0 0E+00	3 1E-04	2 6E-05	6 0E-04	0 0E+00	2 9E-03	
			Average Total mmoles	**ND**	**0.00013**	**0.0095**	**0 000054**	**2.7E-02**	--	**ND**	**0.002**	**0.000015**	**0.017**	**ND**	**0 012**	
	25-Jun-07	168	Lac + WBC-2- 1	<0 010	0 07	4 6	0 05	--	<0 010	<0 010	0 81	0 01	1 4	<0 010	0 32	
			Lac + WBC-2- 2	<0 010	0 06	4 2	<0 010	--	<0 010	<0 010	0 89	<0 010	1 4	<0 010	0 29	
			Lac + WBC-2- 3	<0 010	0 06	4 2	<0 010	--	<0 010	<0 010	0 57	<0 010	1 4	<0 010	0 41	
			Average Concentration (mg/L)	ND	0 06	4 3	0 02	--	ND	ND	0 76	<0 010	1 4	ND	0 34	
			Standard Deviation (mmoles)	0 0E+00	1 2E-05	4 6E-04	9 1E-05	--	0 0E+00	0 0E+00	3 3E-04	2 7E-05	1 1E-04	0 0E+00	2 9E-03	
			Average Total mmoles	**ND**	**0.00013**	**0.0092**	**0 000053**	**2 8E-02**	**ND**	**ND**	**0 0015**	**0 000015**	**0.019**	**ND**	**0 016**	
	05-Jul-07	178														Amended with lactate to a target concentration of 75 mg/L
	23-Jul-07	196	Lac + WBC-2- 1	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	0 05	0 01	1 7	<0 010	0 45	
			Lac + WBC-2- 2	<0 010	0 02	0 67	0 01	--	<0 010	<0 010	0 05	<0 010	1 8	<0 010	0 42	
			Lac + WBC-2- 3	<0 010	0 05	2 0	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 5	<0 010	0 81	
			Average Concentration (mg/L)	ND	0 02	0 90	<0 010	--	ND	ND	0 03	<0 010	1 7	ND	0 56	
			Standard Deviation (mmoles)	0 0E+00	5 5E-05	2 2E-03	2 8E-05	--	0 0E+00	0 0E+00	5 7E-05	2 2E-05	1 8E-03	0 0E+00	1 0E-02	
			Average Total mmoles	**ND**	**0.000049**	**0.0019**	**0.000016**	**2 4E-02**	**ND**	**ND**	**0 000066**	**0.000013**	**0.022**	**ND**	**0.026**	
	20-Aug-07	224	Lac + WBC-2- 1	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	0 03	0 01	1 8	<0 010	0 72	
			Lac + WBC-2- 2	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 7	<0 010	0 61	
			Lac + WBC-2- 3	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 6	<0 010	1 0	
			Average Concentration (mg/L)	ND	ND	ND	ND	--	ND	ND	0 01	<0 010	1 7	ND	0 78	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	0 0E+00	0 0E+00	--	0 0E+00	0 0E+00	3 9E-05	2 0E-05	1 5E-03	0 0E+00	9 5E-03	
			Average Total mmoles	**ND**	**ND**	**ND**	**ND**	**2.2E-02**	**ND**	**ND**	**0.000023**	**0 000012**	**0.022**	**ND**	**0.036**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
EOS™ Amended/WBC-2 Bioaugmented	03-Jan-07	-5														Amended the first replicate with 100 µL of resazunn
	08-Jan-07	0														Amended with EOS™ to a target concentration of 0 1 % as oil
	08-Jan-07	0	EOS + WBC-2- 1	0 69	0 03	<0 010	<0 010	--	1 3	0 06	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS + WBC-2- 2	0 68	0 03	<0 010	<0 010	--	1 3	0 07	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 69	0 03	ND	ND	--	1 3	0 07	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	9 2E-06	1 2E-06	0 0E+00	0 0E+00	--	1 1E-05	3 6E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 3E-06	
			Average Total mmoles	**0.0011**	**0 000069**	**ND**	**ND**	**1.2E-03**	**0.0017**	**0 000097**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	EOS + WBC-2- 1	0 62	0 05	<0 010	<0 010	--	--	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS + WBC-2- 2	0 64	0 06	0 01	<0 010	--	--	0 10	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 63	0 05	0 01	ND	--	--	0 09	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 7E-05	1 4E-05	1 5E-05	0 0E+00	--	--	1 4E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 3E-05	
			Average Total mmoles	**0 001**	**0 00011**	**0 000011**	**ND**	**1 1E-03**	**--**	**0.00014**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	05-Feb-07	28	EOS + WBC-2- 1	0 46	0 28	<0 010	<0 010	--	1 7	0 12	<0 010	<0 010	<0 010	<0 010	0 03	
			EOS + WBC-2- 2	0 65	0 07	0 01	<0 010	--	1 6	0 21	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 55	0 18	0 01	ND	--	1 6	0 17	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	2 2E-04	3 2E-04	2 0E-05	0 0E+00	--	8 5E-05	9 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	9 8E-06	
			Average Total mmoles	**0.00089**	**0.00038**	**0.000014**	**ND**	**1 3E-03**	**0.0021**	**0.00025**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	09-Feb-07	32														Bioaugmented with WBC-2
	12-Feb-07	35	EOS + WBC-2- 1	<0 010	0 66	0 21	0 07	--	--	0 18	<0 010	<0 010	0 01	<0 010	0 15	
			EOS + WBC-2- 2	<0 010	0 66	0 22	0 06	--	--	0 16	<0 010	<0 010	<0 010	<0 010	0 12	
			Average Concentration (mg/L)	ND	0 66	0 21	0 06	--	--	0 17	ND	ND	0 01	ND	0 14	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	1 2E-05	3 9E-05	--	--	2 6E-05	0 0E+00	0 0E+00	1 0E-04	0 0E+00	1 1E-03	
			Average Total mmoles	**ND**	**0 0014**	**0.00046**	**0.00022**	**2.2E-03**	**--**	**0.00025**	**ND**	**ND**	**0.00007**	**ND**	**0.0064**	
	19-Feb-07	42	EOS + WBC-2- 1	<0 010	0 47	0 90	0 17	--	<0 010	<0 010	<0 010	<0 010	0 02	<0 010	0 35	
			EOS + WBC-2- 2	<0 010	0 56	0 91	0 16	--	<0 010	<0 010	<0 010	<0 010	0 02	<0 010	0 34	
			Average Concentration (mg/L)	ND	0 52	0 90	0 16	--	ND	ND	ND	ND	0 02	ND	0 34	
			Standard Deviation (mmoles)	0 0E+00	1 3E-04	1 6E-05	9 4E-06	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 4E-05	0 0E+00	2 7E-04	
			Average Total mmoles	**ND**	**0.0011**	**0.0019**	**0 00058**	**3 8E-03**	**ND**	**ND**	**ND**	**ND**	**0.00026**	**ND**	**0.016**	
	26-Feb-07	49	EOS + WBC-2- 1	<0 010	0 21	0 92	0 22	--	--	<0 010	<0 010	<0 010	0 06	<0 010	0 71	
			EOS + WBC-2- 2	<0 010	0 22	0 89	0 26	--	--	<0 010	<0 010	<0 010	0 05	<0 010	0 95	
			Average Concentration (mg/L)	ND	0 21	0 91	0 24	--	--	ND	ND	ND	0 05	ND	0 83	
			Standard Deviation (mmoles)	0 0E+00	1 2E-05	4 3E-05	9 6E-05	--	--	0 0E+00	0 0E+00	0 0E+00	1 1E-04	0 0E+00	7 9E-03	
			Average Total mmoles	**ND**	**0 00046**	**0 0019**	**0.00086**	**3.9E-03**	**--**	**ND**	**ND**	**ND**	**0.00069**	**ND**	**0.039**	
	05-Mar-07	56	EOS + WBC-2- 1	<0 010	0 06	0 86	0 17	--	<0 010	<0 010	<0 010	<0 010	0 09	<0 010	1 0	
			EOS + WBC-2- 2	<0 010	0 04	0 85	0 24	--	<0 010	<0 010	<0 010	<0 010	0 07	<0 010	1 2	
			Average Concentration (mg/L)	ND	0 05	0 85	0 20	--	ND	ND	ND	ND	0 08	ND	1 1	
			Standard Deviation (mmoles)	0 0E+00	2 8E-05	1 3E-05	1 7E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 5E-04	0 0E+00	7 3E-03	
			Average Total mmoles	**ND**	**0.000098**	**0.0018**	**0.00072**	**3 7E-03**	**ND**	**ND**	**ND**	**ND**	**0.0011**	**ND**	**0.051**	
	12-Mar-07	63	EOS + WBC-2- 1	<0 010	0 02	0 86	0 11	--	--	<0 010	<0 010	<0 010	0 11	<0 010	1 3	
			EOS + WBC-2- 2	<0 010	0 01	0 87	0 17	--	--	<0 010	<0 010	<0 010	0 09	<0 010	1 5	
			Average Concentration (mg/L)	ND	0 02	0 87	0 14	--	--	ND	ND	ND	0 10	ND	1 4	
			Standard Deviation (mmoles)	0 0E+00	1 1E-05	1 6E-06	1 4E-04	--	--	0 0E+00	0 0E+00	0 0E+00	1 6E-04	0 0E+00	8 1E-03	
			Average Total mmoles	**ND**	**0.000037**	**0.0018**	**0.00048**	**3 6E-03**	**--**	**ND**	**ND**	**ND**	**0.0013**	**ND**	**0.065**	
	20-Mar-07	71	EOS + WBC-2- 1	<0 010	0 02	0 75	0 07	--	--	<0 010	<0 010	<0 010	0 11	<0 010	1 5	
			EOS + WBC-2- 2	<0 010	0 01	0 71	0 10	--	--	<0 010	<0 010	<0 010	0 09	<0 010	1 6	
			Average Concentration (mg/L)	ND	0 01	0 73	0 09	--	--	ND	ND	ND	0 10	ND	1 5	
			Standard Deviation (mmoles)	0 0E+00	6 2E-06	6 6E-05	9 1E-05	--	--	0 0E+00	0 0E+00	0 0E+00	2 3E-04	0 0E+00	4 5E-03	
			Average Total mmoles	**ND**	**0.000029**	**0.0015**	**0.0003**	**3 1E-03**	**--**	**ND**	**ND**	**ND**	**0.0013**	**ND**	**0.07**	
	26-Mar-07	77	EOS + WBC-2- 1	<0 010	0 02	0 77	0 04	--	<0 010	<0 010	<0 010	<0 010	0 12	<0 010	1 7	
			EOS + WBC-2- 2	<0 010	0 01	0 78	0 10	--	<0 010	<0 010	<0 010	<0 010	0 09	<0 010	1 8	
			Average Concentration (mg/L)	ND	0 01	0 78	0 07	--	ND	ND	ND	ND	0 11	ND	1 8	
			Standard Deviation (mmoles)	0 0E+00	5 1E-06	1 4E-05	1 3E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 0E-04	0 0E+00	3 8E-03	
			Average Total mmoles	**ND**	**0.000028**	**0.0016**	**0.00024**	**3 3E-03**	**ND**	**ND**	**ND**	**ND**	**0.0014**	**ND**	**0.082**	
	02-Apr-07	84	EOS + WBC-2- 1	<0 010	<0 010	0 74	0 01	--	<0 010	<0 010	<0 010	<0 010	0 13	<0 010	1 9	
			EOS + WBC-2- 2	<0 010	<0 010	0 82	0 09	--	<0 010	<0 010	<0 010	<0 010	0 10	<0 010	2 0	
			Average Concentration (mg/L)	ND	ND	0 78	0 05	--	ND	ND	ND	ND	0 11	ND	2 0	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	1 3E-04	1 8E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2 8E-04	0 0E+00	6 2E-03	
			Average Total mmoles	**ND**	**ND**	**0.0017**	**0.00017**	**3.4E-03**	**ND**	**ND**	**ND**	**ND**	**0.0015**	**ND**	**0.091**	
	17-Apr-07	99	EOS + WBC-2- 1	<0 010	<0 010	0 70	<0 010	--	<0 010	<0 010	<0 010	<0 010	0 14	<0 010	2 5	
			EOS + WBC-2- 2	<0 010	<0 010	0 72	0 07	--	<0 010	<0 010	<0 010	<0 010	0 09	<0 010	2 4	
			Average Concentration (mg/L)	ND	ND	0 71	0 03	--	ND	ND	ND	ND	0 11	ND	2 5	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	2 1E-05	1 7E-04	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	4 1E-04	0 0E+00	2 2E-03	
			Average Total mmoles	**ND**	**ND**	**0 0015**	**0.00012**	**3 1E-03**	**ND**	**ND**	**ND**	**ND**	**0.0015**	**ND**	**0 11**	
	20-Apr-07	102														Spiked with TeCA to a target concentration of 10 mg/L and with TCE to a target concentration of 6 mg/L. Amended with EOS™ to a target concentration of 0 1 % as oil
	20-Apr-07	102	EOS + WBC-2- 1	5 6	0 01	0 74	<0 010	--	--	0 12	<0 010	<0 010	0 13	<0 010	2 5	
			EOS + WBC-2- 2	3 5	<0 010	0 65	0 07	--	--	0 12	<0 010	<0 010	0 09	<0 010	2 5	
			Average Concentration (mg/L)	4 6	0 01	0 70	0 04	--	--	0 12	ND	ND	0 11	ND	2 5	
			Standard Deviation (mmoles)	2 3E-03	1 8E-05	1 4E-04	1 8E-04	--	--	3 2E-07	0 0E+00	0 0E+00	3 1E-04	0 0E+00	2 4E-03	
			Average Total mmoles	**0 0073**	**0.000013**	**0 0015**	**0.00013**	**1 0E-02**	**--**	**0 00019**	**ND**	**ND**	**0.0014**	**ND**	**0.12**	
	30-Apr-07	112	EOS + WBC-2- 1	<0 010	5 2	0 72	0 25	--	8 4	<0 010	<0 010	<0 010	0 12	<0 010	2 2	
			EOS + WBC-2- 2	3 0	0 11	0 63	0 07	--	4 1	<0 010	0 02	<0 010	0 09	<0 010	2 3	
			Average Concentration (mg/L)	1 5	2 6	0 67	0 16	--	6 2	ND	0 01	ND	0 11	ND	2 3	
			Standard Deviation (mmoles)	3 4E-03	7 6E-03	1 4E-04	4 4E-04	--	3 9E-03	0 0E+00	2 9E-05	0 0E+00	2 8E-04	0 0E+00	5 1E-03	
			Average Total mmoles	**0 0024**	**0.0056**	**0.0014**	**0.00055**	**1 1E-02**	**0 0081**	**ND**	**0.00002**	**ND**	**0.0014**	**ND**	**0 10**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
EOS™ Amended/WBC-2 Bioaugmented Continued	15-May-07	127	EOS + WBC-2- 1	<0 010	4 8	2 5	0 55	--	6 1	<0 010	<0 010	<0 010	0 13	<0 010	2 2	
			EOS + WBC-2- 2	<0 010	4 4	0 58	0 07	--	4 3	<0 010	<0 010	<0 010	0 08	<0 010	1 9	
			Average Concentration (mg/L)	ND	4 6	1 5	0 31	--	5 2	ND	ND	ND	0 11	ND	2 1	
			Standard Deviation (mmoles)	0 0E+00	6 8E-04	2 9E-03	1 2E-03	--	1 7E-03	0 0E+00	0 0E+00	0 0E+00	5 1E-04	0 0E+00	9 1E-03	
			Average Total mmoles	**ND**	**0.0098**	**0.0033**	**0 0011**	**1 6E-02**	**0 0068**	**ND**	**ND**	**ND**	**0.0014**	**ND**	**0.096**	
	28-May-07	140	EOS + WBC-2- 1	<0 010	4 5	4 6	0 64	--	1 9	<0 010	0 03	<0 010	0 12	<0 010	1 8	
			EOS + WBC-2- 2	<0 010	4 5	0 62	0 07	--	4 1	<0 010	0 02	<0 010	0 08	<0 010	1 9	
			Average Concentration (mg/L)	ND	4 5	2 6	0 36	--	3 0	ND	0 03	ND	0 10	ND	1 9	
			Standard Deviation (mmoles)	0 0E+00	5 9E-05	6 0E-03	1 4E-03	--	2 0E-03	0 0E+00	1 9E-05	0 0E+00	4 0E-04	0 0E+00	2 9E-03	
			Average Total mmoles	**ND**	**0.0096**	**0.0056**	**0 0013**	**1 8E-02**	**0.0039**	**ND**	**0 000051**	**ND**	**0.0013**	**ND**	**0.087**	
	11-Jun-07	154	EOS + WBC-2- 1	<0 010	4 4	5 1	0 79	--	<0 010	<0 010	0 03	<0 010	0 14	<0 010	2 0	
			EOS + WBC-2- 2	<0 010	4 4	0 59	0 07	--	4 1	<0 010	0 02	<0 010	0 06	<0 010	1 0	
			Average Concentration (mg/L)	ND	4 4	2 9	0 43	--	2 1	ND	0 02	ND	0 10	ND	1 5	
			Standard Deviation (mmoles)	0 0E+00	1 1E-04	6 8E-03	1 8E-03	--	3 8E-03	0 0E+00	1 6E-05	0 0E+00	7 5E-04	0 0E+00	3 1E-02	
			Average Total mmoles	**ND**	**0.0094**	**0.0061**	**0 0015**	**1.8E-02**	**0.0027**	**ND**	**0.000047**	**ND**	**0.0013**	**ND**	**0.069**	
	20-Jun-07	163	EOS + WBC-2- 1	<0 010	4 3	5 3	0 85	--	--	<0 010	0 03	<0 010	0 13	<0 010	1 8	
			EOS + WBC-2- 2	<0 010	4 3	0 60	0 08	--	--	<0 010	0 01	<0 010	0 05	<0 010	1 1	
			Average Concentration (mg/L)	ND	4 3	3 0	0 46	--	--	ND	0 02	ND	0 09	ND	1 4	
			Standard Deviation (mmoles)	0 0E+00	4 6E-05	7 1E-03	1 9E-03	--	--	0 0E+00	2 0E-05	0 0E+00	7 9E-04	0 0E+00	2 4E-02	
			Average Total mmoles	**ND**	**0.0091**	**0.0063**	**0.0016**	**1.8E-02**	**--**	**ND**	**0.000043**	**ND**	**0.0012**	**ND**	**0.066**	
	25-Jun-07	168	EOS + WBC-2- 1	<0 010	4 0	5 1	0 87	--	0 14	<0 010	0 03	<0 010	0 13	<0 010	1 7	
			EOS + WBC-2- 2	<0 010	4 5	0 61	0 09	--	4 2	<0 010	0 02	<0 010	0 05	<0 010	0 88	
			Average Concentration (mg/L)	ND	4 3	2 9	0 48	--	2 2	ND	0 03	ND	0 09	ND	1 3	
			Standard Deviation (mmoles)	0 0E+00	8 3E-04	6 8E-03	1 9E-03	--	3 7E-03	0 0E+00	1 1E-05	0 0E+00	8 1E-04	0 0E+00	2 5E-02	
			Average Total mmoles	**ND**	**0.0091**	**0.0061**	**0.0017**	**1.8E-02**	**0.0028**	**ND**	**0.000053**	**ND**	**0.0012**	**ND**	**0.059**	
	05-Jul-07	178														Amended with EOS™ to a target concentration of 0 1 % as oil
	23-Jul-07	196	EOS + WBC-2- 1	<0 010	2 2	4 8	1 5	--	<0 010	<0 010	0 03	<0 010	0 18	<0 010	1 6	
			EOS + WBC-2- 2	<0 010	4 4	0 54	0 13	--	3 9	<0 010	0 03	<0 010	0 05	<0 010	0 75	
			Average Concentration (mg/L)	ND	3 3	2 7	0 83	--	1 9	ND	0 03	ND	0 12	ND	1 2	
			Standard Deviation (mmoles)	0 0E+00	3 4E-03	6 4E-03	3 5E-03	--	3 6E-03	0 0E+00	4 3E-06	0 0E+00	1 3E-03	0 0E+00	2 7E-02	
			Average Total mmoles	**ND**	**0 0071**	**0 0057**	**0.0029**	**1.7E-02**	**0 0025**	**ND**	**0 000064**	**ND**	**0.0015**	**ND**	**0.054**	
	20-Aug-07	224	EOS + WBC-2- 1	<0 010	0 11	4 8	2 3	--	<0 010	<0 010	<0 010	<0 010	0 34	<0 010	1 5	
			EOS + WBC-2- 2	<0 010	4 8	0 60	0 16	--	3 6	<0 010	0 04	<0 010	0 04	<0 010	0 7	
			Average Concentration (mg/L)	ND	2 4	2 7	1 2	--	1 8	ND	0 02	ND	0 19	ND	1 1	
			Standard Deviation (mmoles)	0 0E+00	7 0E-03	6 3E-03	5 4E-03	--	3 4E-03	0 0E+00	6 1E-05	0 0E+00	2 8E-03	0 0E+00	2 6E-02	
			Average Total mmoles	**ND**	**0 0052**	**0.0057**	**0.0043**	**1 8E-02**	**0.0024**	**ND**	**0.000043**	**ND**	**0 0025**	**ND**	**0.051**	
Chitin Amended/WBC-2 Bioaugmented	03-Jan-07	-5														Amended the first replicate with 100 µL of resazunn
	08-Jan-07	0														Amended with 0 5 g of Chitin
	08-Jan-07	0	Chitin + WBC-2-1	1 2	0 04	<0 010	<0 010	--	2 1	0 06	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-2	0 98	0 04	<0 010	<0 010	--	1 8	0 05	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-3	1 1	0 04	<0 010	<0 010	--	2 0	0 05	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	1 1	0 04	ND	ND	--	2 0	0 05	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 6E-04	9 3E-06	0 0E+00	0 0E+00	--	1 9E-04	8 0E-06	0 0E+00	0 0E+00	0 0E+00	0 0E+00	9 3E-05	
			Average Total mmoles	**0.0017**	**0.000085**	**ND**	**ND**	**1 8E-03**	**0.0026**	**0.000078**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	22-Jan-07	14	Chitin + WBC-2-1	1 3	0 2	0 02	0 06	--	--	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-2	0 05	0 97	0 03	0 06	--	--	0 11	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-3	1 2	0 10	0 02	0 05	--	--	0 89	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 85	0 42	0 02	0 06	--	--	0 38	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 1E-03	1 0E-03	9 3E-06	2 9E-05	--	--	6 6E-04	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 5E-05	
			Average Total mmoles	**0 0014**	**0.0009**	**0.00005**	**0.0002**	**2 6E-03**	**--**	**0 00057**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	05-Feb-07	28	Chitin + WBC-2-1	0 14	1 3	0 04	<0 010	--	1 7	0 20	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-2	0 11	1 2	0 05	<0 010	--	1 4	0 15	<0 010	<0 010	<0 010	<0 010	0 03	
			Chitin + WBC-2-3	1 3	0 12	0 04	<0 010	--	0 88	1 1	0 01	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	0 51	0 88	0 04	ND	--	1 3	0 48	<0 010	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	1 1E-03	1 4E-03	1 1E-05	0 0E+00	--	5 6E-04	8 0E-04	1 3E-05	0 0E+00	0 0E+00	0 0E+00	4 0E-05	
			Average Total mmoles	**0.00081**	**0.0019**	**0.000084**	**ND**	**2 8E-03**	**0.0017**	**0.00072**	**0 0000078**	**ND**	**ND**	**ND**	**0.0014**	
	09-Feb-07	32														Bioaugmented with WBC-2
	12-Feb-07	35	Chitin + WBC-2-1	0 3	1 3	0 06	0 09	--	--	0 02	<0 010	<0 010	0 01	<0 010	0 30	
			Chitin + WBC-2-2	0 11	1 2	0 06	0 08	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 21	
			Chitin + WBC-2-3	1 3	0 17	0 16	0 22	--	--	0 40	0 21	<0 010	0 02	<0 010	0 25	
			Average Concentration (mg/L)	0 56	0 87	0 10	0 13	--	--	0 14	0 07	ND	0 01	ND	0 25	
			Standard Deviation (mmoles)	1 0E-03	1 3E-03	1 2E-04	2 7E-04	--	--	3 4E-04	2 5E-04	0 0E+00	1 1E-04	0 0E+00	2 1E-03	
			Average Total mmoles	**0 0009**	**0.0019**	**0 0002**	**0 00046**	**3 6E-03**	**--**	**0.00021**	**0.00014**	**ND**	**0.00012**	**ND**	**0 012**	
	19-Feb-07	42	Chitin + WBC-2-1	0 30	1 0	0 10	0 17	--	0 86	<0 010	<0 010	<0 010	0 01	<0 010	0 73	
			Chitin + WBC-2-2	<0 010	0 33	0 21	0 14	--	0 56	<0 010	<0 010	<0 010	0 26	<0 010	1 2	
			Chitin + WBC-2-3	<0 010	0 31	0 33	0 11	--	<0 010	<0 010	0 28	<0 010	0 25	<0 010	0 97	
			Average Concentration (mg/L)	0 10	0 56	0 21	0 14	--	0 47	ND	0 09	ND	0 17	ND	0 98	
			Standard Deviation (mmoles)	2 7E-04	8 9E-04	2 5E-04	1 1E-04	--	5 7E-04	0 0E+00	3 3E-04	0 0E+00	1 8E-03	0 0E+00	1 1E-02	
			Average Total mmoles	**0.00016**	**0.0012**	**0.00045**	**0.0005**	**4 6E-03**	**0.00062**	**ND**	**0.00019**	**ND**	**0.0023**	**ND**	**0.045**	
	26-Feb-07	49	Chitin + WBC-2-1	<0 010	0 09	0 46	0 57	--	--	<0 010	0 02	<0 010	0 14	<0 010	1 3	
			Chitin + WBC-2-2	<0 010	<0 010	0 45	<0 010	--	--	<0 010	<0 010	<0 010	0 25	<0 010	1 7	
			Chitin + WBC-2-3	<0 010	<0 010	0 24	<0 010	--	--	<0 010	0 23	<0 010	0 33	<0 010	3 1	
			Average Concentration (mg/L)	ND	0 03	0 38	0 19	--	--	ND	0 08	ND	0 24	ND	2 0	
			Standard Deviation (mmoles)	0 0E+00	1 0E-04	2 6E-04	1 2E-03	--	--	0 0E+00	2 6E-04	0 0E+00	1 3E-03	0 0E+00	4 3E-02	
			Average Total mmoles	**ND**	**0.00006**	**0.00081**	**0 00067**	**4.6E-03**	**--**	**ND**	**0.00017**	**ND**	**0.0031**	**ND**	**0.094**	

TABLE 2A: SUMMARY OF PHASE 1 MICROCOSM cVOC'S, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Chitin Amended/WBC-2 Bioaugmented Continued	05-Mar-07	56	Chitin + WBC-2-1	<0 010	<0 010	0 39	<0 010	--	<0 010	<0 010	0 01	<0 010	0 30	<0 010	2 4	
			Chitin + WBC-2-2	<0 010	<0 010	0 20	<0 010	--	<0 010	<0 010	<0 010	<0 010	0 27	<0 010	1 7	
			Chitin + WBC-2-3	<0 010	<0 010	0 02	<0 010	--	<0 010	<0 010	0 18	<0 010	0 34	<0 010	4 0	
			Average Concentration (mg/L)	ND	ND	0 20	ND	--	ND	ND	0 06	ND	0 30	ND	2 7	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	3 9E-04	0 0E+00	--	0 0E+00	0 0E+00	2 0E-04	0 0E+00	4 9E-04	0 0E+00	5 4E-02	
			Average Total mmoles	**ND**	**ND**	**0.00043**	**ND**	**4 4E-03**	**ND**	**ND**	**0.00013**	**ND**	**0.004**	**ND**	**0.13**	
	12-Mar-07	63														Amended with 0 5 g of chitin Spiked replicate 1 with 1,1,2-TCA to a target concentration of 10 mg/L and all replicates with TeCA to a target concentration of 10 mg/L and with TCE to a target concentration of 6 mg/L
	12-Mar-07	63	Chitin + WBC-2-1	<0 010	<0 010	0 08	<0 010	--	--	<0 010	<0 010	<0 010	0 32	<0 010	2 4	
			Chitin + WBC-2-2	<0 010	<0 010	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	0 28	<0 010	2 0	
			Chitin + WBC-2-3	<0 010	<0 010	<0 010	<0 010	--	--	<0 010	0 15	<0 010	0 35	<0 010	4 6	
			Average Concentration (mg/L)	ND	ND	0 03	ND	--	--	ND	0 05	ND	0 32	ND	3 0	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	9 4E-05	0 0E+00	--	--	0 0E+00	1 7E-04	0 0E+00	4 5E-04	0 0E+00	6 5E-02	
			Average Total mmoles	**ND**	**ND**	**0.000054**	**ND**	**4 3E-03**	**--**	**ND**	**0.000099**	**ND**	**0.0042**	**ND**	**0 14**	
	13-Mar-07	64	Chitin + WBC-2-1	6 7	0 10	0 07	0 01	--	10	11	0 03	<0 010	0 33	<0 010	2 5	
			Chitin + WBC-2-2	6 4	0 05	0 01	<0 010	--	10	<0 010	<0 010	<0 010	0 24	<0 010	1 7	
			Chitin + WBC-2-3	6 5	0 09	0 02	<0 010	--	11	<0 010	0 15	<0 010	0 27	<0 010	4 3	
			Average Concentration (mg/L)	6 5	0 08	0 04	<0 010	--	10	3 6	0 06	ND	0 28	ND	2 8	
			Standard Deviation (mmoles)	2 7E-04	5 9E-05	6 6E-05	2 2E-05	--	5 0E-04	9 4E-03	1 6E-04	0 0E+00	6 0E-04	0 0E+00	6 4E-02	
			Average Total mmoles	**0.01**	**0 00017**	**0.000073**	**0.000013**	**1.4E-02**	**0.013**	**0 0054**	**0.00012**	**ND**	**0.0036**	**ND**	**0.13**	
	20-Mar-07	71	Chitin + WBC-2-1	2 2	1 4	2 1	1 2	--	--	3 0	1 6	<0 010	1 4	<0 010	3 4	
			Chitin + WBC-2-2	0 55	1 4	0 20	0 24	--	--	0 24	0 01	<0 010	1 0	<0 010	3 1	
			Chitin + WBC-2-3	0 21	1 9	0 38	0 25	--	--	0 05	0 15	<0 010	1 1	<0 010	4 2	
			Average Concentration (mg/L)	0 98	1 6	0 89	0 58	--	--	1 1	0 59	ND	1 2	ND	3 6	
			Standard Deviation (mmoles)	1 7E-03	5 7E-04	2 2E-03	2 0E-03	--	--	2 5E-03	1 8E-03	0 0E+00	2 4E-03	0 0E+00	2 7E-02	
			Average Total mmoles	**0.0016**	**0.0034**	**0.0019**	**0 002**	**2.4E-02**	**--**	**0.0016**	**0.0012**	**ND**	**0 015**	**ND**	**0 17**	
	26-Mar-07	77	Chitin + WBC-2-1	<0 010	0 05	4 5	0 03	--	1 2	0 27	1 7	<0 010	2 3	<0 010	3 4	
			Chitin + WBC-2-2	<0 010	0 04	4 3	<0 010	--	0 82	0 21	0 06	<0 010	1 2	<0 010	3 0	
			Chitin + WBC-2-3	<0 010	0 06	4 1	0 02	--	1 9	0 10	0 15	<0 010	1 4	<0 010	3 8	
			Average Concentration (mg/L)	ND	0 05	4 3	0 02	--	1 3	0 19	0 65	ND	1 6	ND	3 4	
			Standard Deviation (mmoles)	0 0E+00	1 8E-05	3 9E-04	5 3E-05	--	7 2E-04	1 3E-04	1 9E-03	0 0E+00	7 7E-03	0 0E+00	2 0E-02	
			Average Total mmoles	**ND**	**0.0001**	**0 0091**	**0.000056**	**3.0E-02**	**0.0017**	**0.00029**	**0.0013**	**ND**	**0 021**	**ND**	**0.16**	
	02-Apr-07	84	Chitin + WBC-2-1	<0 010	<0 010	3 8	<0 010	--	<0 010	<0 010	0 65	<0 010	2 1	<0 010	2 8	
			Chitin + WBC-2-2	<0 010	<0 010	3 9	<0 010	--	<0 010	<0 010	0 05	<0 010	1 2	<0 010	3 0	
			Chitin + WBC-2-3	<0 010	<0 010	4 2	<0 010	--	<0 010	<0 010	0 13	<0 010	1 3	<0 010	4 4	
			Average Concentration (mg/L)	ND	ND	4 0	ND	--	ND	ND	0 28	ND	1 5	ND	3 4	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	3 9E-04	0 0E+00	--	0 0E+00	0 0E+00	6 7E-04	0 0E+00	6 3E-03	0 0E+00	4 0E-02	
			Average Total mmoles	**ND**	**ND**	**0.0084**	**ND**	**2 8E-02**	**ND**	**ND**	**0.00056**	**ND**	**0.02**	**ND**	**0.16**	
	17-Apr-07	99	Chitin + WBC-2-1	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	2 6	<0 010	3 0	
			Chitin + WBC-2-2	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 6	<0 010	3 4	
			Chitin + WBC-2-3	<0 010	<0 010	0 95	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 8	<0 010	4 4	
			Average Concentration (mg/L)	ND	ND	0 32	ND	--	ND	ND	ND	ND	2 0	ND	3 6	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	1 2E-03	0 0E+00	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 4E-03	0 0E+00	3 4E-02	
			Average Total mmoles	**ND**	**ND**	**0 00067**	**ND**	**2.7E-02**	**ND**	**ND**	**ND**	**ND**	**0.026**	**ND**	**0 17**	
	30-Apr-07	112	Chitin + WBC-2-1	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	2 6	<0 010	4 1	
			Chitin + WBC-2-2	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 5	<0 010	4 1	
			Chitin + WBC-2-3	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 7	<0 010	5 4	
			Average Concentration (mg/L)	ND	ND	ND	ND	--	ND	ND	ND	ND	1 9	ND	4 5	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	0 0E+00	0 0E+00	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	7 8E-03	0 0E+00	3 4E-02	
			Average Total mmoles	**ND**	**ND**	**ND**	**ND**	**2 6E-02**	**ND**	**ND**	**ND**	**ND**	**0.026**	**ND**	**0.21**	
	15-May-07	127	Chitin + WBC-2-1	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	2 1	<0 010	5 0	
			Chitin + WBC-2-2	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 4	<0 010	5 2	
			Chitin + WBC-2-3	<0 010	<0 010	<0 010	<0 010	--	<0 010	<0 010	<0 010	<0 010	1 2	<0 010	5 2	
			Average Concentration (mg/L)	ND	ND	ND	ND	--	ND	ND	ND	ND	1 6	ND	5 1	
			Standard Deviation (mmoles)	0 0E+00	0 0E+00	0 0E+00	0 0E+00	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	6 2E-03	0 0E+00	4 5E-03	
			Average Total mmoles	**ND**	**ND**	**ND**	**ND**	**2 1E-02**	**ND**	**ND**	**ND**	**ND**	**0 021**	**ND**	**0.24**	

Notes:

1,2-DCA - 1,2-dichloroethane
1,1,2-TCA - 1,1,2-trichloroethane
1,1,2,2-TeCA - 1,1,2,2-tetrachloroethane
ANAC - anaerobic active control
ANSC - anaerobic sterile control
CA - chloroethane
cis-1,2-DCE - *cis*-1,2-dichloroethene
EOS™ - emulsified oil substrate
g - grams
mg/L - milligrams per liter
µL - microliter
mmoles - millimoles
mmol/L - millimoles per liter
NZ - newmans zone
ND - not detected
PCE - tetrachloroethene
TCE - trichloroethene
trans-1,2-DCE - *trans*-1,2-dichloroethene
VC - vinyl chloride
-- - not analyzed/not applicable
% - percent

TABLE 2B: SUMMARY OF PHASE 1 MICROCOSM ANION RESULTS
Former Defense Depot, Memphis, Tennessee

SiREM

9531851

TREATMENT	DATE	DAY	Treatment Replicate	Total VFA*	Chloride	Nitrite	Nitrate	Sulfate	Bromide	Phosphate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Anaerobic Sterile Control	8-Jan-07	0	ANSC-1	8 0	82	<0 12	12	23	<0 39	<0 59
			ANSC-2	12	84	0 25	12	22	<0 39	<0 59
			ANSC-3	4 9	80	0 21	12	21	<0 39	<0 59
			Average Concentration	**8.2**	**82**	**0.23**	**12**	**22**	**ND**	**ND**
	22-Jan-07	14	ANSC-1	8 5	95	<0 12	13	34	<0 39	<0 59
			ANSC-2	9 6	95	<0 12	13	33	<0 39	<0 59
			ANSC-3	9 4	89	<0 12	13	34	<0 39	<0 59
			Average Concentration	**9.2**	**93**	**ND**	**13**	**34**	**ND**	**ND**
	5-Feb-07	28	ANSC-1	12	118	<0 12	22	23	<0 39	<0 59
			ANSC-2	4 4	110	<0 12	21	23	<0 39	<0 59
			ANSC-3	7 4	103	<0 12	21	23	<0 39	<0 59
			Average Concentration	**8.0**	**110**	**ND**	**21**	**23**	**ND**	**ND**
	5-Mar-07	56	ANSC-1	6 6	109	<0 12	18	24	<0 39	<0 59
			ANSC-2	4 6	109	<0 12	18	24	<0 39	<0 59
			ANSC-3	11	104	<0 12	17	23	<0 39	<0 59
			Average Concentration	**7.2**	**107**	**ND**	**18**	**24**	**ND**	**ND**
	2-Apr-07	84	ANSC-1	6 4	107	<0 12	17	23	<0 39	0 72
			ANSC-2	5 7	112	<0 12	18	24	<0 39	<0 59
			ANSC-3	8 5	108	<0 12	17	23	<0 39	<0 59
			Average Concentration	**6.9**	**109**	**ND**	**17**	**23**	**ND**	**0.72**
	30-Apr-07	112	ANSC-1	13	107	<0 12	17	20	<0 39	<0 59
			ANSC-2	5 9	99	<0 12	17	20	<0 39	<0 59
			ANSC-3	7 2	93	<0 12	17	19	<0 39	2 6
			Average Concentration	**8.7**	**100**	**ND**	**17**	**20**	**ND**	**2.6**
	28-May-07	140	ANSC-1	12	102	<0 12	16	20	<0 39	<0 59
			ANSC-2	14	115	<0 12	18	21	<0 39	<0 59
			ANSC-3	14	100	<0 12	16	20	<0 39	<0 59
			Average Concentration	**14**	**106**	**ND**	**17**	**20**	**ND**	**ND**
	25-Jun-07	168	ANSC-1	6 3	86	<0 12	14	15	<0 39	<0 59
			ANSC-2	5 2	111	<0 12	18	20	<0 39	<0 59
			ANSC-3	7 0	108	<0 12	18	20	<0 39	<0 59
			Average Concentration	**6.1**	**101**	**ND**	**17**	**18**	**ND**	**ND**
Anaerobic Active Control	8-Jan-07	0	ANAC-1	3 1	11	0 24	1 9	18	<0 39	<0 59
			ANAC-2	7 7	11	<0 12	2 3	19	<0 39	<0 59
			ANAC-3	12	10	0 21	2 2	18	<0 39	<0 59
			Average Concentration	**7 5**	**11**	**0 23**	**2.2**	**18**	**ND**	**ND**
	22-Jan-07	14	ANAC-1	8 3	20	<0 12	2 3	26	<0 39	<0 59
			ANAC-2	7 1	13	<0 12	2 4	26	<0 39	<0 59
			ANAC-3	6 9	12	<0 12	2 4	26	<0 39	<0 59
			Average Concentration	**7.4**	**15**	**ND**	**2.4**	**26**	**ND**	**ND**
	5-Feb-07	28	ANAC-1	3 9	16	<0 12	2 7	22	<0 39	<0 59
			ANAC-2	4 0	16	<0 12	2 8	23	<0 39	<0 59
			ANAC-3	4 0	17	<0 12	2 6	24	<0 39	<0 59
			Average Concentration	**4.0**	**16**	**ND**	**2.7**	**23**	**ND**	**ND**
	5-Mar-07	56	ANAC-1	6 8	17	<0 12	2 5	23	<0 39	<0 59
			ANAC-2	4 2	15	<0 12	2 3	21	<0 39	<0 59
			ANAC-3	3 5	15	<0 12	1 7	21	<0 39	<0 59
			Average Concentration	**4.8**	**15**	**ND**	**2.1**	**22**	**ND**	**ND**
	2-Apr-07	84	ANAC-1	4 6	16	<0 12	2 0	23	<0 39	<0 59
			ANAC-2	4 7	16	<0 12	2 0	23	<0 39	<0 59
			ANAC-3	5 0	18	<0 12	1 0	23	<0 39	<0 59
			Average Concentration	**4.8**	**17**	**ND**	**1 7**	**23**	**ND**	**ND**
	30-Apr-07	112	ANAC-1	8 8	15	<0 12	1 6	19	<0 39	<0 59
			ANAC-2	11	17	<0 12	1 6	19	<0 39	<0 59
			ANAC-3	4 8	13	<0 12	0 29	18	<0 39	<0 59
			Average Concentration	**8.1**	**15**	**ND**	**1.2**	**19**	**ND**	**ND**
	28-May-07	140	ANAC-1	11	16	<0 12	1 3	21	<0 39	<0 59
			ANAC-2	13	14	<0 12	<0 10	19	<0 39	<0 59
			ANAC-3	11	15	<0 12	<0 10	22	<0 39	<0 59
			Average Concentration	**11**	**15**	**ND**	**1 3**	**20**	**ND**	**ND**
	25-Jun-07	168	ANAC-1	6 3	20	<0 12	1 0	20	<0 39	<0 59
			ANAC-2	5 0	15	<0 12	0 67	20	<0 39	<0 59
			ANAC-3	6 0	15	<0 12	0 11	19	<0 39	<0 59
			Average Concentration	**5 7**	**17**	**ND**	**0.58**	**20**	**ND**	**ND**
Lactate Amended	8-Jan-07	0	Lac - 1	203	13	0 26	2 3	18	<0 39	<0 59
			Lac - 2	187	10	0 37	2 1	18	<0 39	<0 59
			Lac - 3	186	10	0 22	2 0	18	<0 39	<0 59
			Average Concentration	**192**	**11**	**0 28**	**2 1**	**18**	**ND**	**ND**
	22-Jan-07	14	Lac - 1	110	21	<0 12	<0 10	16	<0 39	<0 59
			Lac - 2	108	13	<0 12	<0 10	22	<0 39	<0 59
			Lac - 3	102	14	<0 12	<0 10	17	<0 39	<0 59
			Average Concentration	**106**	**16**	**ND**	**ND**	**18**	**ND**	**ND**
	5-Feb-07	28	Lac - 1	258	16	<0 12	<0 10	1 8	<0 39	<0 59
			Lac - 2	238	18	<0 12	0 12	2 6	<0 39	<0 59
			Lac - 3	244	17	<0 12	0 20	2 2	<0 39	<0 59
			Average Concentration	**247**	**17**	**ND**	**0.16**	**2.2**	**ND**	**ND**
	5-Mar-07	56	Lac - 1	250	21	<0 12	<0 10	0 87	<0 39	<0 59
			Lac - 2	230	17	<0 12	<0 10	0 80	<0 39	<0 59
			Lac - 3	232	16	<0 12	<0 10	1 0	<0 39	<0 59
			Average Concentration	**237**	**18**	**ND**	**ND**	**0.88**	**ND**	**ND**
	2-Apr-07	84	Lac - 1	204	17	<0 12	0 12	2 4	<0 39	0 94
			Lac - 2	196	18	<0 12	<0 10	2 3	<0 39	0 84
			Lac - 3	193	17	<0 12	0 16	1 8	<0 39	<0 59
			Average Concentration	**198**	**17**	**ND**	**0.14**	**2.2**	**ND**	**0.89**
	30-Apr-07	112	Lac - 1	266	19	<0 12	0 23	1 8	<0 39	9 7
			Lac - 2	286	16	<0 12	<0 10	1 1	<0 39	<0 59
			Lac - 3	254	15	<0 12	<0 10	0 57	<0 39	<0 59
			Average Concentration	**268**	**17**	**ND**	**0.23**	**1.2**	**ND**	**9.7**
	28-May-07	140	Lac - 1	271	14	<0 12	<0 10	3 0	<0 39	<0 59
			Lac - 2	268	13	<0 12	<0 10	0 67	<0 39	<0 59
			Lac - 3	365	17	<0 12	<0 10	1 0	<0 39	<0 59
			Average Concentration	**302**	**14**	**ND**	**ND**	**1.6**	**ND**	**ND**
	25-Jun-07	168	Lac - 1	291	15	<0 12	<0 10	0 81	<0 39	<0 59
			Lac - 2	303	16	<0 12	0 11	0 37	<0 39	<0 59
			Lac - 3	512	15	<0 12	<0 10	0 30	<0 39	<0 59
			Average Concentration	**369**	**15**	**ND**	**0.11**	**0.50**	**ND**	**ND**
EOS™ Amended	8-Jan-07	0	EOS -1	50	10	<0 12	2 2	18	<0 39	<0 59
			EOS -2	45	10	<0 12	2 1	18	<0 39	<0 59
			EOS -3	46	10	0 23	2 2	17	<0 39	<0 59
			Average Concentration	**47**	**10**	**0.23**	**2.1**	**18**	**ND**	**ND**
	22-Jan-07	14	EOS -1	40	13	<0 12	<0 10	24	<0 39	<0 59
			EOS -2	37	12	<0 12	<0 10	26	<0 39	<0 59
			EOS -3	38	12	<0 12	<0 10	24	<0 39	<0 59
			Average Concentration	**38**	**13**	**ND**	**ND**	**25**	**ND**	**ND**
	5-Feb-07	28	EOS -1	99	16	<0 12	0 11	2 1	<0 39	<0 59
			EOS -2	67	18	<0 12	0 12	25	<0 39	<0 59
			EOS -3	62	16	<0 12	<0 10	2 1	<0 39	<0 59
			Average Concentration	**76**	**17**	**ND**	**0.11**	**10**	**ND**	**ND**
	5-Mar-07	56	EOS -1	120	14	<0 12	<0 10	0 58	<0 39	<0 59
			EOS -2	84	17	<0 12	<0 10	21	<0 39	<0 59
			EOS -3	92	15	<0 12	<0 10	0 78	<0 39	<0 59
			Average Concentration	**98**	**16**	**ND**	**ND**	**7.5**	**ND**	**ND**
	2-Apr-07	84	EOS -1	106	17	<0 12	<0 10	1 1	<0 39	<0 59
			EOS -2	74	18	<0 12	<0 10	24	<0 39	0 85
			EOS -3	95	18	<0 12	<0 10	2 3	<0 39	<0 59
			Average Concentration	**91**	**18**	**ND**	**ND**	**9.0**	**ND**	**0.85**
	30-Apr-07	112	EOS -1	189	14	<0 12	0 34	1 4	<0 39	<0 59
			EOS -2	137	13	<0 12	0 23	20	<0 39	<0 59
			EOS -3	205	15	<0 12	0 13	0 91	<0 39	<0 59
			Average Concentration	**177**	**14**	**ND**	**0.24**	**7.4**	**ND**	**ND**
	28-May-07	140	EOS -1	260	17	<0 12	<0 10	0 53	<0 39	<0 59
			EOS -2	160	15	<0 12	<0 10	22	<0 39	<0 59
			EOS -3	323	15	<0 12	<0 10	0 88	<0 39	<0 59
			Average Concentration	**248**	**15**	**ND**	**ND**	**7.9**	**ND**	**ND**
	25-Jun-07	168	EOS -1	269	16	<0 12	<0 10	0 71	<0 39	<0 59
			EOS -2	149	13	<0 12	<0 10	19	<0 39	<0 59
			EOS -3	353	15	<0 12	<0 10	0 75	<0 39	<0 59
			Average Concentration	**257**	**15**	**ND**	**ND**	**6.9**	**ND**	**ND**

TABLE 2B: SUMMARY OF PHASE 1 MICROCOSM ANION RESULTS
Former Defense Depot, Memphis, Tennessee

TREATMENT	DATE	DAY	Treatment Replicate	Total VFA*	Chloride	Nitrite	Nitrate	Sulfate	Bromide	Phosphate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactate Amended/WBC-2 Bioaugmented	8-Jan-07	0	Lac + WBC-2- 1	191	10	0 24	2 1	19	<0 39	<0 59
			Lac + WBC-2- 2	180	10	0 16	2 1	18	<0 39	<0 59
			Lac + WBC-2- 3	188	10	0 18	2 1	18	<0 39	<0 59
			Average Concentration	**186**	**10**	**ND**	**2.1**	**18**	**ND**	**ND**
	22-Jan-07	14	Lac + WBC-2- 1	106	15	<0 12	<0 10	22	<0 39	<0 59
			Lac + WBC-2- 2	104	18	<0 12	<0 10	21	<0 39	<0 59
			Lac + WBC-2- 3	104	12	<0 12	<0 10	22	<0 39	<0 59
			Average Concentration	**105**	**15**	**ND**	**ND**	**21**	**ND**	**ND**
	5-Feb-07	28	Lac + WBC-2- 1	223	17	<0 12	0 30	4 3	<0 39	<0 59
			Lac + WBC-2- 2	238	20	<0 12	0 37	3 0	<0 39	<0 59
			Lac + WBC-2- 3	232	19	<0 12	0 14	1 7	<0 39	<0 59
			Average Concentration	**231**	**18**	**ND**	**0.27**	**3.0**	**ND**	**ND**
	5-Mar-07	56	Lac + WBC-2- 1	245	20	<0 12	<0 10	0 78	<0 39	<0 59
			Lac + WBC-2- 2	248	21	<0 12	<0 10	0 41	<0 39	<0 59
			Lac + WBC-2- 3	252	21	<0 12	<0 10	0 52	<0 39	<0 59
			Average Concentration	**248**	**20**	**ND**	**ND**	**0.57**	**ND**	**ND**
	2-Apr-07	84	Lac + WBC-2- 1	236	29	<0 12	0 15	2 1	<0 39	<0 59
			Lac + WBC-2- 2	240	29	<0 12	0 18	2 1	<0 39	<0 59
			Lac + WBC-2- 3	250	29	<0 12	<0 10	1 2	<0 39	<0 59
			Average Concentration	**242**	**29**	**ND**	**0.16**	**1.8**	**ND**	**ND**
	30-Apr-07	112	Lac + WBC-2- 1	296	33	<0 12	0 14	2 3	<0 39	<0 59
			Lac + WBC-2- 2	353	39	<0 12	0 18	1 5	<0 39	<0 59
			Lac + WBC-2- 3	353	39	<0 12	0 37	2 0	<0 39	<0 59
			Average Concentration	**334**	**37**	**ND**	**0 23**	**1.9**	**ND**	**ND**
	28-May-07	140	Lac + WBC-2- 1	353	43	<0 12	<0 10	0 84	<0 39	<0 59
			Lac + WBC-2- 2	358	59	<0 12	0 21	2 5	<0 39	<0 59
			Lac + WBC-2- 3	367	43	<0 12	<0 10	0 94	<0 39	<0 59
			Average Concentration	**359**	**48**	**ND**	**0 21**	**1.4**	**ND**	**ND**
	25-Jun-07	168	Lac + WBC-2- 1	326	42	<0 12	<0 10	0 37	<0 39	<0 59
			Lac + WBC-2- 2	343	42	<0 12	<0 10	1 6	<0 39	<0 59
			Lac + WBC-2- 3	340	42	<0 12	<0 10	1 6	<0 39	<0 59
			Average Concentration	**337**	**42**	**ND**	**ND**	**1.2**	**ND**	**ND**
EOS™ Amended/WBC-2 Bioaugmented	8-Jan-07	0	EOS + WBC-2- 1	37	10	<0 12	2 1	18	<0 39	<0 59
			EOS + WBC-2- 2	38	9 3	<0 12	2 1	17	<0 39	<0 59
			EOS + WBC-2- 3	43	9 3	<0 12	2 0	17	<0 39	<0 59
			Average Concentration	**39**	**10**	**ND**	**2.1**	**17**	**ND**	**ND**
	22-Jan-07	14	EOS + WBC-2- 1	35	12	<0 12	<0 10	24	<0 39	<0 59
			EOS + WBC-2- 2	42	13	<0 12	<0 10	2 0	<0 39	<0 59
			EOS + WBC-2- 3	34	11	<0 12	<0 10	24	<0 39	<0 59
			Average Concentration	**37**	**12**	**ND**	**ND**	**17**	**ND**	**ND**
	5-Feb-07	28	EOS + WBC-2- 1	90	16	<0 12	0 16	3 8	<0 39	<0 59
			EOS + WBC-2- 2	106	17	<0 12	<0 10	1 8	<0 39	<0 59
			EOS + WBC-2- 3	71	16	<0 12	0 25	1 9	<0 39	<0 59
			Average Concentration	**89**	**16**	**ND**	**0.20**	**2.5**	**ND**	**ND**
	5-Mar-07	56	EOS + WBC-2- 1	174	22	<0 12	<0 10	1 4	<0 39	<0 59
			EOS + WBC-2- 2	183	19	<0 12	<0 10	0 49	<0 39	<0 59
			EOS + WBC-2- 3	153	19	<0 12	<0 10	0 60	<0 39	<0 59
			Average Concentration	**170**	**20**	**ND**	**ND**	**0.83**	**ND**	**ND**
	2-Apr-07	84	EOS + WBC-2- 1	178	20	<0 12	<0 10	0 91	<0 39	<0 59
			EOS + WBC-2- 2	195	23	<0 12	0 26	1 5	<0 39	<0 59
			EOS + WBC-2- 3	136	21	<0 12	0 13	1 0	<0 39	<0 59
			Average Concentration	**170**	**21**	**ND**	**0.20**	**1.1**	**ND**	**ND**
	30-Apr-07	112	EOS + WBC-2- 1	204	23	<0 12	0 18	3 3	<0 39	18
			EOS + WBC-2- 2	312	22	<0 12	0 15	1 6	<0 39	18
			EOS + WBC-2- 3	145	16	<0 12	<0 10	1 3	<0 39	<0 59
			Average Concentration	**221**	**20**	**ND**	**0 17**	**2.0**	**ND**	**18**
	25-Jun-07	168	EOS + WBC-2- 1	222	33	<0 12	0 11	2 0	<0 39	<0 59
			EOS + WBC-2- 2	352	33	<0 12	<0 10	1 6	<0 39	<0 59
			EOS + WBC-2- 3	--	--	--	--	--	<0 39	--
			Average Concentration	**287**	**33**	**ND**	**0.11**	**1 8**	**ND**	**ND**
Chitin Amended/WBC-2 Bioaugmented	8-Jan-07	0	Chitin + WBC-2-1	3 2	28	0 20	1 9	19	<0 39	<0 59
			Chitin + WBC-2-2	4 5	29	0 21	2 0	18	<0 39	<0 59
			Chitin + WBC-2-3	4 1	32	0 23	1 8	18	<0 39	<0 59
			Average Concentration	**3 9**	**30**	**0.21**	**1.9**	**18**	**ND**	**ND**
	22-Jan-07	14	Chitin + WBC-2-1	146	41	<0 12	<0 10	0 66	<0 39	<0 59
			Chitin + WBC-2-2	115	43	<0 12	<0 10	0 52	<0 39	<0 59
			Chitin + WBC-2-3	102	44	<0 12	<0 10	0 24	<0 39	<0 59
			Average Concentration	**121**	**43**	**ND**	**ND**	**0.47**	**ND**	**ND**
	5-Feb-07	28	Chitin + WBC-2-1	313	56	<0 12	0 12	2 3	<0 39	<0 59
			Chitin + WBC-2-2	330	60	<0 12	0 20	6 1	<0 39	<0 59
			Chitin + WBC-2-3	310	59	<0 12	0 16	2 4	<0 39	<0 59
			Average Concentration	**318**	**58**	**ND**	**0.16**	**3.6**	**ND**	**ND**
	5-Mar-07	56	Chitin + WBC-2-1	365	57	<0 12	<0 10	0 54	<0 39	6 3
			Chitin + WBC-2-2	358	60	<0 12	<0 10	5 4	<0 39	5 0
			Chitin + WBC-2-3	379	62	<0 12	<0 10	1 1	<0 39	7 6
			Average Concentration	**367**	**60**	**ND**	**ND**	**2.3**	**ND**	**6 3**
	2-Apr-07	84	Chitin + WBC-2-1	431	107	<0 12	0 19	2 1	<0 39	<0 59
			Chitin + WBC-2-2	431	101	<0 12	0 11	6 2	<0 39	<0 59
			Chitin + WBC-2-3	398	117	<0 12	<0 10	2 7	<0 39	<0 59
			Average Concentration	**420**	**108**	**ND**	**0.15**	**3.6**	**ND**	**ND**
	30-Apr-07	112	Chitin + WBC-2-1	508	93	<0 12	0 11	1 7	<0 39	7 6
			Chitin + WBC-2-2	525	89	<0 12	0 17	5 1	<0 39	7 4
			Chitin + WBC-2-3	219	87	<0 12	0 15	1 1	<0 39	11
			Average Concentration	**417**	**90**	**ND**	**0.15**	**2 6**	**ND**	**8 7**

Notes:

ANAC - anaerobic active control
ANSC - anaerobic sterile control
EOS™ - emulsified oil substrate
mg/L - milligrams per liter
ND - not detected
Total VFA* - total volatile fatty acid - calibrated as lactate, but may include other VFAs, such as formate, acetate, propionate, pyruvate, and butyrate
-- - not analyzed

9531852

TABLE 2C: SUMMARY OF PHASE 1 MICROCOSM VFA RESULTS

Former Defense Depot, Memphis, Tennessee

SiREM

TREATMENT	DATE	DAY	Treatment Replicate	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Lactate Amended/WBC-2 Bioaugmented	19-Jun-07	162	Lac + WBC-2- 1	1 5	136	196	1 7	<0.41	<0 69
			Lac + WBC-2- 2	1 7	142	203	1 7	<0 41	<0 69
			Lac + WBC-2- 3	<0 39	151	205	2 3	<0 41	<0 69
			Average Concentration	**1.6**	**143**	**202**	**1.9**	**ND**	**ND**
EOS™ Amended/WBC-2 Bioaugmented	19-Jun-07	162	EOS + WBC-2- 1	1 7	185	33	1 5	19	<0 69
			EOS + WBC-2- 2	<0 39	240	132	2 6	23	<0 69
			EOS + WBC-2- 3	--	--	--	--	--	--
			Average Concentration	**1.7**	**213**	**83**	**2.0**	**21**	**ND**

Notes:

EOS™ - emulsified oil substrate
Lac - lactate
mg/L - milligrams per liter

9531853

TABLE 2D: SUMMARY OF PHASE 1 MICROCOSM pH RESULTS

Former Defense Depot, Memphis, Tennessee

TREATMENT	DATE	DAY	Treatment Replicate	pH	Comment
Anaerobic Sterile Control	8-Jan-07	0	ANSC-1	6 40	
			ANSC-2	--	
			ANSC-3	--	
			Average	**6.40**	
	22-Jan-07	14	ANSC-1	--	
			ANSC-2	6 27	
			ANSC-3	--	
			Average	**6.27**	
	5-Feb-07	28	ANSC-1	--	
			ANSC-2	6 73	
			ANSC-3	6 31	
			Average	**6.52**	
	5-Mar-07	56	ANSC-1	6 18	
			ANSC-2	6.18	
			ANSC-3	6.12	
			Average	**6.16**	
	22-Mar-07	73	ANSC-1	--	
			ANSC-2	6 30	
			ANSC-3	--	
			Average	**6.30**	
	2-Apr-07	84	ANSC-1	6 34	
			ANSC-2	--	
			ANSC-3	--	
			Average	**6.34**	
	30-Apr-07	112	ANSC-1	--	
			ANSC-2	6 21	
			ANSC-3	--	
			Average	**6.21**	
	28-May-07	140	ANSC-1	--	
			ANSC-2	--	
			ANSC-3	6 44	
			Average	**6.44**	
	11-Jun-07	154	ANSC-1	--	
			ANSC-2	--	
			ANSC-3	--	
			Average	**--**	
Anaerobic Active Control	8-Jan-07	0	ANAC-1	6 49	
			ANAC-2	--	
			ANAC-3	--	
			Average	**6.49**	
	22-Jan-07	14	ANAC-1	--	
			ANAC-2	6 54	
			ANAC-3	--	
			Average	**6.54**	
	5-Feb-07	28	ANAC-1	--	
			ANAC-2	6 91	
			ANAC-3	6 64	
			Average	**6.78**	
	5-Mar-07	56	ANAC-1	6 19	
			ANAC-2	6 17	
			ANAC-3	6 18	
			Average	**6.18**	
	22-Mar-07	73	ANAC-1	--	
			ANAC-2	6 32	
			ANAC-3	--	
			Average	**6.32**	
	2-Apr-07	84	ANAC-1	6 35	
			ANAC-2	--	
			ANAC-3	--	
			Average	**6.35**	
	30-Apr-07	112	ANAC-1	--	
			ANAC-2	6 31	
			ANAC-3	--	
			Average	**6.31**	
	28-May-07	140	ANAC-1	--	
			ANAC-2	--	
			ANAC-3	6 75	
			Average	**6.75**	
Lactate Amended	8-Jan-07	0	Lac - 1	6 56	
			Lac - 2	--	
			Lac - 3	--	
			Average	**6.56**	
	22-Jan-07	14	Lac - 1	--	
			Lac - 2	--	
			Lac - 3	6 53	
			Average	**6.53**	
	5-Feb-07	28	Lac - 1	6 82	
			Lac - 2	6.70	
			Lac - 3	--	
			Average	**6.76**	
	5-Mar-07	56	Lac - 1	6 46	
			Lac - 2	6 50	
			Lac - 3	6 49	
			Average	**6.48**	
	22-Mar-07	73	Lac - 1	--	
			Lac - 2	6 57	
			Lac - 3	--	
			Average	**6.57**	
	26-Mar-07	77	Lac - 1	6 87	
			Lac - 2	6 45	
			Lac - 3	--	
			Average	**6.66**	
	2-Apr	84	Lac - 1	6 47	
			Lac - 2	--	
			Lac - 3	--	
			Average	**6.47**	
	30-Apr-07	112	Lac - 1	--	
			Lac - 2	6 54	
			Lac - 3	--	
			Average	**6.54**	
	28-May	140	Lac - 1	--	
			Lac - 2	--	
			Lac - 3	6.65	
			Average	**6.65**	

TABLE 2D: SUMMARY OF PHASE 1 MICROCOSM pH RESULTS

Former Defense Depot, Memphis, Tennessee

TREATMENT	DATE	DAY	Treatment Replicate	pH	Comment
EOS™ Amended	8-Jan-07	0	EOS -1	6 24	
			EOS -2	--	
			EOS -3	--	
			Average	**6.24**	
	22-Jan-07	14	EOS -1	--	
			EOS -2	--	
			EOS -3	6 38	
			Average	**6.38**	
	5-Feb-07	28	EOS -1	6 77	
			EOS -2	6 62	
			EOS -3	--	
			Average	**6.70**	
	5-Mar-07	56	EOS -1	6 48	
			EOS -2	6 22	
			EOS -3	6 33	
			Average	**6.34**	
	22-Mar-07	73	EOS -1	--	
			EOS -2	6 33	
			EOS -3	--	
			Average	**6.33**	
	26-Mar-07	77	EOS -1	6 57	
			EOS -2	--	
			EOS -3	--	
			Average	**6.57**	
	2-Apr-07	84	EOS -1	--	
			EOS -2	6.50	
			EOS -3	--	
			Average	**6.50**	
	30-Apr-07	112	EOS -1	--	
			EOS -2	--	
			EOS -3	6 17	
			Average	**6.17**	
	28-May	140	EOS -1	--	
			EOS -2	6 30	
			EOS -3	--	
			Average	**6.30**	
Lactate Amended/WBC-2 Bioaugmented	8-Jan-07	0	Lac + WBC-2- 1	6 46	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	--	
			Average	**6.46**	
	22-Jan-07	14	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	6 52	
			Lac + WBC-2- 3	--	
			Average	**6.52**	
	5-Feb-07	28	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	6 87	
			Lac + WBC-2- 3	6 83	
			Average	**6.85**	
	5-Mar-07	56	Lac + WBC-2- 1	6 49	
			Lac + WBC-2- 2	6 59	
			Lac + WBC-2- 3	6 61	
			Average	**6.56**	
	22-Mar-07	73	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	6 59	
			Lac + WBC-2- 3	--	
			Average	**6.59**	
	26-Mar-07	77	Lac + WBC-2- 1	6 62	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	--	
			Average	**6.62**	
	2-Apr-07	84	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	6 48	
			Lac + WBC-2- 3	--	
			Average	**6.48**	
	17-Apr-07	99	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	6 55	
			Average	**6.55**	
	30-Apr-07	112	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	6 47	
			Average	**6.47**	
	28-May	140	Lac + WBC-2- 1	6 62	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	--	
			Average	**6.62**	
	11-Jun	154	Lac + WBC-2- 1	6 51	
			Lac + WBC-2- 2	6 57	
			Lac + WBC-2- 3	6 58	
			Average	**6.55**	
	19-Jun	162			Buffered with 100 µl saturated sodium bicarbonate
	19-Jun	162	Lac + WBC-2- 1	6 79	
			Lac + WBC-2- 2	6 75	
			Lac + WBC-2- 3	6 68	
			Average	**6.74**	
	20-Jun	163			Buffered with 100 µl saturated sodium bicarbonate
	20-Jun	163	Lac + WBC-2- 1	6 98	
			Lac + WBC-2- 2	6 99	
			Lac + WBC-2- 3	6 97	
			Average	**6.98**	
	25-Jun	168	Lac + WBC-2- 1	--	
			Lac + WBC-2- 2	--	
			Lac + WBC-2- 3	6 54	
			Average	**6.54**	
	3-Jul	176			Buffered with 500 µl saturated sodium bicarbonate.
	3-Jul	176	Lac + WBC-2- 1	7 23	
			Lac + WBC-2- 2	7 29	
			Lac + WBC-2- 3	7 28	
			Average	**7.27**	
	23-Jul	196	Lac + WBC-2- 1	6 87	
			Lac + WBC-2- 2	6 88	
			Lac + WBC-2- 3	6 98	
			Average	**6.91**	

9531855

TABLE 2D: SUMMARY OF PHASE 1 MICROCOSM pH RESULTS

Former Defense Depot, Memphis, Tennessee

TREATMENT	DATE	DAY	Treatment Replicate	pH	Comment
EOS™ Amended/WBC-2 Bioaugmented	8-Jan-07	0	EOS + WBC-2- 1	6 23	
			EOS + WBC-2- 2	--	
			EOS + WBC-2- 3	--	
			Average	**6.23**	
	22-Jan-07	14	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 42	
			EOS + WBC-2- 3	--	
			Average	**6.42**	
	5-Feb-07	28	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 67	
			EOS + WBC-2- 3	6 85	
			Average	**6.76**	
	5-Mar-07	56	EOS + WBC-2- 1	6 26	
			EOS + WBC-2- 2	6.22	
			EOS + WBC-2- 3	6 20	
			Average	**6.23**	
	22-Mar-07	73	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 49	
			EOS + WBC-2- 3	--	
			Average	**6.49**	
	26-Mar-07	77	EOS + WBC-2- 1	6 43	
			EOS + WBC-2- 2	--	
			EOS + WBC-2- 3	--	
			Average	**6.43**	
	2-Apr-07	84	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 53	
			EOS + WBC-2- 3	--	
			Average	**6.53**	
	17-Apr-07	99	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	--	
			EOS + WBC-2- 3	6 43	
			Average	**6.43**	
	30-Apr	112	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	--	
			EOS + WBC-2- 3	6 43	
			Average	**6.43**	
	28-May	140	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 19	
			EOS + WBC-2- 3	--	
			Average	**6.19**	
	11-Jun	154	EOS + WBC-2- 1	6 25	
			EOS + WBC-2- 2	6 13	
			EOS + WBC-2- 3	--	
			Average	**6.19**	
	19-Jun	162			Buffered with 250 µl saturated sodium bicarbonate
	19-Jun	162	EOS + WBC-2- 1	6 70	
			EOS + WBC-2- 2	6 62	
			EOS + WBC-2- 3	--	
			Average	**6.66**	
	20-Jun	163			Buffered with 250 µl saturated sodium bicarbonate
	20-Jun	163	EOS + WBC-2- 1	6 93	
			EOS + WBC-2- 2	6 85	
			EOS + WBC-2- 3	--	
			Average	**6.89**	
	25-Jun	168	EOS + WBC-2- 1	--	
			EOS + WBC-2- 2	6 50	
			EOS + WBC-2- 3	--	
			Average	**6.50**	
	3-Jul	176			Buffered with 500 µl saturated sodium bicarbonate
	3-Jul	176	EOS + WBC-2- 1	7 26	
			EOS + WBC-2- 2	7 13	
			EOS + WBC-2- 3	--	
			Average	**7.20**	
	23-Jul	196	EOS + WBC-2- 1	6 91	
			EOS + WBC-2- 2	6 81	
			EOS + WBC-2- 3	--	
			Average	**6.86**	
Chitin Amended/WBC-2 Bioaugmented	8-Jan-07	0	Chitin + WBC-2-1	6 48	
			Chitin + WBC-2-2	--	
			Chitin + WBC-2-3	--	
			Average	**6.48**	
	22-Jan-07	14	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	6 76	
			Chitin + WBC-2-3	--	
			Average	**6.76**	
	5-Feb-07	28	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	6 82	
			Chitin + WBC-2-3	7 02	
			Average	**6.92**	
	5-Mar-07	56	Chitin + WBC-2-1	6 74	
			Chitin + WBC-2-2	6 78	
			Chitin + WBC-2-3	6 74	
			Average	**6.75**	
	22-Mar-07	73	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	6 82	
			Chitin + WBC-2-3	--	
			Average	**6.82**	
	26-Mar-07	77	Chitin + WBC-2-1	6 84	
			Chitin + WBC-2-2	--	
			Chitin + WBC-2-3	--	
			Average	**6.84**	
	2-Apr-07	84	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	6 52	
			Chitin + WBC-2-3	--	
			Average	**6.52**	
	17-Apr-07	99	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	--	
			Chitin + WBC-2-3	6 70	
			Average	**6.70**	
	30-Apr-07	112	Chitin + WBC-2-1	--	
			Chitin + WBC-2-2	--	
			Chitin + WBC-2-3	6 81	
			Average	**6.81**	

Notes:

ANAC - anaerobic active control
ANSC - anaerobic sterile control
EOS™ - emulsified oil substrate
Lac - lactate
µL - microliters

TABLE 3A: SUMMARY OF PHASE 2 MICROCOSM cVOC, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Corn Syrup Amended/WBC-2 Bioaugmented	21-Aug-07	0														Amended with Corn Syrup to a target concentration of 160 mg/L Spiked with TCE to a target concentration of 6 mg/L Spiked with 1,1,2,2-TeCA to a target concentration of 10 mg/L
	21-Aug-07	0	Corn Syrup-1	7 1	0 04	<0 010	<0 010	--	7 8	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-2	6 7	0 03	<0 010	<0 010	--	7 8	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-3	6 8	0 04	<0 010	<0 010	--	8 0	<0 010	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	6 8	0 04	ND	ND	--	7 9	ND	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	3 1E-04	1 7E-05	0 0E+00	0 0E+00	--	1 7E-04	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 0E-04	
			Average Total mmoles	**0.011**	**0.000081**	**ND**	**ND**	**1 1E-02**	**0.01**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0017**	
	27-Aug-07	6	Corn Syrup-1	7 0	0 05	<0 010	<0 010	--	--	0 20	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-2	7 1	0 03	<0 010	<0 010	--	--	0 17	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-3	7 2	0 04	<0 010	<0 010	--	--	0 16	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	7 1	0 04	ND	ND	--	--	0 17	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	1 9E-04	1 7E-05	0 0E+00	0 0E+00	--	--	3 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 3E-04	
			Average Total mmoles	**0.011**	**0.000084**	**ND**	**ND**	**1 1E-02**	--	**0.00026**	**ND**	**ND**	**ND**	**ND**	**0.0017**	
	10-Sep-07	20	Corn Syrup-1	6 4	0 36	0 02	<0 010	--	5 6	0 08	<0 010	<0 010	<0 010	<0 010	0 03	
			Corn Syrup-2	6 8	0 04	<0 010	<0 010	--	5 6	0 05	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-3	7 1	0 06	<0 010	<0 010	--	5 6	0 05	<0 010	<0 010	<0 010	0 014	0 03	
			Average Concentration (mg/L)	6 7	0 15	0 01	ND	--	5 6	0 06	ND	ND	ND	0 0047	0 03	
			Standard Deviation (mmoles)	5 4E-04	3 9E-04	2 1E-05	0 0E+00	--	4 8E-05	2 8E-05	0 0E+00	0 0E+00	0 0E+00	1 6E-04	9 4E-05	
			Average Total mmoles	**0.011**	**0 00032**	**0.000012**	**ND**	**1.1E-02**	**0.0073**	**0.00009**	**ND**	**ND**	**ND**	**0.000092**	**0.0015**	
	24-Sep-07	34	Corn Syrup-1	1 4	3 5	0 05	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-2	4 3	0 96	0 01	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-3	5 5	0 21	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	0 03	0 04	
			Average Concentration (mg/L)	3 7	1 6	0 02	ND	--	--	ND	ND	ND	ND	0 01	0 04	
			Standard Deviation (mmoles)	3 4E-03	3 7E-03	5 2E-05	0 0E+00	--	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 1E-04	4 4E-05	
			Average Total mmoles	**0.006**	**0.0033**	**0.000043**	**ND**	**9.3E-03**	--	**ND**	**ND**	**ND**	**ND**	**0.00018**	**0.0019**	
	01-Oct-07	41	Corn Syrup-1	0 15	5 7	0 07	<0 010	--	6 8	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			Corn Syrup-2	2 8	3 2	0 03	<0 010	--	7 0	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			Corn Syrup-3	2 7	3 7	0 04	<0 010	--	7 0	<0 010	<0 010	<0 010	<0 010	0 03	0 06	
			Average Concentration (mg/L)	1 9	4 2	0 04	ND	--	6 9	ND	ND	ND	ND	0 01	0 03	
			Standard Deviation (mmoles)	2 4E-03	2 8E-03	4 3E-05	0 0E+00	--	1 3E-04	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 8E-04	8 9E-04	
			Average Total mmoles	**0.003**	**0.009**	**0.000092**	**ND**	**1.2E-02**	**0 009**	**ND**	**ND**	**ND**	**ND**	**0 00022**	**0 0016**	
	02-Oct-07	42														Bioaugmented with WBC-2 culture Amended with corn syrup to a target concentration of 160 mg/L
	15-Oct-07	55	Corn Syrup-1	0 27	5 0	0 11	0 36	--	6 4	0 01	<0 010	<0 010	<0 010	<0 010	0 04	
			Corn Syrup-2	0 28	4 8	0 26	0 40	--	6 2	0 04	<0 010	<0 010	<0 010	<0 010	0 03	
			Corn Syrup-3	0 80	4 8	0 10	0 26	--	6 6	<0 010	<0 010	<0 010	<0 010	0 03	0 04	
			Average Concentration (mg/L)	0 45	4 8	0 15	0 34	--	6 4	0 02	ND	ND	ND	0 01	0 04	
			Standard Deviation (mmoles)	4 8E-04	2 8E-04	2 0E-04	2 5E-04	--	2 0E-04	3 4E-05	0 0E+00	0 0E+00	0 0E+00	3 1E-04	1 8E-04	
			Average Total mmoles	**0.00072**	**0 01**	**0.00033**	**0 0012**	**1.2E-02**	**0.0083**	**0.000028**	**ND**	**ND**	**ND**	**0.00018**	**0.0016**	
	29-Oct-07	69	Corn Syrup-1	0 22	4 7	3 0	0 67	--	1 5	0 15	0 12	<0 010	0 02	<0 010	0 06	
			Corn Syrup-2	0 34	4 5	1 8	0 69	--	3 4	0 20	0 09	<0 010	0 01	<0 010	0 05	
			Corn Syrup-3	0 89	4 5	0 22	0 38	--	6 1	<0 010	<0 010	<0 010	0 01	0 03	0 08	
			Average Concentration (mg/L)	0 48	4 6	1 7	0 58	--	3 6	0 12	0 072	ND	0 01	0 01	0 06	
			Standard Deviation (mmoles)	5 8E-04	2 3E-04	2 9E-03	6 2E-04	--	3 0E-03	1 5E-04	1 3E-04	0 0E+00	3 5E-05	3 3E-04	6 2E-04	
			Average Total mmoles	**0.00077**	**0.0098**	**0.0035**	**0.002**	**1.6E-02**	**0.0048**	**0.00017**	**0.00015**	**ND**	**0.00018**	**0.00019**	**0.0029**	
	12-Nov-07	83	Corn Syrup-1	0 06	2 8	3 8	1 2	--	0 07	0 10	0 10	<0 010	0 20	<0 010	0 07	
			Corn Syrup-2	0 27	4 1	3 3	0 84	--	0 70	0 07	0 28	<0 010	0 02	<0 010	0 05	
			Corn Syrup-3	0 11	5 0	3 8	0 48	--	0 10	0 09	0 06	<0 010	0 01	0 03	0 07	
			Average Concentration (mg/L)	0 15	4 0	3 6	0 83	--	0 29	0 08	0 15	ND	0 08	0 01	0 06	
			Standard Deviation (mmoles)	1 7E-04	2 3E-03	5 6E-04	1 2E-03	--	4 7E-04	2 5E-05	2 4E-04	0 0E+00	1 4E-03	3 1E-04	5 5E-04	
			Average Total mmoles	**0.00023**	**0 0085**	**0.0077**	**0.0029**	**2.0E-02**	**0 00037**	**0 00013**	**0.00029**	**ND**	**0.001**	**0.00018**	**0.0027**	
	26-Nov-07	97	Corn Syrup-1	<0 010	0 13	3 8	0 012	--	<0 010	0 11	0 10	<0 010	0 84	<0 010	0 09	
			Corn Syrup-2	<0 010	0 71	3 9	0 50	--	<0 010	0 09	0 21	<0 010	0 62	<0 010	0 05	
			Corn Syrup-3	<0 010	4 5	3 8	0 83	--	<0 010	0 10	0 06	<0 010	0 01	0 03	0 09	
			Average Concentration (mg/L)	ND	1 8	3 8	0 45	--	ND	0 10	0 12	ND	0 49	0 01	0 07	
			Standard Deviation (mmoles)	0 0E+00	5 1E-03	1 2E-04	1 4E-03	--	0 0E+00	1 5E-05	1 5E-04	0 0E+00	5 6E-03	3 1E-04	1 2E-03	
			Average Total mmoles	**ND**	**0.0038**	**0.0081**	**0.0016**	**2.0E-02**	**ND**	**0.00015**	**0.00025**	**ND**	**0.0064**	**0.00018**	**0.0034**	
	02-Jan-08	134	Corn Syrup-1	<0 010	0 08	3 7	<0 010	--	<0 010	<0 010	<0 010	<0 010	0 82	<0 010	0 20	
			Corn Syrup-2	<0 010	0 09	3 9	<0 010	--	<0 010	<0 010	<0 010	<0 010	0 72	<0 010	0 19	
			Corn Syrup-3	<0 010	0 07	3 7	3 1	--	<0 010	<0 010	<0 010	<0 010	0 06	0 03	0 19	
			Average Concentration (mg/L)	ND	0 08	3 8	1 0	--	ND	ND	ND	ND	0 53	0 01	0 19	
			Standard Deviation (mmoles)	0 0E+00	1 7E-05	2 6E-04	6 3E-03	--	0 0E+00	0 0E+00	0 0E+00	0 0E+00	5 5E-03	3 3E-04	2 9E-04	
			Average Total mmoles	**ND**	**0.00017**	**0 008**	**0.0036**	**1.9E-02**	**ND**	**ND**	**ND**	**ND**	**0.007**	**0 00019**	**0 0089**	

TABLE 3A: SUMMARY OF PHASE 2 MICROCOSM cVOC, ETHENE, ETHANE AND METHANE RESULTS
Former Defense Depot, Memphis, Tennessee

Treatment	Date	Day	Replicate	Chlorinated Ethenes					Chlorinated Ethanes				Ethene	Ethane	Methane	Comment
				TCE	cis-1,2-DCE	trans-1,2-DCE	VC	Total Ethenes	1,1,2,2-TECA	1,1,2-TCA	1,2-DCA	CA	Ethene	Ethane	Methane	
				mg/L	mg/L	mg/L	mg/L	mmol/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
HRC-Advanced® Amended/WBC-2 Bioaugmented	21-Aug-07	0														Amended with HRC-Advanced® to a target concentration of 0.1% as oil Spiked with TCE to a target concentration of 6 mg/L. Spiked with 1,1,2,2-TeCA to a target concentration of 10 mg/L
	21-Aug-07	0	HRC-A-1	5 8	0 03	<0 010	<0 010	--	6 8	<0 010	<0 010	<0.010	<0 010	<0 010	0 02	
			HRC-A-2	6 3	0 04	<0 010	<0 010	--	18	<0.010	<0 010	<0 010	<0 010	<0 010	0 03	
			HRC-A-3	5.9	0 04	<0 010	<0 010	--	7.1	<0 010	<0 010	<0 010	<0 010	<0 010	0 03	
			Average Concentration (mg/L)	6 0	0 04	ND	ND	--	11	ND	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	3.9E-04	1 1E-05	0 0E+00	0 0E+00	--	8.2E-03	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	2.5E-04	
			Average Total mmoles	**0.0096**	**0.000073**	**ND**	**ND**	**9.7E-03**	**0.014**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0013**	
	27-Aug-07	6	HRC-A-1	5 7	0 03	<0 010	<0 010	--	--	0.14	<0 010	<0 010	<0.010	<0 010	0.03	
			HRC-A-2	6.0	0 04	<0 010	<0.010	--	--	0 14	<0.010	<0.010	<0 010	<0 010	0 03	
			HRC-A-3	5.6	0.04	<0.010	<0 010	--	--	0 13	<0.010	<0 010	<0.010	<0 010	0 03	
			Average Concentration (mg/L)	5.8	0 04	ND	ND	--	--	0 14	ND	ND	ND	ND	0.03	
			Standard Deviation (mmoles)	3 6E-04	9 2E-06	0.0E+00	0 0E+00	--	--	1 2E-05	0.0E+00	0 0E+00	0 0E+00	0 0E+00	1 9E-05	
			Average Total mmoles	**0.0092**	**0.000074**	**ND**	**ND**	**9.3E-03**	--	**0.0002**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	10-Sep-07	20	HRC-A-1	5 4	0 03	<0.010	<0 010	--	4 9	0 04	<0 010	<0.010	<0 010	<0.010	0 03	
			HRC-A-2	5 5	0 04	<0.010	<0 010	--	13	0 05	<0.010	<0 010	<0 010	<0.010	0.03	
			HRC-A-3	5.7	0 05	<0.010	<0 010	--	5 2	<0 010	<0 010	<0 010	<0.010	<0.010	0.03	
			Average Concentration (mg/L)	5.6	0 04	ND	ND	--	7.5	0 03	ND	ND	ND	ND	0 03	
			Standard Deviation (mmoles)	2 7E-04	2.1E-05	0 0E+00	0 0E+00	--	5 6E-03	3 8E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1.9E-05	
			Average Total mmoles	**0.0089**	**0.000082**	**ND**	**ND**	**9.0E-03**	**0.0098**	**0 000043**	**ND**	**ND**	**ND**	**ND**	**0.0014**	
	24-Sep-07	34	HRC-A-1	4 4	0 02	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-2	4 6	0 03	<0 010	<0 010	--	--	<0 010	<0 010	<0 010	<0 010	<0 010	0.04	
			HRC-A-3	4 5	0 05	<0 010	<0 010	--	--	<0 010	<0.010	<0 010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	4 5	0 04	ND	ND	--	--	ND	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	1.4E-04	2 6E-05	0 0E+00	0 0E+00	--	--	0 0E+00	0 0E+00	0 0E+00	0.0E+00	0 0E+00	2.8E-05	
			Average Total mmoles	**0.0072**	**0.000075**	**ND**	**ND**	**7.3E-03**	--	**ND**	**ND**	**ND**	**ND**	**ND**	**0.0018**	
	01-Oct-07	41	HRC-A-1	5 2	0 03	<0 010	<0 010	--	6 2	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			HRC-A-2	5 6	0 04	<0 010	<0 010	--	16	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			HRC-A-3	5.4	0 06	<0 010	<0.010	--	6 7	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			Average Concentration (mg/L)	5.4	0 05	ND	ND	--	9 5	ND	ND	ND	ND	ND	0 02	
			Standard Deviation (mmoles)	3 1E-04	3 1E-05	0 0E+00	0 0E+00	--	6 9E-03	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 5E-05	
			Average Total mmoles	**0.0086**	**0.000097**	**ND**	**ND**	**8.7E-03**	**0.012**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.00089**	
	02-Oct-07	42														Bioaugmented with WBC-2 culture
	15-Oct-07	55	HRC-A-1	5 5	0 04	<0 010	<0 010	--	6 1	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			HRC-A-2	6 0	0 06	0 01	<0 010	--	17	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			HRC-A-3	5 6	0 11	0 01	<0 010	--	6 4	<0 010	<0 010	<0 010	<0 010	<0 010	0 02	
			Average Concentration (mg/L)	5 7	0 07	0 01	ND	--	9.7	ND	ND	ND	ND	ND	0 02	
			Standard Deviation (mmoles)	4 1E-04	7 5E-05	1 4E-05	0 0E+00	--	7 8E-03	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	3 3E-05	
			Average Total mmoles	**0.0091**	**0.00014**	**0.000016**	**ND**	**9.3E-03**	**0.013**	**ND**	**ND**	**ND**	**ND**	**ND**	**0 001**	
	29-Oct-07	69	HRC-A-1	5 7	0 04	<0 010	<0 010	--	6.1	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-2	6.2	0.06	0 01	<0 010	--	16	<0 010	<0 010	<0 010	<0.010	<0.010	0 05	
			HRC-A-3	0 81	4 7	0 07	<0 010	--	6 4	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	4 2	1 6	0 03	ND	--	9 5	ND	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	4 8E-03	5 7E-03	7.3E-05	2 4E-05	--	7 4E-03	0 0E+00	0 0E+00	0 0E+00	0 0E+00	0 0E+00	5 7E-05	
			Average Total mmoles	**0.0068**	**0.0034**	**0.000055**	**0.000014**	**1.0E-02**	**0 012**	**ND**	**ND**	**ND**	**ND**	**ND**	**0.002**	
	12-Nov-07	83	HRC-A-1	2 8	1 9	0 03	0 09	--	6 2	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-2	6 4	0 06	0 01	<0 010	--	16	0 05	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-3	0 95	4.4	0.08	<0.010	--	6 6	0 09	<0 010	<0 010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	3 4	2 1	0 04	0 03	--	9 8	0 05	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	4 5E-03	4 7E-03	6 9E-05	1 7E-04	--	7.6E-03	6 6E-05	0.0E+00	0 0E+00	0 0E+00	0 0E+00	1 7E-04	
			Average Total mmoles	**0.0054**	**0.0046**	**0.000083**	**0.0001**	**1.0E-02**	**0.013**	**0.000069**	**ND**	**ND**	**ND**	**ND**	**0.0017**	
	26-Nov-07	97	HRC-A-1	0 18	5 2	0 07	<0 010	--	6 2	0 10	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-2	6 3	0 06	0 01	0 01	--	16	0.08	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-3	0 86	4 9	0 08	0 01	--	6 6	0 11	<0 010	<0.010	<0 010	<0 010	0 04	
			Average Concentration (mg/L)	2 4	3.4	0 06	0 01	--	9 7	0 10	ND	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	5 3E-03	6 2E-03	8 0E-05	2 4E-05	--	7 5E-03	2 0E-05	0 0E+00	0 0E+00	0 0E+00	0 0E+00	1 8E-05	
			Average Total mmoles	**0.0039**	**0.0072**	**0.00012**	**0.000027**	**1.1E-02**	**0.013**	**0.00014**	**ND**	**ND**	**ND**	**ND**	**0.0016**	
	02-Jan-08	134	HRC-A-1	0 45	5.3	0 06	<0 010	--	5 9	<0 010	<0 010	<0.010	<0 010	<0 010	0 04	
			HRC-A-2	7 4	0 07	0 03	<0 010	--	16	<0 010	<0 010	<0 010	<0 010	<0 010	0 04	
			HRC-A-3	0 44	5 9	0 07	<0 010	--	6.2	<0 010	0 04	<0 010	<0.010	<0 010	0.04	
			Average Concentration (mg/L)	2 8	3.7	0 05	ND	--	9 3	ND	0 01	ND	ND	ND	0 04	
			Standard Deviation (mmoles)	6.4E-03	6 8E-03	4 4E-05	0 0E+00	--	7 4E-03	0 0E+00	5 0E-05	0 0E+00	0 0E+00	0 0E+00	4 8E-05	
			Average Total mmoles	**0.0044**	**0.008**	**0.00011**	**ND**	**1 3E-02**	**0.012**	**ND**	**0.000029**	**ND**	**ND**	**ND**	**0.0017**	

Notes.

1,2-DCA - 1,2-dichloroethane
1,1,2-TCA - 1,1,2-trichloroethane
1,1,2,2-TECA - 1,1,2,2-tetrachloroethane
CA - chloroethane
cis-1,2-DCE - *cis*-1,2-dichloroethene
mg/L - milligrams per liter
mmoles - millimoles
mmol/L - millimoles per liter
ND - not detected
TCE - trichloroethene
trans-1,2-DCE - *trans*-1,2-dichloroethene
VC - vinyl chloride
-- - not analyzed/not applicable
% - percent

TABLE 3B: SUMMARY OF PHASE 2 MICROCOSM ANION RESULTS
Former Defense Depot, Memphis, Tennessee

SiREM

TREATMENT	DATE	DAY	Treatment Replicate	Total VFA*	Chloride	Nitrite	Nitrate	Sulfate	Bromide	Phosphate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Corn Syrup Amended/WBC-2 Bioaugmented	21-Aug-07	0	Corn Syrup-1	8 8	24	<0 12	2 4	25	<0 39	<0 57
			Corn Syrup-2	8 4	26	<0 12	2 7	23	<0 39	<0 57
			Corn Syrup-3	8 1	16	<0 12	2 8	23	<0 39	<0 57
			Average	**8.4**	**22**	**ND**	**2.6**	**24**	**ND**	**ND**
	10-Sep-07	20	Corn Syrup-1	78	15	<0 12	<0 10	1 9	<0 39	<0 57
			Corn Syrup-2	73	15	<0 12	<0 10	15	<0 39	2 1
			Corn Syrup-3	24	17	<0 12	0 13	15	<0 39	2 1
			Average	**58**	**16**	**ND**	**0.13**	**11**	**ND**	**2.1**
	24-Sep-07	34	Corn Syrup-1	75	19	<0 12	<0 10	6 5	<0 39	<0 57
			Corn Syrup-2	50	18	<0 12	<0 10	5 6	<0 39	<0 57
			Corn Syrup-3	<0 41	16	<0 12	<0 10	6 8	<0 39	<0 57
			Average	**63**	**18**	**ND**	**ND**	**6.3**	**ND**	**ND**
	15-Oct-07	55	Corn Syrup-1	200	23	<0 12	<0 10	1 1	<0 39	2 2
			Corn Syrup-2	176	22	<0 12	<0 10	0 72	<0 39	2 7
			Corn Syrup-3	156	21	<0 12	<0 10	0 59	<0 39	2 7
			Average	**178**	**22**	**ND**	**ND**	**0.80**	**ND**	**2.6**
	29-Oct-07	69	Corn Syrup-1	198	22	<0 12	<0 10	1 1	<0 39	2 2
			Corn Syrup-2	179	21	<0 12	<0 10	1 0	<0 39	2 2
			Corn Syrup-3	184	19	<0 12	<0 10	0 77	<0 39	2 1
			Average	**187**	**21**	**ND**	**ND**	**0.94**	**ND**	**2.2**
	12-Nov-07	83	Corn Syrup-1	204	26	<0 12	<0 10	0 85	<0 39	2 0
			Corn Syrup-2	190	25	<0 12	<0 10	0 89	<0 39	<0 57
			Corn Syrup-3	193	24	<0 12	<0 10	0 55	<0 39	<0 57
			Average	**196**	**25**	**ND**	**ND**	**0.76**	**ND**	**2.0**
	26-Nov-07	97	Corn Syrup-1	205	27	<0 12	<0 10	<0 73	<0 39	<0 57
			Corn Syrup-2	186	28	<0 12	<0 10	0 47	<0 39	<0 57
			Corn Syrup-3	183	26	<0 12	<0 10	1 1	<0 39	<0 57
			Average	**195**	**27**	**ND**	**ND**	**0.77**	**ND**	**ND**
	2-Jan-08	134	Corn Syrup-1	196	26	<0 12	<0 10	0 43	<0 39	<0 57
			Corn Syrup-2	182	26	<0 12	<0 10	0 66	<0 39	<0 57
			Corn Syrup-3	179	24	<0 12	<0 10	0 66	<0 39	<0 57
			Average	**185**	**25**	**ND**	**ND**	**0.58**	**ND**	**ND**
HRC-Advanced® Amended/WBC-2 Bioaugmented	21-Aug-07	0	HRC-A-1	219	17	<0 12	3 2	25	<0 39	11
			HRC-A-2	227	16	<0 12	2 9	24	<0 39	10
			HRC-A-3	228	38	<0 12	3 2	23	<0 39	10
			Average	**225**	**24**	**ND**	**3.1**	**24**	**ND**	**10**
	10-Sep-07	20	HRC-A-1	187	14	<0 12	0 11	24	<0 39	2 6
			HRC-A-2	204	15	<0 12	<0 10	25	<0 39	2 5
			HRC-A-3	158	18	<0 12	<0 10	2 1	<0 39	1 6
			Average	**183**	**16**	**ND**	**0.11**	**17**	**ND**	**2.2**
	24-Sep-07	34	HRC-A-1	196	16	<0 12	<0 10	29	<0 39	3 4
			HRC-A-2	120	17	<0 12	<0 10	25	<0 39	<0 57
			HRC-A-3	35	22	<0 12	<0 10	1 7	<0 39	2 6
			Average	**117**	**18**	**ND**	**ND**	**19**	**ND**	**3.0**
	15-Oct-07	55	HRC-A-1	197	18	<0 12	<0 10	1 4	<0 39	–
			HRC-A-2	202	20	<0 12	<0 10	1 1	<0 39	3 5
			HRC-A-3	77	17	<0 12	<0 10	0 25	<0 39	2 6
			Average	**159**	**18**	**ND**	**ND**	**0.95**	**ND**	**3.05**
	29-Oct-07	69	HRC-A-1	185	17	<0 12	<0 10	0 78	<0 39	2 4
			HRC-A-2	191	17	<0 12	<0 10	0 69	<0 39	2 4
			HRC-A-3	136	19	<0 12	<0 10	0 87	<0 39	2 3
			Average	**171**	**18**	**ND**	**ND**	**0.78**	**ND**	**2.4**
	12-Nov-07	83	HRC-A-1	198	19	<0 12	<0 10	0 94	<0 39	2 4
			HRC-A-2	196	18	<0 12	<0 10	0 74	<0 39	<0 57
			HRC-A-3	128	21	<0 12	<0 10	2 9	<0 39	<0 57
			Average	**174**	**19**	**ND**	**ND**	**1.5**	**ND**	**2.4**
	26-Nov-07	97	HRC-A-1	186	23	<0 12	0 11	1 7	<0 39	<0 57
			HRC-A-2	201	25	<0 12	<0 10	1 6	<0 39	0 88
			HRC-A-3	125	19	<0 12	<0 10	<0 73	2 29	<0 57
			Average	**171**	**22**	**ND**	**0.11**	**1.6**	**2.3**	**0.88**
	2-Jan-08	134	HRC-A-1	180	18	<0 12	<0 10	0 63	<0 39	<0 57
			HRC-A-2	190	17	<0 12	<0 10	0 40	<0 39	<0 57
			HRC-A-3	59	19	<0 12	<0 10	0 48	<0 39	<0 57
			Average	**143**	**18**	**ND**	**ND**	**0.50**	**ND**	**ND**

Notes:

mg/L - milligrams per liter
ND - not detected
Total VFA* - total volatile fatty acid - calibrated as lactate, but may include other VFAs, such as formate, acetate, propionate, pyruvate, and butyrate
– - not analyzed

TABLE 3C: SUMMARY OF PHASE 2 MICROCOSM VFA RESULTS

Army Depot Site, Memphis, TN

SiREM

TREATMENT	DATE	DAY	Treatment Replicate	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Corn Syrup Amended/WBC-2 Bioaugmented	1-Oct-07	41	Corn Syrup-1	<0.39	51	7 0	1.4	0.67	3 0
			Corn Syrup-2	<0.39	51	3.7	0.92	2 2	<0.69
			Corn Syrup-3	<0 39	43	6.0	0.61	2.7	<0.69
			Average	**ND**	**48**	**5.6**	**1.0**	**1.9**	**3.0**
	29-Oct-07	69	Corn Syrup-1	<0.39	137	22	<0 22	2.4	<0.69
			Corn Syrup-2	2 0	121	16	0 67	32	<0.69
			Corn Syrup-3	<0.39	100	44	<0.22	4.7	<0 69
			Average	**2.0**	**119**	**27**	**0.67**	**13**	**ND**
HRC-Advanced® Amended/WBC-2 Bioaugmented	1-Oct-07	41	HRC-A-1	147	4.6	<0.31	1.7	<0.41	<0.69
			HRC-A-2	151	<0 54	<0.31	1.1	<0.41	<0.69
			HRC-A-3	4.3	32	<0.31	<0 22	4 2	70
			Average	**101**	**18**	**ND**	**1.4**	**4.2**	**70**
	29-Oct-07	69	HRC-A-1	<0.39	64	<0 31	37	2.9	<0.69
			HRC-A-2	8 4	74	<0 31	38	2.6	<0.69
			HRC-A-3	6 3	34	13	<0.22	4.1	<0.69
			Average	**7.3**	**57**	**13**	**38**	**3.2**	**ND**

Notes:

mg/L - milligrams per liter

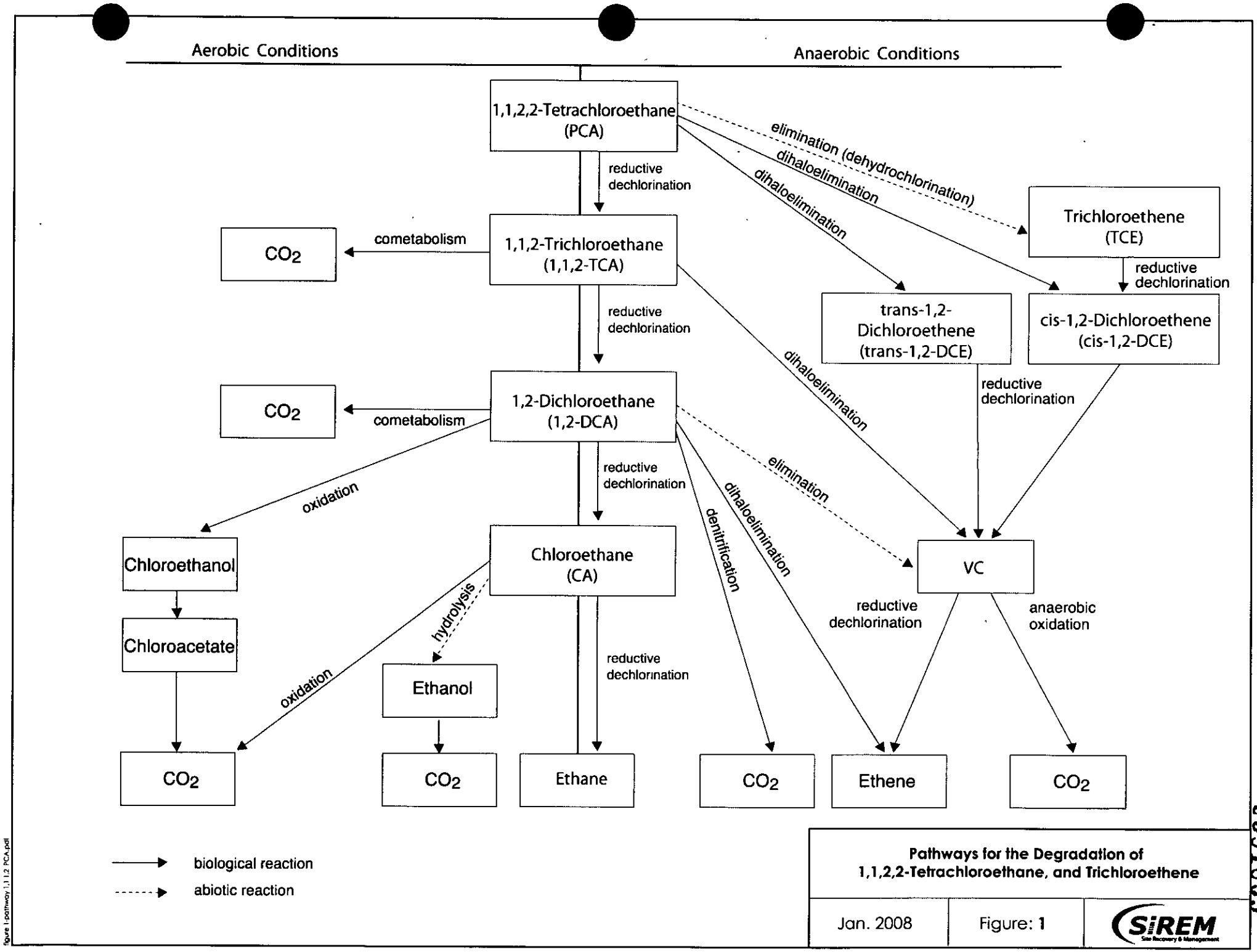
ND - not detected

9531860

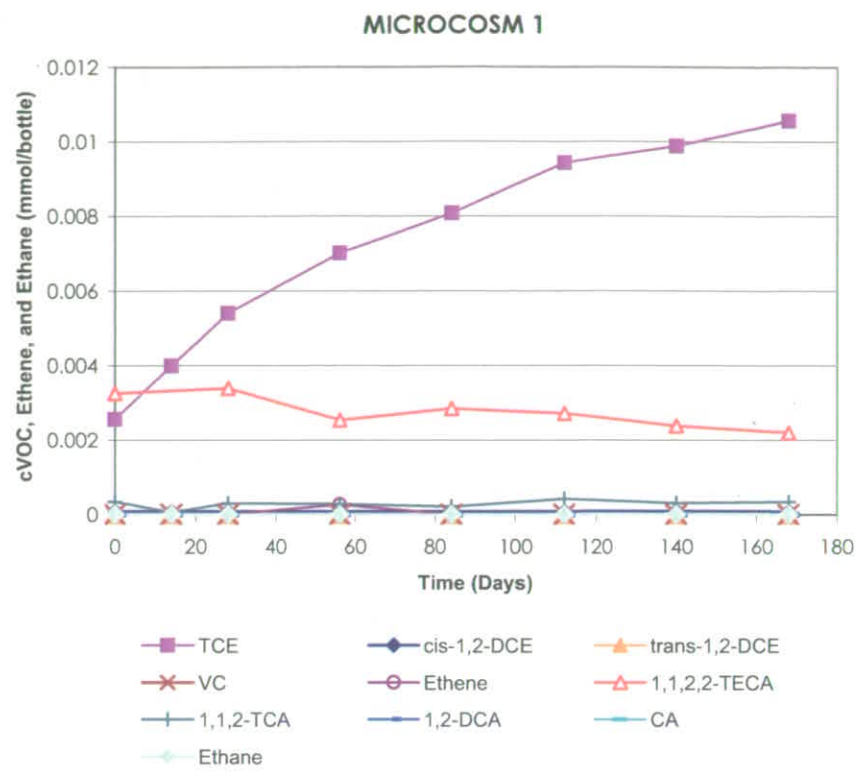
TABLE 3D: SUMMARY OF PHASE 2 MICROCOSM pH RESULTS
Former Defense Depot, Memphis, Tennessee

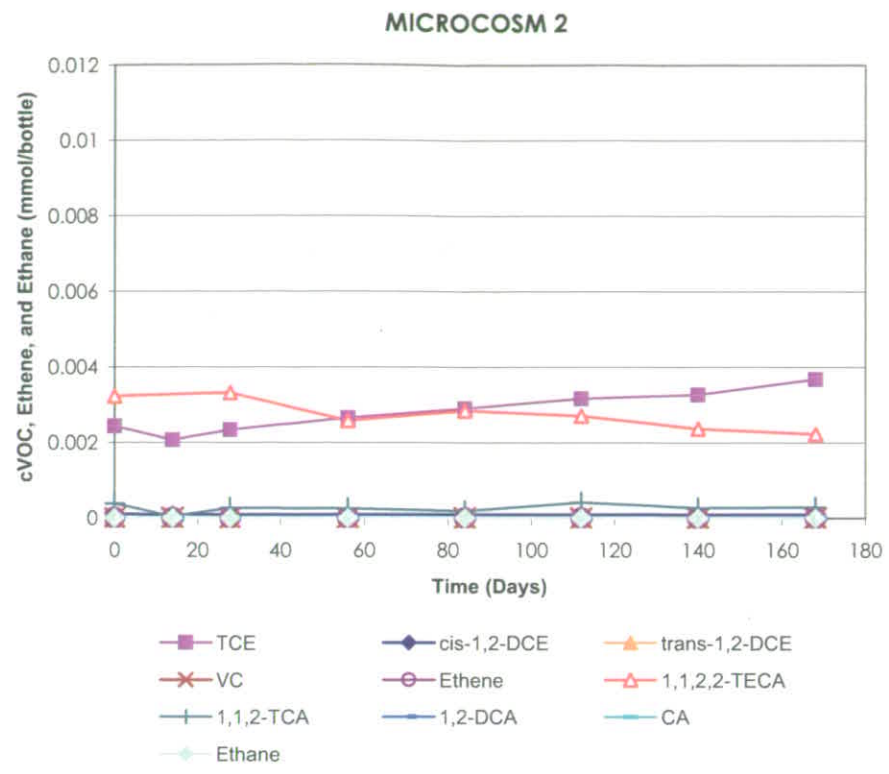
TREATMENT	DATE	DAY	Treatment Replicate	pH
Corn Syrup Amended/WBC-2 Bioaugmented	21-Aug-07	0	Corn Syrup-1	6 61
			Corn Syrup-2	6.43
			Corn Syrup-3	6.45
			Average	**6.50**
	27-Aug-07	6	corn syrup-1	6.56
			Corn Syrup-1	6.54
			Corn Syrup-2	6.53
			Corn Syrup-3	**6.54**
	10-Sep-07	20	Corn Syrup-1	7.14
			Corn Syrup-2	7 27
			Corn Syrup-3	7.00
			Average	**7.14**
	24-Sep-07	34	Corn Syrup-1	6.64
			Corn Syrup-2	6 69
			Corn Syrup-3	6.73
			Average	**6.69**
	1-Oct-07	41	Corn Syrup-1	6.95
			Corn Syrup-2	6.97
			Corn Syrup-3	6.92
			Average	**6.95**
	15-Oct-07	55	Corn Syrup-1	6.90
			Corn Syrup-2	6.77
			Corn Syrup-3	6.80
			Average	**6.82**
	29-Oct-07	69	Corn Syrup-1	6 46
			Corn Syrup-2	6 43
			Corn Syrup-3	6 44
			Average	**6.44**
	12-Nov-07	83	Corn Syrup-1	6.47
			Corn Syrup-2	6 44
			Corn Syrup-3	6.45
			Average	**6.45**
	2-Jan-08	134	Corn Syrup-1	6.54
			Corn Syrup-2	6.51
			Corn Syrup-3	6.59
			Average	**6.55**
HRC-Advanced® Amended/WBC-2 Bioaugmented	21-Aug-07	0	HRC-A-1	5.85
			HRC-A-2	5.88
			HRC-A-3	5.86
			Average	**5.86**
	27-Aug-07	6	HRC-A-1	6.02
			HRC-A-2	6.01
			HRC-A-3	6.03
			Average	**6.02**
	10-Sep-07	20	HRC-A-1	6 42
			HRC-A-2	6 43
			HRC-A-3	6.30
			Average	**6.38**
	24-Sep-07	34	HRC-A-1	6.19
			HRC-A-2	6.16
			HRC-A-3	6.43
			Average	**6.26**
	1-Oct-07	41	HRC-A-1	6.31
			HRC-A-2	6.28
			HRC-A-3	6.43
			Average	**6.34**
	15-Oct-07	55	Corn Syrup-1	6.65
			Corn Syrup-2	6.52
			Corn Syrup-3	6.65
			Average	**6.61**
	29-Oct-07	69	HRC-A-1	6.43
			HRC-A-2	6.57
			HRC-A-3	6.50
			Average	**6.50**
	12-Nov-07	83	HRC-A-1	6.39
			HRC-A-2	6.38
			HRC-A-3	6.46
			Average	**6.41**
	2-Jan-08	134	HRC-A-1	6.50
			HRC-A-2	6.37
			HRC-A-3	6.51
			Average	**6.46**

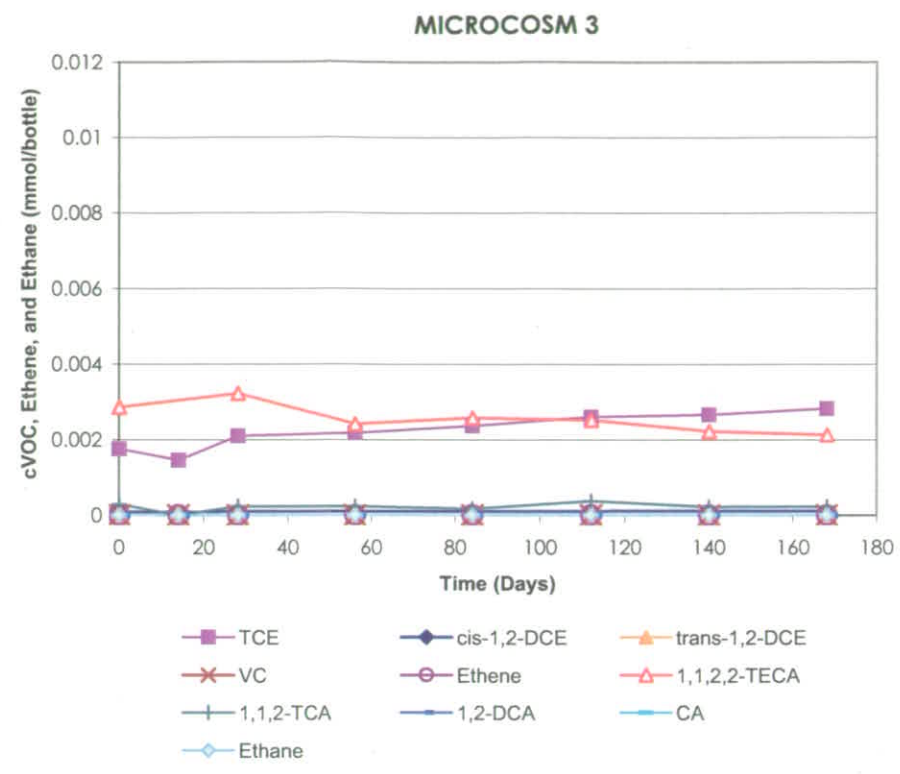
FIGURES

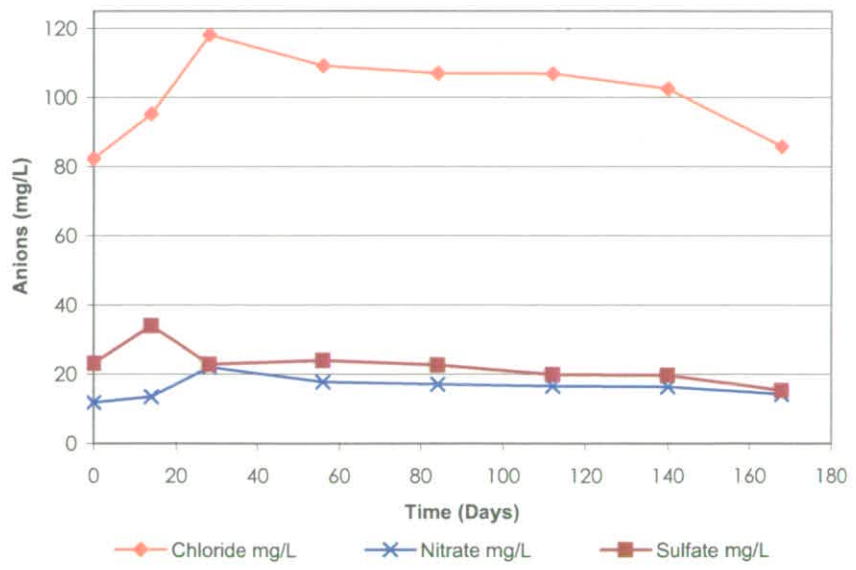

Aerobic Conditions
Anaerobic Conditions
1,1,2,2-Tetrachloroethane (PCA)
reductive dechlorination
elimination (dehydrochlorination)
dihaloelimination
dihaloelimination
Trichloroethene (TCE)
reductive dechlorination
CO2
cometabolism
1,1,2-Trichloroethane (1,1,2-TCA)
reductive dechlorination
trans-1,2-Dichloroethene (trans-1,2-DCE)
cis-1,2-Dichloroethene (cis-1,2-DCE)
dihaloelimination
reductive dechlorination
CO2
cometabolism
1,2-Dichloroethane (1,2-DCA)
reductive dechlorination
elimination
oxidation
dihaloelimination
denitrification
dihaloelimination
Chloroethanol
Chloroethane (CA)
VC
reductive dechlorination
anaerobic oxidation
Chloroacetate
hydrolysis
oxidation
Ethanol
reductive dechlorination
CO2
CO2
Ethane
CO2
Ethene
CO2
biological reaction
abiotic reaction
Pathways for the Degradation of 1,1,2,2-Tetrachloroethane, and Trichloroethene
Jan. 2008
Figure: 1
SiREM
figure 1-pathway 1,1,1,2 PCA.pdf

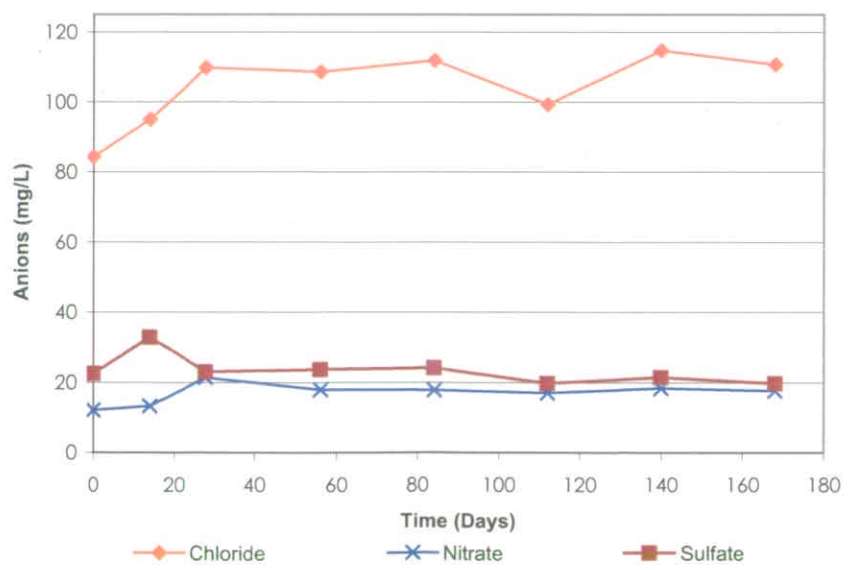
9531863

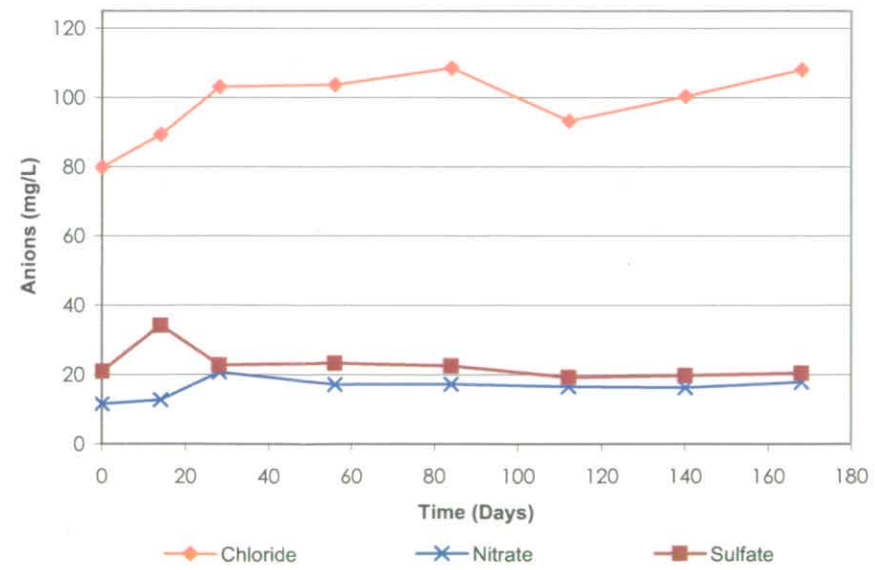












Notes:

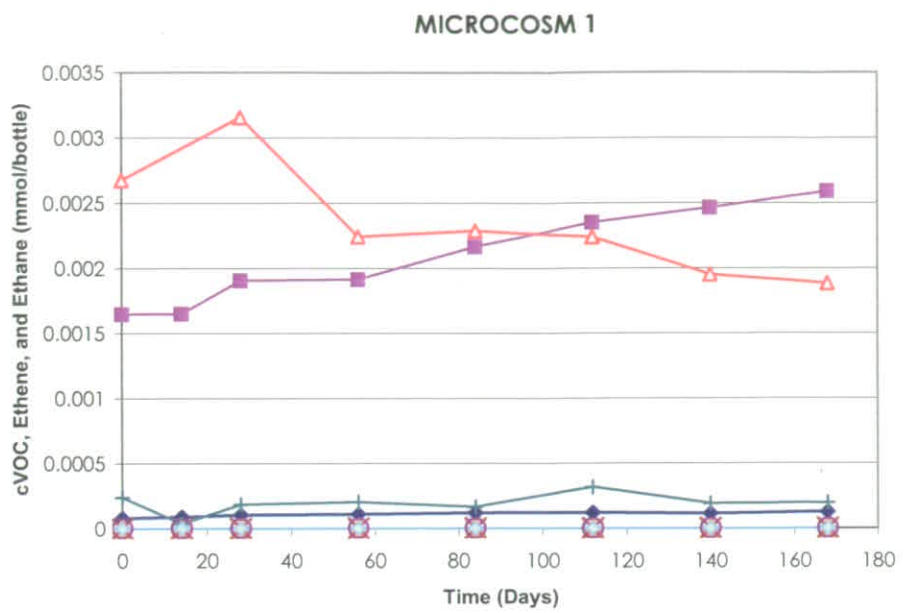
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

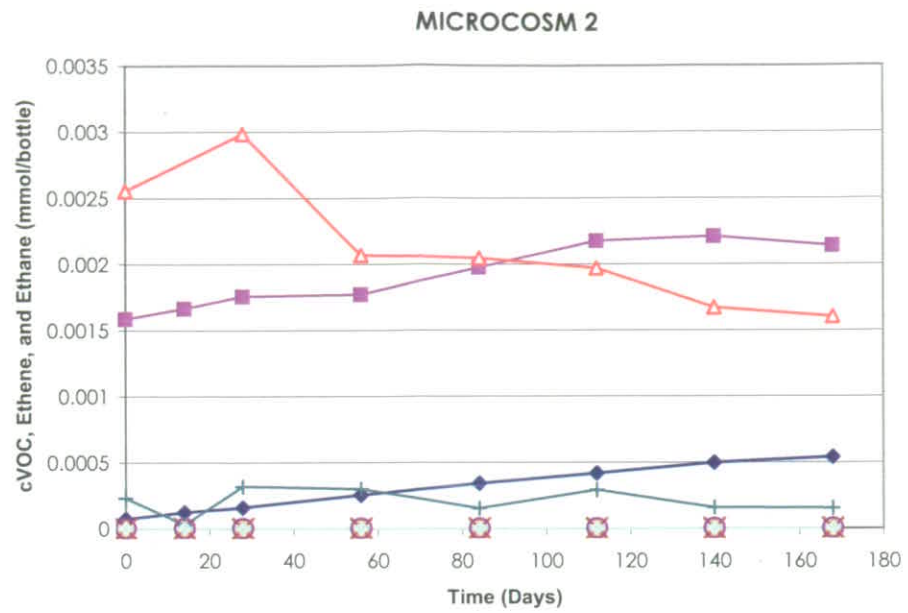
cVOC, Ethene, Ethane and Anion Concentration Trends in Anaerobic Sterile Control Microcosms

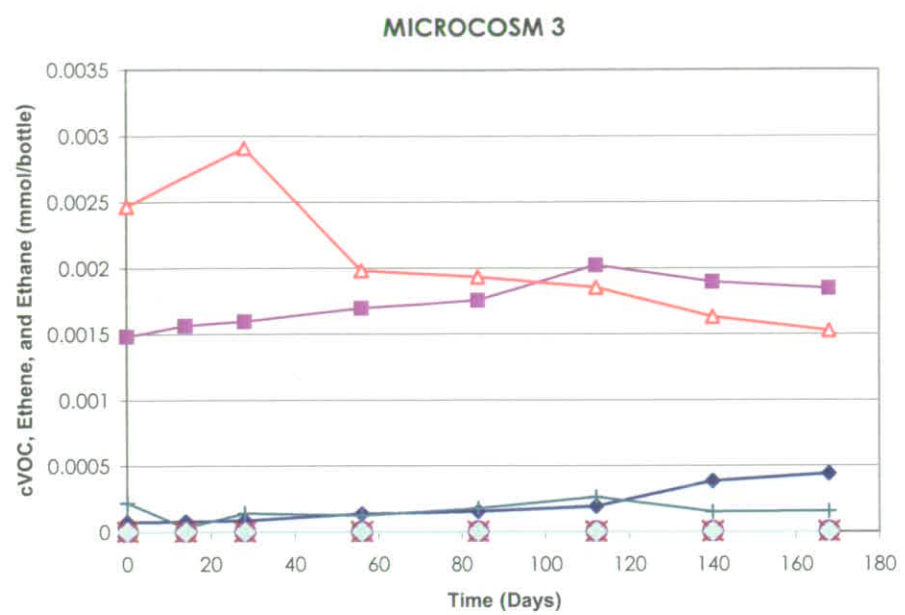
Former Defense Depot, Memphis, Tennessee

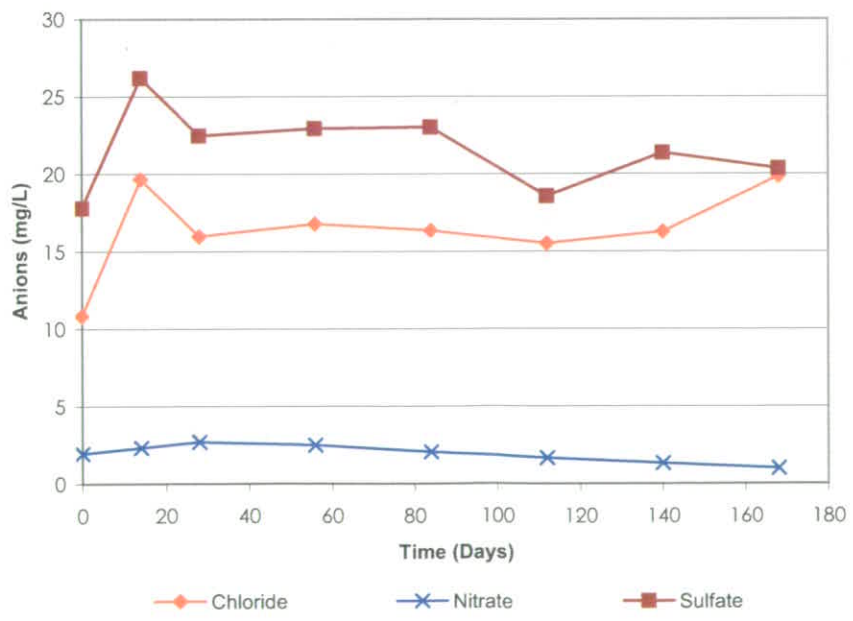
11-Feb-08 | Figure: **2** | SiREM

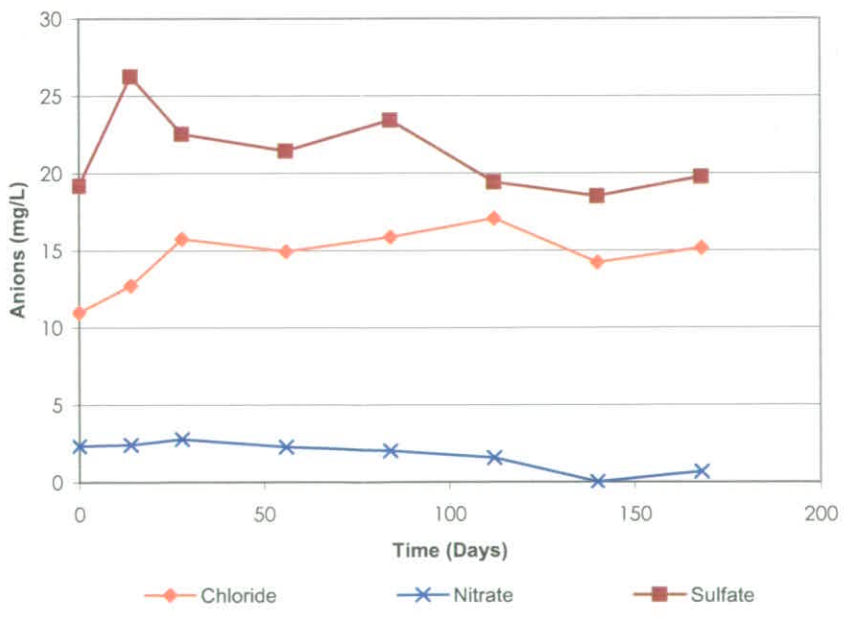
9531865

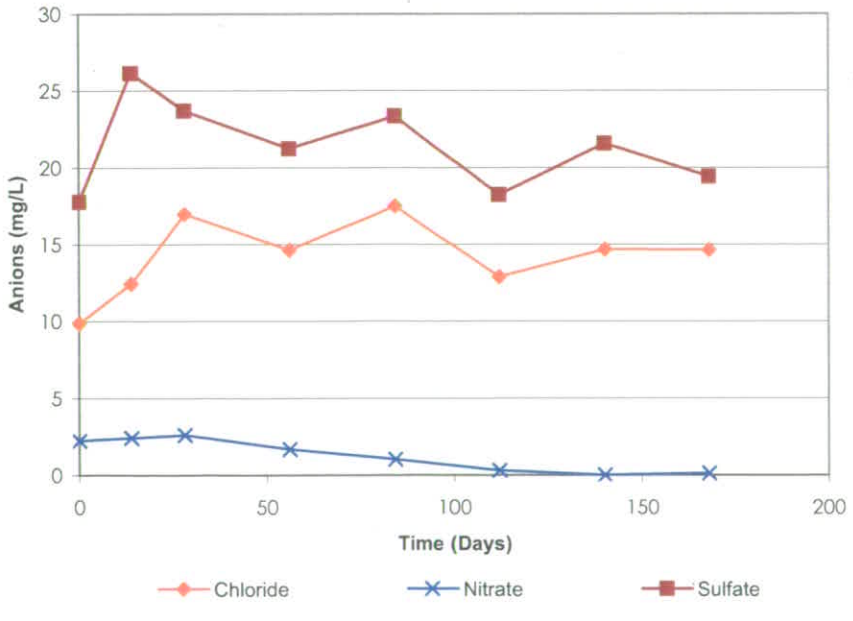












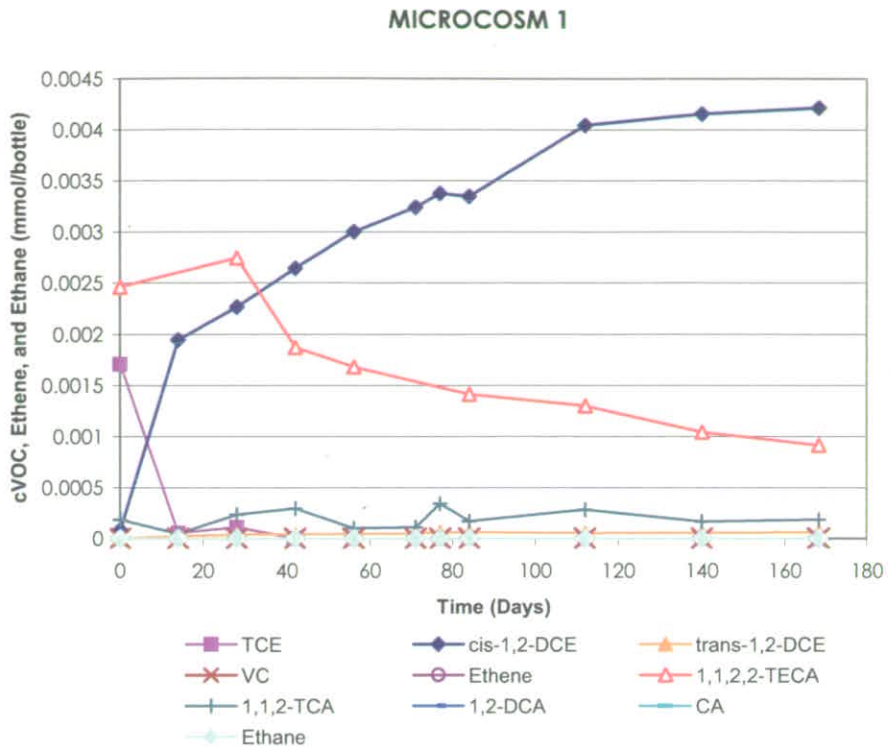
Notes:

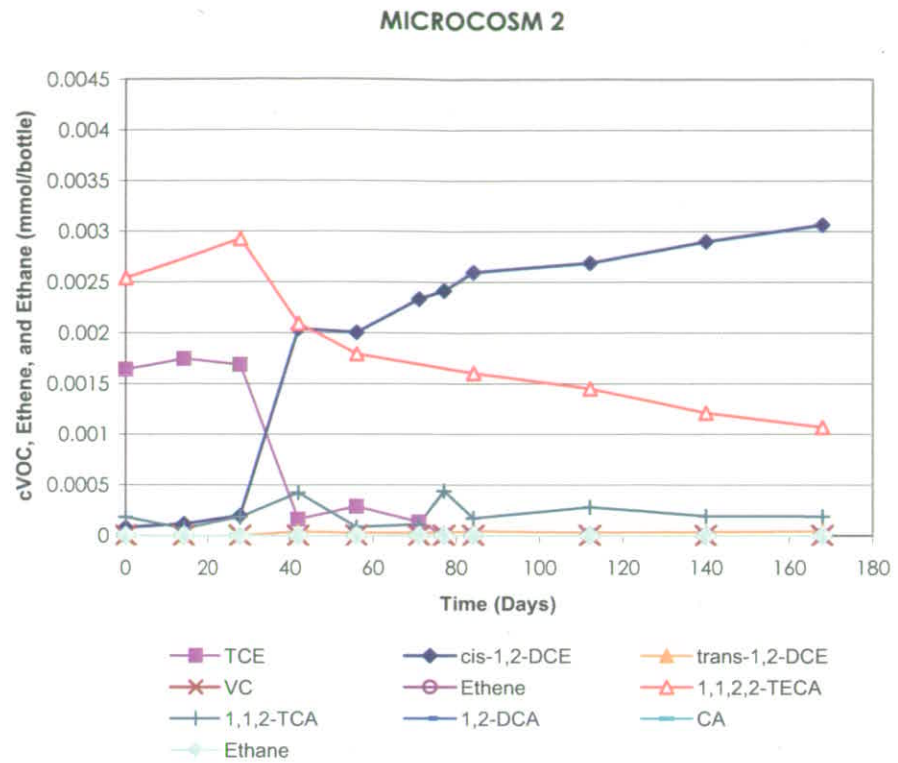
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

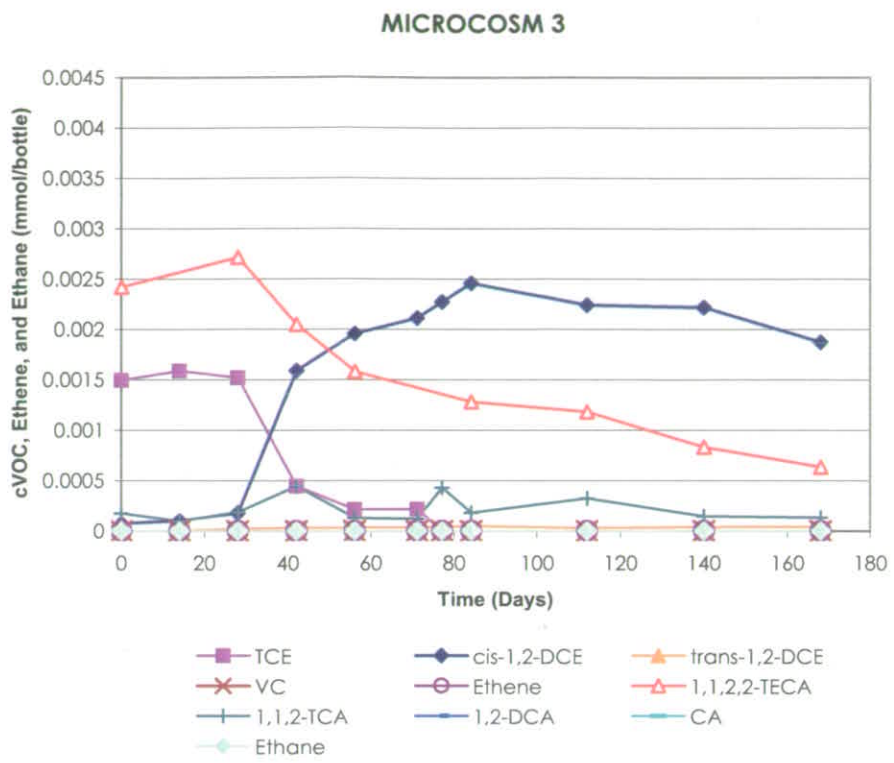
cVOC, Ethene, Ethane and Anion Concentration Trends in Anaerobic Active Control Microcosms

Former Defense Depot, Memphis, Tennessee

11-Feb-08 | Figure: **3** | SiREM







Notes:

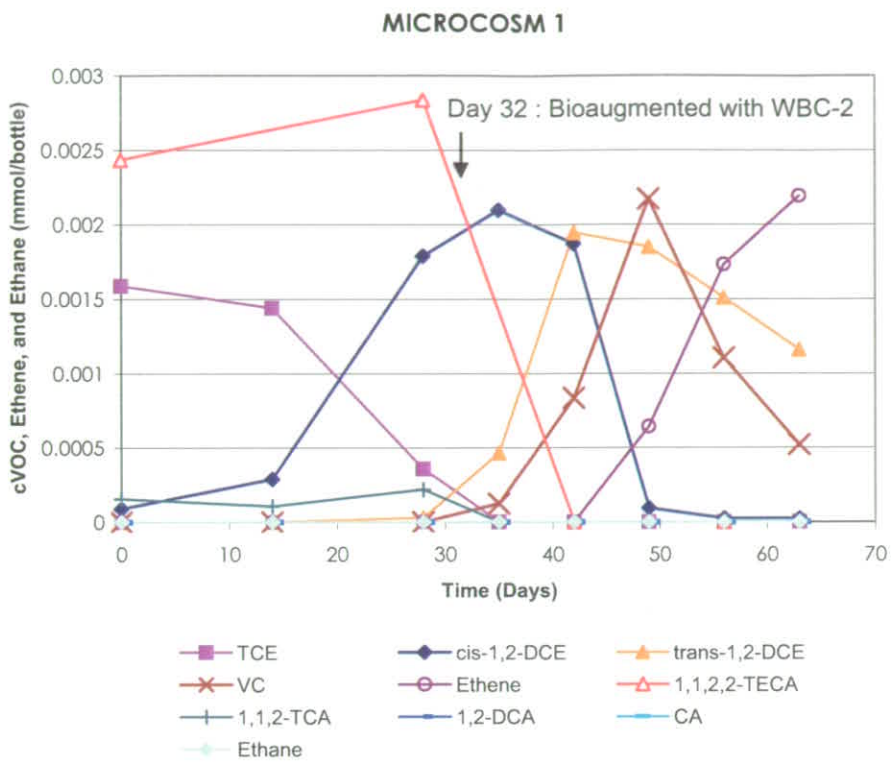
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

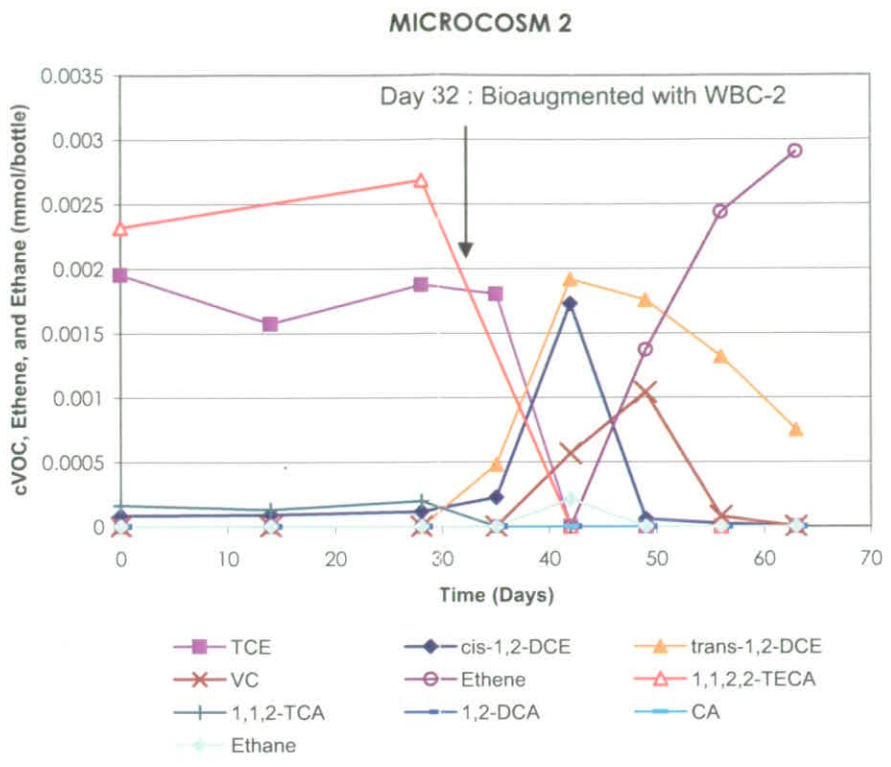
cVOC, Ethene, Ethane and Anion Concentration Trends in Lactate Amended Microcosms

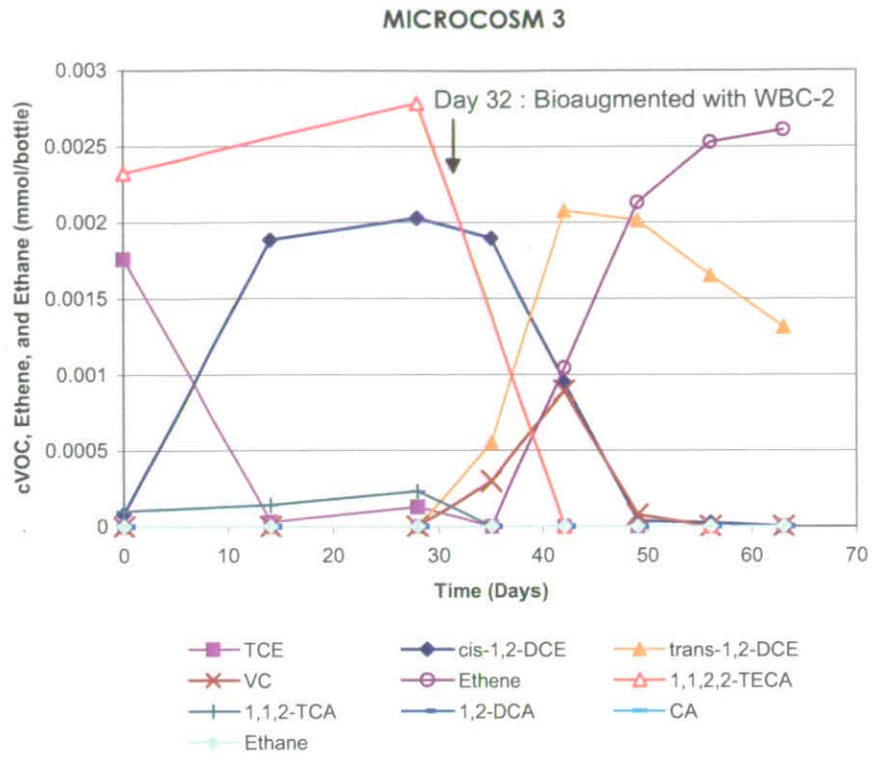
Former Defense Depot, Memphis, Tennessee

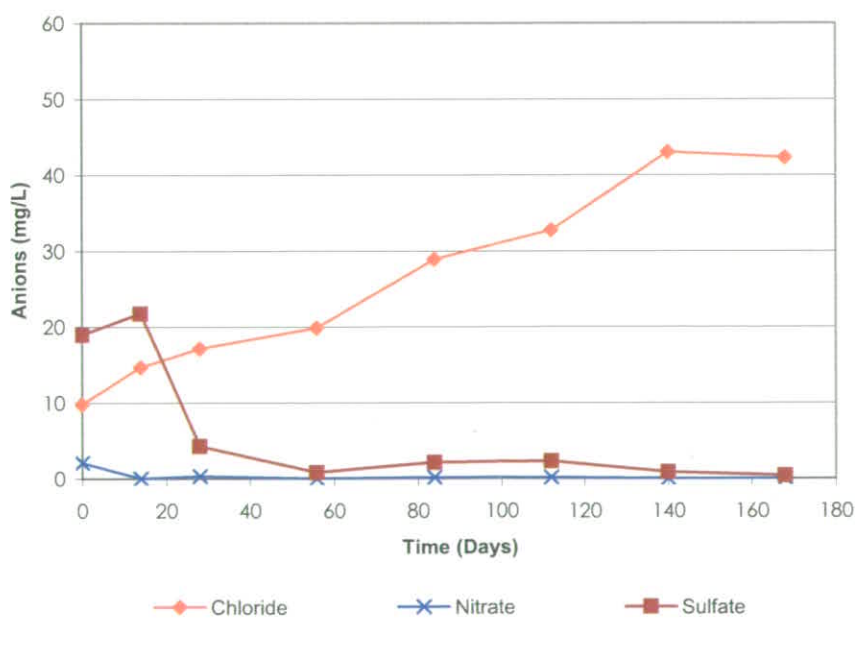
11-Feb-08 | Figure: **4** | SiREM

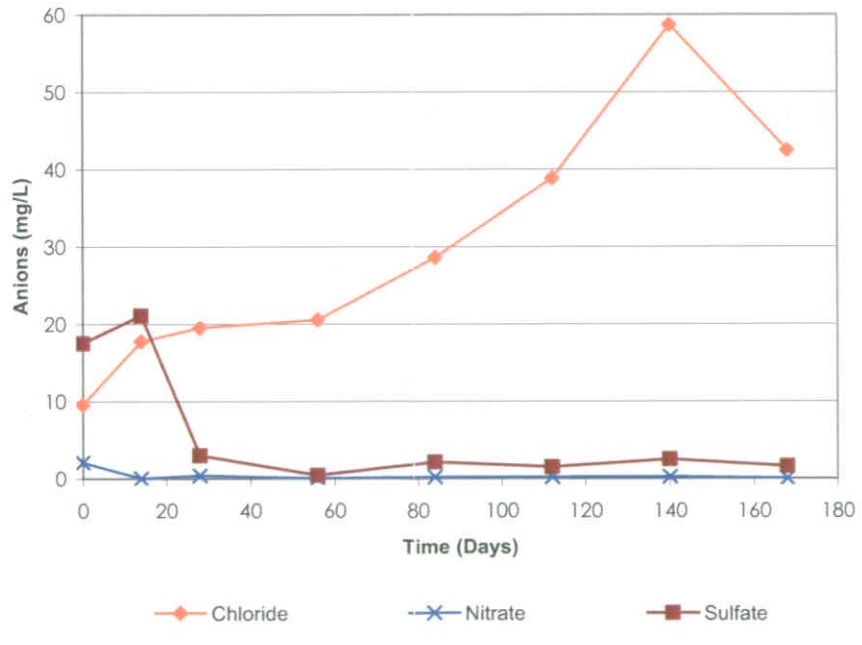
9531867

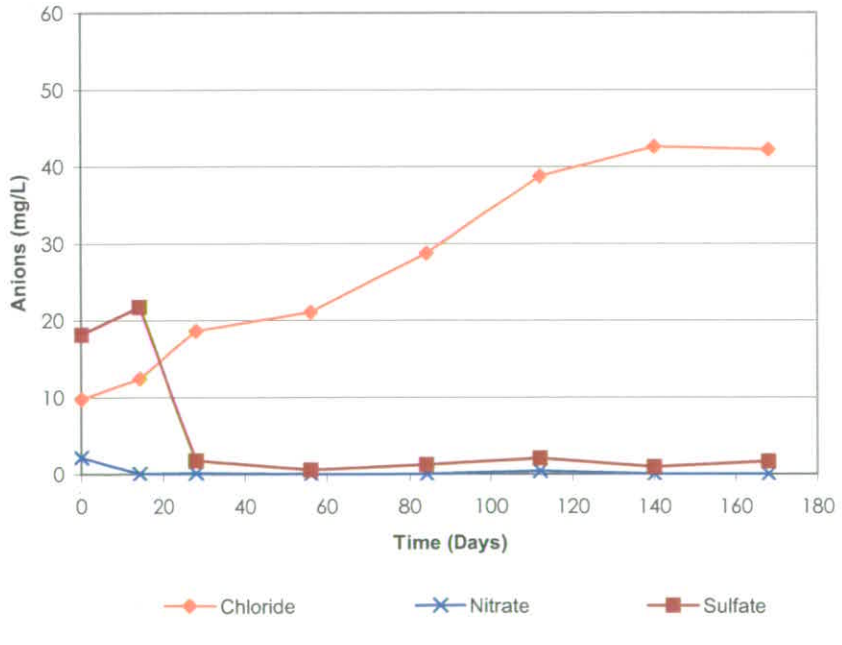












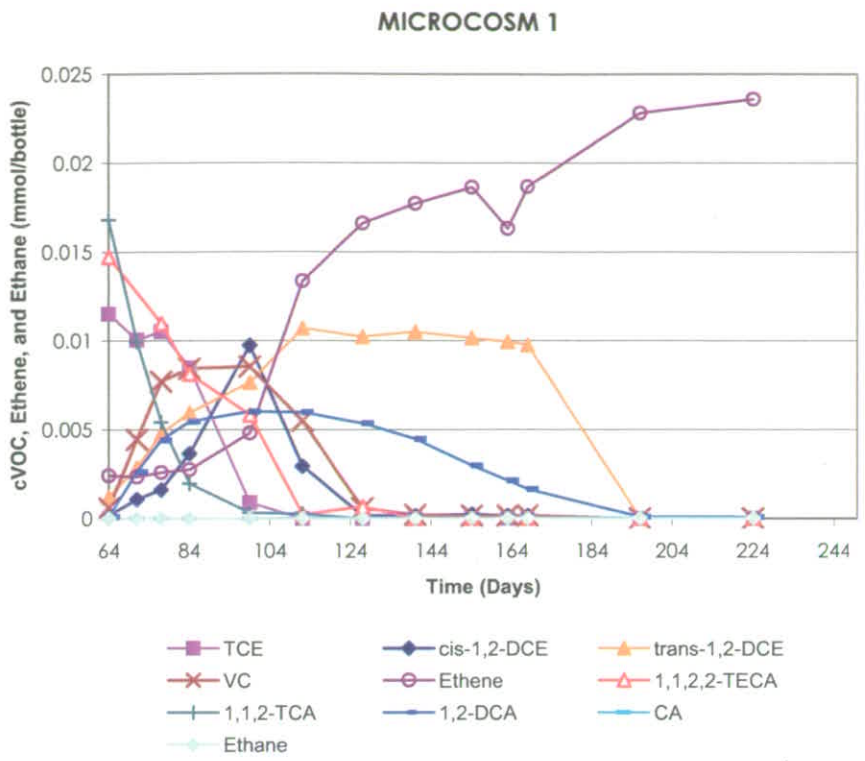
Notes:

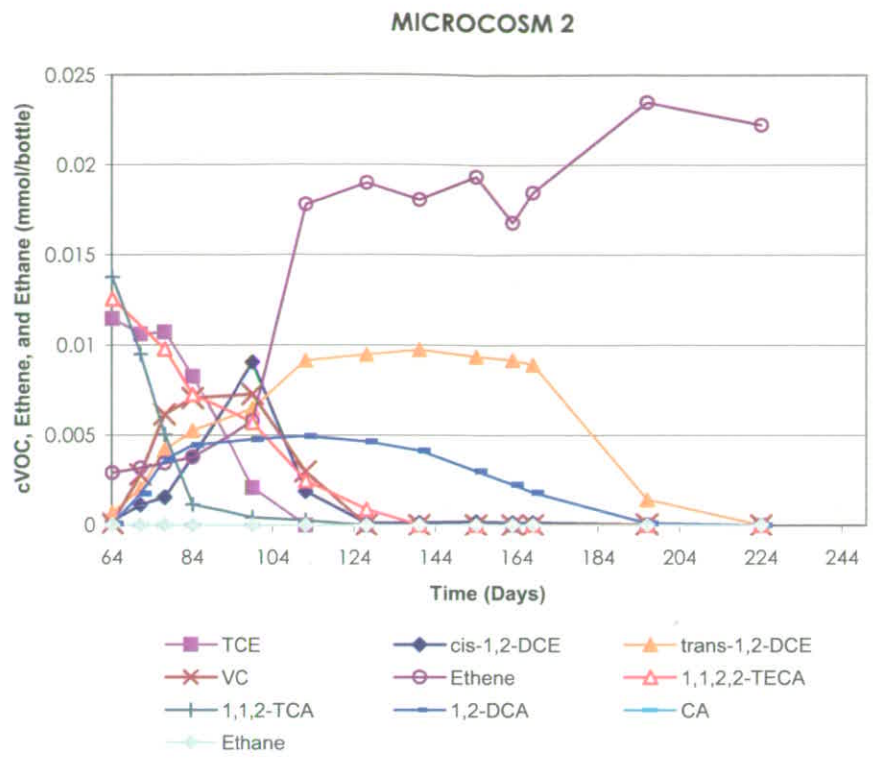
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

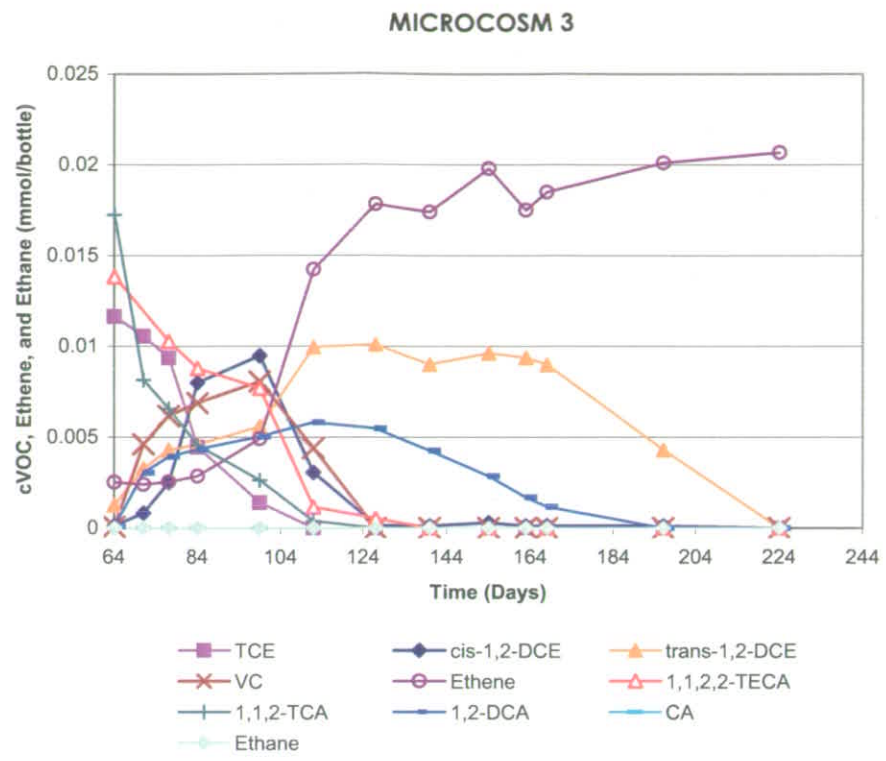
cVOC, Ethene, Ethane and Anion Concentration Trends in Lactate Amended / WBC-2 Bioaugmented Microcosms

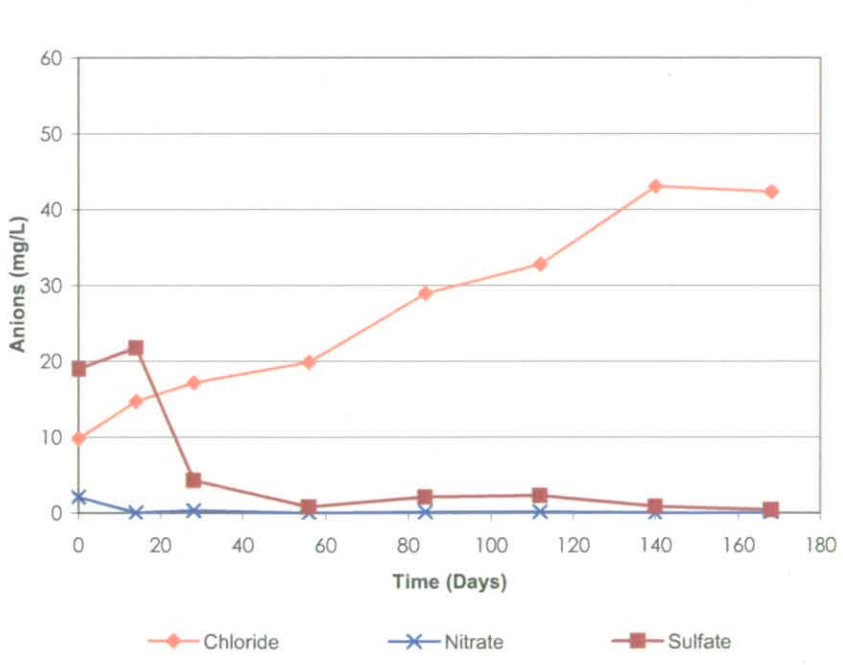
Former Defense Depot, Memphis, Tennessee

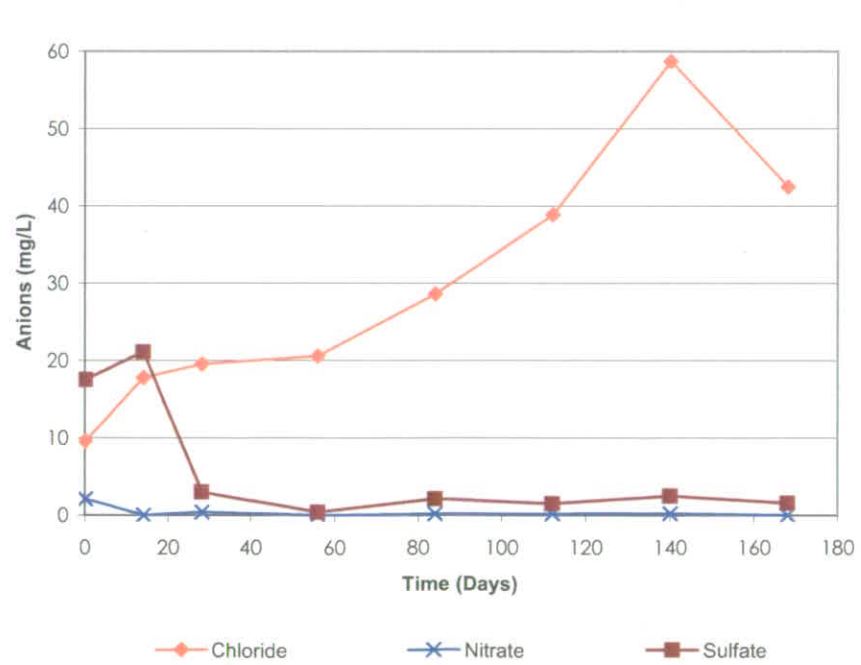
11-Feb-08 | Figure: **5A** | SiREM

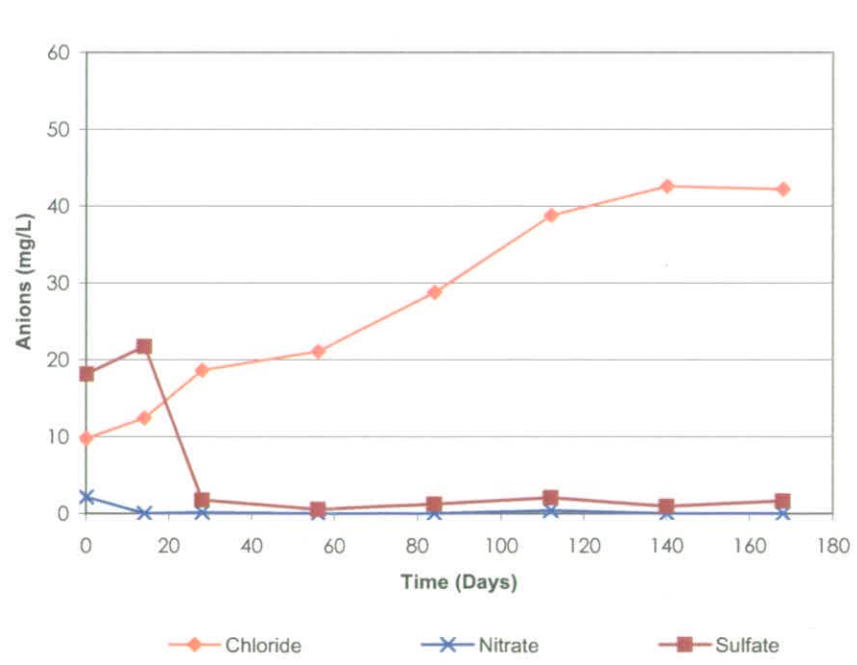












Notes:

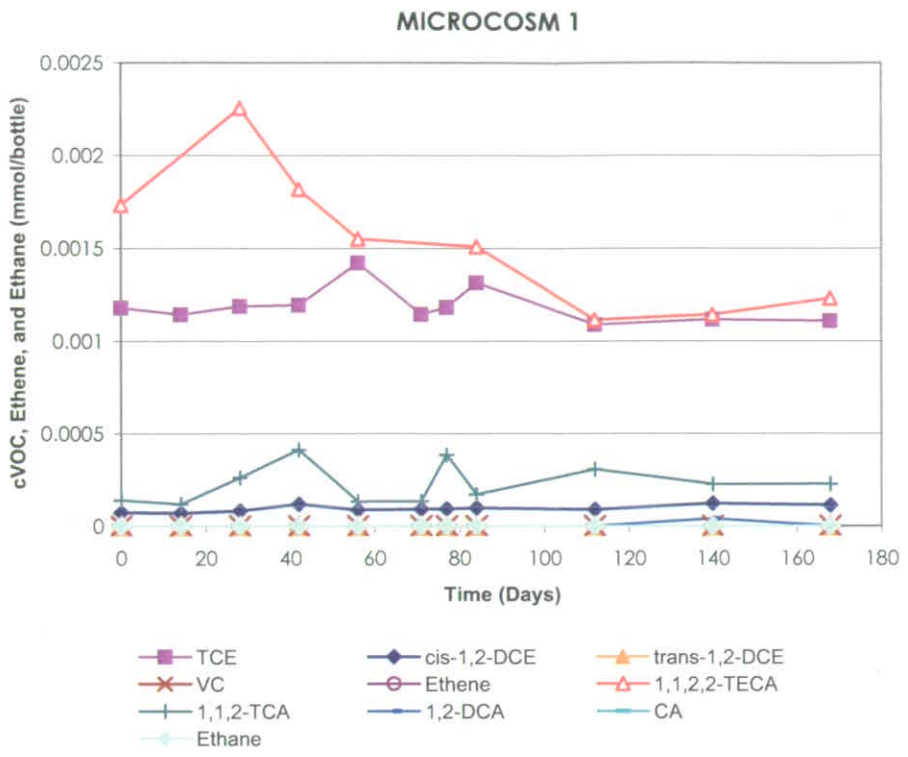
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

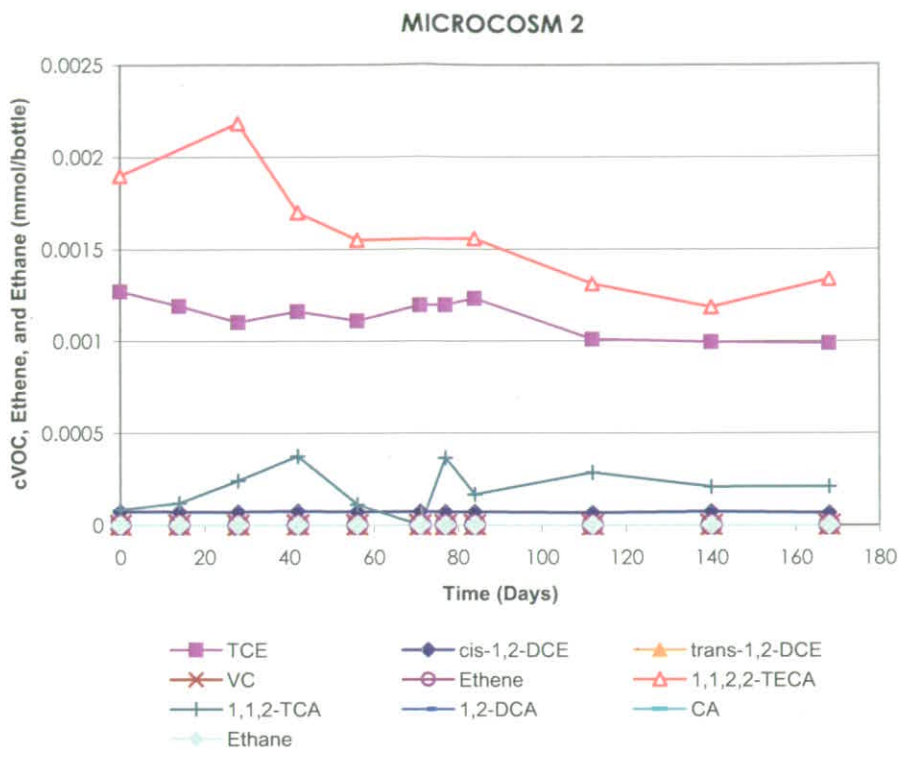
cVOC, Ethene, Ethane and Anion Concentration Trends in Re-Spiked Lactate Amended / WBC-2 Bioaugmented Microcosms

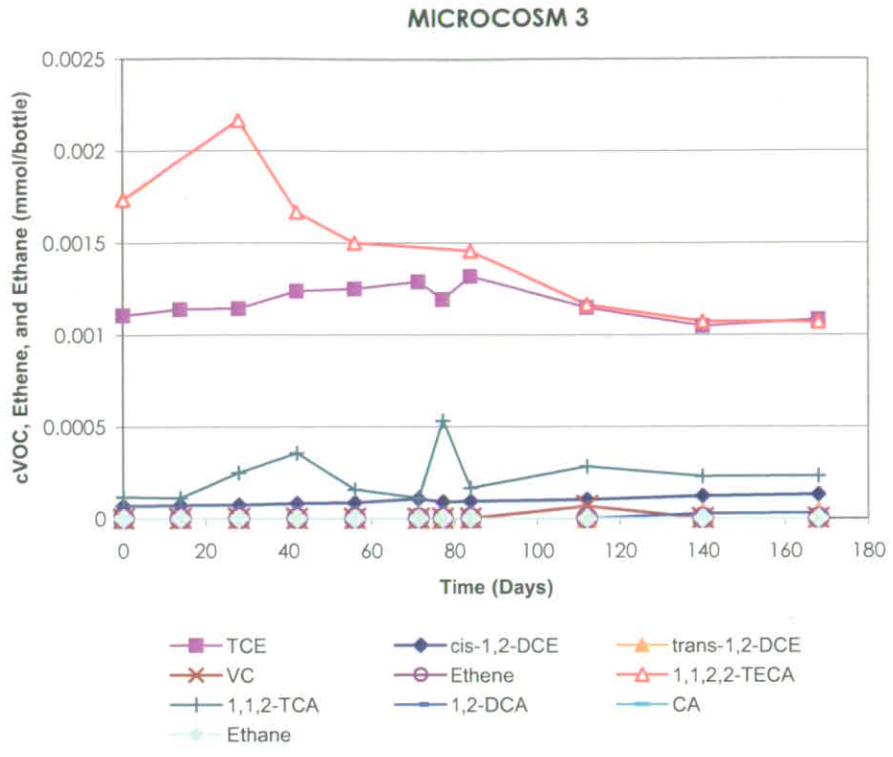
Former Defense Depot, Memphis, Tennessee

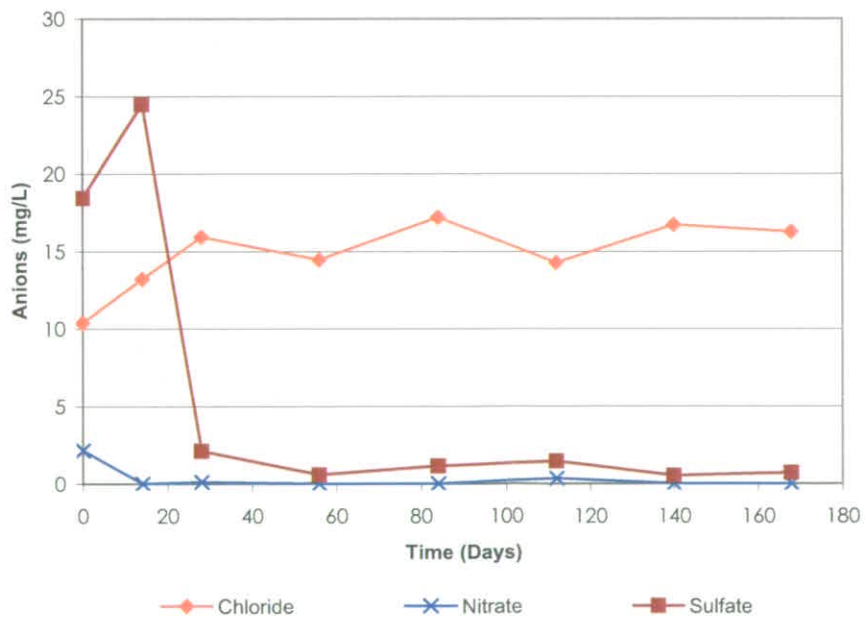
11-Feb-08 | Figure: **5B** | SiREM

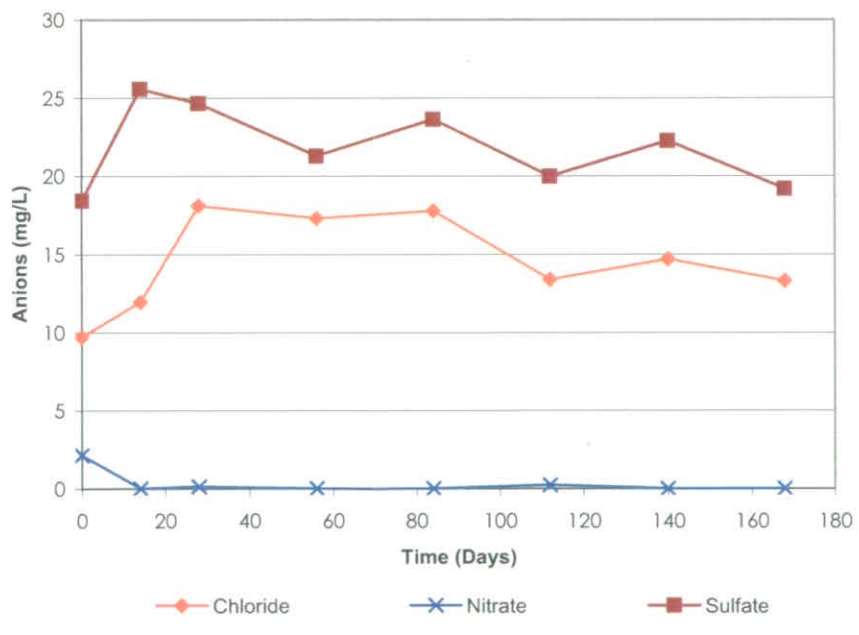
9531869

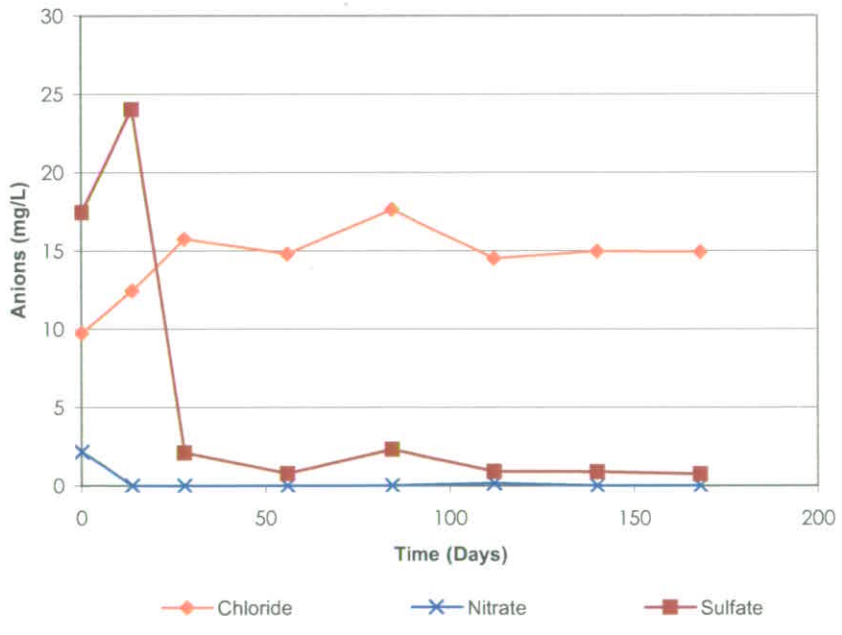












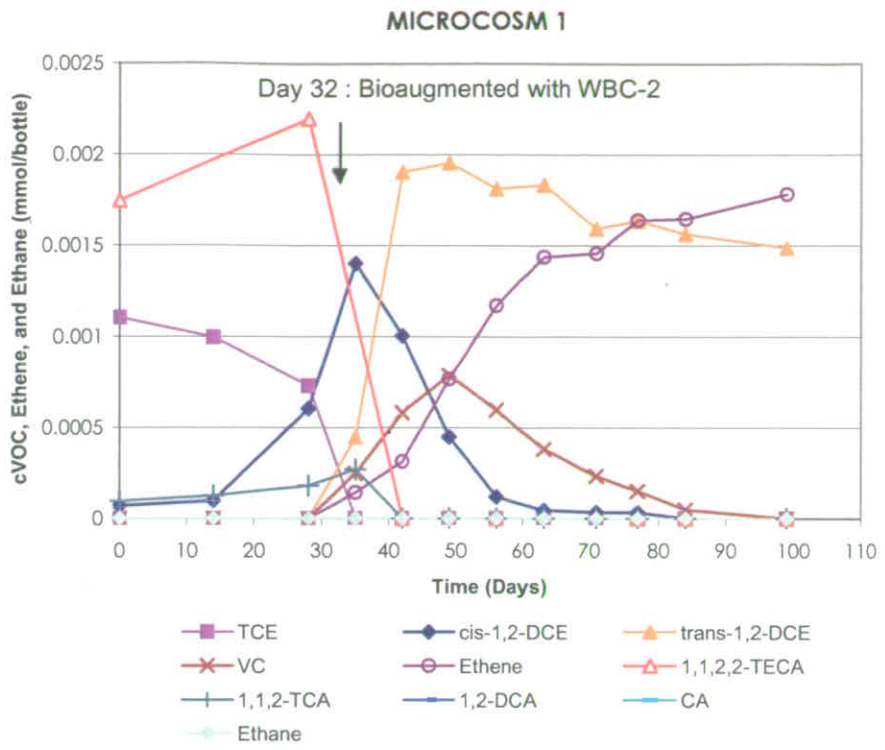
Notes:

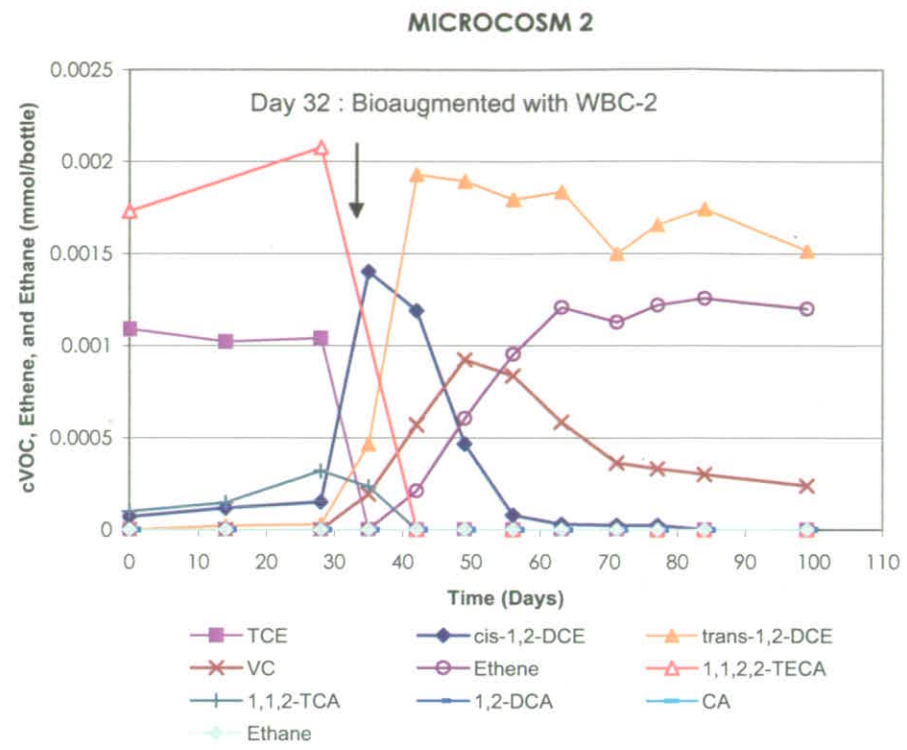
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

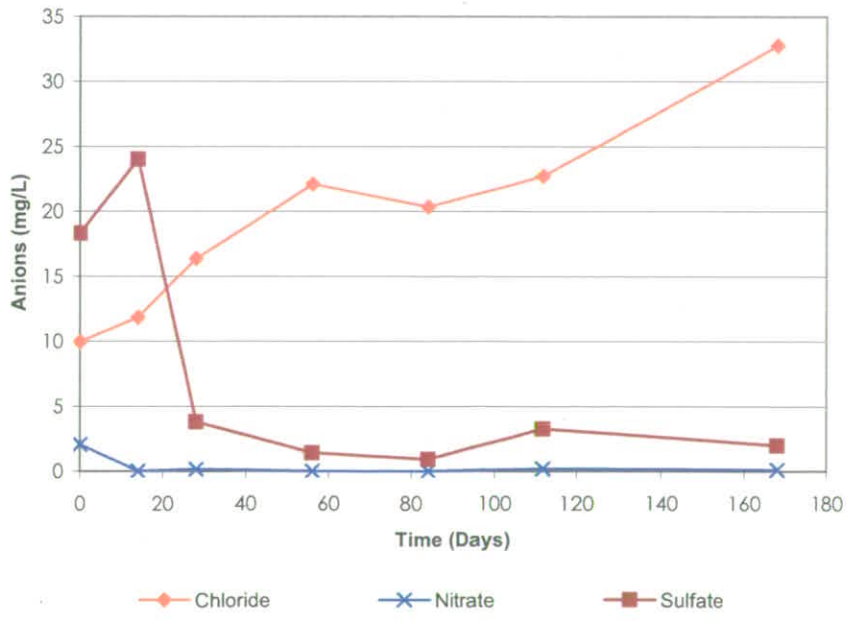
cVOC, Ethene, Ethane and Anion Concentration Trends in EOS Amended Microcosms

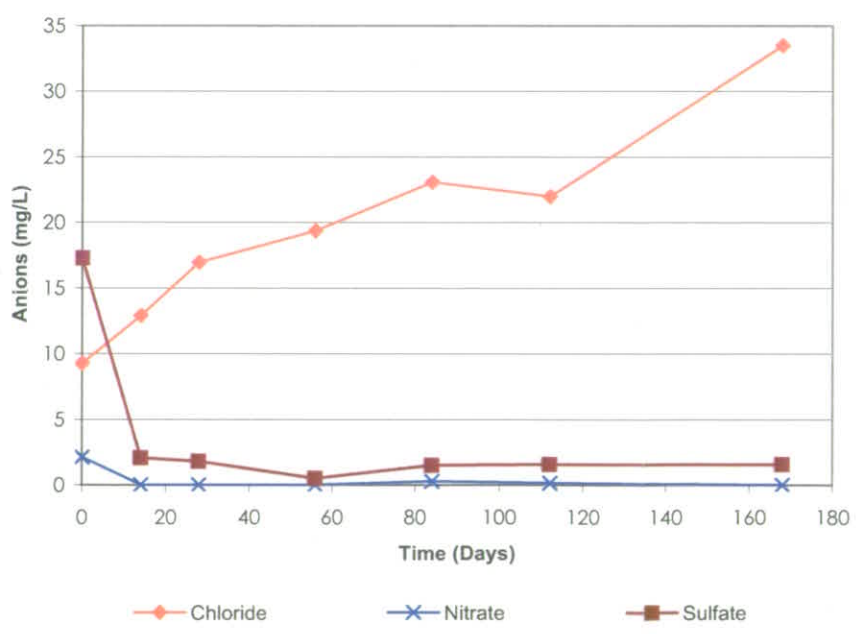
Former Defense Depot, Memphis, Tennessee

11-Feb-08 | Figure: **6** | SiREM









Notes:

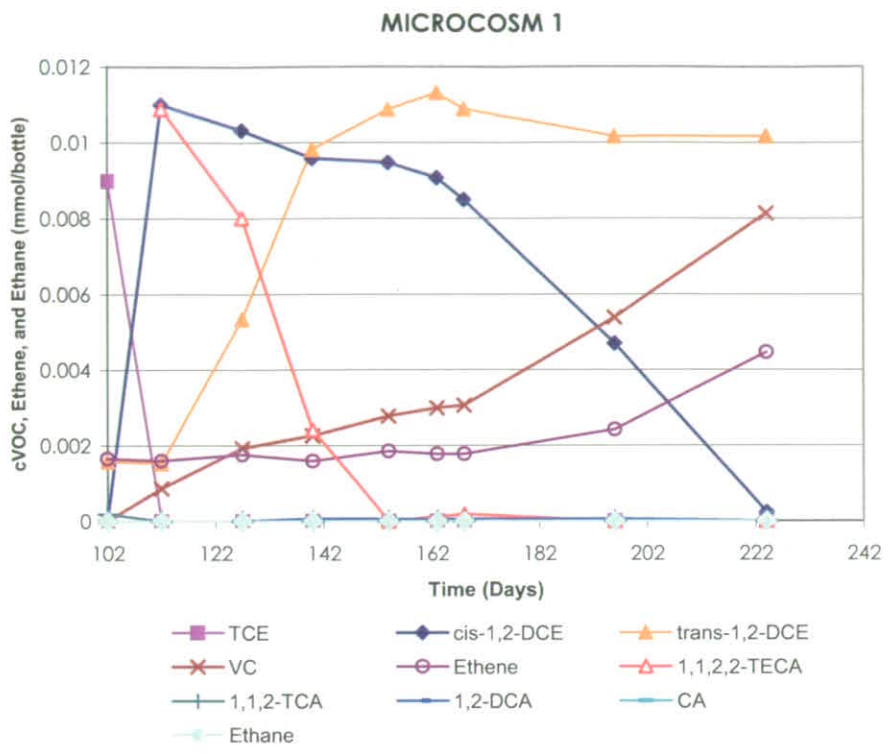
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

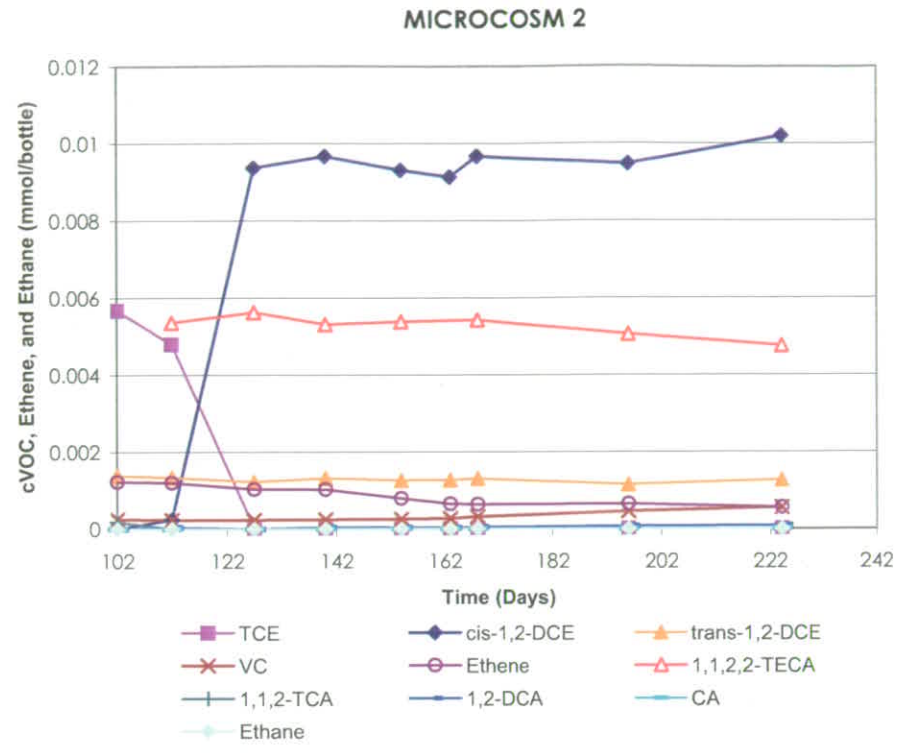
cVOC, Ethene, Ethane and Anion Concentration Trends in EOS™ Amended / WBC-2 Bioaugmented Microcosms

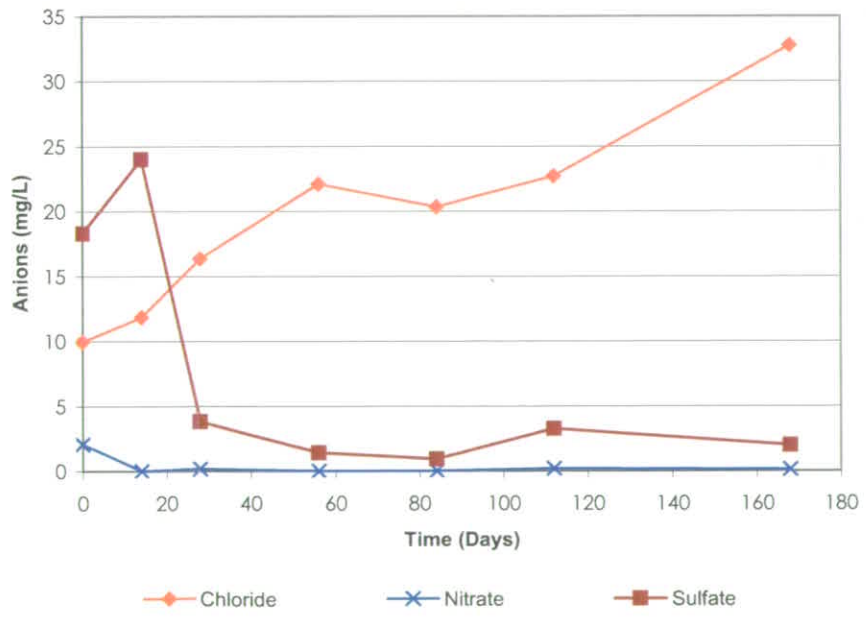
Former Defense Depot, Memphis, Tennessee

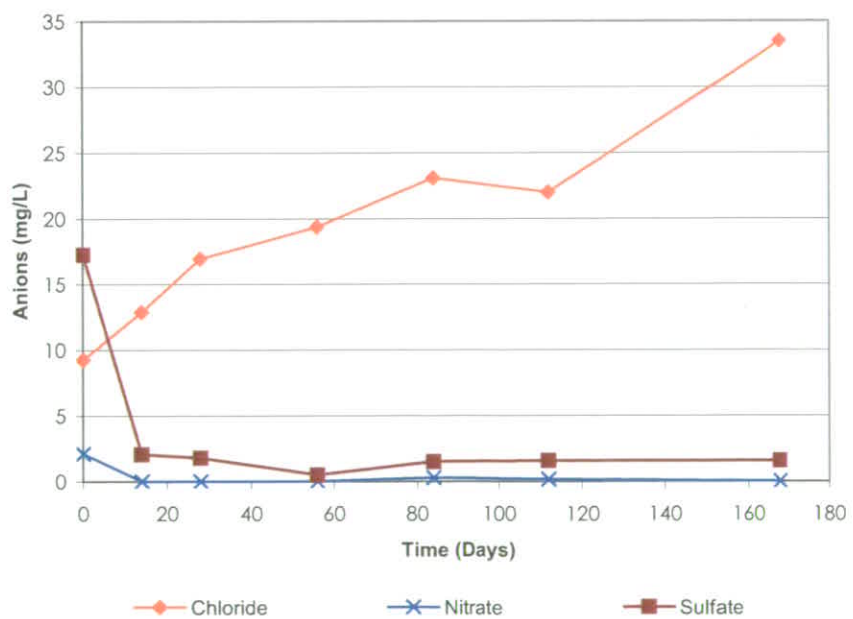
11-Feb-08 | Figure: **7A** | SiREM

9531871









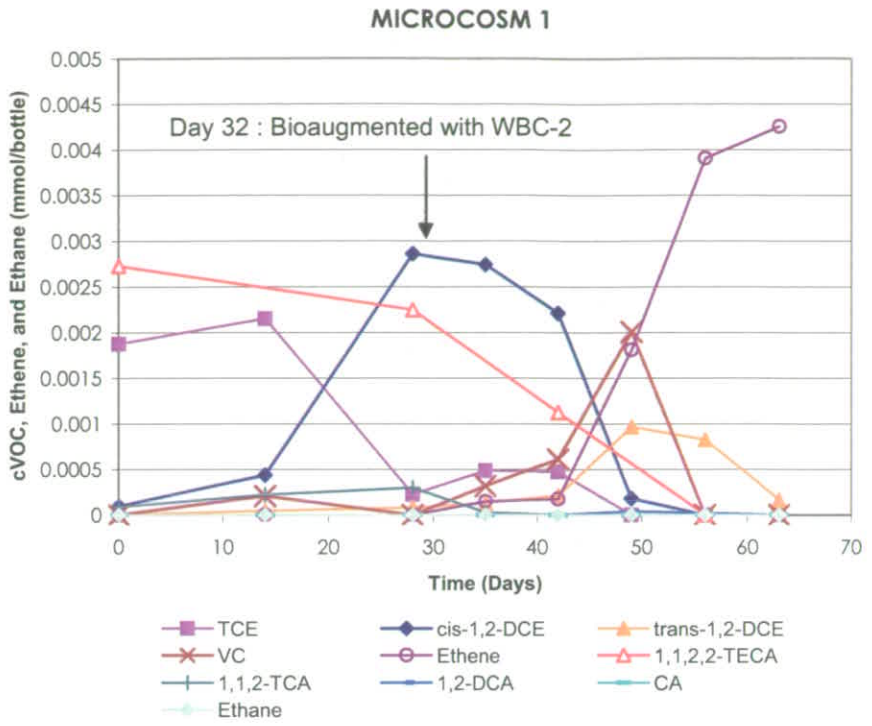
Notes:

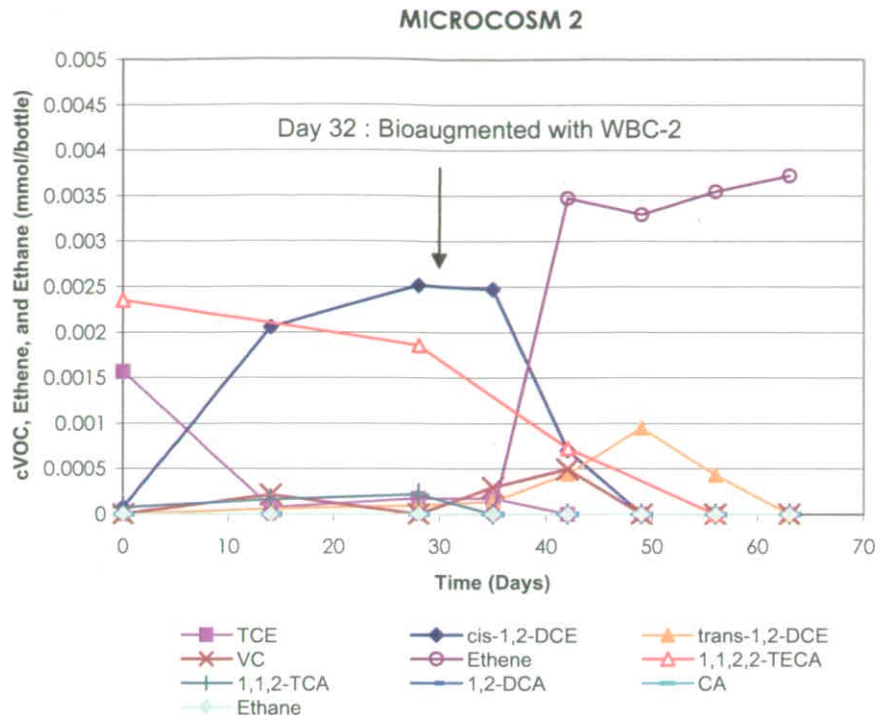
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloroethane
mg/L - milligrams per liter

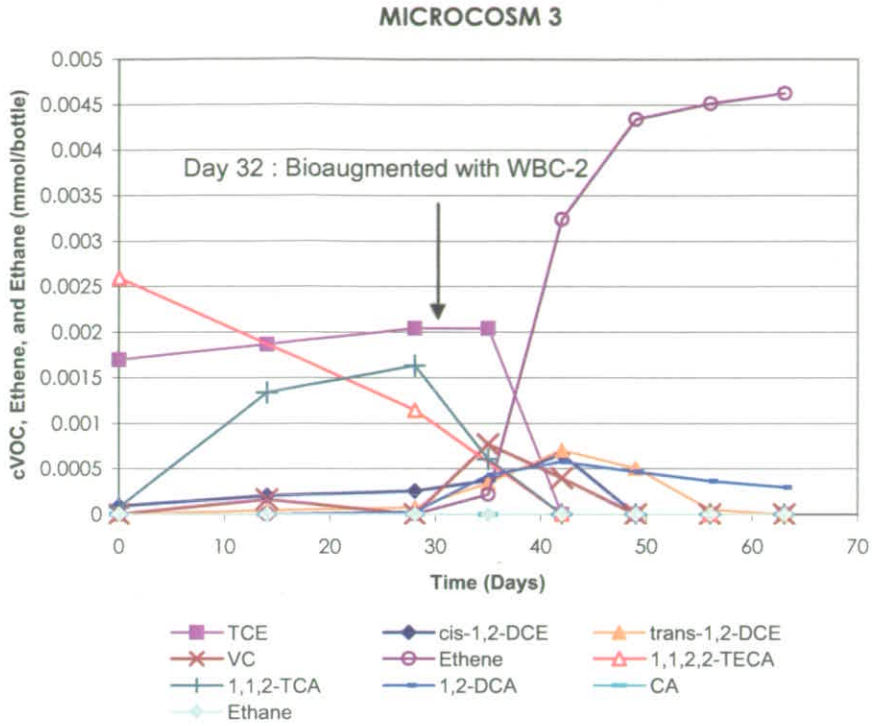
cVOC, Ethene, Ethane and Anion Concentration Trends in Re-Spiked EOS™ Amended / WBC-2 Bioaugmented Microcosms

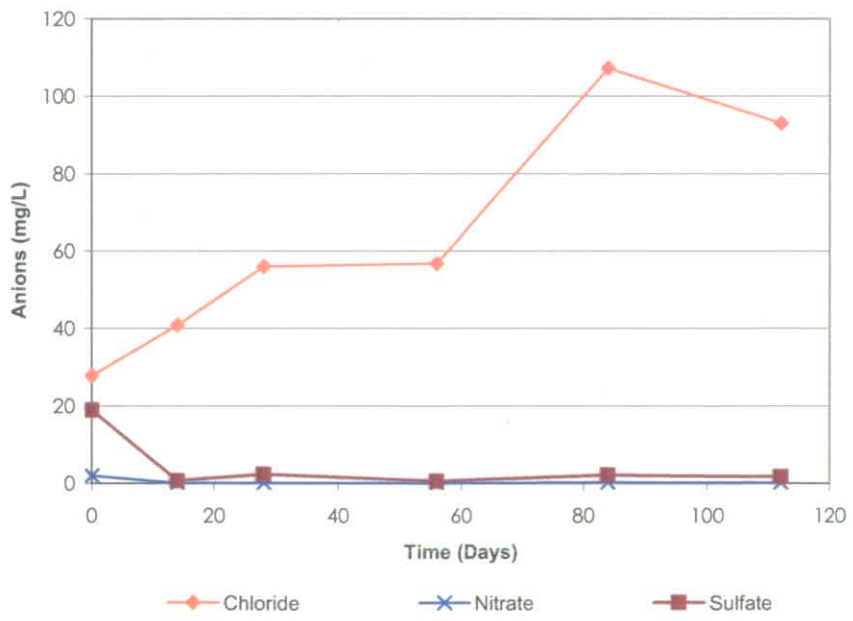
Former Defense Depot, Memphis, Tennessee

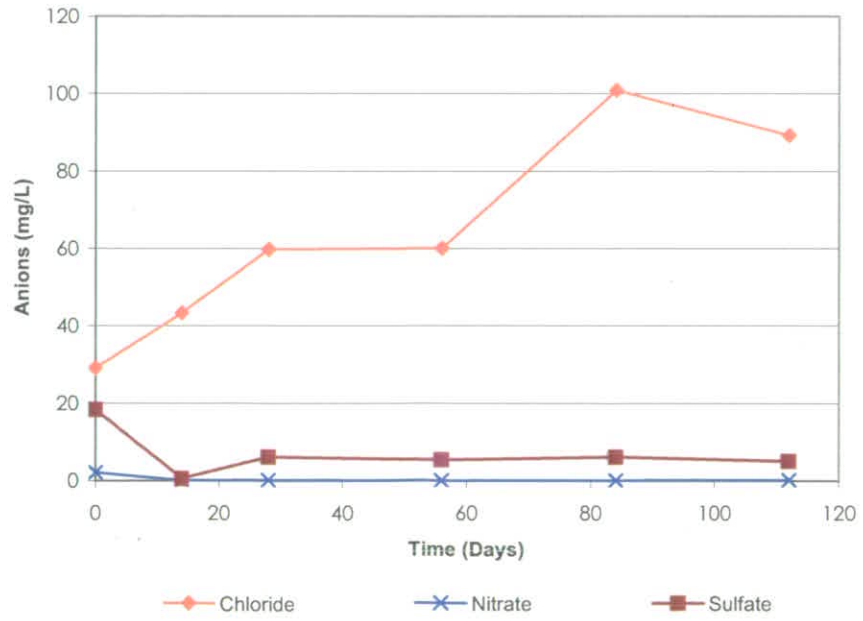
11-Feb-08 | Figure: **7B** | SiREM

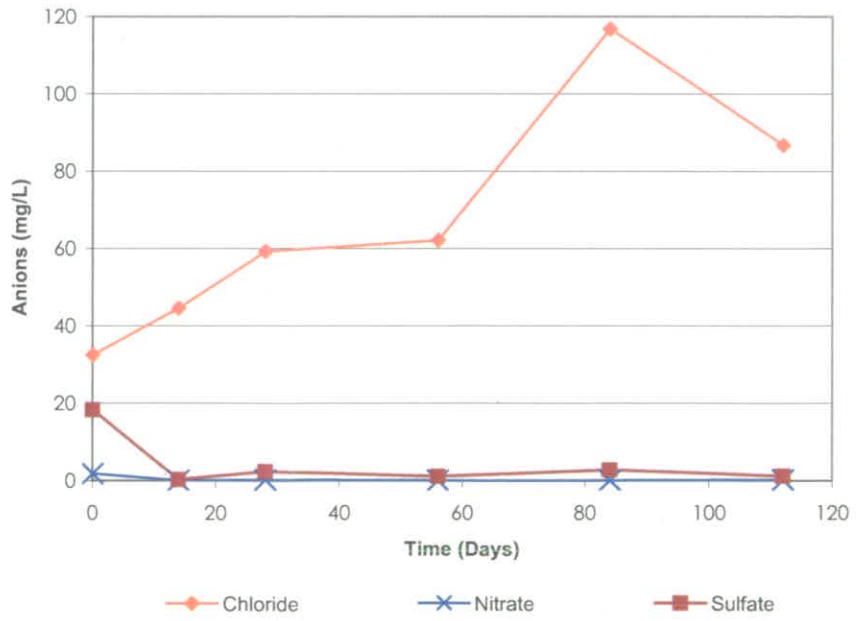












Notes:

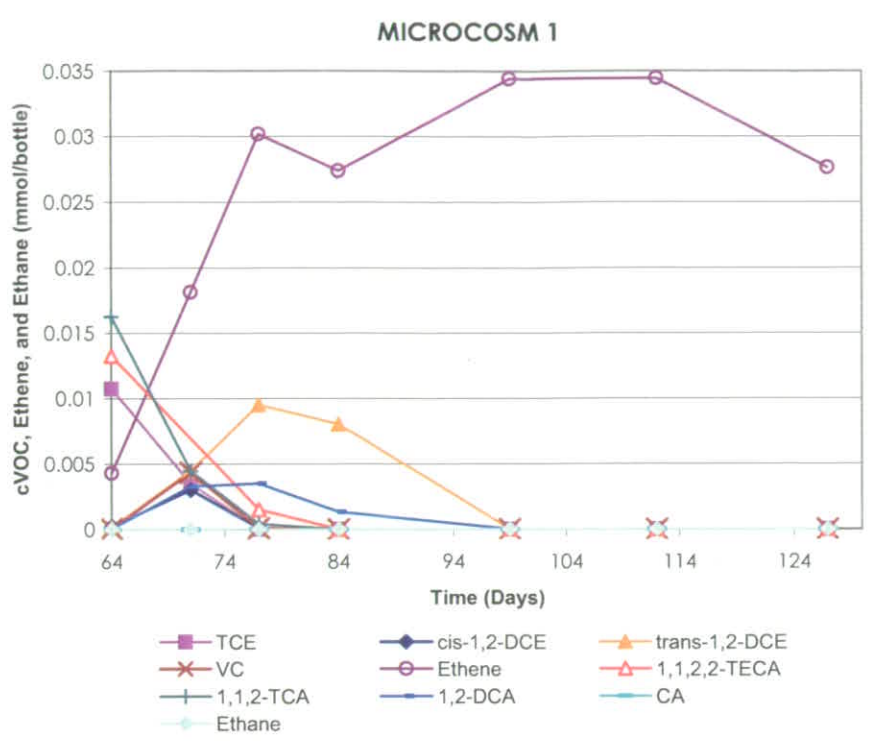
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloro cells/L - cells per liter
mg/L - milligrams per liter

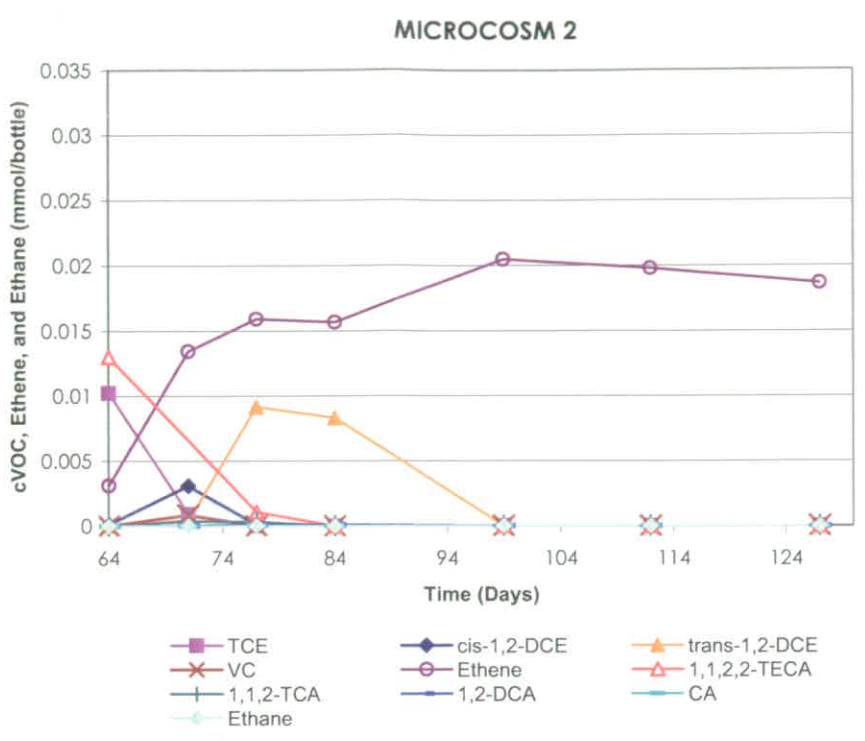
cVOC, Ethene, Ethane and Anion Concentration Trends in Chitin Amended / WBC-2 Bioaugmented Microcosms

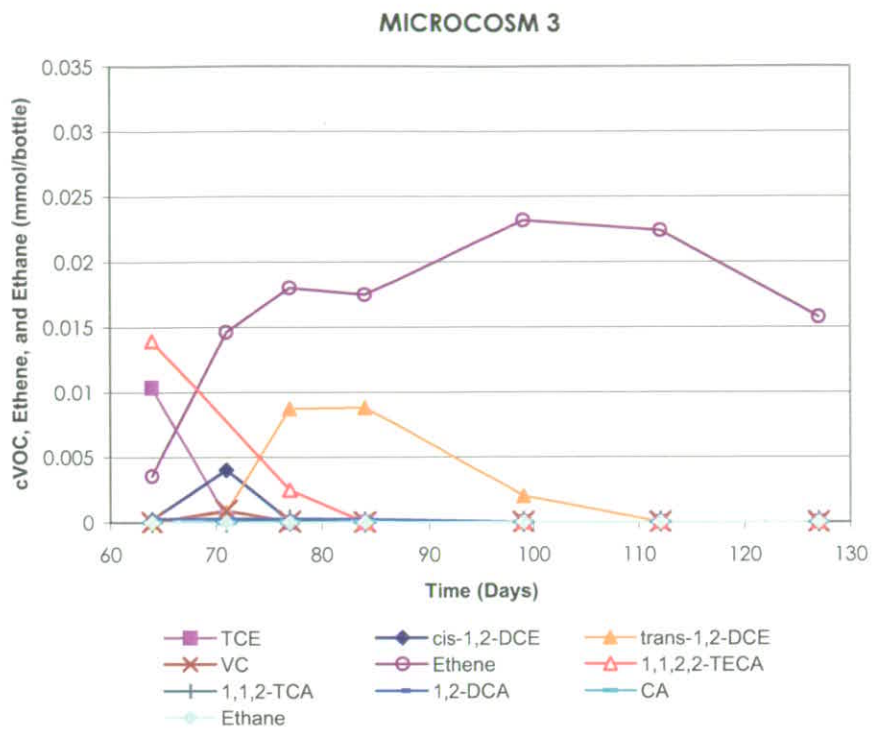
Former Defense Depot, Memphis, Tennessee

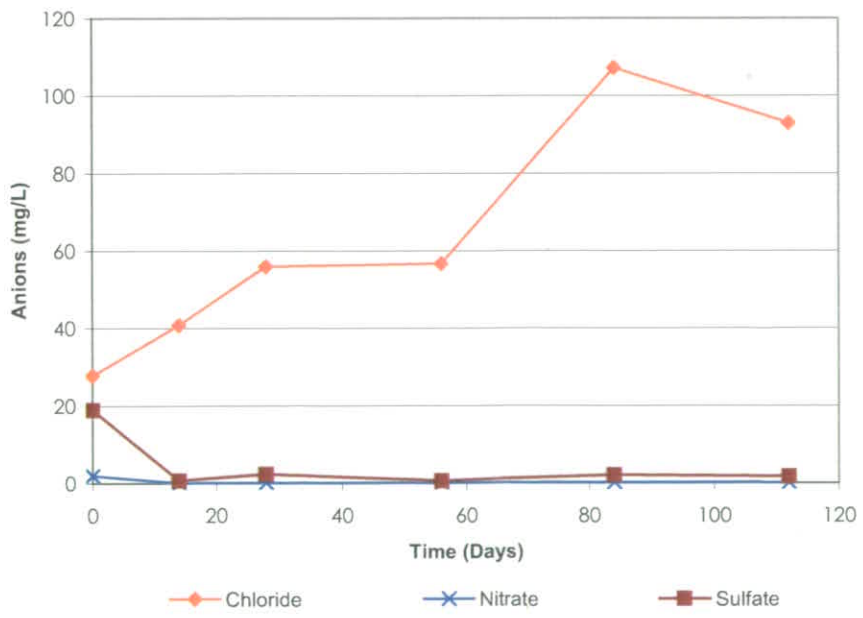
11-Feb-08 | Figure: **8A** | SiREM

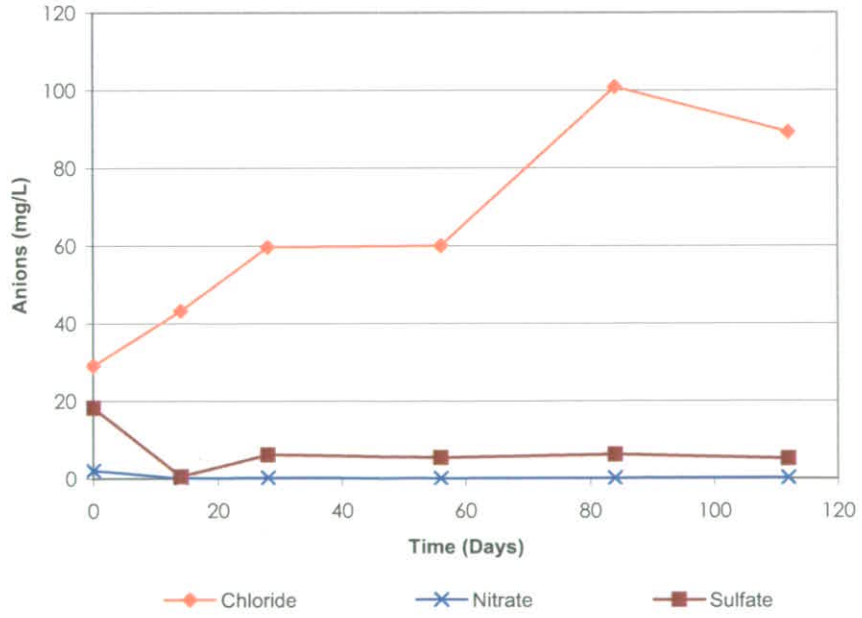
9531873

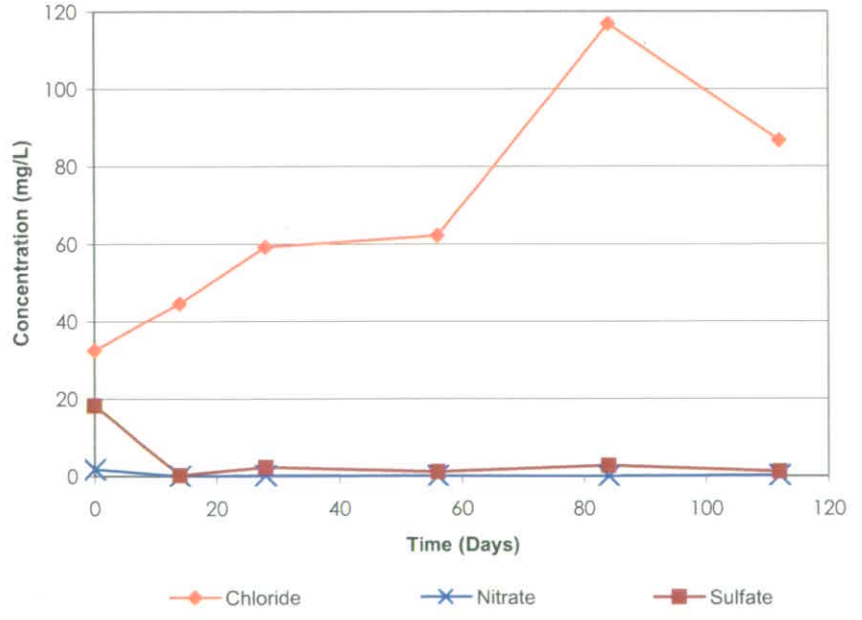












Notes:

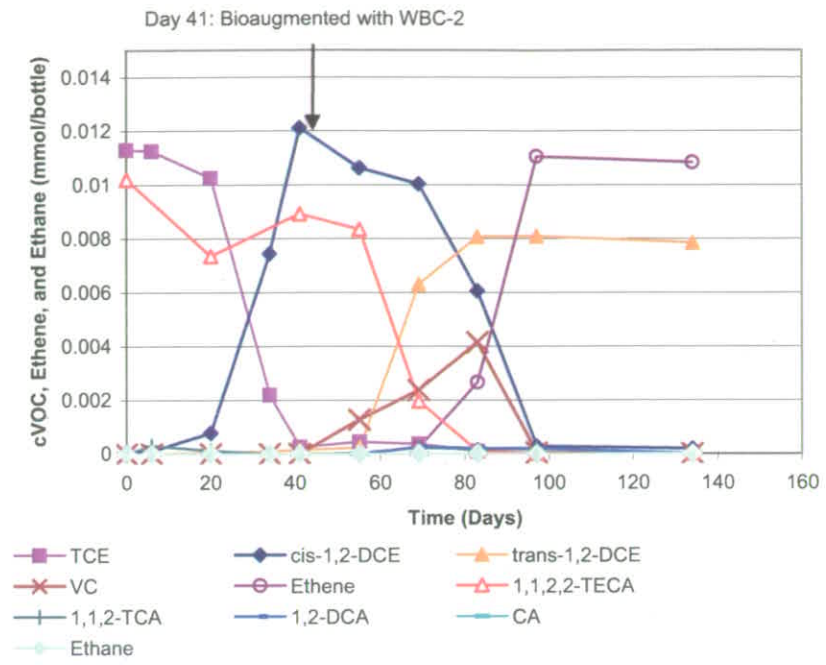
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloro cells/L - cells per liter
mg/L - milligrams per liter

cVOC, Ethene, Ethane and Anion Concentration Trends in Re-Spiked Chitin Amended / WBC-2 Bioaugmented Microcosms

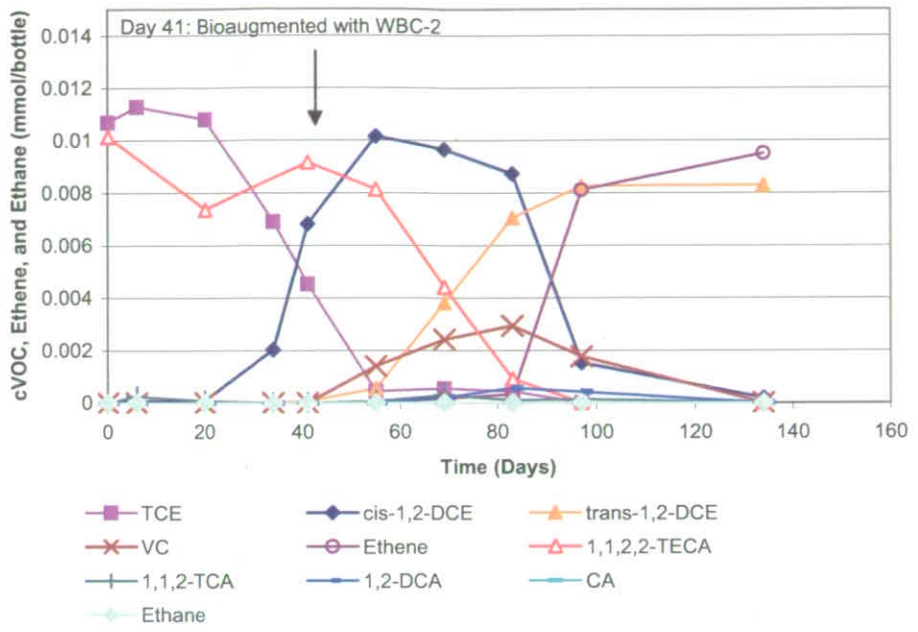
Former Defense Depot, Memphis, Tennessee

11-Feb-08 | Figure: **8B** | SiREM

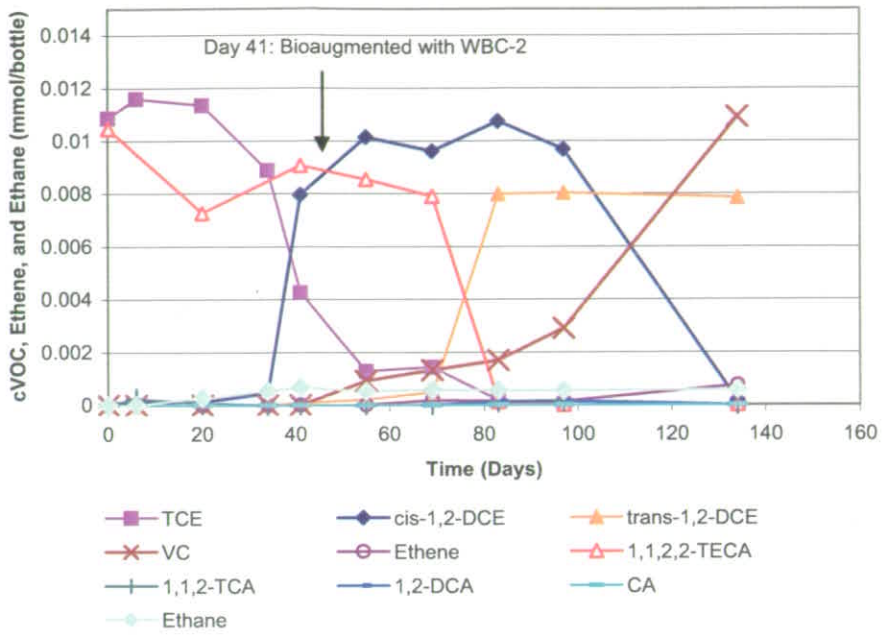
Microcosm 1

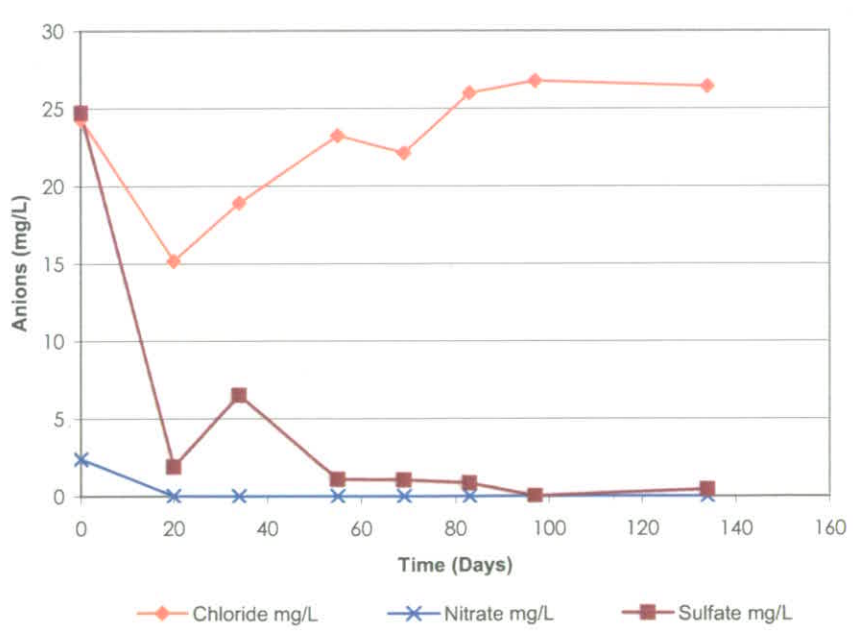


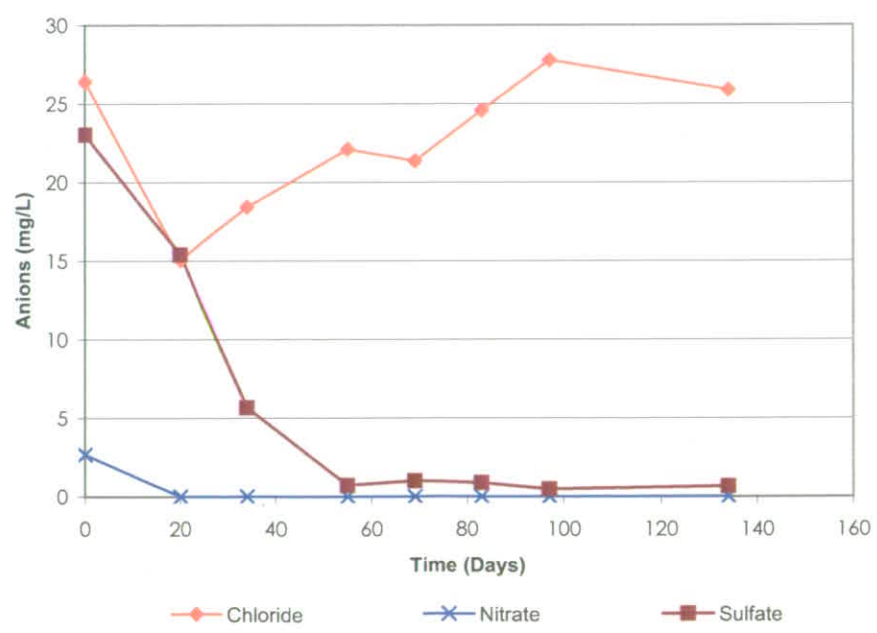
Microcosm 2

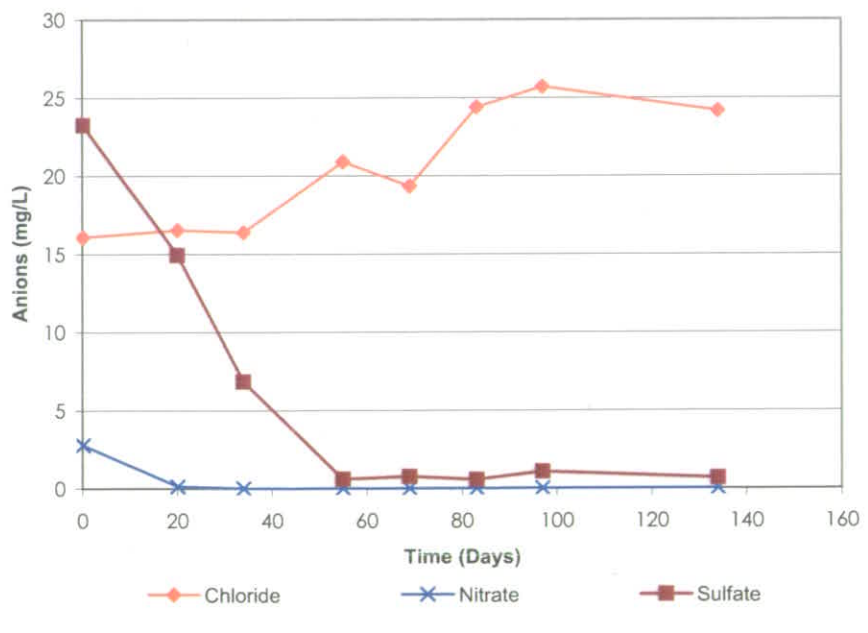


Microcosm 3









Notes:

TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloro cells/L - cells per liter
mg/L - milligrams per liter

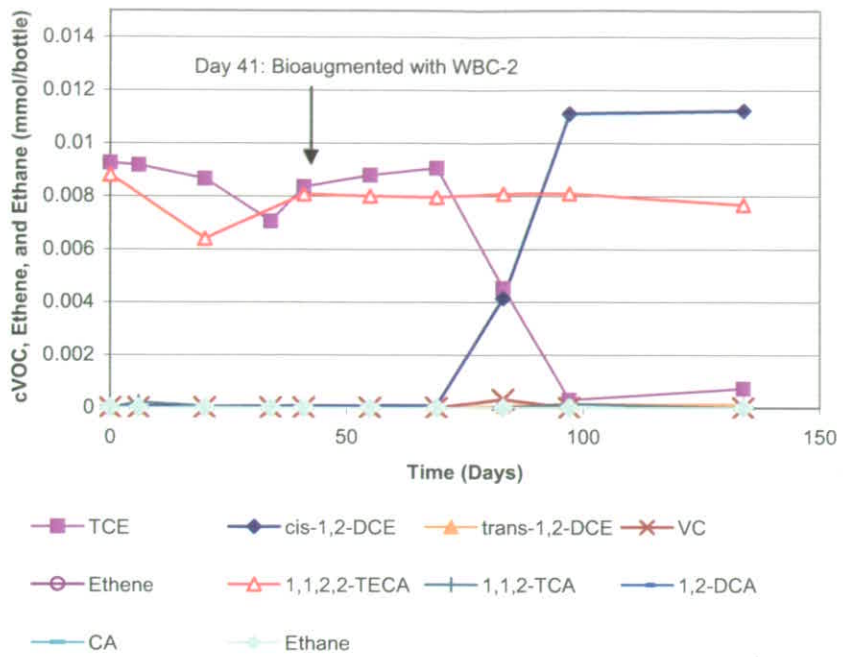
cVOC, Ethene, Ethane and Anion Concentration Trends in Corn Syrup Amended / WBC-2 Bioaugmented Microcosms

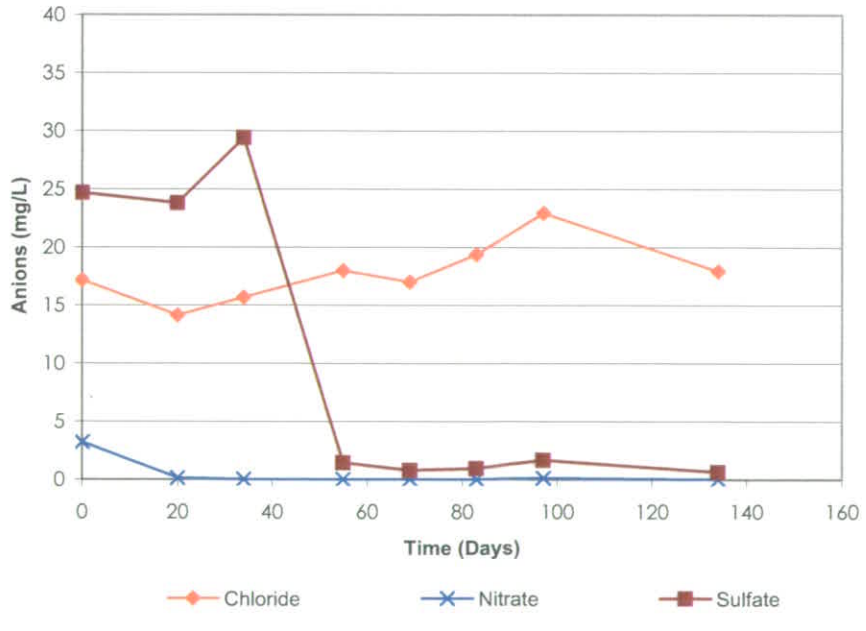
Former Defense Depot, Memphis, Tennessee

11-Feb-08 | Figure: **9** | SiREM

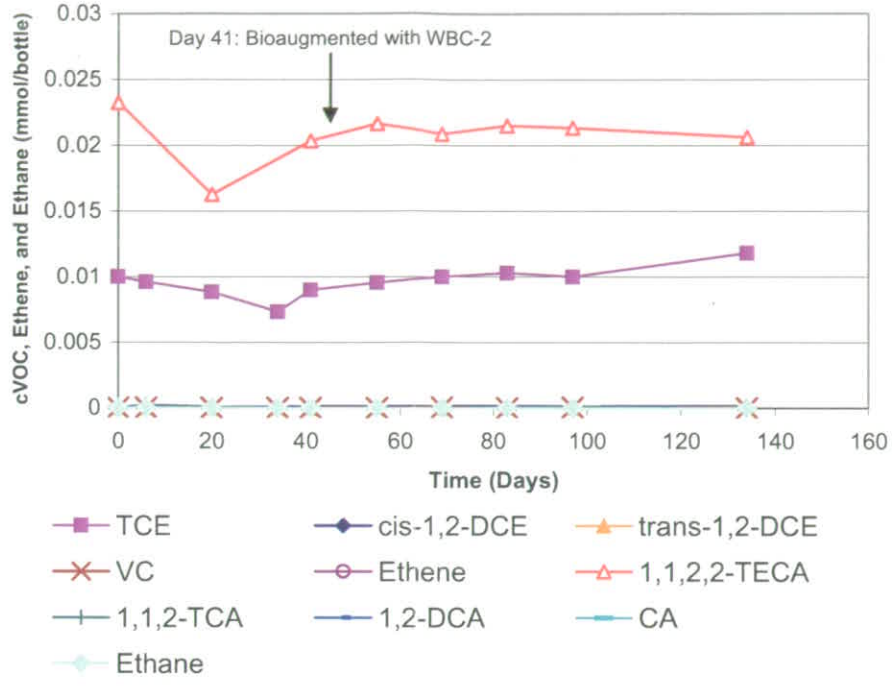
9531875

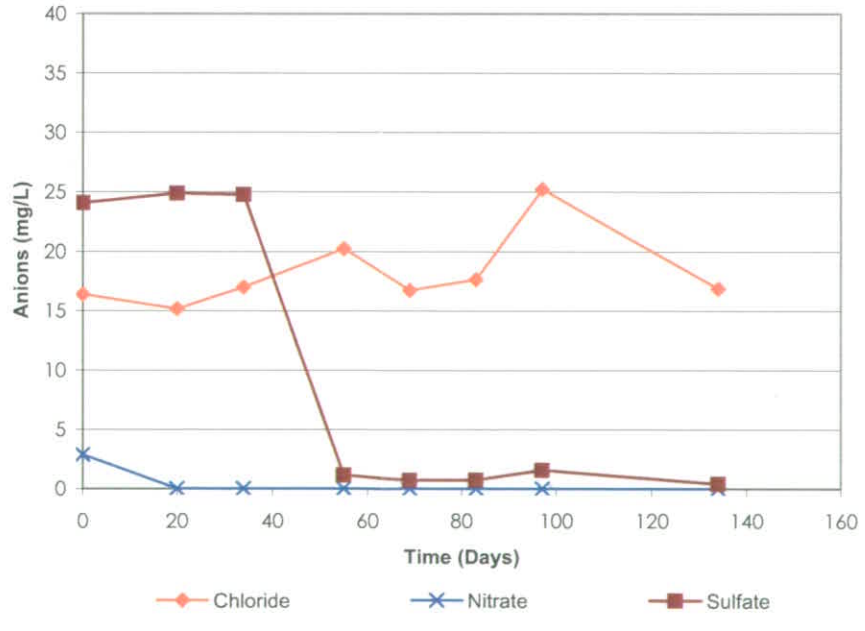
Microcosm 1



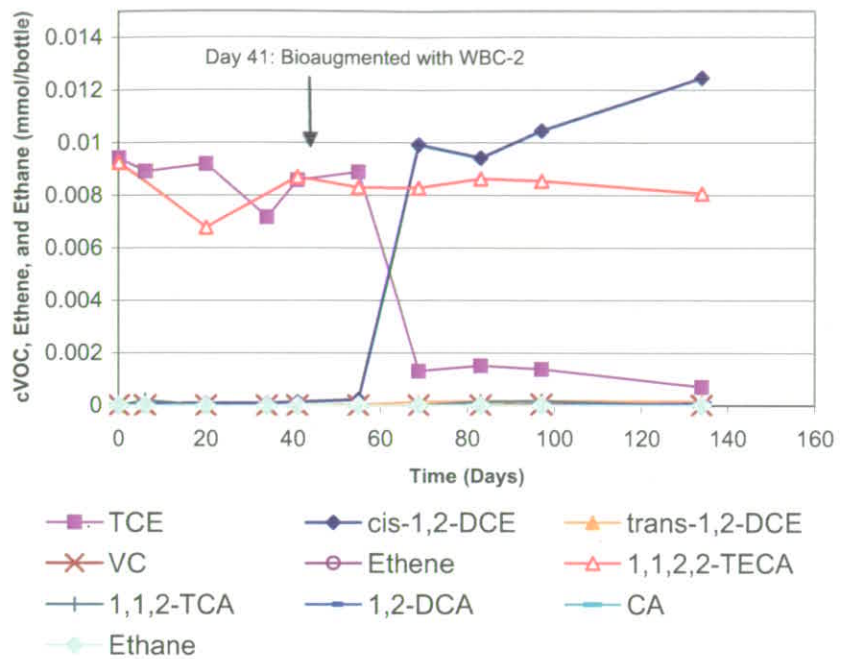


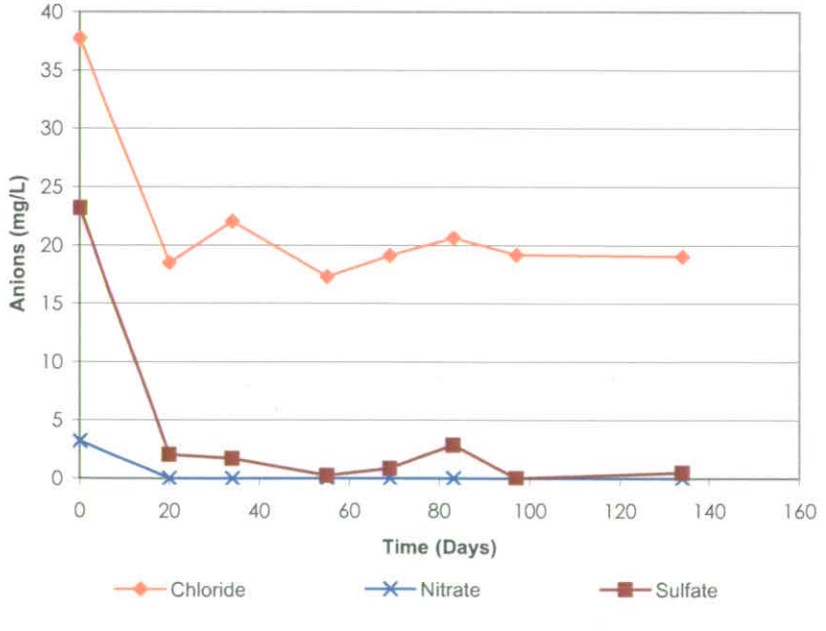
Microcosm 2





Microcosm 3





Notes:

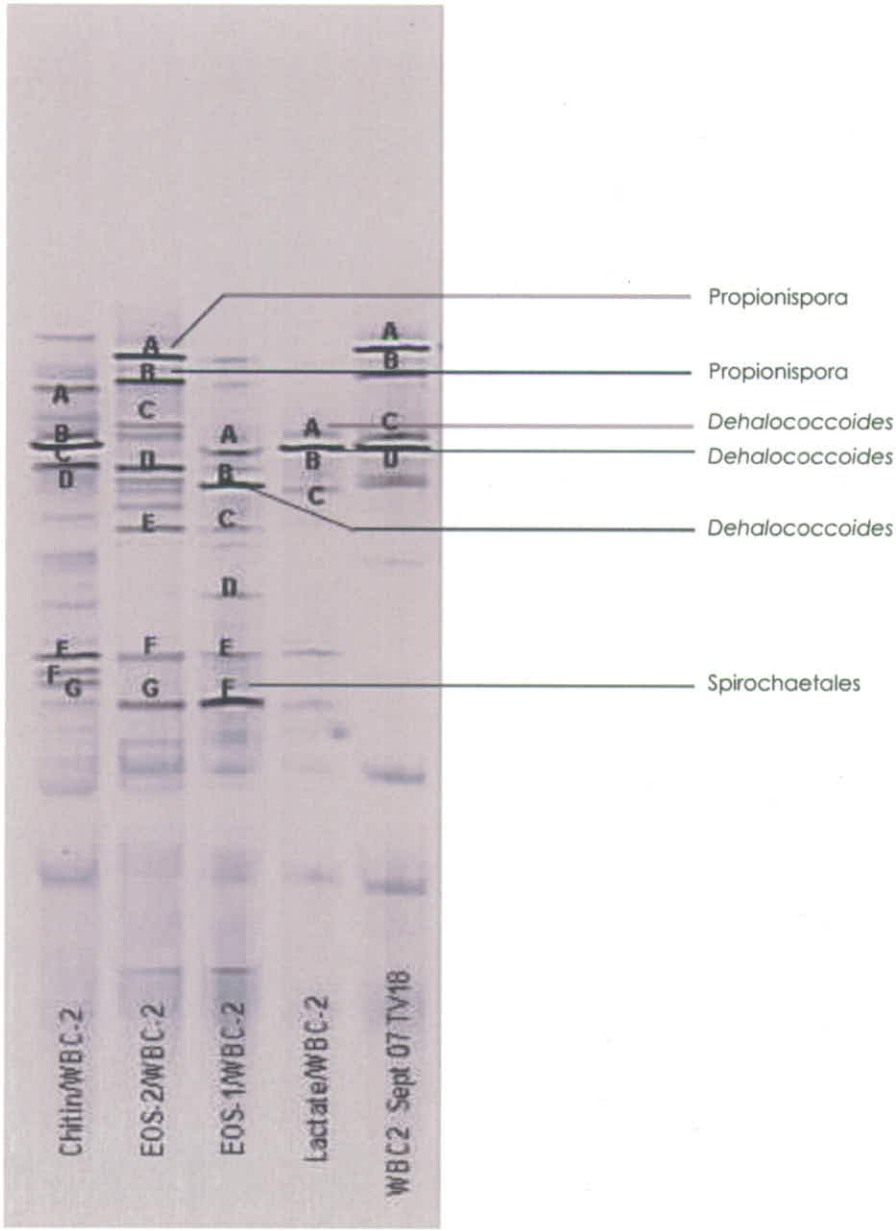
TCE - trichloroethene
cis -1,2-DCE - *cis* -1,2-dichloroethene
VC - vinyl chloride
1,1,2,2 TECA - 1,1,2,2 - tertrachloroethane
trans -1,2, - DCE - *trans* -1, 2-dichloroehtene
1,1,2 TCA - 1,1,2 - trichloroethane
1,2 DCA - 1,2 dichloroethane
CA -chloro cells/L - cells per liter
mg/L - milligrams per liter

cVOC, Ethene, Ethane and Anion Concentration Trends in HRC-Advanced® Amended / WBC-2 Bioaugmented Microcosms

Former Defense Depot, Memphis, Tennessee

11-Feb-08 | Figure: **10** | SiREM

9531876



DGGE Gel Image Highlighting Bacterial Banding Patterns for Electron Donors Used in Phase One of the Microcosm Study

Former Defense Depot, Memphis, Tennessee

February 2008	Figure: **11**	SiREM Site Recovery & Management

DGGE Bacterial Banding.cdr

APPENDIX A: Henry's Law Calculation

The following Henry's Law calculation was used to convert aqueous concentrations (Table 2A and 3A) to total mmoles of each analyte per microcosm bottle (Figures 1 to 10):

$$\text{Total mmoles} = \frac{C_{liq} \times (V_{liq} + H \times V_{gas})}{\text{Molecular Weight (mg/mmol)}}$$

Where

C_{liq} = liquid concentration (mg/L)
V_{liq} = liquid volume (0.20 L) per bottle
V_{gas} = headspace volume (0.02 L) per bottle
H = Henry's Law constant (dimensionless)

The Henry's Law constants used are summarized in the table below.

Analyte	Henry's Law Constant [a] (dimensionless)
1,1,2,2-tetrachloroethane	0.014
1,1,2-trichloroethane	0.035
1,2-dichloroethane	0.04
Chloroethane	0.04
Trichloroethene	0.48
cis-1,2-Dichloroethene	0.31
trans-1,2-Dichloroethene	0.27
Vinyl chloride	0.95
Ethene	8.76
Methane	27.2

[a] Source: Montgomery, J.H. 2000. *Groundwater Chemicals Desk Reference, Third Edition.* CRC Press LLC, Boca Raton, FL.

APPENDIX B: DGGE Analysis Report

SiREM
Site Recovery & Management
130 Research Lane, Suite 2
Guelph, Ontario N1G 5G3
Phone: (519) 822-2265
Fax: (519) 822-3151
www.siremlab.com

Denaturing Gradient Gel Electrophoresis (DGGE) Analysis Report

Customer: CH2MHill, David Nelson
Former Defense Depot
Biotreatability Study

SiREM Reference #: DGGE-080

Report Issued: 31 January 2008

Analyst: _____

Elizabeth Ney, B.Sc.
Molecular Biologist

Reviewed by: _____

Philip Dennis, M.A.Sc.
Technology Manager

Summary

Denaturing gradient gel electrophoresis (DGGE) analysis allows the assessment of microbial diversity and the assignment of putative taxonomic identifications for members of mixed microbial communities. This procedure relies on the separation of a mixture of products derived from the amplification of the 16S rRNA genes of a mixed microbial community. The microbial diversity of the community can be determined by the number of bands generated on the gel, each band represents a single species. The identification of individual microbes can be determined by obtaining the 16S rRNA gene sequences of individual bands (Muyzer *et al.*, 1993).

DGGE analysis (Figure 1) was performed on DNA isolated from microcosm samples taken on September 9th, 2007 (S-1098). Genomic DNA reference numbers assigned to the samples were: GDNA 4853 (Lactate/WBC-2), GDNA 4854 (EOS-1/WBC-2), GDNA 4855 (EOS-2/WBC-2), GDNA 4856 (Chitin/WBC-2). In addition to the microcosm samples several lanes representing the WBC-2™ culture were also run in parallel, for the purpose of identifying micro-organisms from the WBC-2™ culture in the microcosms. Table 1 summarizes the putative phylogenetic designation of sequenced bands as determined by BLAST searches (National Center for Biotechnology Information NCBI database) or by Classifier (Ribosomal Database Project II – Center for Microbial Ecology Michigan State University).

Materials and Methods

DNA Extraction / Polymerase Chain Reaction:

Genomic DNA was extracted from samples using the PowerSoil™ DNA Isolation Kit (MO BIO Laboratories Inc, Solona Beach, CA). Duplicate PCR reactions were assembled as follows: 6 µL of the genomic DNA preparation was added to a 40 µL 2.5X Eppendorf PCR Master mix PCR reaction (Brinkmann, Mississauga, ON.), 50 µL of RNAse, DNAse Free water, containing 4 µL of 20 pmole each of primer 2 (5'-ATTACCGCGGCTGCTGG-3') and primer 3 (5'-CGCCCGCCGCGCGCGGCGGGCGGGGCGGGGGCACGGGGGGCCTACGGGAGGCAGCAG-3') (Muyzer *et al.*, 1993). Thermocycling was performed using an I-Cycler (BIO-RAD, Mississauga, ON) with a thermocycling program as follows: initial denaturation at 94°C for 5.0 minutes followed by 10 cycles of 94°C for 1.0 min., annealing at 65°C ramping down 2°C every second cycle to 55°C and extension at 72°C for 1.5 min, after which 30 further cycles with a fixed annealing temperature of 55°C, followed by a final extension of 72°C for 5.0 min. Duplicate PCR reactions were pooled (total 200 µL) and were purified and concentrated using Qiaquick® Spin Columns (Qiagen, Mississauga, ON) and eluted in 30 µL elution buffer.

Denaturing Gradient Gel Electrophoresis (DGGE):

DGGE was performed using an 8.0% 0.5 X TAE acrylamide gel with a 30-65% urea/formamide gradient at a constant temperature of 60°C in a D-code electrophoresis unit (BIO-RAD, Mississauga, ON). Electrophoresis was performed at 180 V for 6.5 hr after which the gel was stained for 15 min in 0.5 mg/L ethidium bromide in warm 0.5 X TAE and then de-stained for 15 min in warm 0.5 X TAE buffer. The gel image was captured using a SynGene gel documentation system with GeneSnap™ and GeneTools™ software (Synoptics Ltd, Cambridge, UK).

Generation of DNA Sequences:

Selected gel bands were excised from the DGGE gel. The DNA was purified from the gel slice using a Qiaquick® spin column (Qiagen, Mississauga, ON) according to the manufacturer's instructions. Six µL of gel-slice elutant was used as a template in a re-amplification PCR reaction performed as described above. Resulting PCR products were purified using Qiaquick® spin columns (Qiagen, Mississauga, ON). DNA sequencing of re-amplified bands was performed by Laboratory Services at the University of Guelph (Guelph, ON) using an ABI Model 377 Sequencer.

Analysis of DNA Sequences:

DNA sequences were compared to sequences in GenBank using BLAST (National Center for Biotechnology Information http://www.ncbi.nlm.nih.gov) or by using Classifier (Ribosomal Database Project II – Center for Microbial Ecology Michigan State University http://rdp.cme.msu.edu/classifier/classifier). Putative phylogenetic identities were determined based on the top matches to the subject sequence. Where the phylogenetic lineage of the closest match was unclear, the phylogenetic identity of more conclusively identified organisms less closely related to the subject sequence was used to determine a phylogenetic designation.

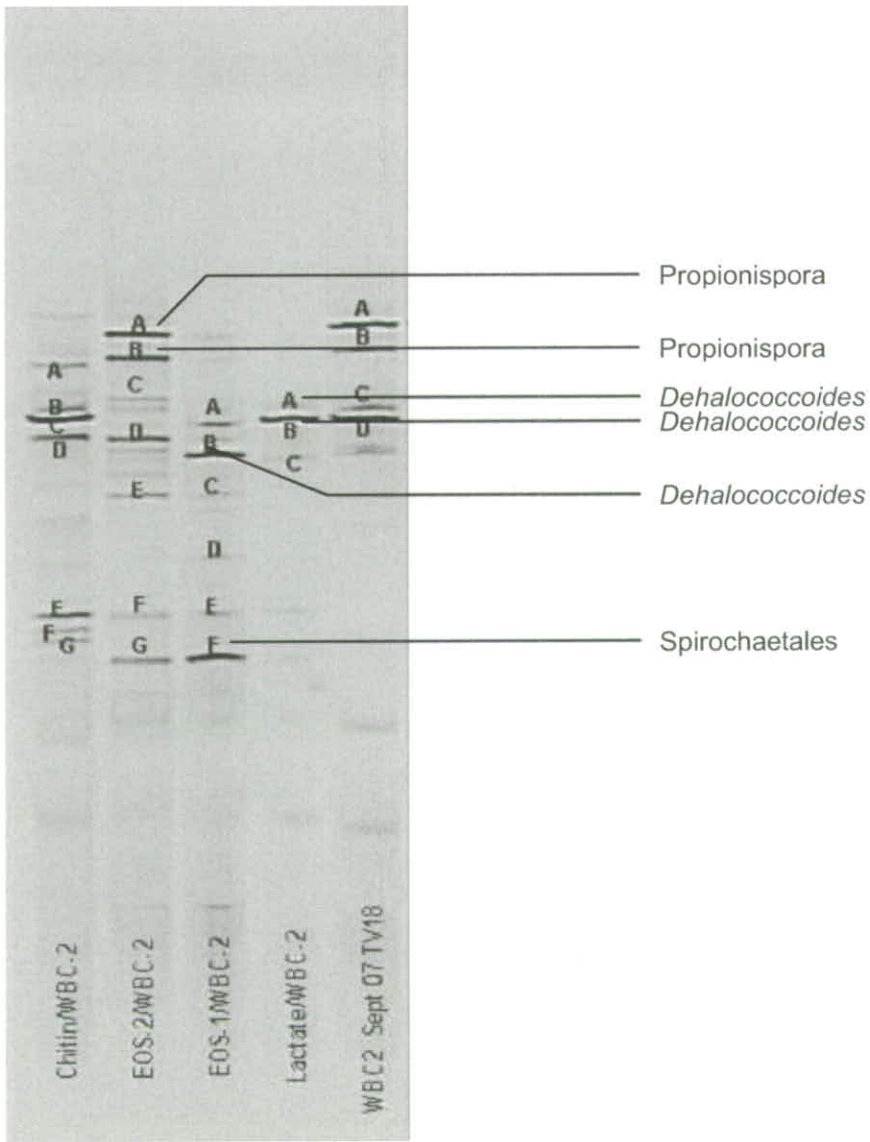


Figure 1: DGGE-080 Army Depot Microcosms

SiREM

Table 3: BLAST Results for DGGE - 080 Army Depot Microcosm Band Sequences

Sample ID	Sequence (Band)	Closest Phylogenetic Relative Based on BLAST Search*	GenBank Accession # of Nearest Relative	Putative Phylogenetic Designation	Identity with Nearest Relative	Comment	Reference
Lactate/ WBC-2	4853A	Uncultured bacterium clone LaC20H47	EF667876	*Dehalococcoides***	119/119 base pairs (bp) 100%	Possible *Dehaloco-ccoides**** sp. BAV1 119/119 (100%)	2
Lactate/ WBC-2	4853B	Uncultured bacterium clone LaC20H47	EF667876	*Dehalococcoides***	126/127bp 99%	Possible *Dehaloco-ccoides**** sp. BAV1 119/119 (100%)	2
EOS-1/ WBC-2	4854B	*Dehalococcoides* enrichment culture clone ANAS	DQ855129	*Dehalococcoides*	119/120bp 99%	Possible *Dehaloco-ccoides etheno-genes* ***195 119/120 (99%)	3
EOS-1/ WBC-2	4854F	Uncultured spirochete clone Ev219h1bfT3b46	EF446829	Spirochaetales	143/144bp 99%	–	4
EOS-2/ WBC-2	4855A	Uncultured bacterium clone: GLY1B01	AB244745	*Propionispora***	145/145bp 100%	–	5
EOS-2/ WBC-2	4855B	Uncultured bacterium clone: GLY1B01	AB244745	*Propionispora***	132/134bp 98%	2/2 confirmed mismatches	5

Sample ID	Sequence (Band)	Closest Phylogenetic Relative Based on BLAST Search*	GenBank Accession # of Nearest Relative	Putative Phylogenetic Designation	Identity with Nearest Relative	Comment	Reference
EOS-2/ WBC-2	4855D	Uncultured Bacteroidetes bacterium isolate DGGE gel band B2	EF491060	Bacteroidetes	141/145bp 97%	1/4 confirmed mismatches	6
EOS-2/ WBC-2	4855E	Uncultured bacterium clone BE325FW032701 CTS_hole1-41	DQ088761	Bacteria	114/118bp 96%	4/4 confirmed mismatches	7
Chitin/ WBC-2	4856B	Uncultured bacterium clone LaC20H47	EF667876	Bacteria	75/87bp 86%	11/12 confirmed mismatches	2
Chitin/ WBC-2	4856C	Uncultured bacterium clone LaC20H47	EF667876	*Dehalococcoides***	121/122bp 99%	–	2
Chitin/ WBC-2	4856E	Uncultured bacterium mle1-9	AF280848	Firmicutes	115/125bp 92%	4/10 confirmed mismatches	8

Notes:

* Closest phylogenetic relative is the organism with highest score based on nucleotide BLAST search results. Where multiple matches have identical scores other organisms may be as closely related to the subject sequence as the listed organism.

** Putative Phylogenetic Designation using Classifier (Ribosomal Database Project II – Center for Microbial Ecology Michigan State University).

***Possible nearest relative as determined by BLAST searches using BLAST assembled genomes – Microbes (National Center for Biotechnology Information database).

References

1. Muyzer, G., DeWaal, E.C., and Uitierlinden A. G., Profiling of Complex Microbial Populations by Denaturing Gradient Gel Electrophoresis Analysis of Polymerase Chain Reaction-Amplified Genes Coding for 16S rRNA. 1993. Applied and Environmental Microbiology, Vol. 59 No. 3, p.695-700.

2. Kittelmann,S. and Friedrich,M.W. Identification of novel PCE-respiring microorganisms in anoxic river sediment by RNA-based stable isotope probing Unpublished Direct Submission Submitted (11-JUN-2007) Molecular Geobiology, Max Planck Institute for Terrestrial Microbiology, Karl-von-Frisch Strasse, Marburg 35043, Germany.

3. Holmes,V.F., He,J., Lee,P.K. and Alvarez-Cohen,L. Discrimination of multiple dehalococcoides strains in a trichloroethene enrichment by quantification of their reductive dehalogenase genes Appl. Environ. Microbiol. 72 (9), 5877-5883 (2006) PUBMED 16957207 Direct Submission Submitted (15-JUL-2006) Environmental Engineering, UC Berkeley, 726 Davis Hall, Berkeley, CA 94720, USA.

4. Onstott,T.C. Mineralogical, Chemical and Biological Characterization of an Anaerobic Biofilm Collected from a Borehole in a Deep Gold Mine in South Africa Geomicrobiol. J. (2007) In press Direct Submission Submitted (06-FEB-2007) Department of Geosciences, Princeton University, Guyot Hall, Princeton, NJ 08544, USA.

5. Shigematsu,T., Mizuno,Y., Kawaguchi,H., Morimura,S. and Kida,K. Microbial Community Analysis of Mesophilic Anaerobic Glycerol Degradation Process Using Chemostat Cultivation Unpublished Morimura,S., Shigematsu,T. and Kida,K. Direct Submission Submitted (19-DEC-2005) Shigeru Morimura, Kumamoto University.

6. Moura,A., Henriques,I., Dias,J. and Correia,A. Characterization of bacterial diversity in a wastewater treatment plant using PCR-DGGE analysis Direct Submission Submitted (14-MAR-2007) CESAM & Dept Biologia, Universidade de Aveiro, Campus Universitario de Santiago, Aveiro 3810-199 Aveiro, Portugal.

7. Lin,L.-H., Hall,J., Onstott,T.C., Gihring,T., Sherwood Lollar,B., Boice,E., Pratt,L., Lippmann-Pipke,J. and Bellamy,R.E.S. Planktonic microbial communities associated with fracture-derived groundwater in a deep gold mine of South Africa Geomicrobiol. J. 23 (6), 475-497 (2006) Direct Submission Submitted (08-JUN-2005) Department of Geosciences, Princeton University, Washington Road, Princeton, NJ 08540, USA.

8. LaPara,T.M., Nakatsu,C.H., Pantea,L. and Alleman,J.E. Phylogenetic analysis of bacterial communities in mesophilic and thermophilic bioreactors treating pharmaceutical wastewater Appl. Environ. Microbiol. 66 (9), 3951-3959 (2000)PUBMED 10966414 AUTHORS Nakatsu,C.H., LaPara,T.M., Pantea,L.M. and Alleman,J.E. Direct Submission Submitted (21-JUN-2000) Department of Agronomy, Purdue University, 1150 Lilly Hall of Life Sciences, West Lafayette, IN 47907-1150,USA.

SiREM

Attachment A: Chain-of-Custody

9531888

Chain-of-Custody Form

SiREM Site Recovery & Management
130 Research Lane, Suite 2 · Guelph, Ontario, Canada N1G 5G3 · Phone (519) 822-2265 or toll free 1-866-251-1747 Fax (519) 822-3151
www.siremlab.com

№ 1410 Lab # S-1098

Page 1 of 1

Project Name	Army Depot
Project #	
Project Manager	Jeff Roberts
Email Address	jroberts@siremlab.com
Company	SiREM
Address	as above
Phone #	
Fax #	
Sampler's Signature	Rita Schofield
Sampler's Printed Name	Rita Schofield

Analysis

Preservative: 0

DGGE

Preservative Key
0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Client Sample ID	Lab ID	Sampling Date	Sampling Time	Matrix	# of Containers	Other Information
AD-1		4Sept07		H2O	1x120ml	✓
AD-2		↓		↓	↓	✓
AD-3						✓
AD-4						✓

Sample Receipt

Cooler Conditions:

Cooler Temperature: N/A

Custody Seals: Yes ☐ No ☐

Invoice Information

P.O. #

Bill To

Quotation #

For Lab Use Only

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature	Signature	Signature	Signature	Signature: Rita Schofield
Printed Name	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name: Rita Schofield
Firm	Firm	Firm	Firm	Firm	Firm: SiREM
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time: 04 Sept 07

Distribution: White - Return to Originator; Yellow - Lab Copy; Pink - Retained by Client

In the absence of an executed agreement, submission of samples to SiREM implies consent for performance of analyses specified on this Chain-of-Custody form and agreement with the terms and conditions of the SiREM Laboratory Services Agreement. The party submitting samples shall be responsible for payment in full for said analyses.

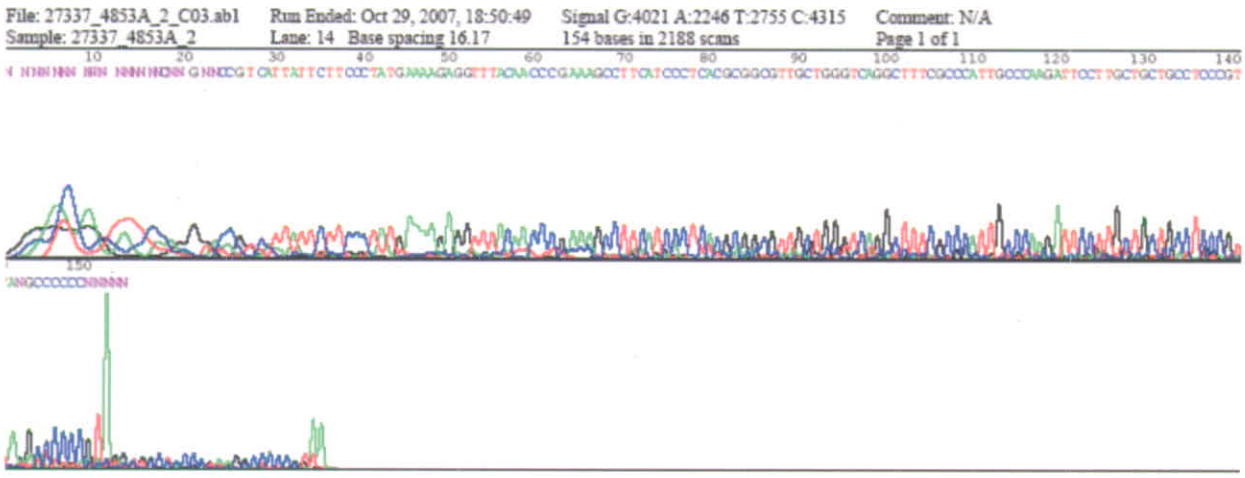
Leading Science. Lasting Solutions

SiREM

Attachment B: DNA Sequences and Chromatograms

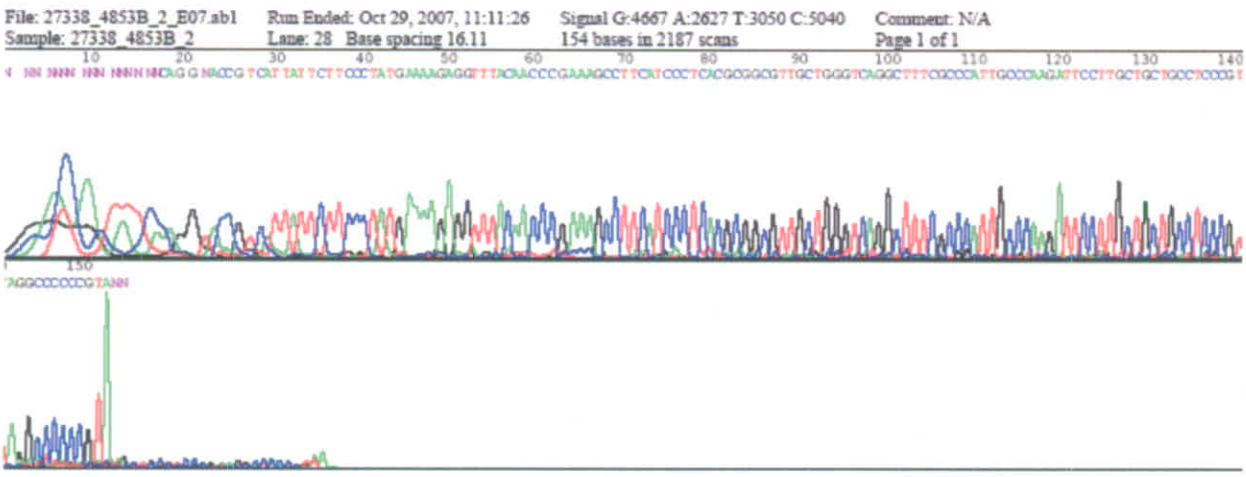
DGGE Band 4853 A (Sample ID AD-1 Lactate)

NNNNNNNNNNNNNNNNCNNGNNCCGTCATTATTCTTCCCTATGAAAAGAGGTTTACAACCCGAAAGC
CTTCATCCCTCACGCGGCGTTGCTGGGTCAGGCTTTCGCCCATTGCCCAAGATTCCTTGCTGCTGCC
TCCCGTANGCCCCCCNNNNN



DGGE Band 4853 B (Sample ID AD-1 Lactate)

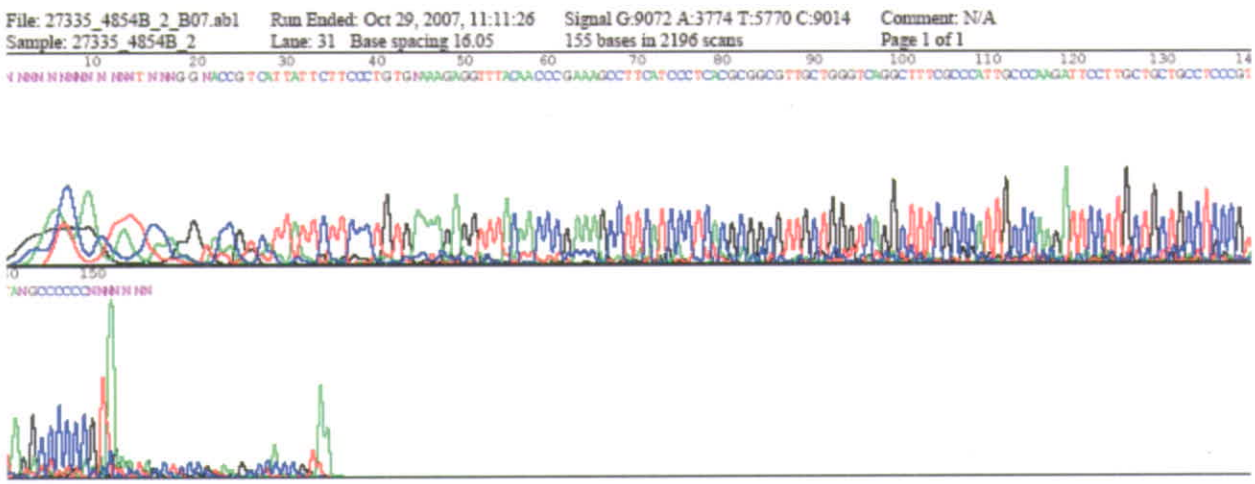
NNNNNNNNNNNNNNNNCAGGNACCGTCATTATTCTTCCCTATGAAAAGAGGTTTACAACCCGAAAGC
CTTCATCCCTCACGCGGCGTTGCTGGGTCAGGCTTTCGCCCATTGCCCAAGATTCCTTGCTGCTGCC
TCCCGTAGGCCCCCCGTANN



9531891

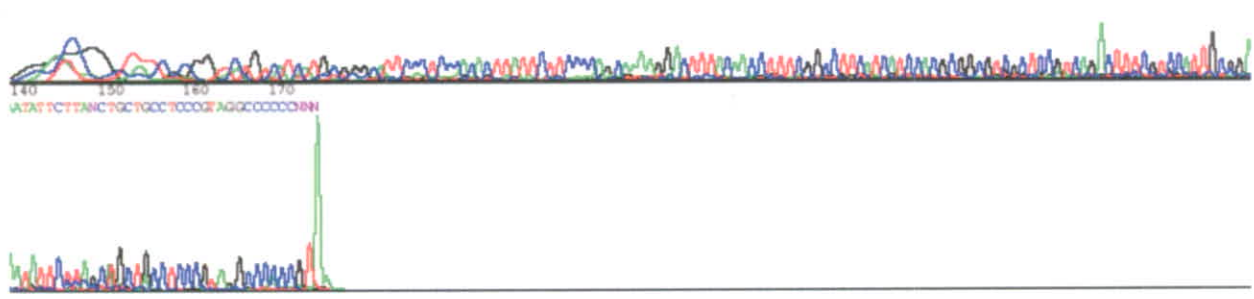
DGGE Band 4854 B (Sample ID EOS-1/WBC-2)

NNNNNNNNNNNNNTNNNGGNACCGTCATTATTCTTCCCTGTGNAAAGAGGTTTACAACCCGAAAGCC
TTCATCCCTCACGCGGCGTTGCTGGGTCAGGCTTTCGCCCATTGCCCAAGATTCCTTGCTGCTGCCT
CCCGTANGCCCCCCNNNNNNN



DGGE Band 4854 F (Sample ID EOS-1/WBC-2)

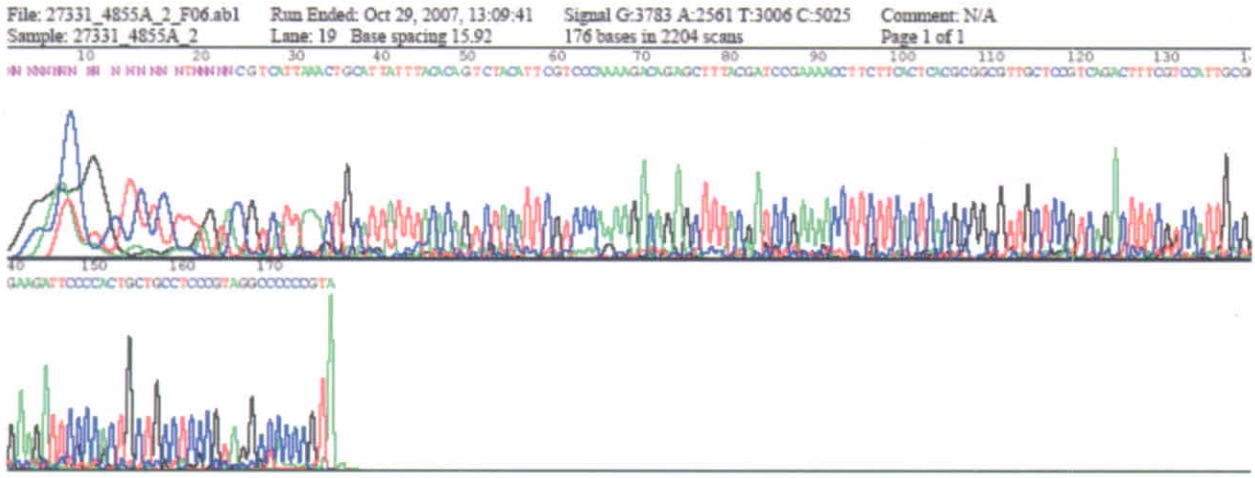
NNNNNNNNNNNTCNCGGNNCTGTCATCATGCGGGCATTCCCTCCCACACTTATTCTTCCCCAGCAAA
AGGACTTTACAACCTTTCGGCCTTCATCATCCACGCGGCGTCGCTCCGTCAGACTTTCGTCCATTGC
GGAATATTCTTANCTGCTGCCTCCCGTAGGCCCCCCNNN



SiREM
Site Recovery & Management

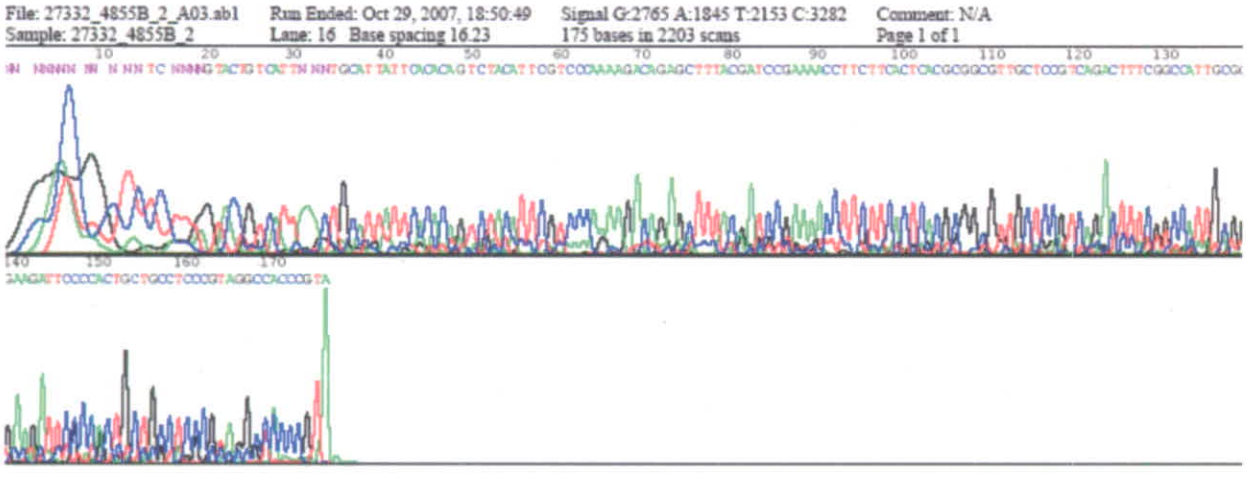
DGGE Band 4855 A (Sample ID EOS-2/WBC-2)

NNNNNNNNNNNNNNNNTNNNNNCGTCATTAAACTGCATTATTTACACAGTCTACATTCGTCCCAAAA
GACAGAGCTTTACGATCCGAAAACCTTCTTCACTCACGCGGCGTTGCTCCGTCAGACTTTCGTCCAT
TGCGGAAGATTCCCCACTGCTGCCTCCCGTAGGCCCCCCGTA



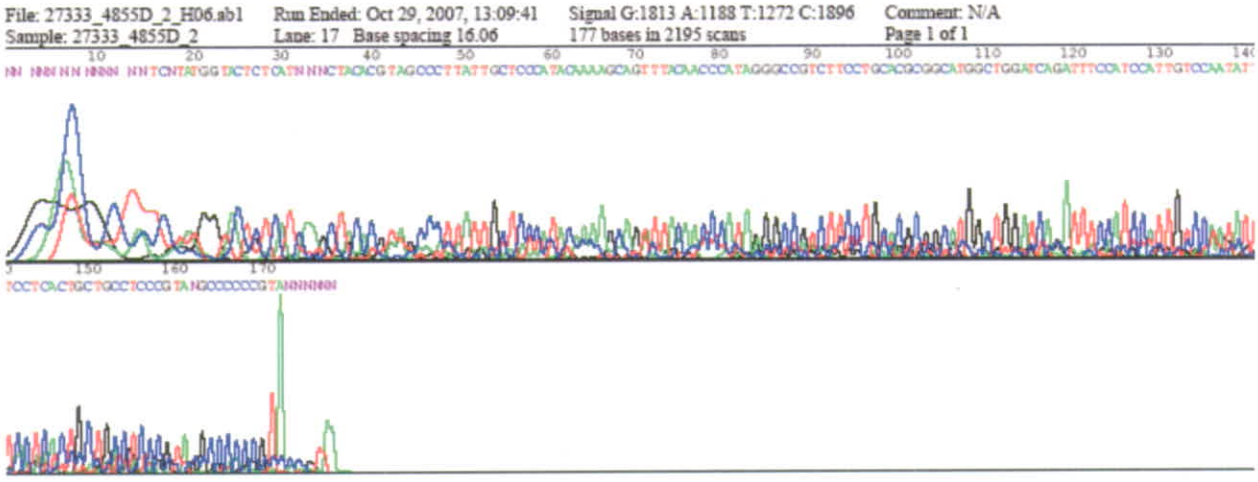
DGGE Band 4855 B (Sample ID EOS-2/WBC-2)

NNNNNNNNNNNNTCNNNNGTACTGTCATTNNNTGCATTATTCACACAGTCTACATTCGTCCCAAAAG
ACAGAGCTTTACGATCCGAAAACCTTCTTCACTCACGCGGCGTTGCTCCGTCAGACTTTCGGCCATT
GCGGAAGATTCCCCACTGCTGCCTCCCGTAGGCCACCCGTA



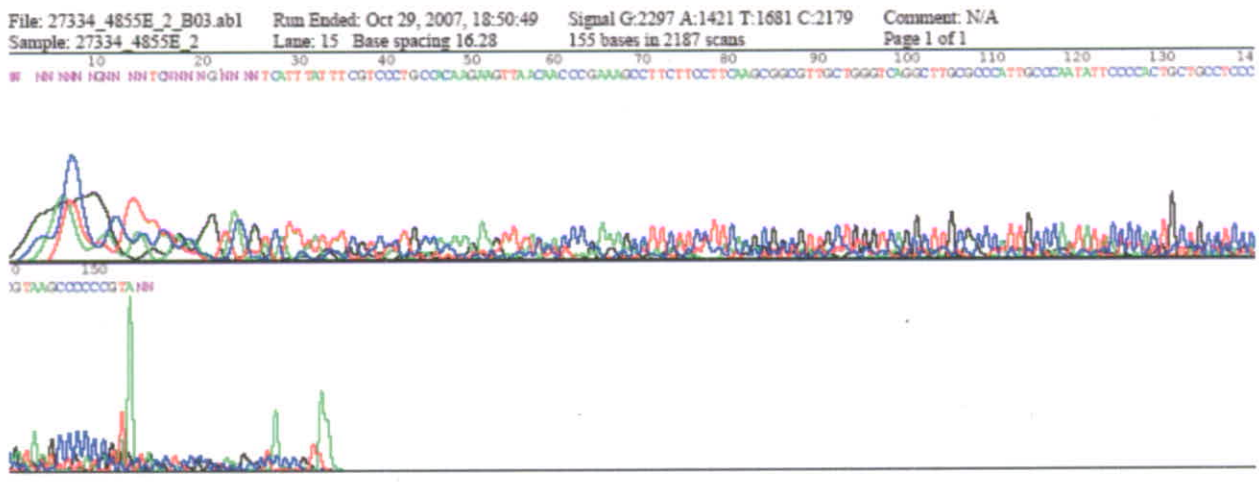
DGGE Band 4855 D (Sample ID EOS-2/WBC-2)

NNNNNNNNNNNNNTCNTATGGTACTCTCATNNNCTACACGTAGCCCTTATTGCTCCCATACAAAAGC
AGTTTACAACCCATAGGGCCGTCTTCCTGCACGCGGCATGGCTGGATCAGATTTCCATCCATTGTCC
AATATTCCTCACTGCTGCCTCCCGTANGCCCCCCGTANNNNNN



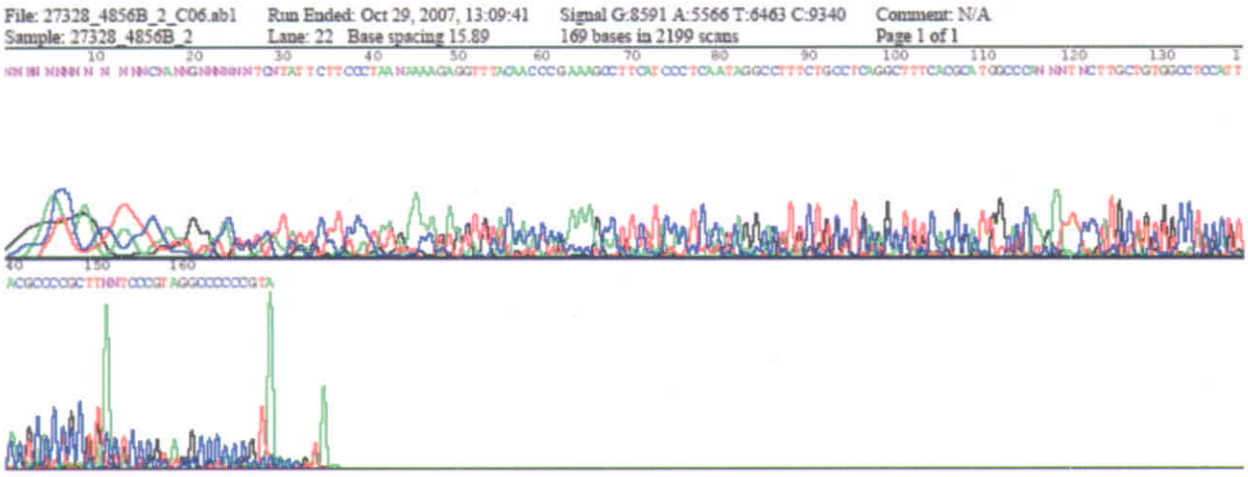
DGGE Band 4855 E (Sample ID EOS-2/WBC-2)

NNNNNNNNGNNNNTCNNNNGNNNNTCATTTATTTCGTCCCTGCCACAAGAAGTTAACAACCCGAAAG
CCTTCTTCCTTCAAGCGGCGTTGCTGGGTCAGGCTTGCGCCCATTGCCCAATATTCCCCACTGCTGC
CTCCCGTAAGCCCCCCGTANN



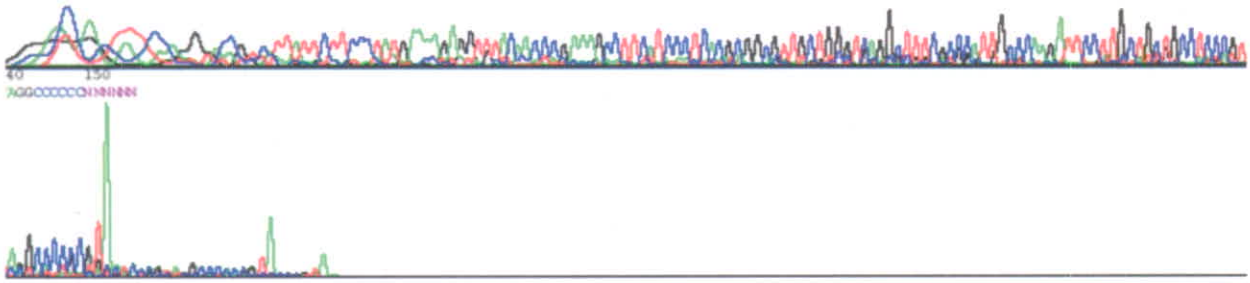
DGGE Band 4856 B (Sample ID Chitin/WBC-2)

NNNNNNNNNNNNNCNANNGNNNNNNTCNTATTCTTCCCTAANAAAAGAGGTTTACAACCCGAAAGCC
TTCATCCCTCAATAGGCCTTTCTGCCTCAGGCTTTCACGCATGGCCCANNNTNCTTGCTGTGGCCTC
CATTACGCCCCGCTTNNTCCCGTAGGCCCCCCGTA



DGGE Band 4856 C (Sample ID Chitin/WBC-2)

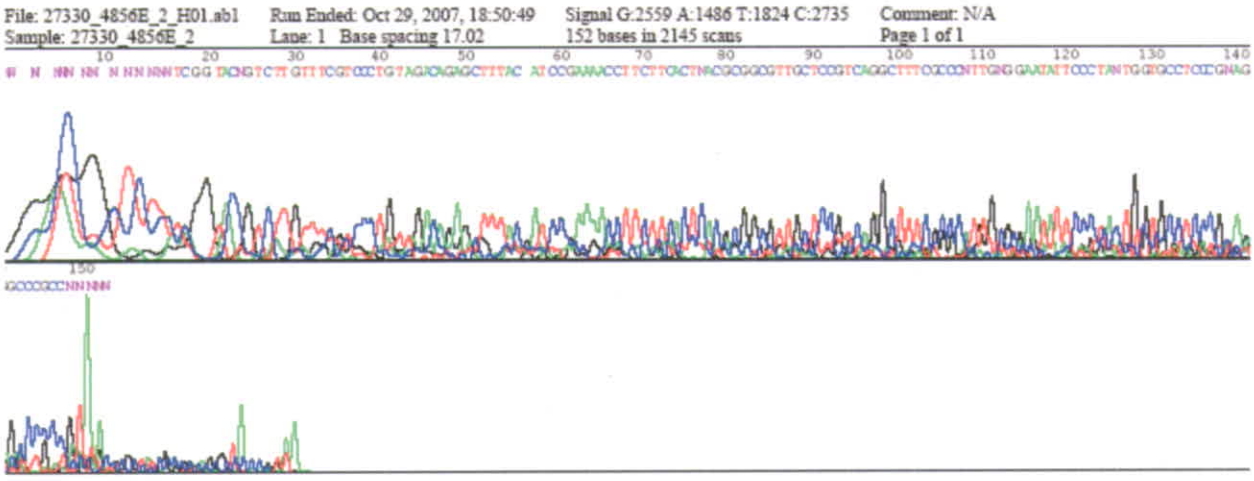
NNNNNNNNNNNNNNNNGGNACCGNCATTATTCTTCCCTATGAAAAGAGGTTTACAACCCGAAAGCCT
TCATCCCTCACGCGGCGTTGCTGGGTCAGGCTTTCGCCCATTGCCCAAGATTCCTTGCTGCTGCCTC
CCGTAGGCCCCCCNNNNNN



9531895

DGGE Band 4856 E (Sample ID Chitin/WBC-2)

NNNNNNNNNNNNNNNTCGGTACNGTCTTGTTTCGTCCCTGTAGACAGAGCTTTACATCCGAAAACCT
TCTTCACTNACGCGGCGTTGCTCCGTCAGGCTTTCGCCCNTTGNGGAATATTCCCTANTGGTGCCTC
CCGNAGGCCCGCCNNNNN



APPENDIX F

Sampling and Analysis Plan and Quality Assurance Plan for Indoor Air Quality Monitoring

9531897

Defense Distribution Center (Memphis)
Dunn Field

Off-Depot Groundwater Remedial Design

Sampling and Analysis Plan and Quality Assurance Plan for Indoor Air Quality Monitoring

Rev. 1

PREPARED FOR

U.S. Army Engineering and Support Center, Huntsville
4820 University Square
Huntsville, AL 35816

May 2008

PREPARED BY

CH2M HILL
1000 Abernathy Road, Suite 1600
Atlanta, GA 30328

Contents

Acronyms and Abbreviations iii
1.0 Introduction 1-1
1.1 Site Setting 1-1
2.0 Project Organization 2-1
2.1 Project Organization 2-1
3.0 Sampling and Analysis Plan 3-1
3.1 Jobsite Health and Safety 3-1
3.2 Pre-Sampling Structural Survey 3-2
3.3 Mobilization/Utility Locating 3-2
3.4 Soil Physical Parameters 3-2
3.5 Soil Vapor Sampling 3-3
3.5.1 Soil Vapor Probe Installation 3-3
3.5.2 Sampling Methods 3-3
3.6 Laboratory Analysis 3-4
3.7 Equipment Decontamination 3-4
3.8 Investigation-Derived Waste Management 3-4
3.9 Demobilization 3-4
4.0 Sampling Procedures 4-1
4.1 Sampling Design 4-1
4.2 Sampling Methods 4-1
4.2.1 Standard Operating Procedures 4-1
4.2.2 Sample Containers, Volume, Preservation, and Holding Times 4-1
4.2.3 Field Records 4-2
4.3 Quality Control 4-2
5.0 Sample Custody 5-1
5.1 Sample Handling and Shipment 5-1
5.2 Sample Custody Procedures 5-1
6.0 Reporting 6-1
7.0 Analytical Procedures 7-1
8.0 QA Objectives for Measurement Data 8-1
8.1 Data Quality Objectives 8-1
8.2 Quality Criteria for Measurement Data 8-1
8.2.1 Data Precision 8-1
8.2.2 Data Accuracy 8-2
8.2.3 Data Representativeness 8-2
8.2.4 Data Completeness 8-2
8.2.5 Data Comparability 8-3
9.0 Calibration Procedures and Frequency 9-1

10.0 Data Reduction, Validation, and Reporting 10-1
10.1 Data Review, Validation and Verification Requirements 10-1
10.2 Validation and Verification Methods 10-1
10.3 Data Acquisition Requirements 10-1
10.4 Data Management 10-1
11.0 Preventive Maintenance 11-1
11.1 Instrument/Equipment Inspection and Maintenance 11-1
11.2 Inspection/Acceptance Requirements for Supplies and Consumables 11-1
12.0 Acceptance of Measurements 12-1
13.0 Corrective Action 13-1
14.0 References 14-1

Figures

F-1 Target Areas for Indoor Air Quality Monitoring

F-2 Remedial Action Project Team and Responsibilities (*to be provided by Remedial Action Contractor*)

F-3 Generalized Locations of Soil Gas Samples

Tables

F-1 Sampling Program for Indoor Air Quality Monitoring
F-2 Sampling and Analysis Protocols
F-3 Target Reporting Limits for Soil Vapor Samples (Analysis by EPA Method TO-15)
F-4 Acceptance Criteria for Duplicate Samples

Attachments

F-1 Health and Safety Plan

F-2 U.S. EPA Method TO-15 (January 1999) - Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specialty-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). http://www.epa.gov/ttn/amtic/airtox.html

F-3 Standard Operating Procedures

F-4 Example Forms

Acronyms and Abbreviations

API	American Petroleum Institute
AS/SVE	Air sparge/soil vapor extraction
ASTM	American Society for Testing Materials
bgs	Below ground surface
CVOC	Chlorinated volatile organic compound
cis-DCE	cis-1,2-Dichloroethene
DOT	Department of Transportation
DPT	Direct push (drilling) technology
FD	Field duplicate
GC/MS	Gas chromatography/mass spectroscopy
HSP	Health and Safety Plan
IAQ	Indoor air quality
IATA	International Air Transport Association
IDW	Investigation-derived waste
IPA	Isopropyl alcohol
LCS	Laboratory control samples
µg/kg	micrograms per kilogram
µg/m^3	micrograms per cubic meter
mg/kg	milligrams per kilogram
mm	millimeters
MS/MSD	Matrix spike/matrix spike duplicate
NJDEP	New Jersey Department of Environmental Protection
PCE	tetrachloroethene
PM	Project Manager
ppb	parts per billion
QA/QC	Quality assurance/quality control
RD	Remedial Design
SAP	Sampling and Analysis Plan
TCE	trichloroethene
PCA	tetrachloroethane
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 Introduction

The first part of this appendix to the Dunn Field Remedial Design (RD) contains sampling and analysis procedures for indoor air quality (IAQ) monitoring. Quality assurance procedures for the IAQ monitoring are provided in the second part of this appendix. As discussed in the RD, air sparging (AS) and soil vapor extraction (SVE) will be used to limit further migration of the Off-Depot chlorinated volatile organic compounds (CVOCs) plume. The objective of surveying and monitoring around structures in the offsite area is to determine whether AS/SVE operations to cleanup the groundwater plume may create IAQ issues. The work will be performed prior to and during operation of the AS/SVE system. **Figure F-1** shows the Dunn Field and offsite areas, and the 2007 extent of the CVOC plume. The areas where structures may have IAQ issues during AS/SVE operations are highlighted on the figure. The target areas identified on **Figure F-1** were selected because they are over or near the periphery of the known extent of the offsite CVOC plumes. Structures within the highlighted target areas will be surveyed and monitored as described in this appendix.

1.1 Site Setting

The Dunn Field offsite area is underlain by soil and loess to a depth of about 30 ft below ground surface (bgs). The loess overlies about 30 to 40 ft of fluvial deposits composed of gravel and sand with some silt and clay. The water table occurs at about 70 ft bgs within the fluvial deposits (fluvial aquifer) and the majority of the offsite contaminants migrate within this aquifer. The fluvial deposits overlie much thicker sandy and clayey units that contain an intermediate aquifer. Throughout much of Dunn Field and the offsite areas, there is a confining clay unit between the fluvial and intermediate aquifers. However, in a few places the intermediate aquifer is directly connected to the fluvial aquifer. Neither the fluvial aquifer nor the intermediate aquifer are used for water supply in the vicinity of Dunn Field.

The contaminant plume in the fluvial aquifer contains high concentrations (>1000 parts per billion [ppb]) of tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (*cis*-DCE), and 1,1,2,2–tetrachloroethane (PCA), and lower concentrations of other CVOCs. Analysis of groundwater samples from the intermediate aquifer in offsite areas has shown very low levels of CVOCs.

2.0 Project Organization

2.1 Project Organization

The following organization chart presents the key personnel and their corresponding responsibilities.

[REMEDIAL ACTION CONTRACTOR TO INSERT FIGURE F-2 SHOWING REMEDIAL ACTION PROJECT TEAM AND RESPONSIBILITIES]

3.0 Sampling and Analysis Plan

The sampling and analysis of soil vapor involves the following tasks:

- Pre-sampling structural survey
- Mobilization and underground utility search,
- Soil sampling,
- Soil vapor sampling
- Laboratory analysis
- Equipment decontamination,
- Demobilization, and
- Site restoration.

After initial soil and soil vapor sampling, the results will be compared to soil screening criteria to select structures for further testing. The selected structures would be tested for air pressure differentials between the sub-slab soil and the building interior. Contaminant vapors should not migrate into buildings that have higher indoor pressure than the sub-slab soil zone. **Table F-1** summarizes the number and types of samples to be collected, the proposed sampling depths, and the constituents of concern in soil vapor. **Table F-1** would be modified after completion of the structure surveys, so that only structures with basements or sitting on slabs would undergo soil vapor sampling. **Figure F-3** shows typical locations for soil vapor probes around a small building (residence).

TABLE F-1
Sampling Program for Indoor Air Quality Monitoring
Off-Depot Groundwater Remedial Design

Sample Type	Quantity	Depth	Analysis
Soil	4 locations (see **Figure F-1**)	5, 10 , 15 ft bgs	soil bulk density (ASTM D2937), grain density (API RP40), soil moisture content (ASTM D2216), grain size (D422), and Atterberg Limits (ASTM D4318)
Soil vapor	3 locations (~6 samples) per building	~5, ~15 ft bgs	VOCs by EPA Method TO-15
Sub-slab/Indoor Pressure Differential	1-2 per building	~1 ft below slab	Direct reading/recording pressure gauges

3.1 Jobsite Health and Safety

To perform the sampling tasks, sampling personnel may be exposed to potential occupational and/or environmental hazards. As a result, it is important for field personnel to be familiar with:

- Concepts, principles, and guidelines intended to protect field personnel.
- Organizational structures and standard operating procedures used to mitigate potential environmental hazards.

- Identifying methods and procedures for recognizing, evaluating and controlling hazardous substances.
- Discussing regulations and action levels to ensure the health and safety of field personnel.
- Demonstrating the selection and use of dermal and respiratory protective equipment.
- Demonstrating the selection and use of direct-reading air monitoring instrumentation (if applicable).

All fieldwork will be performed under an approved Health and Safety Plan (HSP). All field personnel must review and sign the HSP (**Attachment F-1**). In practice, not all of the potential environmental hazards that may be inherent to a site can be readily anticipated in the HSP. To mitigate these circumstances, field personnel must learn, follow, and enforce industry standard practices governing occupational health and safety. In addition, they must maintain awareness, and exercise common sense and good judgment when confronting possibly unsafe situations.

3.2 Pre-Sampling Structural Survey

Prior to sampling, a qualitative assessment of the factors influencing potential indoor air contamination will be evaluated by conducting a survey of structures within the target area shown on **Figure F-1**. All structures will be surveyed from the street, and if access is granted, an interior survey will be conducted. Observations for each structure will be noted and logged separately by completing the example *Pre-Sampling Structural Survey* (**Attachment F-4**). The final number of soil vapor sample locations (**Table F-1**) will be determined following the survey of the target area.

Permission to follow up and install both soil vapor sampling probes and indoor pressure monitoring points will also be obtained during this task. Soil vapor probes will be installed only at structures indicated by the pre-sampling survey as potentially receptive to soil vapors. Indoor air pressure probes would be installed only in structures that show soil vapor contaminant levels above soil screening levels (see below).

3.3 Mobilization/Utility Locating

Field mobilization activities will include mobilizing field crews, subcontractors, and associated equipment and supplies to obtain soil samples and to install soil vapor sampling points. A site health and safety briefing for all field personnel will be conducted as part of the mobilization before the start of field activities each day.

In preparation for installing subsurface sampling points, an underground utility survey of all planned drilling locations will be conducted. Both the utility one-call service and a licensed utility locate company will be used to mark the presence of subsurface utilities and structures in the proposed work areas.

3.4 Soil Physical Parameters

Soil borings will be installed using direct push drilling technology (DPT) so that soil samples may be collected to determine physical parameters. Soil physical parameters will be needed if vapor

intrusion modeling is performed. Three soil samples will be collected at four locations (SP-1, SP-2, SP-3, and SP-4) within the target areas (**Figure F-1**). These samples will be collected by capping 6-inch sections of the acetate liners (or brass sleeves) driven to depths of approximately 5, 10, and 15 feet bgs at each location. The lithology of each probe boring will be logged by collecting "continuous" cores to the bottom of the hole. Soil samples will be selected from the approximate depths specified, but will be biased toward the three cores that visually exhibit the coarsest grain size. Coarse-grained sediment is expected to be a preferential pathway for migration of soil vapors, thus these zones will be tested for physical properties to estimate potentially worst-case contaminant migration conditions. The twelve soil samples will be analyzed by a geotechnical laboratory as described in Section 4.

3.5 Soil Vapor Sampling

Impacted soil vapor, if present, is expected to be related to the Off-Depot groundwater plume. Soil vapor samples will be collected to assess the concentrations of VOCs near buildings that are within the target areas shown on **Figure F-1** and were identified by the pre-sampling survey as potentially of concern for indoor air quality issues. Soil vapor sampling locations will be based on the pre-sampling survey, but may be adjusted due to access constraints. **Table F-1** will be modified to provide a summary of the soil vapor sampling to be performed including the location (street address), number of probes, sample depths, and analytical method(s). As indicated on **Figure F-3**, typical structures will have three outside locations for soil vapor probes. At each vapor sampling location two soil vapor probes will be installed at approximately 5 and 15 feet bgs, as described below. Soil vapor samples will be collected in Summa™ canisters, and will be analyzed using EPA Method TO-15 (**Attachment F-2**) at a fixed-based laboratory.

3.5.1 Soil Vapor Probe Installation

The soil vapor probes will be installed using DPT. At each soil vapor location, lithology will first be continuously cored from surface to 18 feet bgs to identify potential zones of distinctly coarser material (greater permeability) in which soil vapor may preferentially flow or accumulate. If such a zone is observed between 4 and 8 feet bgs, the soil vapor probe will be constructed at that corresponding depth. If no such zone is observed, the soil vapor probe will be constructed at the default depth of 5 feet bgs. A similar approach will be used to define the depth of the probe installed between 14 and 18 feet bgs (nominal 15 ft bgs). Sub-slab probes may also be installed inside structures. Additional details on probe installation are provided in **Attachment F-3** (Standard Operating Procedures).

3.5.2 Sampling Methods

After the soil vapor probes have been installed and allowed to equilibrate, soil vapor samples will be collected by connecting the probe tubing to an aboveground sampling system with a glass syringe fitted with a disposable needle and Mininert™ gas-tight valve. The aboveground sampling system will first be checked for leaks and then the probe will be purged. If a soil vapor probe cannot be sampled due to a lack of flow, the lack of flow will be logged and no additional efforts made to obtain a vapor sample. Vapor samples will be collected in an 850 mL or 1 L Summa™ Canister that has been certified clean by the analytical laboratory. The sample will be submitted to the laboratory under standard chain of custody procedures for analysis by EPA

Method TO-15. Full details on the sampling procedures are provided in **Attachment F-3** Standard Operating Procedures. Additional details on sample handling and custody requirements are provided in Sections 4 and 5.

3.6 Laboratory Analysis

The soil samples will be analyzed for soil bulk density (American Society for Testing Materials [ASTM] D2937), grain density (American Petroleum Institute [API] RP40), soil moisture content (ASTM D2216), grain size (D422), and Atterberg Limits (ASTM D4318). Soil vapor samples will be analyzed for VOCs by EPA Method TO-15 (**Attachment F-2**). Additional details regarding quality assurance of laboratory methods are provided in Sections 7 through 13.

3.7 Equipment Decontamination

Prior to each use, downhole equipment will be decontaminated at a central location capable of containing waste liquids and solids. Downhole equipment includes drive samplers, drive rods, trowels, and miscellaneous field equipment that may contact soil in the borehole. The following decontamination procedures will be followed.

- Wash with tap water, using a brush if necessary.
- Wash with Alconox ™, or a phosphate-free detergent, and tap water solution, using a brush if necessary.
- Rinse with tap water.
- Rinse with deionized water.
- Air dry.

3.8 Investigation-Derived Waste Management

Investigation-derived waste (IDW) generated during this investigation is expected to include disposable materials (e.g., paper towels and gloves), soil cuttings, and decontamination water. Disposable materials will be placed in appropriate waste containers at the end of each work shift. Soil cuttings will be spread at the drill site. Decontamination waste liquids and solids will be disposed in the sanitary sewer.

3.9 Demobilization

At the end of the probe installation and soil sampling, demobilization will occur. This will include final decontamination activities, cleanup and restoration of the site, and removal of equipment and personnel from the site.

4.0 Sampling Procedures

4.1 Sampling Design

The structural survey will identify buildings within the target area that require soil vapor sampling. Probes for sampling soil vapor will be installed near each building and sub-slab pressure differential probes may be installed within buildings where needed and access is granted. As discussed in Section 3, indoor air pressure measurements will be made only within structures with associated soil vapor results that exceed the soil screening criteria (**Table F-3**). Soil vapor samples will be collected in evacuated Summa™ canisters, and analyzed by EPA Method TO-15 (**Attachment F-2**). An initial round of soil vapor sampling will be performed before start up of the offsite AS/SVE system. The results of the initial sampling will be compared to soil screening levels (**Table F-3**) to determine whether differential air pressure testing inside buildings is needed. The sample probes will remain in place for periodic sampling during operation of the AS/SVE system. At a minimum a second round of soil vapor sampling should occur within three months of startup of the AS/SVE system. The results from the second sampling event will also be compared to soil screening levels to determine whether differential air pressure testing inside buildings is needed, and to determine additional vapor sampling and frequency.

Soil vapor samples will be grab samples taken over a 5 minute period. Sampling should include at least one duplicate sample for every 10 field samples. Rather than co-locating two probes, duplicate samples will be collected from a single probe in series (one after the other). The proposed sampling and analysis protocol is listed in **Table F-2**. Results from analysis of soil vapor samples will be compared to risk-based soil screening levels to evaluate potential indoor air quality concerns. This evaluation may indicate the need for testing indoor air pressures to confirm that contaminated vapors might be entering the structure. Depending on results, risk analysis and additional testing of indoor air may be performed, but that is beyond the scope of this plan.

4.2 Sampling Methods

4.2.1 Standard Operating Procedures

All samples including quality assurance/quality control (QA/QC) samples will be collected from soil probes installed at designated structures. The standard operating procedures (SOPs) for air sampling are presented in **Attachment F-3**.

4.2.2 Sample Containers, Volume, Preservation, and Holding Times

Vapor samples will be collected by connecting a pre-cleaned 850 mL or 1L Summa™ canister to a soil probe with a preset valve for 5-minute sampling. **Attachment F-3** has additional details regarding sample collection and handling. The laboratory will clean and certify each canister clean according to EPA Method TO-15 (**Attachment F-2**) prior to sending them to the site. Copies of laboratory certifications will be retained in the project file, and included in each soil vapor monitoring report. **Table F-2** presents additional details of sampling protocols.

TABLE F-2
Sampling and Analysis Protocols
Off-Depot Groundwater Remedial Design

Sample Type	Number of Samples [1]	Matrix	Parameter/ Fraction	Sample Container	Sample Pres.	Analytical Method [2]	Rpt. Limits	Holding Time
Soil	12	Soil	Grain size, grain density, moisture content, bulk density, and Atterberg Limits	Acetate liner	NA	various	NA	NA
Soil Vapor	TBD	Air	Volatile Organic Compounds (VOCs)	850 mL or 1-L Summa™ Canister	---------	TO-15	See **Table F-3**	14 days

Notes:

1 – Initial vapor sampling will be determined by pre-sampling survey and access. Follow up sampling events will be determined after evaluation of the results of the initial sampling event.

2 – USEPA (January 1999) Method TO-15: Determination of VOCs in Air Collected in Specialty-Prepared Canisters and Analyzed by GC/MS. Geotechnical samples analyzed by ASTM and API methods described in Section 8.

4.2.3 Field Records

All field and sample documents must be written legibly in indelible ink. Any corrections or revisions will be made by marking a single line through the original entry and initialing the change. The *Sampling Log*, Chain of Custody, and the field notebook will be completed for each sample collected. A *Pre-Sampling Structural Survey* (Section 3.2) should have already been completed that records building information for each sample location. The *Sampling Log* will be used to record the sample location, canister and flow controller IDs, sampling period, initial and final sample times, flow rate, initial and final pressures, and comments. Examples of the *Pre-Sampling Structural Survey* and *Sampling Log* forms are presented in **Attachment F-4**. The Chain of Custody is a record of the sample location, sample canister and valve numbers and time and date of the sample that accompanies the sample to the laboratory.

The field notebook will be used by field personnel to record field measurements, all aspects of sample collection and handling, and visual observations. The field notebook is a descriptive notebook detailing site activities and observations so that an accurate, factual account of field procedures may be reconstructed. The sample team or individuals performing a particular sampling activity are required to maintain a field notebook. The field notebook should be a bound weatherproof logbook that shall be filled out at the location of sample collection immediately after sampling. All entries will be signed by the individuals making them. At a minimum, the notebook will contain sample particulars including sample number, collection time, location, descriptions, methods used, daily weather conditions, field measurements, name of sampler(s), sample preservation, names of contractor/subcontractor personnel, and other site-specific observations including any deviations from protocol.

4.3 Quality Control

Field QC samples will be collected and submitted to the analytical laboratory to assess chemical data quality during the field investigations. Laboratory QC samples also will be analyzed to

assess the accuracy and precision of laboratory chemical analytical techniques. The following types of QC samples will be collected.

- **Field Duplicate (FD):** An FD is a sample that will be collected and analyzed for VOCs to check for the natural sample variance and the consistency of field collection techniques and laboratory analyses. One soil vapor duplicate sample will be collected per field day or per 10 normal samples whichever is more frequent. The specific samples to be duplicated will be determined in the field by the field team leader.
- **Ambient Blank:** One ambient blank will be collected per day.
- **Laboratory QC Samples:** The analytical laboratories will analyze method blanks, matrix spike/matrix spike duplicates (MS/MSDs), and laboratory control samples (LCS), as required by the analytical method. The results of these QC samples will be used to validate the laboratory results.

5.0 Sample Custody

5.1 Sample Handling and Shipment

Soil samples destined for geotechnical analysis should be handled and shipped in accordance with ASTM Method D 4220 Groups B, C, and D. In general the method requires proper sample containers, labels, and shipping containers to preserve native soil moisture and compaction characteristics.

A sample tag, also provided by the laboratory, will be securely affixed to each Summa™ canister and include the sample ID, sampling date and time, and canister identification number. Once sealed, filled canisters will be placed back in the cardboard boxes in which they were received. Custody seals and strapping tape will then be affixed to the boxes. Custody seals will demonstrate that a sample container or cooler has not been opened or tampered with. The sampler will sign and date the custody seal and affix it to the container and/or cooler in such a manner that it cannot be opened without breaking the seal. Canisters must be packaged and shipped in accordance with Federal Department of Transportation (DOT) and International Air Transport Association (IATA) procedures (http://www.iata.org/ps/dgr). All samples will be shipped within 24 hours of collection.

5.2 Sample Custody Procedures

Chain of Custody records will be maintained from the time of sample collection until final disposition. Every transfer of custody will be noted and signed by the person receiving and relinquishing the sample. The chain-of-custody records will include, at a minimum, sample identification number, number of samples collected, sample collection date and time, sample type, sample matrix, sample container type, sample analysis requested, sample preservation, and the name(s) and signature(s) of samplers and all individuals who have had custody.

6.0 Reporting

At the conclusion of the investigation activities the field methodology and the analytical results of the soil and soil vapor sampling activities described in this work plan will be summarized and presented in an initial monitoring report. The report will be submitted to US EPA and TDEC within three months of completion of the initial sampling events. Subsequent vapor monitoring reports will be prepared semi-annually during the period of operation of the AS/SVE system.

Depending on the findings from initial soil vapor sampling, a site-specific human health risk assessment may be conducted to evaluate the potential for indoor air impact from VOCs in offsite plumes. If a human health indoor air risk assessment is conducted, the results will be reported in a technical memorandum and incorporated into the initial monitoring report as an attachment.

7.0 Analytical Procedures

Soil samples will be analyzed for geotechnical parameters using ASTM and API methods listed below. The analytical methods, equipment and performance requirements for analysis of soil vapor samples will be according to EPA Method TO-15 (**Attachment F-2**). Additional QC requirements may be found in US EPA SOP #HW-31 *Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15* (Oct. 2006) (http://www.epa.gov/region02/qa/documents.htm).

The soil samples will be analyzed by a qualified geotechnical laboratory using the following methods:

- Soil Bulk Density (ASTM D2937)
- Grain Density (API RP40)
- Soil Moisture Content (ASTM D2216)
- Atterberg Limits (ASTM D4318)
- Grain Size (ASTM D422)

The reporting limits for these tests will be defined by the selected laboratory. The target reporting limits for contaminants in soil vapor analyses are presented in **Table F-3**.

TABLE F-3
Target Reporting Limits for Soil Vapor Samples (Analysis by EPA Method TO-15)
Off-Depot Groundwater Remedial Design

Constituent	CA #	Soil vapor Screening Value, µg/m^3 (a)		Target Reporting Limit, µg/m^3 (b)
		Residential	Non-Residential	
Carbon tetrachloride	56235	31	31	2
Chloroform	67663	24	24	1
1,2-Dichloroethane	107062	20	20	1
1,1-Dichloroethene	75354	11,000	15,000	100
cis-1,2-Dichloroethene	156592	1,800	2,600	30
trans-1,2-Dichloroethene	156605	3,600	5,100	50
Methylene Chloride	75092	190	430	20
1,1,2,2-Tetrachloroethane	79345	34	34	1
Tetrachloroethene	127184	34	36	2
1,1,2-Trichloroethane	79005	27	27	1
Trichloroethene	79016	27	27	1
Vinyl chloride	75014	13	48	1

Notes:

(a) – Screening values from NJ DEP website. Values last updated March 2007. http://www.nj.gov/dep/srp/guidance/vaporintrusion/whatsnew.htm#200703a

(b) - Table should be updated after selected laboratory provides its RLs.

8.0 QA Objectives for Measurement Data

8.1 Data Quality Objectives

Data will be generated through the collection of soil and air samples in appropriate locations. The data will be used to determine the location and concentration of vapor contamination in the shallow sub-surface near structures, to measure the potential for vapor migration into structures, and to evaluate potential health threats. The soil laboratory results may be used to perform modeling of vapor migration in the soil.

Sub-slab pressure differentials will be measured to assess the potential for soil vapor to enter buildings. Individual measurements may be averaged over a specified time period (for example, a 9-hour work shift) to estimate a longer-period average pressure difference. The longer-term average value may indicate whether a building is positively pressurized (hence vapor resistant) or negatively pressurized (hence prone to vapor intrusion). These measurements may also be used to identify "worst-case" time periods for collecting indoor air samples.

Soil vapor samples will be collected in 850 mL or 1 L Summa™ canisters and analyzed for VOCs by EPA Method TO-15. The data may be compared to soil vapor screening values developed by the New Jersey Department of Environmental Protection (NJDEP) using EPA Region III Risk Based Concentration data (**Table F-3**). The data may be used to perform modeling of vapor migration in the soil.

8.2 Quality Criteria for Measurement Data

To assess data quality, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters will be used. Precision and accuracy are expressed in purely quantitative terms. The other parameters are only expressed using a mixture of quantitative and qualitative terms. All of these parameters are interrelated in terms of overall data quality. The relative significance of each parameter depends on the type and intended use of the data being collected.

8.2.1 Data Precision

The measure of replicate precision is the absolute value of the difference between replicate measurements of the sample divided by the average value and expressed as a percentage as follows:

$$\text{Percent difference} = \frac{|X_1 - X_2|}{X} \times 100$$

where: X_1 - First measurement value
X_2 - Second Measurement value
X - Average of the two values

Factors that affected the precision of chemical measurements are: molecular weight, water solubility, polarizability, etc. A primary influence is the concentration level of the compound.

An analytical replicate precision value of ≤25 percent should be achieved for each of the target compounds (**Table F-3**). For more information, refer to EPA Method TO-15 (**Attachment F-2**).

Sample Collection Precision

Sample collection precision will be assessed by collecting field co-located (duplicate) samples. The field duplicate samples will be used to evaluate errors associated with sample heterogeneity, sampling methodology, and analytical procedures. The analytical results from these samples will provide data on the overall measurement precision. The field duplicate precision value should be ≤30 percent for each of the target compounds detected above the reporting limit (**Table F-3**).

8.2.2 Data Accuracy

Accuracy is defined as the degree of difference between measured or calculated values and the true value. Sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation and analysis techniques. A measurement of analytical accuracy is the degree of agreement with audit standards. Accuracy is defined as the difference between the nominal concentration of the audit compound and the measured value divided by the audit value and expressed as a percentage as follows:

$$\text{Audit Accuracy, \%} = \frac{\text{Spiked Value - Observed Value}}{\text{Spiked Value}} \times 100$$

The performance criteria for laboratory control spike accuracy should be ≤ 30 percent for the target compounds (**Table F-3**). For more information, refer to EPA Method TO-15 (**Attachment F-2**).

Sample Canister and Analysis Integrity

Method blanks will be used to monitor possible laboratory contamination. The laboratory shall provide results for the method blanks or the blank analysis for the canisters prior to use.

8.2.3 Data Representativeness

As previously discussed, data representativeness will be assessed by collecting field co-located samples. The field co-located samples are by definition equally representative of a given point and space and time. The laboratory also collects two samples from one canister; the sample and a duplicate. Representativeness is a qualitative parameter that is dependent upon both the design of the sampling program and the laboratory protocol. For this project, data representativeness will be satisfied by ensuring that approved field sampling methods and laboratory analytical methods are followed. The proper sampling techniques are provided in the SOPs (**Attachment F-3**). Proper analytical procedures are provided in EPA Method TO-15 (**Attachment F-2**).

8.2.4 Data Completeness

Data completeness will be expressed as the percentage of valid data obtained from measurements. For each datum to be considered valid, it must meet all the acceptable criteria including accuracy and precision, as well as any other criteria specified by the analytical method used. Therefore, all data points critical to the sampling program in terms of completeness will be 100 percent validated. The completeness goal for this sampling project will

be 90 percent, although sample results significantly outside quality control criteria may be re-collected based on project decisions.

8.2.5 Data Comparability

To ensure data comparability, the work will be performed using standard sampling and analytical methods and by adhering to the quality control procedures outlined in the methods and this QAPP.

9.0 Calibration Procedures and Frequency

Laboratory analytical equipment calibration will follow procedures as specified under EPA Method TO-15 (**Attachment F-2**). Additional QC requirements may be found in US EPA *SOP #HW-31 Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15* (rev.4, Oct 2006) (http://www.epa.gov/region02/qa/documents.htm).

The laboratory will also be responsible for calibration of the vapor sampling equipment including: sampling canisters, flow controllers, and gauges. Other field equipment will be calibrated according to manufacturer's recommendations. Field equipment will be calibrated daily or at more frequent intervals as recommended by the manufacturer. Calibration checks and results will be recorded in the field notebook.

10.0 Data Reduction, Validation, and Reporting

10.1 Data Review, Validation and Verification Requirements

Standard methods and references will be used as guidelines for data reduction and reporting. All data generated by the laboratory will be reported in standard deliverable format and accompanied by an electronic data deliverable.

10.2 Validation and Verification Methods

Analytical data will be reviewed by a independent qualified chemist to determine whether the samples were analyzed in according to the project requirements and to assess the validity of the analytical results. One hundred percent of the data will undergo a data summary validation using a combination of electronic and manual review using the applicable quality criteria in SOP #HW-31 (EPA, 2006) and EPA Method TO-15.

The data review will include a review of the following items:

- Chain of custody and completeness of reports
- Sample receipt conditions
- Case narrative information
- Holding times
- Laboratory control sample accuracy
- Method blank results
- Field and laboratory duplicate precision
- Surrogate recovery accuracy
- Internal standard recovery accuracy and retention time precision
- Initial and continuing calibration verification precision and accuracy
- GC/MS instrument tune criteria

10.3 Data Acquisition Requirements

Data acquisition from sources other than direct field and laboratory measurements (for example from databases) is not anticipated at this time; therefore, this is not applicable.

10.4 Data Management

All project data and information must be documented in a format that is usable by project personnel. This section of the QAPP describes how project data and information will be documented, tracked, and managed from their generation in the field to final use and storage in a manner that ensures data integrity and defensibility.

The following document management procedures should apply:

- All final project plans, field notes, laboratory reports, measurements, calculations, maps and drawings, designs, and reports must be archived in the project files.
- Field data forms, e.g., *Pre-Sampling Structural Survey, Sampling Log,* field notebooks, and corresponding sample labels will be completed at the time of sample collection and will include appropriate information. All field and sample documents will be legibly written in indelible ink. Any correction or revisions will be made by lining through the original entry and initialing the change.
- Field notebooks and field forms shall be maintained at the field site by the responsible (designated) individual(s) until completion of the field work.
- Upon completion of sample analyses the chain-of-custody records should be archived in the project files.
- It is recommended that paper copies of correspondence be maintained in the project files. Email correspondence that documents scope and/or schedule changes should be printed and kept in the project files.
- Procedures are provided for project personnel to make changes, take corrective actions and document the process through Corrective Action Request Forms. Corrective action can occur during field activities, laboratory analysis, data validation, and data assessment. For further information, refer to Section 13, Corrective Action.

11.0 Preventive Maintenance

11.1 Instrument/Equipment Inspection and Maintenance

Inspection and preventative maintenance of laboratory equipment will be conducted by the laboratory. The laboratory will also be responsible for inspection and preventative maintenance of the vapor sampling equipment including: sampling canisters, flow controllers, and gauges. Other field equipment will be inspected at time of calibration and during each use. Field equipment will be maintained according to manufacturer's recommendations. Equipment that cannot be calibrated will be removed from use and sent offsite for service. All routine field maintenance will be recorded in the field notebook.

11.2 Inspection/Acceptance Requirements for Supplies and Consumables

Due to the nature of air sampling, rinsate and trip blanks are not applicable. Quality control of the Summa™ canisters includes certification of the canister, method blanks performed by the laboratory and analysis of laboratory control samples. Canisters will be cleaned and certified to the limit specified in EPA Method TO-15 (**Attachment F-2**). Laboratory canister certifications will be maintained in the project files and copies will be provided with each monitoring report.

12.0 Acceptance of Measurements

Criteria for acceptance of laboratory data are provided in Section 8. Sample collection precision will be evaluated by collecting and analyzing duplicate samples. The duplicate samples will be used to evaluate errors associated with sample heterogeneity, sampling methodology and analytical procedures. The analytical results from duplicates will provide data on the overall measurement precision. As part of the analytical procedure, the laboratory also collects and analyzes two samples from each canister. Precision will be reported as the relative percent difference (RPD) for two measurements. The acceptance criteria for duplicate samples are provided in **Table F-4**.

TABLE F-4
Acceptance Criteria for Duplicate Samples
Off-Depot Groundwater Remedial Design

Sample Parameter/ Fraction	Matrix	Analytical Method	Method Detection Limits	Reporting Limit	Estimated Accuracy[2]	Estimated Laboratory Precision, RPD[2]	Estimated Field Precision, RPD
VOCs	Air	*TO-15*	Note 1	See **Table F-3**	≤ 30%	≤ 25%	≤ 30%

[1] The method detection limits will be provided by the laboratory.
[2] *TO-15: Determination of VOCs in Air Collected in Specialty-Prepared Canisters and Analyzed by GC/MS.*

13.0 Corrective Action

Corrective actions can occur during field activities, laboratory analysis, data validation, and data assessment. The project manager (PM) will describe procedures for project personnel to make changes, take corrective actions, and to document the process. Corrective action in the field may be necessary when the monitoring design is changed due to access restrictions or unforeseen changes in the offsite plume. A change in the field may include: increasing the number or type of samples or analyses; changing sampling locations; and/or modifying sampling protocol. When this occurs, the project manager or project chemist will identify any suspected technical or QA deficiencies and note them in the field logbook. The project chemist will be responsible for assessing the suspected deficiency and determining the impact on the quality of the data. Implementing the appropriate corrective action will be the responsibility of the PM.

14.0 References

U.S. Environmental Protection Agency (EPA). 1999. *Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)*. Office of Research and Development. Cincinnati, OH EPA/625/R-96/010b. http://www.epa.gov/ttn/amtic/airtox.html

_____. 2003. *Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings*, Version 3.0.

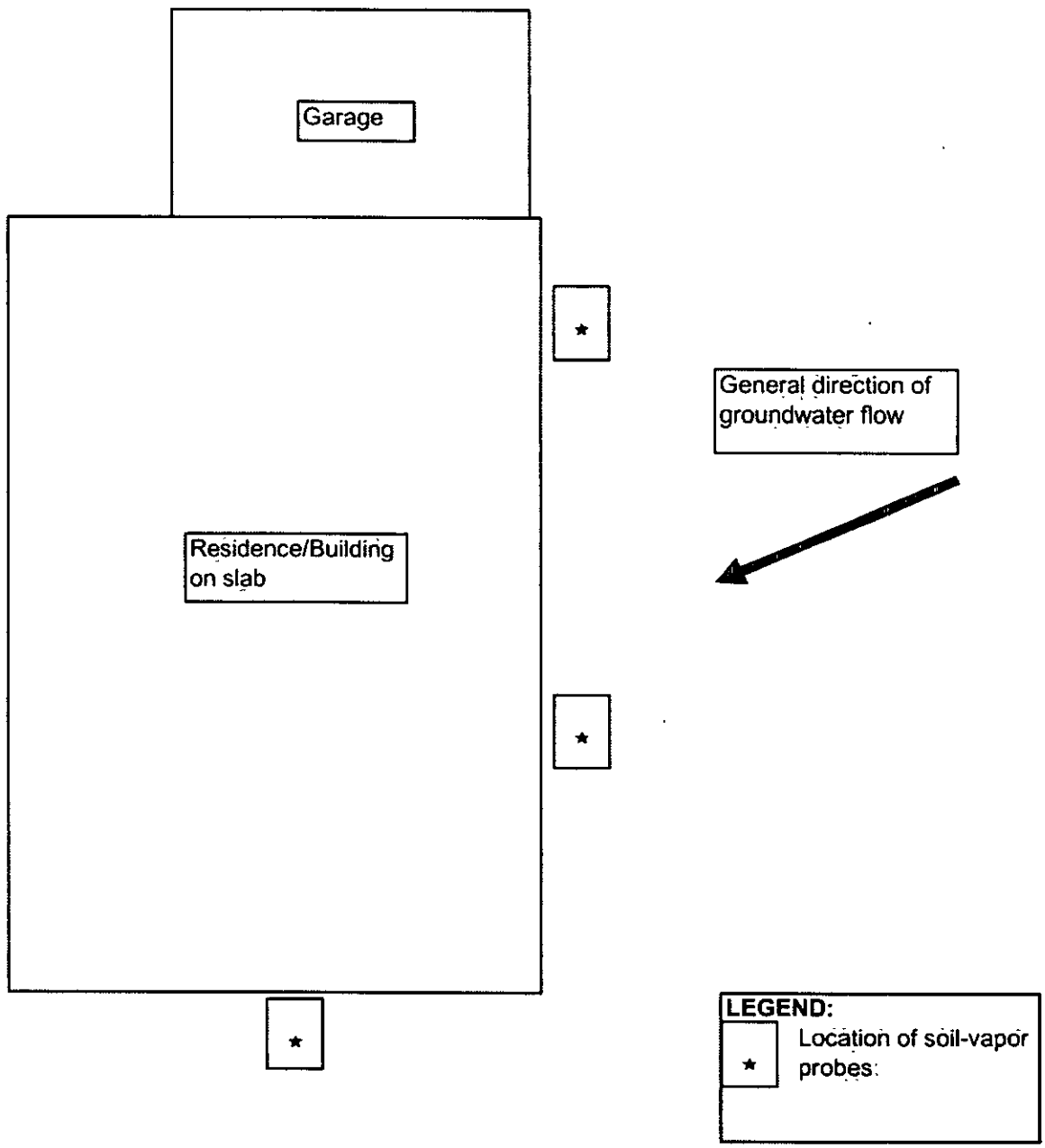
_____. 2006. *SOP #HW-31: Validating Air Samples Volatile Organic Analysis of Ambient Air in Canister by Method TO-15* (rev. 4). Hazardous Waste Support Branch, Wash, DC. http://www.epa.gov/region02/qa/documents.htm.

Figures

9531924

Figure F-1
Target Areas For Indoor Air Quality Monitoring
Dunn Field Offsite Plume RD
Memphis, TN

FIGURE F-3
Generalized locations of Soil Gas Samples
Dunn Field Offsite Plume RD



ATTACHMENT F-1

Health and Safety Plan

(To be added by Remedial Action Contractor)

ATTACHMENT F-2

US EPA TO-15: Determination of VOCs in Air Collected in Specialty-Prepared Canisters and Analyzed by GC/MS

EPA/625/R-96/010b

9531928

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air

Second Edition

Compendium Method TO-15

Determination Of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS)

Center for Environmental Research Information
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, OH 45268

January 1999

Method TO-15
Acknowledgements

This Method was prepared for publication in the *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition* (EPA/625/R-96/010b), which was prepared under Contract No. 68-C3-0315, WA No. 3-10, by Midwest Research Institute (MRI), as a subcontractor to Eastern Research Group, Inc. (ERG), and under the sponsorship of the U.S. Environmental Protection Agency (EPA). Justice A. Manning, John O. Burckle, and Scott Hedges, Center for Environmental Research Information (CERI), and Frank F. McElroy, National Exposure Research Laboratory (NERL), all in the EPA Office of Research and Development, were responsible for overseeing the preparation of this method. Additional support was provided by other members of the Compendia Workgroup, which include:

- John O. Burckle, EPA, ORD, Cincinnati, OH
- James L. Cheney, Corps of Engineers, Omaha, NB
- Michael Davis, U.S. EPA, Region 7, KC, KS
- Joseph B. Elkins Jr., U.S. EPA, OAQPS, RTP, NC
- Robert G. Lewis, U.S. EPA, NERL, RTP, NC
- Justice A. Manning, U.S. EPA, ORD, Cincinnati, OH
- William A. McClenny, U.S. EPA, NERL, RTP, NC
- Frank F. McElroy, U.S. EPA, NERL, RTP, NC
- Heidi Schultz, ERG, Lexington, MA
- William T. "Jerry" Winberry, Jr., EnviroTech Solutions, Cary, NC

This Method is the result of the efforts of many individuals. Gratitude goes to each person involved in the preparation and review of this methodology.

Author(s)

- William A. McClenny, U.S. EPA, NERL, RTP, NC
- Michael W. Holdren, Battelle, Columbus, OH

Peer Reviewers

- Karen Oliver, ManTech, RTP, NC
- Jim Cheney, Corps of Engineers, Omaha, NB
- Elizabeth Almasi, Varian Chromatography Systems, Walnut Creek, CA
- Norm Kirshen, Varian Chromatography Systems, Walnut Creek, CA
- Richard Jesser, Graseby, Smyrna, GA
- Bill Taylor, Graseby, Smyrna, GA
- Lauren Drees, U.S. EPA, NRMRL, Cincinnati, OH

Finally, recognition is given to Frances Beyer, Lynn Kaufman, Debbie Bond, Cathy Whitaker, and Kathy Johnson of Midwest Research Institute's Administrative Services staff whose dedication and persistence during the development of this manuscript has enabled it's production.

DISCLAIMER

This Compendium has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

9531930

METHOD TO-15

Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS)

TABLE OF CONTENTS

		Page
1.	Scope	15-1
2.	Summary of Method	15-2
3.	Significance	15-3
4.	Applicable Documents	15-4
	4.1 ASTM Standards	15-4
	4.2 EPA Documents	15-4
5.	Definitions	15-4
6.	Interferences and Contamination	15-6
7.	Apparatus and Reagents	15-6
	7.1 Sampling Apparatus	15-6
	7.2 Analytical Apparatus	15-8
	7.3 Calibration System and Manifold Apparatus	15-10
	7.4 Reagents	15-10
8.	Collection of Samples in Canisters	15-10
	8.1 Introduction	15-10
	8.2 Sampling System Description	15-11
	8.3 Sampling Procedure	15-12
	8.4 Cleaning and Certification Program	15-14
9.	GC/MS Analysis of Volatiles from Canisters	15-16
	9.1 Introduction	15-16
	9.2 Preparation of Standards	15-17
10.	GC/MS Operating Conditions	15-21
	10.1 Preconcentrator	15-21
	10.2 GC/MS System	15-22
	10.3 Analytical Sequence	15-22
	10.4 Instrument Performance Check	15-23
	10.5 Initial Calibration	15-23
	10.6 Daily Calibration	15-27
	10.7 Blank Analyses	15-27
	10.8 Sample Analysis	15-28

TABLE OF CONTENTS (continued)

	Page
11. Requirements for Demonstrating Method Acceptability for VOC Analysis from Canisters	15-31
11.1 Introduction	15-31
11.2 Method Detection Limit	15-31
11.3 Replicate Precision	15-31
11.4 Audit Accuracy	15-32
12. References	15-32

METHOD TO-15

Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS)

1. Scope

1.1 This method documents sampling and analytical procedures for the measurement of subsets of the 97 volatile organic compounds (VOCs) that are included in the 189 hazardous air pollutants (HAPs) listed in Title III of the Clean Air Act Amendments of 1990. VOCs are defined here as organic compounds having a vapor pressure greater than 10^{-1} Torr at 25 °C and 760 mm Hg. Table 1 is the list of the target VOCs along with their CAS number, boiling point, vapor pressure and an indication of their membership in both the list of VOCs covered by Compendium Method TO-14A (1) and the list of VOCs in EPA's Contract Laboratory Program (CLP) document entitled: *Statement-of-Work (SOW) for the Analysis of Air Toxics from Superfund Sites (2).*

Many of these compounds have been tested for stability in concentration when stored in specially-prepared canisters (see Section 8) under conditions typical of those encountered in routine ambient air analysis. The stability of these compounds under all possible conditions is not known. However, a model to predict compound losses due to physical adsorption of VOCs on canister walls and to dissolution of VOCs in water condensed in the canisters has been developed (3). Losses due to physical adsorption require only the establishment of equilibrium between the condensed and gas phases and are generally considered short term losses, (i.e., losses occurring over minutes to hours). Losses due to chemical reactions of the VOCs with cocollected ozone or other gas phase species also account for some short term losses. Chemical reactions between VOCs and substances inside the canister are generally assumed to cause the gradual decrease of concentration over time (i.e., long term losses over days to weeks). Loss mechanisms such as aqueous hydrolysis and biological degradation (4) also exist. No models are currently known to be available to estimate and characterize all these potential losses, although a number of experimental observations are referenced in Section 8. Some of the VOCs listed in Title III have short atmospheric lifetimes and may not be present except near sources.

1.2 This method applies to ambient concentrations of VOCs above 0.5 ppbv and typically requires VOC enrichment by concentrating up to one liter of a sample volume. The VOC concentration range for ambient air in many cases includes the concentration at which continuous exposure over a lifetime is estimated to constitute a 10^{-6} or higher lifetime risk of developing cancer in humans. Under circumstances in which many hazardous VOCs are present at 10^{-6} risk concentrations, the total risk may be significantly greater.

1.3 This method applies under most conditions encountered in sampling of ambient air into canisters. However, the composition of a gas mixture in a canister, under unique or unusual conditions, will change so that the sample is known not to be a true representation of the ambient air from which it was taken. For example, low humidity conditions in the sample may lead to losses of certain VOCs on the canister walls, losses that would not happen if the humidity were higher. If the canister is pressurized, then condensation of water from high humidity samples may cause fractional losses of water-soluble compounds. Since the canister surface area is limited, all gases are in competition for the available active sites. Hence an absolute storage stability cannot be assigned to a specific gas. Fortunately, under conditions of normal usage for sampling ambient air, most VOCs can be recovered from canisters near their original concentrations after storage times of up to thirty days (see Section 8).

1.4 Use of the Compendium Method TO-15 for many of the VOCs listed in Table 1 is likely to present two difficulties: (1) what calibration standard to use for establishing a basis for testing and quantitation, and (2) how

9531933

to obtain an audit standard. In certain cases a chemical similarity exists between a thoroughly tested compound and others on the Title III list. In this case, what works for one is likely to work for the other in terms of making standards. However, this is not always the case and some compound standards will be troublesome. The reader is referred to the Section 9.2 on standards for guidance. Calibration of compounds such as formaldehyde, diazomethane, and many of the others represents a challenge.

1.5 Compendium Method TO-15 should be considered for use when a subset of the 97 Title III VOCs constitute the target list. Typical situations involve ambient air testing associated with the permitting procedures for emission sources. In this case sampling and analysis of VOCs is performed to determine the impact of dispersing source emissions in the surrounding areas. Other important applications are prevalence and trend monitoring for hazardous VOCs in urban areas and risk assessments downwind of industrialized or source-impacted areas.

1.6 Solid adsorbents can be used in lieu of canisters for sampling of VOCs, provided the solid adsorbent packings, usually multisorbent packings in metal or glass tubes, can meet the performance criteria specified in Compendium Method TO-17 which specifically addresses the use of multisorbent packings. The two sample collection techniques are different but become the same upon movement of the sample from the collection medium (canister or multisorbent tubes) onto the sample concentrator. Sample collection directly from the atmosphere by automated gas chromatographs can be used in lieu of collection in canisters or on solid adsorbents.

2. Summary of Method

2.1 The atmosphere is sampled by introduction of air into a specially-prepared stainless steel canister. Both subatmospheric pressure and pressurized sampling modes use an initially evacuated canister. A pump ventilated sampling line is used during sample collection with most commercially available samplers. Pressurized sampling requires an additional pump to provide positive pressure to the sample canister. A sample of air is drawn through a sampling train comprised of components that regulate the rate and duration of sampling into the pre-evacuated and passivated canister.

2.2 After the air sample is collected, the canister valve is closed, an identification tag is attached to the canister, and the canister is transported to the laboratory for analysis.

2.3 Upon receipt at the laboratory, the canister tag data is recorded and the canister is stored until analysis. Storage times of up to thirty days have been demonstrated for many of the VOCs (5).

2.4 To analyze the sample, a known volume of sample is directed from the canister through a solid multisorbent concentrator. A portion of the water vapor in the sample breaks through the concentrator during sampling, to a degree depending on the multisorbent composition, duration of sampling, and other factors. Water content of the sample can be further reduced by dry purging the concentrator with helium while retaining target compounds. After the concentration and drying steps are completed, the VOCs are thermally desorbed, entrained in a carrier gas stream, and then focused in a small volume by trapping on a reduced temperature trap or small volume multisorbent trap. The sample is then released by thermal desorption and carried onto a gas chromatographic column for separation.

As a simple alternative to the multisorbent/dry purge water management technique, the amount of water vapor in the sample can be reduced below any threshold for affecting the proper operation of the analytical system by

reducing the sample size. For example, a small sample can be concentrated on a cold trap and released directly to the gas chromatographic column. The reduction in sample volume may require an enhancement of detector sensitivity.

Other water management approaches are also acceptable as long as their use does not compromise the attainment of the performance criteria listed in Section 11. A listing of some commercial water management systems is provided in Appendix A. One of the alternative ways to dry the sample is to separate VOCs from condensate on a low temperature trap by heating and purging the trap.

2.5 The analytical strategy for Compendium Method TO-15 involves using a high resolution gas chromatograph (GC) coupled to a mass spectrometer. If the mass spectrometer is a linear quadrupole system, it is operated either by continuously scanning a wide range of mass to charge ratios (SCAN mode) or by monitoring select ion monitoring mode (SIM) of compounds on the target list. If the mass spectrometer is based on a standard ion trap design, only a scanning mode is used (note however, that the Selected Ion Storage (SIS) mode for the ion trap has features of the SIM mode). Mass spectra for individual peaks in the total ion chromatogram are examined with respect to the fragmentation pattern of ions corresponding to various VOCs including the intensity of primary and secondary ions. The fragmentation pattern is compared with stored spectra taken under similar conditions, in order to identify the compound. For any given compound, the intensity of the primary fragment is compared with the system response to the primary fragment for known amounts of the compound. This establishes the compound concentration that exists in the sample.

Mass spectrometry is considered a more definitive identification technique than single specific detectors such as flame ionization detector (FID), electron capture detector (ECD), photoionization detector (PID), or a multidetector arrangement of these (see discussion in Compendium Method TO-14A). The use of both gas chromatographic retention time and the generally unique mass fragmentation patterns reduce the chances for misidentification. If the technique is supported by a comprehensive mass spectral database and a knowledgeable operator, then the correct identification and quantification of VOCs is further enhanced.

3. Significance

3.1 Compendium Method TO-15 is significant in that it extends the Compendium Method TO-14A description for using canister-based sampling and gas chromatographic analysis in the following ways:

- Compendium Method TO-15 incorporates a multisorbent/dry purge technique or equivalent (see Appendix A) for water management thereby addressing a more extensive set of compounds (the VOCs mentioned in Title III of the CAAA of 1990) than addressed by Compendium Method TO-14A. Compendium Method TO-14A approach to water management alters the structure or reduces the sample stream concentration of some VOCs, especially water-soluble VOCs.
- Compendium Method TO-15 uses the GC/MS technique as the only means to identify and quantitate target compounds. The GC/MS approach provides a more scientifically-defensible detection scheme which is generally more desirable than the use of single or even multiple specific detectors.
- In addition, Compendium Method TO-15 establishes method performance criteria for acceptance of data, allowing the use of alternate but equivalent sampling and analytical equipment. There are several new and viable commercial approaches for water management as noted in Appendix A of this method on which to base a VOC monitoring technique as well as other approaches to sampling (i.e., autoGCs and solid

9531935

adsorbents) that are often used. This method lists performance criteria that these alternatives must meet to be acceptable alternatives for monitoring ambient VOCs.

- Finally, Compendium Method TO-15 includes enhanced provisions for inherent quality control. The method uses internal analytical standards and frequent verification of analytical system performance to assure control of the analytical system. This more formal and better documented approach to quality control guarantees a higher percentage of good data.

3.2 With these features, Compendium Method TO-15 is a more general yet better defined method for VOCs than Compendium Method TO-14A. As such, the method can be applied with a higher confidence to reduce the uncertainty in risk assessments in environments where the hazardous volatile gases listed in the Title III of the Clean Air Act Amendments of 1990 are being monitored. An emphasis on risk assessments for human health and effects on the ecology is a current goal for the U.S. EPA.

4. Applicable Documents

4.1 ASTM Standards

- **Method D1356** *Definitions of Terms Relating to Atmospheric Sampling and Analysis.*
- **Method E260** *Recommended Practice for General Gas Chromatography Procedures.*
- **Method E355** *Practice for Gas Chromatography Terms and Relationships.*
- **Method D5466** *Standard Test Method of Determination of Volatile Organic Compounds in Atmospheres (Canister Sampling Methodology).*

4.2 EPA Documents

- *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II*, U. S. Environmental Protection Agency, EPA-600/R-94-038b, May 1994.
- *Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Ambient Air*, U. S. Environmental Protection Agency, EPA-600/4-83-027, June 1983.
- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air: Method TO-14, Second Supplement*, U. S. Environmental Protection Agency, EPA-600/4-89-018, March 1989.
- *Statement-of-Work (SOW) for the Analysis of Air Toxics from Superfund Sites*, U. S. Environmental Protection Agency, Office of Solid Waste, Washington, D.C., Draft Report, June 1990.
- *Clean Air Act Amendments of 1990*, U. S. Congress, Washington, D.C., November 1990.

5. Definitions

[Note: Definitions used in this document and any user-prepared standard operating procedures (SOPs) should be consistent with ASTM Methods D1356, E260, and E355. Aside from the definitions given below, all pertinent abbreviations and symbols are defined within this document at point of use.]

5.1 Gauge Pressure—pressure measured with reference to the surrounding atmospheric pressure, usually expressed in units of kPa or psi. Zero gauge pressure is equal to atmospheric (barometric) pressure.

5.2 Absolute Pressure—pressure measured with reference to absolute zero pressure, usually expressed in units of kPa, or psi.

5.3 Cryogen—a refrigerant used to obtain sub-ambient temperatures in the VOC concentrator and/or on front of the analytical column. Typical cryogens are liquid nitrogen (bp -195.8°C), liquid argon (bp -185.7°C), and liquid CO_2 (bp -79.5°C).

5.4 Dynamic Calibration—calibration of an analytical system using calibration gas standard concentrations in a form identical or very similar to the samples to be analyzed and by introducing such standards into the inlet of the sampling or analytical system from a manifold through which the gas standards are flowing.

5.5 Dynamic Dilution—means of preparing calibration mixtures in which standard gas(es) from pressurized cylinders are continuously blended with humidified zero air in a manifold so that a flowing stream of calibration mixture is available at the inlet of the analytical system.

5.6 MS-SCAN—mass spectrometric mode of operation in which the gas chromatograph (GC) is coupled to a mass spectrometer (MS) programmed to SCAN all ions repeatedly over a specified mass range.

5.7 MS-SIM—mass spectrometric mode of operation in which the GC is coupled to a MS that is programmed to scan a selected number of ions repeatedly [i.e., selected ion monitoring (SIM) mode].

5.8 Qualitative Accuracy—the degree of measurement accuracy required to correctly identify compounds with an analytical system.

5.9 Quantitative Accuracy—the degree of measurement accuracy required to correctly measure the concentration of an identified compound with an analytical system with known uncertainty.

5.10 Replicate Precision—precision determined from two canisters filled from the same air mass over the same time period and determined as the absolute value of the difference between the analyses of canisters divided by their average value and expressed as a percentage (see Section 11 for performance criteria for replicate precision).

5.11 Duplicate Precision—precision determined from the analysis of two samples taken from the same canister. The duplicate precision is determined as the absolute value of the difference between the canister analyses divided by their average value and expressed as a percentage.

5.12 Audit Accuracy—the difference between the analysis of a sample provided in an audit canister and the nominal value as determined by the audit authority, divided by the audit value and expressed as a percentage (see Section 11 for performance criteria for audit accuracy).

6. Interferences and Contamination

6.1 Very volatile compounds, such as chloromethane and vinyl chloride can display peak broadening and co-elution with other species if the compounds are not delivered to the GC column in a small volume of carrier gas. Refocusing of the sample after collection on the primary trap, either on a separate focusing trap or at the head of the gas chromatographic column, mitigates this problem.

6.2 Interferences in canister samples may result from improper use or from contamination of: (1) the canisters due to poor manufacturing practices, (2) the canister cleaning apparatus, and (3) the sampling or analytical system. Attention to the following details will help to minimize the possibility of contamination of canisters.

6.2.1 Canisters should be manufactured using high quality welding and cleaning techniques, and new canisters should be filled with humidified zero air and then analyzed, after "aging" for 24 hours, to determine cleanliness. The cleaning apparatus, sampling system, and analytical system should be assembled of clean, high quality components and each system should be shown to be free of contamination.

6.2.2 Canisters should be stored in a contaminant-free location and should be capped tightly during shipment to prevent leakage and minimize any compromise of the sample.

6.2.3 Impurities in the calibration dilution gas (if applicable) and carrier gas, organic compounds out-gassing from the system components ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified zero air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with Buna-N rubber components must be avoided.

6.2.4 Significant contamination of the analytical equipment can occur whenever samples containing high VOC concentrations are analyzed. This in turn can result in carryover contamination in subsequent analyses. Whenever a high concentration (>25 ppbv of a trace species) sample is encountered, it should be followed by an analysis of humid zero air to check for carry-over contamination.

6.2.5 In cases when solid sorbents are used to concentrate the sample prior to analysis, the sorbents should be tested to identify artifact formation (see Compendium Method TO-17 for more information on artifacts).

7. Apparatus and Reagents

[Note: Compendium Method To-14A list more specific requirements for sampling and analysis apparatus which may be of help in identifying options. The listings below are generic.]

7.1 Sampling Apparatus

[Note: Subatmospheric pressure and pressurized canister sampling systems are commercially available and have been used as part of U.S. Environmental Protection Agency's Toxic Air Monitoring Stations (TAMS), Urban Air Toxic Monitoring Program (UATMP), the non-methane organic compound (NMOC) sampling and analysis program, and the Photochemical Assessment Monitoring Stations (PAMS).]

7.1.1 Subatmospheric Pressure (see Figure 1, without metal bellows type pump).

7.1.1.1 Sampling Inlet Line. Stainless steel tubing to connect the sampler to the sample inlet.

7.1.1.2 Sample Canister. Leak-free stainless steel pressure vessels of desired volume (e.g., 6 L), with valve and specially prepared interior surfaces (see Appendix B for a listing of known manufacturers/resellers of canisters).

7.1.1.3 Stainless Steel Vacuum/Pressure Gauges. Two types are required, one capable of measuring vacuum (–100 to 0 kPa or 0 to - 30 in Hg) and pressure (0–206 kPa or 0–30 psig) in the sampling system and a second type (for checking the vacuum of canisters during cleaning) capable of measuring at 0.05 mm Hg (see Appendix B) within 20%. Gauges should be tested clean and leak tight.

7.1.1.4 Electronic Mass Flow Controller. Capable of maintaining a constant flow rate (± 10%) over a sampling period of up to 24 hours and under conditions of changing temperature (20–40°C) and humidity.

7.1.1.5 Particulate Matter Filter. 2-μm sintered stainless steel in-line filter.

7.1.1.6 Electronic Timer. For unattended sample collection.

7.1.1.7 Solenoid Valve. Electrically-operated, bi-stable solenoid valve with Viton® seat and O-rings. A Skinner Magnelatch valve is used for purposes of illustration in the text (see Figure 2).

7.1.1.8 Chromatographic Grade Stainless Steel Tubing and Fittings. For interconnections. All such materials in contact with sample, analyte, and support gases prior to analysis should be chromatographic grade stainless steel or equivalent.

7.1.1.9 Thermostatically Controlled Heater. To maintain above ambient temperature inside insulated sampler enclosure.

7.1.1.10 Heater Thermostat. Automatically regulates heater temperature.

7.1.1.11 Fan. For cooling sampling system.

7.1.1.12 Fan Thermostat. Automatically regulates fan operation.

7.1.1.13 Maximum-Minimum Thermometer. Records highest and lowest temperatures during sampling period.

7.1.1.14 Stainless Steel Shut-off Valve. Leak free, for vacuum/pressure gauge.

7.1.1.15 Auxiliary Vacuum Pump. Continuously draws air through the inlet manifold at 10 L/min. or higher flow rate. Sample is extracted from the manifold at a lower rate, and excess air is exhausted.

[Note: The use of higher inlet flow rates dilutes any contamination present in the inlet and reduces the possibility of sample contamination as a result of contact with active adsorption sites on inlet walls.]

7.1.1.16 Elapsed Time Meter. Measures duration of sampling.

7.1.1.17 Optional Fixed Orifice, Capillary, or Adjustable Micrometering Valve. May be used in lieu of the electronic flow controller for grab samples or short duration time-integrated samples. Usually appropriate only in situations where screening samples are taken to assess future sampling activity.

7.1.2 Pressurized (see Figure 1 with metal bellows type pump and Figure 3).

7.1.2.1 Sample Pump. Stainless steel, metal bellows type, capable of 2 atmospheres output pressure. Pump must be free of leaks, clean, and uncontaminated by oil or organic compounds.

[Note: An alternative sampling system has been developed by Dr. R. Rasmussen, The Oregon Graduate Institute of Science and Technology, 20000 N.W. Walker Rd., Beaverton, Oregon 97006, 503-690-1077, and is illustrated in Figure 3. This flow system uses, in order, a pump, a mechanical flow regulator, and a mechanical compensation flow restrictive device. In this configuration the pump is purged with a large sample flow, thereby eliminating the need for an auxiliary vacuum pump to flush the sample inlet.]

7.1.2.2 Other Supporting Materials. All other components of the pressurized sampling system are similar to components discussed in Sections 7.1.1.1 through 7.1.1.17.

7.2 Analytical Apparatus

7.2.1 Sampling/Concentrator System (many commercial alternatives are available).

7.2.1.1 Electronic Mass Flow Controllers. Used to maintain constant flow (for purge gas, carrier gas and sample gas) and to provide an analog output to monitor flow anomalies.

7.2.1.2 Vacuum Pump. General purpose laboratory pump, capable of reducing the downstream pressure of the flow controller to provide the pressure differential necessary to maintain controlled flow rates of sample air.

7.2.1.3 Stainless Steel Tubing and Stainless Steel Fittings. Coated with fused silica to minimize active adsorption sites.

9531939

7.2.1.4 Stainless Steel Cylinder Pressure Regulators. Standard, two-stage cylinder regulators with pressure gauges.

7.2.1.5 Gas Purifiers. Used to remove organic impurities and moisture from gas streams.

7.2.1.6 Six-port Gas Chromatographic Valve. For routing sample and carrier gas flows.

7.2.1.7 Multisorbent Concentrator. Solid adsorbent packing with various retentive properties for adsorbing trace gases are commercially available from several sources. The packing contains more than one type of adsorbent packed in series.

7.2.1.7.1 A pre-packed adsorbent trap (Supelco 2-0321) containing 200 mg Carbopack B (60/80 mesh) and 50 mg Carbosieve S-III (60/80 mesh) has been found to retain VOCs and allow some water vapor to pass through (6). The addition of a dry purging step allows for further water removal from the adsorbent trap. The steps constituting the dry purge technique that are normally used with multisorbent traps are illustrated in Figure 4. The optimum trapping and dry purging procedure for the Supelco trap consists of a sample volume of 320 mL and a dry nitrogen purge of 1300 mL. Sample trapping and drying is carried out at 25°C. The trap is back-flushed with helium and heated to 220°C to transfer material onto the GC column. A trap bake-out at 260°C for 5 minutes is conducted after each run.

7.2.1.7.2 An example of the effectiveness of dry purging is shown in Figure 5. The multisorbent used in this case is Tenax/Ambersorb 340/Charcoal (7). Approximately 20% of the initial water content in the sample remains after sampling 500 mL of air. The detector response to water vapor (hydrogen atoms detected by atomic emission detection) is plotted versus purge gas volume. Additional water reduction by a factor of 8 is indicated at temperatures of 45°C or higher. Still further water reduction is possible using a two-stage concentration/dryer system.

7.2.1.8 Cryogenic Concentrator. Complete units are commercially available from several vendor sources. The characteristics of the latest concentrators include a rapid, "ballistic" heating of the concentrator to release any trapped VOCs into a small carrier gas volume. This facilitates the separation of compounds on the gas chromatographic column.

7.2.2 Gas Chromatographic/Mass Spectrometric (GC/MS) System.

7.2.2.1 Gas Chromatograph. The gas chromatographic (GC) system must be capable of temperature programming. The column oven can be cooled to subambient temperature (e.g., -50°C) at the start of the gas chromatographic run to effect a resolution of the very volatile organic compounds. In other designs, the rate of release of compounds from the focusing trap in a two stage system obviates the need for retrapping of compounds on the column. The system must include or be interfaced to a concentrator and have all required accessories including analytical columns and gases. All GC carrier gas lines must be constructed from stainless steel or copper tubing. Non-polytetrafluoroethylene (PTFE) thread sealants or flow controllers with Buna-N rubber components must not be used.

7.2.2.2 Chromatographic Columns. 100% methyl silicone or 5% phenyl, 95% methyl silicone fused silica capillary columns of 0.25- to 0.53-mm I.D. of varying lengths are recommended for separation of many of the possible subsets of target compounds involving nonpolar compounds. However, considering the diversity of the target list, the choice is left to the operator subject to the performance standards given in Section 11.

7.2.2.3 Mass Spectrometer. Either a linear quadrupole or ion trap mass spectrometer can be used as long as it is capable of scanning from 35 to 300 amu every 1 second or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode, and producing a mass spectrum which meets all the instrument performance acceptance criteria when 50 ng or less of p-bromofluorobenzene (BFB) is analyzed.

7.2.2.3.1 Linear Quadrupole Technology. A simplified diagram of the heart of the quadrupole mass spectrometer is shown in Figure 6. The quadrupole consists of a parallel set of four rod electrodes mounted in a square configuration. The field within the analyzer is created by coupling opposite pairs of rods together and applying radiofrequency (RF) and direct current (DC) potentials between the pairs of rods. Ions created in the ion source from the reaction of column eluates with electrons from the electron source are moved through the

parallel array of rods under the influence of the generated field. Ions which are successfully transmitted through the quadrupole are said to possess stable trajectories and are subsequently recorded with the detection system. When the DC potential is zero, a wide band of m/z values is transmitted through the quadrupole. This "RF only" mode is referred to as the "total-ion" mode. In this mode, the quadrupole acts as a strong focusing lens analogous to a high pass filter. The amplitude of the RF determines the low mass cutoff. A mass spectrum is generated by scanning the DC and RF voltages using a fixed DC/RF ratio and a constant drive frequency or by scanning the frequency and holding the DC and RF constant. With the quadrupole system only 0.1 to 0.2 percent of the ions formed in the ion source actually reach the detector.

7.2.2.3.2Ion Trap Technology. An ion-trap mass spectrometer consists of a chamber formed between two metal surfaces in the shape of a hyperboloid of one sheet (ring electrode) and a hyperboloid of two sheets (the two end-cap electrodes). Ions are created within the chamber by electron impact from an electron beam admitted through a small aperture in one of the end caps. Radio frequency (RF) (and sometimes direct current voltage offsets) are applied between the ring electrode and the two end-cap electrodes establishing a quadrupole electric field. This field is uncoupled in three directions so that ion motion can be considered independently in each direction; the force acting upon an ion increases with the displacement of the ion from the center of the field but the direction of the force depends on the instantaneous voltage applied to the ring electrode. A restoring force along one coordinate (such as the distance, r, from the ion-trap's axis of radial symmetry) will exist concurrently with a repelling force along another coordinate (such as the distance, z, along the ion traps axis), and if the field were static the ions would eventually strike an electrode. However, in an RF field the force along each coordinate alternates direction so that a stable trajectory may be possible in which the ions do not strike a surface. In practice, ions of appropriate mass-to-charge ratios may be trapped within the device for periods of milliseconds to hours. A diagram of a typical ion trap is illustrated in Figure 7. Analysis of stored ions is performed by increasing the RF voltage, which makes the ions successively unstable. The effect of the RF voltage on the ring electrode is to "squeeze" the ions in the xy plane so that they move along the z axis. Half the ions are lost to the top cap (held at ground potential); the remaining ions exit the lower end cap to be detected by the electron multiplier. As the energy applied to the ring electrode is increased, the ions are collected in order of increasing mass to produce a conventional mass spectrum. With the ion trap, approximately 50 percent of the generated ions are detected. As a result, a significant increase in sensitivity can be achieved when compared to a full scan linear quadrupole system.

7.2.2.4 GC/MS Interface. Any gas chromatograph to mass spectrometer interface that gives acceptable calibration points for each of the analytes of interest and can be used to achieve all acceptable performance criteria may be used. Gas chromatograph to mass spectrometer interfaces constructed of all-glass, glass-lined, or fused silica-lined materials are recommended. Glass and fused silica should be deactivated.

7.2.2.5 Data System. The computer system that is interfaced to the mass spectrometer must allow the continuous acquisition and storage, on machine readable media, of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number. This type of plot is defined as a Selected Ion Current Profile (SICP). Software must also be available that allows integrating the abundance in any SICP between specified time or scan number limits. Also, software must be available that allows for the comparison of sample spectra with reference library spectra. The National Institute of Standards and Technology (NIST) or Wiley Libraries or equivalent are recommended as reference libraries.

7.2.2.6 Off-line Data Storage Device. Device must be capable of rapid recording and retrieval of data and must be suitable for long-term, off-line data storage.

7.3 Calibration System and Manifold Apparatus (see Figure 8)

7.3.1 Calibration Manifold. Stainless steel, glass, or high purity quartz manifold, (e.g.,1.25-cm I.D. x 66-cm) with sampling ports and internal baffles for flow disturbance to ensure proper mixing. The manifold should be heated to ~50°C.

7.3.2 Humidifier. 500-mL impinger flask containing HPLC grade deionized water.

7.3.3 Electronic Mass Flow Controllers. One 0 to 5 L/min unit and one or more 0 to 100 mL/min units for air, depending on number of cylinders in use for calibration.

7.3.4 Teflon Filter(s). 47-mm Teflon® filter for particulate collection.

7.4 Reagents

7.4.1 Neat Materials or Manufacturer-Certified Solutions/Mixtures. Best source (see Section 9).

7.4.2 Helium and Air. Ultra-high purity grade in gas cylinders. He is used as carrier gas in the GC.

7.4.3 Liquid Nitrogen or Liquid Carbon Dioxide. Used to cool secondary trap.

7.4.4 Deionized Water. High performance liquid chromatography (HPLC) grade, ultra-high purity (for humidifier).

8. Collection of Samples in Canisters

8.1 Introduction

8.1.1 Canister samplers, sampling procedures, and canister cleaning procedures have not changed very much from the description given in the original Compendium Method TO-14. Much of the material in this section is therefore simply a restatement of the material given in Compendium Method TO-14, repeated here in order to have all the relevant information in one place.

8.1.2 Recent notable additions to the canister technology has been in the application of canister-based systems for example, to microenvironmental monitoring (8), the capture of breath samples (9), and sector sampling to identify emission sources of VOCs (10).

8.1.3 EPA has also sponsored the development of a mathematical model to predict the storage stability of arbitrary mixtures of trace gases in humidified air (3), and the investigation of the SilcoSteel™ process of coating the canister interior with a film of fused silica to reduce surface activity (11). A recent summary of storage stability data for VOCs in canisters is given in the open literature (5).

8.2 Sampling System Description

8.2.1 Subatmospheric Pressure Sampling [see Figure 1 (without metal bellows type pump)].

8.2.1.1 In preparation for subatmospheric sample collection in a canister, the canister is evacuated to 0.05 mm Hg (see Appendix C for discussion of evacuation pressure). When the canister is opened to the atmosphere containing the VOCs to be sampled, the differential pressure causes the sample to flow into the canister. This technique may be used to collect grab samples (duration of 10 to 30 seconds) or time-weighted-average (TWA) samples (duration of 1-24 hours) taken through a flow-restrictive inlet (e.g., mass flow controller, critical orifice).

8.2.1.2 With a critical orifice flow restrictor, there will be a decrease in the flow rate as the pressure approaches atmospheric. However, with a mass flow controller, the subatmospheric sampling system can maintain a constant flow rate from full vacuum to within about 7 kPa (1.0 psi) or less below ambient pressure.

8.2.2 Pressurized Sampling [see Figure 1 (with metal bellows type pump)].

8.2.2.1 Pressurized sampling is used when longer-term integrated samples or higher volume samples are required. The sample is collected in a canister using a pump and flow control arrangement to achieve a typical 101-202 kPa (15-30 psig) final canister pressure. For example, a 6-liter evacuated canister can be filled at 10 mL/min for 24 hours to achieve a final pressure of 144 kPa (21 psig).

8.2.2.2 In pressurized canister sampling, a metal bellows type pump draws in air from the sampling manifold to fill and pressurize the sample canister.

8.2.3 All Samplers.

8.2.3.1 A flow control device is chosen to maintain a constant flow into the canister over the desired sample period. This flow rate is determined so the canister is filled (to about 88.1 kPa for subatmospheric pressure sampling or to about one atmosphere above ambient pressure for pressurized sampling) over the desired sample period. The flow rate can be calculated by:

$$F = \frac{P \times V}{T \times 60}$$

where:

F = flow rate, mL/min.

P = final canister pressure, atmospheres absolute. P is approximately equal to

$$\frac{\text{kPa gauge}}{101.2} + 1$$

V = volume of the canister, mL.

T = sample period, hours.

For example, if a 6-L canister is to be filled to 202 kPa (2 atmospheres) absolute pressure in 24 hours, the flow rate can be calculated by:

$$F = \frac{2 \times 6000}{24 \times 60} = 8.3 \text{ mL/min}$$

8.2.3.2 For automatic operation, the timer is designed to start and stop the pump at appropriate times for the desired sample period. The timer must also control the solenoid valve, to open the valve when starting the pump and to close the valve when stopping the pump.

8.2.3.3 The use of the Skinner Magnelatch valve (see Figure 2) avoids any substantial temperature rise that would occur with a conventional, normally closed solenoid valve that would have to be energized during the entire sample period. The temperature rise in the valve could cause outgassing of organic compounds from the Viton® valve seat material. The Skinner Magnelatch valve requires only a brief electrical pulse to open or close at the appropriate start and stop times and therefore experiences no temperature increase. The pulses may be obtained either with an electronic timer that can be programmed for short (5 to 60 seconds) ON periods, or with a conventional mechanical timer and a special pulse circuit. A simple electrical pulse circuit for operating the Skinner Magnelatch solenoid valve with a conventional mechanical timer is illustrated in Figure 2(a). However, with this simple circuit, the valve may operate unreliably during brief power interruptions or if the timer is manually switched on and off too fast. A better circuit incorporating a time-delay relay to provide more reliable valve operation is shown in Figure 2(b).

8.2.3.4 The connecting lines between the sample inlet and the canister should be as short as possible to minimize their volume. The flow rate into the canister should remain relatively constant over the entire sampling period.

8.2.3.5 As an option, a second electronic timer may be used to start the auxiliary pump several hours prior to the sampling period to flush and condition the inlet line.

8.2.3.6 Prior to field use, each sampling system must pass a humid zero air certification (see Section 8.4.3). All plumbing should be checked carefully for leaks. The canisters must also pass a humid zero air certification before use (see Section 8.4.1).

8.3 Sampling Procedure

8.3.1 The sample canister should be cleaned and tested according to the procedure in Section 8.4.1.

8.3.2 A sample collection system is assembled as shown in Figures 1 and 3 and must be cleaned according to the procedure outlined in Sections 8.4.2 and 8.4.4.

[Note: The sampling system should be contained in an appropriate enclosure.]

8.3.3 Prior to locating the sampling system, the user may want to perform "screening analyses" using a portable GC system, as outlined in Appendix B of Compendium Method TO-14A, to determine potential volatile organics present and potential "hot spots." The information gathered from the portable GC screening analysis would be used in developing a monitoring protocol, which includes the sampling system location, based upon the "screening analysis" results.

8.3.4 After "screening analysis," the sampling system is located. Temperatures of ambient air and sampler box interior are recorded on the canister sampling field test data sheet (FTDS), as documented in Figure 9.

[Note: The following discussion is related to Figure 1]

8.3.5 To verify correct sample flow, a "practice" (evacuated) canister is used in the sampling system.

[Note: For a subatmospheric sampler, a flow meter and practice canister are needed. For the pump-driven system, the practice canister is not needed, as the flow can be measured at the outlet of the system.]

A certified mass flow meter is attached to the inlet line of the manifold, just in front of the filter. The canister is opened. The sampler is turned on and the reading of the certified mass flow meter is compared to the sampler mass flow controller. The values should agree within ±10%. If not, the sampler mass flow meter needs to be recalibrated or there is a leak in the system. This should be investigated and corrected.

[Note: Mass flow meter readings may drift. Check the zero reading carefully and add or subtract the zero reading when reading or adjusting the sampler flow rate to compensate for any zero drift.]

After 2 minutes, the desired canister flow rate is adjusted to the proper value (as indicated by the certified mass flow meter) by the sampler flow control unit controller (e.g., 3.5 mL/min for 24 hr, 7.0 mL/min for 12 hr). Record final flow under "CANISTER FLOW RATE" on the FTDS.

8.3.6 The sampler is turned off and the elapsed time meter is reset to 000.0.

[Note: Whenever the sampler is turned off, wait at least 30 seconds to turn the sampler back on.]

8.3.7 The "practice" canister and certified mass flow meter are disconnected and a clean certified (see Section 8.4.1) canister is attached to the system.

8.3.8 The canister valve and vacuum/pressure gauge valve are opened.

8.3.9 Pressure/vacuum in the canister is recorded on the canister FTDS (see Figure 9) as indicated by the sampler vacuum/pressure gauge.

8.3.10 The vacuum/pressure gauge valve is closed and the maximum-minimum thermometer is reset to current temperature. Time of day and elapsed time meter readings are recorded on the canister FTDS.

8.3.11 The electronic timer is set to start and stop the sampling period at the appropriate times. Sampling starts and stops by the programmed electronic timer.

8.3.12 After the desired sampling period, the maximum, minimum, current interior temperature and current ambient temperature are recorded on the FTDS. The current reading from the flow controller is recorded.

8.3.13 At the end of the sampling period, the vacuum/pressure gauge valve on the sampler is briefly opened and closed and the pressure/vacuum is recorded on the FTDS. Pressure should be close to desired pressure.

[Note: For a subatmospheric sampling system, if the canister is at atmospheric pressure when the field final pressure check is performed, the sampling period may be suspect. This information should be noted on the sampling field data sheet.]

Time of day and elapsed time meter readings are also recorded.

8.3.14 The canister valve is closed. The sampling line is disconnected from the canister and the canister is removed from the system. For a subatmospheric system, a certified mass flow meter is once again connected to the inlet manifold in front of the in-line filter and a "practice" canister is attached to the Magnelatch valve of the sampling system. The final flow rate is recorded on the canister FTDS (see Figure 9).

[Note: For a pressurized system, the final flow may be measured directly.]

The sampler is turned off.

8.3.15 An identification tag is attached to the canister. Canister serial number, sample number, location, and date, as a minimum, are recorded on the tag. The canister is routinely transported back to the analytical laboratory with other canisters in a canister shipping case.

8.4 Cleaning and Certification Program

8.4.1 Canister Cleaning and Certification.

8.4.1.1 All canisters must be clean and free of any contaminants before sample collection.

8.4.1.2 All canisters are leak tested by pressurizing them to approximately 206 kPa (30 psig) with zero air.

[Note: The canister cleaning system in Figure 10 can be used for this task.]

The initial pressure is measured, the canister valve is closed, and the final pressure is checked after 24 hours. If acceptable, the pressure should not vary more than ± 13.8 kPa (± 2 psig) over the 24 hour period.

8.4.1.3 A canister cleaning system may be assembled as illustrated in Figure 10. Cryogen is added to both the vacuum pump and zero air supply traps. The canister(s) are connected to the manifold. The vent shut-off valve and the canister valve(s) are opened to release any remaining pressure in the canister(s). The vacuum pump is started and the vent shut-off valve is then closed and the vacuum shut-off valve is opened. The canister(s) are evacuated to <0.05 mm Hg (see Appendix B) for at least 1 hour.

[Note: On a daily basis or more often if necessary, the cryogenic traps should be purged with zero air to remove any trapped water from previous canister cleaning cycles.]

Air released/evacuated from canisters should be diverted to a fume hood.

8.4.1.4 The vacuum and vacuum/pressure gauge shut-off valves are closed and the zero air shut-off valve is opened to pressurize the canister(s) with humid zero air to approximately 206 kPa (30 psig). If a zero gas generator system is used, the flow rate may need to be limited to maintain the zero air quality.

8.4.1.5 The zero air shut-off valve is closed and the canister(s) is allowed to vent down to atmospheric pressure through the vent shut-off valve. The vent shut-off valve is closed. Repeat Sections 8.4.1.3 through 8.4.1.5 two additional times for a total of three (3) evacuation/pressurization cycles for each set of canisters.

8.4.1.6 At the end of the evacuation/pressurization cycle, the canister is pressurized to 206 kPa (30 psig) with humid zero air. The canister is then analyzed by a GC/MS analytical system. Any canister that has not tested clean (compared to direct analysis of humidified zero air of less than 0.2 ppbv of targeted VOCs) should not be used. As a "blank" check of the canister(s) and cleanup procedure, the final humid zero air fill of 100% of the canisters is analyzed until the cleanup system and canisters are proven reliable (less than 0.2 ppbv of any target VOCs). The check can then be reduced to a lower percentage of canisters.

8.4.1.7 The canister is reattached to the cleaning manifold and is then reevacuated to <0.05 mm Hg (see Appendix B) and remains in this condition until used. The canister valve is closed. The canister is removed from the cleaning system and the canister connection is capped with a stainless steel fitting. The canister is now ready for collection of an air sample. An identification tag is attached to the inlet of each canister for field notes and chain-of-custody purposes. An alternative to evacuating the canister at this point is to store the canisters and reevacuate them just prior to the next use.

8.4.1.8 As an option to the humid zero air cleaning procedures, the canisters are heated in an isothermal oven not to exceed 100°C during evacuation of the canister to ensure that higher molecular weight compounds are not retained on the walls of the canister.

[Note: For sampling more complex VOC mixtures the canisters should be heated to higher temperatures during the cleaning procedure although a special high temperature valve would be needed].

Once heated, the canisters are evacuated to <0.05 mm Hg (see Appendix B) and maintained there for 1 hour. At the end of the heated/evacuated cycle, the canisters are pressurized with humid zero air and analyzed by a GC/MS system after a minimum of 12 hrs of "aging." Any canister that has not tested clean (less than 0.2 ppbv each of targeted compounds) should not be used. Once tested clean, the canisters are reevacuated to <0.05 mm Hg (see Appendix B) and remain in the evacuated state until used. As noted in Section 8.4.1.7, reevacuation can occur just prior to the next use.

8.4.2 Cleaning Sampling System Components.

8.4.2.1 Sample components are disassembled and cleaned before the sampler is assembled. Nonmetallic parts are rinsed with HPLC grade deionized water and dried in a vacuum oven at 50°C. Typically, stainless steel parts and fittings are cleaned by placing them in a beaker of methanol in an ultrasonic bath for 15 minutes. This procedure is repeated with hexane as the solvent.

8.4.2.2 The parts are then rinsed with HPLC grade deionized water and dried in a vacuum oven at 100°C for 12 to 24 hours.

8.4.2.3 Once the sampler is assembled, the entire system is purged with humid zero air for 24 hours.

8.4.3 Zero Air Certification.

[Note: In the following sections, "certification" is defined as evaluating the sampling system with humid zero air and humid calibration gases that pass through all active components of the sampling system. The system is "certified" if no significant additions or deletions (less than 0.2 ppbv each of target compounds) have occurred when challenged with the test gas stream.]

8.4.3.1 The cleanliness of the sampling system is determined by testing the sampler with humid zero air without an evacuated gas sampling canister, as follows.

8.4.3.2 The calibration system and manifold are assembled, as illustrated in Figure 8. The sampler (without an evacuated gas canister) is connected to the manifold and the zero air cylinder is activated to generate a humid gas stream (2 L/min) to the calibration manifold [see Figure 8(b)].

8.4.3.3 The humid zero gas stream passes through the calibration manifold, through the sampling system (without an evacuated canister) to the water management system/VOC preconcentrator of an analytical system.

[Note: The exit of the sampling system (without the canister) replaces the canister in Figure 11.]

After the sample volume (e.g., 500 mL) is preconcentrated on the trap, the trap is heated and the VOCs are thermally desorbed and refocussed on a cold trap. This trap is heated and the VOCs are thermally desorbed onto the head of the capillary column. The VOCs are refocussed prior to gas chromatographic separation. Then, the oven temperature (programmed) increases and the VOCs begin to elute and are detected by a GC/MS (see Section 10) system. The analytical system should not detect greater than 0.2 ppbv of any targeted VOCs in order for the sampling system to pass the humid zero air certification test. Chromatograms (using an FID) of a certified sampler and contaminated sampler are illustrated in Figures 12(a) and 12(b), respectively. If the sampler passes the humid zero air test, it is then tested with humid calibration gas standards containing selected VOCs at concentration levels expected in field sampling (e.g., 0.5 to 2 ppbv) as outlined in Section 8.4.4.

8.4.4 Sampler System Certification with Humid Calibration Gas Standards from a Dynamic Calibration System

8.4.4.1 Assemble the dynamic calibration system and manifold as illustrated in Figure 8.

8.4.4.2 Verify that the calibration system is clean (less than 0.2 ppbv of any target compounds) by sampling a humidified gas stream, *without* gas calibration standards, with a previously certified clean canister (see Section 8.1).

8.4.4.3 The assembled dynamic calibration system is certified clean if less than 0.2 ppbv of any targeted compounds is found.

8.4.4.4 For generating the humidified calibration standards, the calibration gas cylinder(s) containing nominal concentrations of 10 ppmv in nitrogen of selected VOCs is attached to the calibration system as illustrated in Figure 8. The gas cylinders are opened and the gas mixtures are passed through 0 to 10 mL/min certified mass flow controllers to generate ppb levels of calibration standards.

8.4.4.5 After the appropriate equilibrium period, attach the sampling system (containing a certified evacuated canister) to the manifold, as illustrated in Figure 8(b).

8.4.4.6 Sample the dynamic calibration gas stream with the sampling system.

8.4.4.7 Concurrent with the sampling system operation, realtime monitoring of the calibration gas stream is accomplished by the on-line GC/MS analytical system [Figure 8(a)] to provide reference concentrations of generated VOCs.

8.4.4.8 At the end of the sampling period (normally the same time period used for experiments), the sampling system canister is analyzed and compared to the reference GC/MS analytical system to determine if the concentration of the targeted VOCs was increased or decreased by the sampling system.

8.4.4.9 A recovery of between 90% and 110% is expected for all targeted VOCs.

8.4.5 Sampler System Certification without Compressed Gas Cylinder Standards.

8.4.5.1 Not all the gases on the Title III list are available/compatible with compressed gas standards. In these cases sampler certification must be approached by different means.

8.4.5.2 Definitive guidance is not currently available in these cases; however, Section 9.2 lists several ways to generate gas standards. In general, Compendium Method TO-14A compounds (see Table 1) are available commercially as compressed gas standards.

9. GC/MS Analysis of Volatiles from Canisters

9.1 Introduction

9.1.1 The analysis of canister samples is accomplished with a GC/MS system. Fused silica capillary columns are used to achieve high temporal resolution of target compounds. Linear quadrupole or ion trap mass spectrometers are employed for compound detection. The heart of the system is composed of the sample inlet concentrating device that is needed to increase sample loading into a detectable range. Two examples of concentrating systems are discussed. Other approaches are acceptable as long as they are compatible with achieving the system performance criteria given in Section 11.

9.1.2 With the first technique, a whole air sample from the canister is passed through a multisorbent packing (including single adsorbent packings) contained within a metal or glass tube maintained at or above the surrounding air temperature. Depending on the water retention properties of the packing, some or most of the water vapor passes completely through the trap during sampling. Additional drying of the sample is accomplished after the sample concentration is completed by forward purging the trap with clean, dry helium or another inert gas (air is not used). The sample is then thermally desorbed from the packing and backflushed from the trap onto a gas chromatographic column. In some systems a "refocusing" trap is placed between the primary trap and the gas chromatographic column. The specific system design downstream of the primary trap depends on technical factors such as the rate of thermal desorption and sampled volume, but the objective in most cases is to enhance chromatographic resolution of the individual sample components before detection on a mass spectrometer.

9.1.3 Sample drying strategies depend on the target list of compounds. For some target compound lists, the multisorbent packing of the concentrator can be selected from hydrophobic adsorbents which allow a high percentage of water vapor in the sample to pass through the concentrator during sampling and without significant loss of the target compounds. However, if very volatile organic compounds are on the target list, the adsorbents required for their retention may also strongly retain water vapor and a more lengthy dry purge is necessary prior to analysis.

9.1.4 With the second technique, a whole air sample is passed through a concentrator where the VOCs are condensed on a reduced temperature surface (cold trap). Subsequently, the condensed gases are thermally desorbed and backflushed from the trap with an inert gas onto a gas chromatographic column. This concentration technique is similar to that discussed in Compendium Method TO-14, although a membrane dryer is not used. The sample size is reduced in volume to limit the amount of water vapor that is also collected (100 mL or less may be necessary). The attendant reduction in sensitivity is offset by enhancing the sensitivity of detection, for example by using an ion trap detector.

9.2 Preparation of Standards

9.2.1 Introduction.

9.2.1.1 When available, standard mixtures of target gases in high pressure cylinders must be certified traceable to a NIST Standard Reference Material (SRM) or to a NIST/EPA approved Certified Reference Material (CRM). Manufacturer's certificates of analysis must be retained to track the expiration date.

9.2.1.2 The neat standards that are used for making trace gas standards must be of high purity; generally a purity of 98 percent or better is commercially available.

9.2.1.3 Cylinder(s) containing approximately 10 ppmv of each of the target compounds are typically used as primary stock standards. The components may be purchased in one cylinder or in separate cylinders depending on compatibility of the compounds and the pressure of the mixture in the cylinder. Refer to manufacturer's specifications for guidance on purchasing and mixing VOCs in gas cylinders.

9.2.2 Preparing Working Standards.

9.2.2.1 Instrument Performance Check Standard. Prepare a standard solution of BFB in humidified zero air at a concentration which will allow collection of 50 ng of BFB or less under the optimized concentration parameters.

9.2.2.2 Calibration Standards. Prepare five working calibration standards in humidified zero air at a concentration which will allow collection at the 2, 5, 10, 20, and 50 ppbv level for each component under the optimized concentration parameters.

9.2.2.3 Internal Standard Spiking Mixture. Prepare an internal spiking mixture containing bromochloromethane, chlorobenzene-d_5, and 1,4-difluorobenzene at 10 ppmv each in humidified zero air to be added to the sample or calibration standard. 500 µL of this mixture spiked into 500 mL of sample will result in a concentration of 10 ppbv. The internal standard is introduced into the trap during the collection time for all calibration, blank, and sample analyses using the apparatus shown in Figure 13 or by equivalent means. The volume of internal standard spiking mixture added for each analysis must be the same from run to run.

9.2.3 Standard Preparation by Dynamic Dilution Technique.

9.2.3.1 Standards may be prepared by dynamic dilution of the gaseous contents of a cylinder(s) containing the gas calibration stock standards with humidified zero air using mass flow controllers and a calibration manifold. The working standard may be delivered from the manifold to a clean, evacuated canister using a pump and mass flow controller.

9.2.3.2 Alternatively, the analytical system may be calibrated by sampling directly from the manifold if the flow rates are optimized to provide the desired amount of calibration standards. However, the use of the canister as a reservoir prior to introduction into the concentration system resembles the procedure normally used to collect samples and is preferred. Flow rates of the dilution air and cylinder standards (all expressed in the same units) are measured using a bubble meter or calibrated electronic flow measuring device, and the concentrations of target compounds in the manifold are then calculated using the dilution ratio and the original concentration of each compound.

$$\text{Manifold Conc.} = \frac{(\text{Original Conc.})\ (\text{Std. Gas Flowrate})}{(\text{Air Flowrate}) + (\text{Std. Gas Flowrate})}$$

9.2.3.3 Consider the example of 1 mL/min flow of 10 ppmv standard diluted with 1,000 mL/min of humid air provides a nominal 10 ppbv mixture, as calculated below:

$$\text{Manifold Conc.} = \frac{(10\ \text{ppm})(1\ \text{mL/min})(1000\ \text{ppb}/1\ \text{ppm})}{(1000\ \text{mL/min}) + (1\ \text{mL/min})} = 10\ \text{ppb}$$

9.2.4 Standard Preparation by Static Dilution Bottle Technique

[Note: Standards may be prepared in canisters by spiking the canister with a mixture of components prepared in a static dilution bottle (12). This technique is used specifically for liquid standards.]

9.2.4.1 The volume of a clean 2-liter round-bottom flask, modified with a threaded glass neck to accept a Mininert septum cap, is determined by weighing the amount of water required to completely fill up the flask. Assuming a density for the water of 1 g/mL, the weight of the water in grams is taken as the volume of the flask in milliliters.

9.2.4.2 The flask is flushed with helium by attaching a tubing into the glass neck to deliver the helium. After a few minutes, the tubing is removed and the glass neck is immediately closed with a Mininert septum cap.

9.2.4.3 The flask is placed in a 60°C oven and allowed to equilibrate at that temperature for about 15 minutes. Predetermined aliquots of liquid standards are injected into the flask making sure to keep the flask temperature constant at 60°C.

9.2.4.4 The contents are allowed to equilibrate in the oven for at least 30 minutes. To avoid condensation, syringes must be preheated in the oven at the same temperature prior to withdrawal of aliquots to avoid condensation.

9.2.4.5 Sample aliquots may then be taken for introduction into the analytical system or for further dilution. An aliquot or aliquots totaling greater than 1 percent of the flask volume should be avoided.

9.2.4.6 Standards prepared by this method are stable for one week. The septum must be replaced with each freshly prepared standard.

9.2.4.7 The concentration of each component in the flask is calculated using the following equation:

$$\text{Concentration, mg/L} = \frac{(V_a)(d)}{V_f}$$

where: V_a = Volume of liquid neat standard injected into the flask, µL.
d = Density of the liquid neat standard, mg/µL.
V_f = Volume of the flask, L.

9.2.4.8 To obtain concentrations in ppbv, the equation given in Section 9.2.5.7 can be used.

[Note: In the preparation of standards by this technique, the analyst should make sure that the volume of neat standard injected into the flask does not result in an overpressure due to the higher partial pressure produced by the standard compared to the vapor pressure in the flask. Precautions should also be taken to avoid a significant decrease in pressure inside the flask after withdrawal of aliquot(s).]

9.2.5 Standard Preparation Procedure in High Pressure Cylinders

[Note: Standards may be prepared in high pressure cylinders (13). A modified summary of the procedure is provided below.]

9.2.5.1 The standard compounds are obtained as gases or neat liquids (greater than 98 percent purity).

9.2.5.2 An aluminum cylinder is flushed with high-purity nitrogen gas and then evacuated to better than 25 in. Hg.

9.2.5.3 Predetermined amounts of each neat standard compound are measured using a microliter or gastight syringe and injected into the cylinder. The cylinder is equipped with a heated injection port and nitrogen flow to facilitate sample transfer.

9.2.5.4 The cylinder is pressurized to 1000 psig with zero nitrogen.

[Note: User should read all SOPs associated with generating standards in high pressure cylinders. Follow all safety requirements to minimize danger from high pressure cylinders.]

9.2.5.5 The contents of the cylinder are allowed to equilibrate (~24 hrs) prior to withdrawal of aliquots into the GC system.

9.2.5.6 If the neat standard is a gas, the cylinder concentration is determined using the following equation:

$$\text{Concentration, ppbv} = \frac{\text{Volume}_{\text{standard}}}{\text{Volume}_{\text{dilution gas}}} \times 10^9$$

[Note: Both values must be expressed in the same units.]

9.2.5.7 If the neat standard is a liquid, the gaseous concentration can be determined using the following equations:

$$V = \frac{nRT}{P}$$

and:

$$n = \frac{(mL)(d)}{MW}$$

where:
- V = Gaseous volume of injected compound at EPA standard temperature (25°C) and pressure (760 mm Hg), L.
- n = Moles.
- R = Gas constant, 0.08206 L-atm/mole °K.
- T = 298°K (standard temperature).
- P = 1 standard pressure, 760 mm Hg (1 atm).
- mL = Volume of liquid injected, mL.
- d = Density of the neat standard, g/mL.
- MW = Molecular weight of the neat standard expressed, g/g-mole.

The gaseous volume of the injected compound is divided by the cylinder volume at STP and then multiplied by 10^9 to obtain the component concentration in ppb units.

9.2.6 Standard Preparation by Water Methods.

[Note: Standards may be prepared by a water purge and trap method (14) and summarized as follows].

9.2.6.1 A previously cleaned and evacuated canister is pressurized to 760 mm Hg absolute (1 atm) with zero grade air.

9.2.6.2 The air gauge is removed from the canister and the sparging vessel is connected to the canister with the short length of 1/16 in. stainless steel tubing.

[Note: Extra effort should be made to minimize possible areas of dead volume to maximize transfer of analytes from the water to the canister.]

9.2.6.3 A measured amount of the stock standard solution and the internal standard solution is spiked into 5 mL of water.

9.2.6.4 This water is transferred into the sparge vessel and purged with nitrogen for 10 mins at 100 mL/min. The sparging vessel is maintained at 40°C.

9.2.6.5 At the end of 10 mins, the sparge vessel is removed and the air gauge is re-installed, to further pressurize the canister with pure nitrogen to 1500 mm Hg absolute pressure (approximately 29 psia).

9.2.6.6 The canister is allowed to equilibrate overnight before use.

9.2.6.7 A schematic of this approach is shown in Figure 14.

9.2.7 Preparation of Standards by Permeation Tubes.

9.2.7.1 Permeation tubes can be used to provide standard concentration of a trace gas or gases. The permeation of the gas can occur from inside a permeation tube containing the trace species of interest to an air stream outside. Permeation can also occur from outside a permeable membrane tube to an air stream passing through the tube (e.g., a tube of permeable material immersed in a liquid).

9.2.7.2 The permeation system is usually held at a constant temperature to generate a constant concentration of trace gas. Commercial suppliers provide systems for generation and dilution of over 250 compounds. Some commercial suppliers of permeation tube equipment are listed in Appendix D.

9.2.8 Storage of Standards.

9.2.8.1 Working standards prepared in canisters may be stored for thirty days in an atmosphere free of potential contaminants.

9.2.8.2 It is imperative that a storage logbook be kept to document storage time.

10. GC/MS Operating Conditions

10.1 Preconcentrator

The following are typical cryogenic and adsorbent preconcentrator analytical conditions which, however, depend on the specific combination of solid sorbent and must be selected carefully by the operator. The reader is referred to Tables 1 and 2 of Compendium Method TO-17 for guidance on selection of sorbents. An example of a system using a solid adsorbent preconcentrator with a cryofocusing trap is discussed in the literature (15). Oven temperature programming starts above ambient.

10.1.1 Sample Collection Conditions

Cryogenic Trap	Adsorbent Trap

Set point	-150°C	Set point	27°C
Sample volume	- up to 100 mL	Sample volume	- up to 1,000 mL
Carrier gas purge flow	- none	Carrier gas purge flow	- selectable

[Note: The analyst should optimize the flow rate, duration of sampling, and absolute sample volume to be used. Other preconcentration systems may be used provided performance standards (see Section 11) are realized.]

10.1.2 Desorption Conditions

Cryogenic Trap		Adsorbent Trap	
Desorb Temperature	120°C	Desorb Temperature	Variable
Desorb Flow Rate	~ 3 mL/min He	Desorb Flow Rate	~3 mL/min He
Desorb Time	<60 sec	Desorb Time	<60 sec

The adsorbent trap conditions depend on the specific solid adsorbents chosen (see manufacturers' specifications).

10.1.3 Trap Reconditioning Conditions.

Cryogenic Trap		Adsorbent Trap	
Initial bakeout	120°C (24 hrs)	Initial bakeout	
Variable (24 hrs)			
After each run	120°C (5 min)	After each run	Variable (5 min)

10.2 GC/MS System

10.2.1 Optimize GC conditions for compound separation and sensitivity. Baseline separation of benzene and carbon tetrachloride on a 100% methyl polysiloxane stationary phase is an indication of acceptable chromatographic performance.

10.2.2 The following are the recommended gas chromatographic analytical conditions when using a 50-meter by 0.3-mm I.D., 1 μm film thickness fused silica column with refocusing on the column.

Item	Condition	
Carrier Gas:	Helium	
Flow Rate:	Generally 1-3 mL/min as recommended by manufacturer	
Temperature Program:	Initial Temperature:	-50°C
	Initial Hold Time:	2 min
	Ramp Rate:	8° C/min
	Final Temperature:	200°C
	Final Hold Time:	Until all target compounds elute.

10.2.3 The following are the recommended mass spectrometer conditions:

Item	Condition

Electron Energy:	70 Volts (nominal)
Mass Range:	35-300 amu [the choice of 35 amu excludes the detection of some target compounds such as methanol and formaldehyde, and the quantitation of others such as ethylene oxide, ethyl carbamate, etc. (see Table 2). Lowering the mass range and using special programming features available on modern gas chromatographs will be necessary in these cases, but are not considered here.
Scan Time:	To give at least 10 scans per peak, not to exceed 1 second per scan].

A schematic for a typical GC/MS analytical system is illustrated in Figure 15.

10.3 Analytical Sequence

10.3.1 Introduction. The recommended GC/MS analytical sequence for samples during each 24-hour time period is as follows:

- Perform instrument performance check using bromofluorobenzene (BFB).
- Initiate multi-point calibration or daily calibration checks.
- Perform a laboratory method blank.
- Complete this sequence for analysis of ≤20 field samples.

10.4 Instrument Performance Check

10.4.1 Summary. It is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to initiating any data collection. The GC/MS system is set up according to the manufacturer's specifications, and the mass calibration and resolution of the GC/MS system are then verified by the analysis of the instrument performance check standard, bromofluorobenzene (BFB).

10.4.2 Frequency. Prior to the analyses of any samples, blanks, or calibration standards, the Laboratory must establish that the GC/MS system meets the mass spectral ion abundance criteria for the instrument performance check standard containing BFB. The instrument performance check solution must be analyzed initially and once per 24-hour time period of operation.

The 24-hour time period for GC/MS instrument performance check and standards calibration (initial calibration or daily calibration check criteria) begins at the injection of the BFB which the laboratory records as documentation of a compliance tune.

10.4.3 Procedure. The analysis of the instrument performance check standard is performed by trapping 50 ng of BFB under the optimized preconcentration parameters. The BFB is introduced from a cylinder into the GC/MS via a sample loop valve injection system similar to that shown in Figure 13.

The mass spectrum of BFB must be acquired in the following manner. Three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is conducted using a single scan prior to the elution of BFB.

10.4.4 Technical Acceptance Criteria. Prior to the analysis of any samples, blanks, or calibration standards, the analyst must establish that the GC/MS system meets the mass spectral ion abundance criteria for the instrument performance check standard as specified in Table 3.

10.4.5 Corrective Action. If the BFB acceptance criteria are not met, the MS must be retuned. It may be necessary to clean the ion source, or quadrupoles, or take other necessary actions to achieve the acceptance criteria.

10.4.6 Documentation. Results of the BFB tuning are to be recorded and maintained as part of the instrumentation log.

10.5 Initial Calibration

10.5.1 Summary. Prior to the analysis of samples and blanks but after the instrument performance check standard criteria have been met, each GC/MS system must be calibrated at five concentrations that span the monitoring range of interest in an initial calibration sequence to determine instrument sensitivity and the linearity of GC/MS response for the target compounds. For example, the range of interest may be 2 to 20 ppbv, in which case the five concentrations would be 1, 2, 5, 10 and 25 ppbv.

One of the calibration points from the initial calibration curve must be at the same concentration as the daily calibration standard (e.g., 10 ppbv).

10.5.2 Frequency. Each GC/MS system must be recalibrated following corrective action (e.g., ion source cleaning or repair, column replacement, etc.) which may change or affect the initial calibration criteria or if the daily calibration acceptance criteria have not been met.

If time remains in the 24-hour time period after meeting the acceptance criteria for the initial calibration, samples may be analyzed.

If time does not remain in the 24-hour period after meeting the acceptance criteria for the initial calibration, a new analytical sequence shall commence with the analysis of the instrument performance check standard followed by analysis of a daily calibration standard.

10.5.3 Procedure. Verify that the GC/MS system meets the instrument performance criteria in Section 10.4.

The GC must be operated using temperature and flow rate parameters equivalent to those in Section 10.2.2. Calibrate the preconcentration-GC/MS system by drawing the standard into the system. Use one of the standards preparation techniques described under Section 9.2 or equivalent.

A minimum of five concentration levels are needed to determine the instrument sensitivity and linearity. One of the calibration levels should be near the detection level for the compounds of interest. The calibration range should be chosen so that linear results are obtained as defined in Sections 10.5.1 and 10.5.5.

Quantitation ions for the target compounds are shown in Table 2. The primary ion should be used unless interferences are present, in which case a secondary ion is used.

10.5.4 Calculations.

[Note: In the following calculations, an internal standard approach is used to calculate response factors. The area response used is that of the primary quantitation ion unless otherwise stated.]

10.5.4.1 Relative Response Factor (RRF). Calculate the relative response factors for each target compound relative to the appropriate internal standard (i.e., standard with the nearest retention time) using the following equation:

$$RRF = \frac{A_x C_{is}}{A_{is} C_x}$$

where: RRF = Relative response factor.
A_x = Area of the primary ion for the compound to be measured, counts.
A_{is} = Area of the primary ion for the internal standard, counts.
C_{is} = Concentration of internal standard spiking mixture, ppbv.
C_x = Concentration of the compound in the calibration standard, ppbv.

[Note: The equation above is valid under the condition that the volume of internal standard spiking mixture added in all field and QC analyses is the same from run to run, and that the volume of field and QC sample introduced into the trap is the same for each analysis. C_{is} and C_x must be in the same units.]

10.5.4.2 Mean Relative Response Factor. Calculate the mean RRF for each compound by averaging the values obtained at the five concentrations using the following equation:

$$\overline{RRF} = \sum_{i=1}^{n} \frac{x_i}{n}$$

where: $\overline{RRF}$ = Mean relative response factor.
x_i = RRF of the compound at concentration i.
n = Number of concentration values, in this case 5.

10.5.4.3 Percent Relative Standard Deviation (%RSD). Using the RRFs from the initial calibration, calculate the %RSD for all target compounds using the following equations:

$$\%RSD = \frac{SD_{RRF}}{\overline{RRF}} \times 100$$

and

$$SD_{RRF} = \sqrt{\sum_{i=1}^{N} \frac{(RRF_i - \overline{RRF})^2}{N - 1}}$$

where: SD_{RRF} = Standard deviation of initial response factors (per compound).
RRF_i = Relative response factor at a concentration level i.
$\overline{RRF}$ = Mean of initial relative response factors (per compound).

10.5.4.4 Relative Retention Times (RRT). Calculate the RRTs for each target compound over the initial calibration range using the following equation:

$$RRT = \frac{RT_c}{RT_{is}}$$

where: RT_c = Retention time of the target compound, seconds
RT_{is} = Retention time of the internal standard, seconds.

10.5.4.5 Mean of the Relative Retention Times ($\overline{RRT}$). Calculate the mean of the relative retention times ($\overline{RRT}$) for each analyte target compound over the initial calibration range using the following equation:

$$\overline{RRT} = \sum_{i=1}^{n} \frac{RRT}{n}$$

where: $\overline{RRT}$ = Mean relative retention time for the target compound for each initial calibration standard.

RRT = Relative retention time for the target compound at each calibration level.

10.5.4.6 Tabulate Primary Ion Area Response (Y) for Internal Standard. Tabulate the area response (Y) of the primary ions (see Table 2) and the corresponding concentration for each compound and internal standard.

10.5.4.7 Mean Area Response ($\overline{Y}$) for Internal Standard. Calculate the mean area response ($\overline{Y}$) for each internal standard compound over the initial calibration range using the following equation:

$$\overline{Y} = \sum_{i=1}^{n} \frac{Y_i}{n}$$

where: $\overline{Y}$ = Mean area response.

Y = Area response for the primary quantitation ion for the internal standard for each initial calibration standard.

10.5.4.8 Mean Retention Times ($\overline{RT}$). Calculate the mean of the retention times ($\overline{RT}$) for each internal standard over the initial calibration range using the following equation:

$$\overline{RT} = \sum_{i=1}^{n} \frac{RT_i}{n}$$

where: $\overline{RT}$ = Mean retention time, seconds

RT = Retention time for the internal standard for each initial calibration standard, seconds.

10.5.5 Technical Acceptance Criteria for the Initial Calibration.

10.5.5.1 The calculated %RSD for the RRF for each compound in the calibration table must be less than 30% with at most two exceptions up to a limit of 40%.

[Note: This exception may not be acceptable for all projects. Many projects may have a specific target list of compounds which would require the lower limit for all compounds.]

10.5.5.2 The RRT for each target compound at each calibration level must be withiin 0.06 RRT units of the mean RRT for the compound.

10.5.5.3 The area response Y of at each calibration level must be within 40% of the mean area response $\overline{Y}$ over the initial calibration range for each internal standard.

10.5.5.4 The retention time shift for each of the internal standards at each calibration level must be within 20 s of the mean retention time over the initial calibration range for each internal standard.

10.5.6 Corrective Action.

10.5.6.1 Criteria. If the initial calibration technical acceptance criteria are not met, inspect the system for problems. It may be necessary to clean the ion source, change the column, or take other corrective actions to meet the initial calibration technical acceptance criteria.

10.5.6.2 Schedule. Initial calibration acceptance criteria ***must*** be met before any field samples, performance evaluation (PE) samples, or blanks are analyzed.

9531957

10.6 Daily Calibration

10.6.1 Summary. Prior to the analysis of samples and blanks but after tuning criteria have been met, the initial calibration of each GC/MS system must be routinely checked by analyzing a daily calibration standard to ensure that the instrument continues to remain under control. The daily calibration standard, which is the nominal 10 ppbv level calibration standard, should contain all the target compounds.

10.6.2 Frequency. A check of the calibration curve must be performed once every 24 hours on a GC/MS system that has met the tuning criteria. The daily calibration sequence starts with the injection of the BFB. If the BFB analysis meets the ion abundance criteria for BFB, then a daily calibration standard may be analyzed.

10.6.3 Procedure. The mid-level calibration standard (10 ppbv) is analyzed in a GC/MS system that has met the tuning and mass calibration criteria following the same procedure in Section 10.5.

10.6.4 Calculations. Perform the following calculations.

[Note: As indicated earlier, the area response of the primary quantitation ion is used unless otherwise stated.]

10.6.4.1 Relative Response Factor (RRF). Calculate a relative response factor (RRF) for each target compound using the equation in Section 10.5.4.1.

10.6.4.2 Percent Difference (%D). Calculate the percent difference in the RRF of the daily RRF (24-hour) compared to the mean RRF in the most recent initial calibration. Calculate the %D for each target compound using the following equation:

$$\%D = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \times 100$$

where: RRF_c = RRF of the compound in the continuing calibration standard.

$\overline{RRF_i}$ = Mean RRF of the compound in the most recent initial calibration.

10.6.5 Technical Acceptance Criteria. The daily calibration standard must be analyzed at the concentration level and frequency described in this Section 10.6 and on a GC/MS system meeting the BFB instrument performance check criteria (see Section 10.4).

The %D for each target compound in a daily calibration sequence must be within ±30 percent in order to proceed with the analysis of samples and blanks. A control chart showing %D values should be maintained.

10.6.6 Corrective Action. If the daily calibration technical acceptance criteria are not met, inspect the system for problems. It may be necessary to clean the ion source, change the column, or take other corrective actions to meet the daily calibration technical acceptance criteria.

Daily calibration acceptance criteria must be met before any field samples, performance evaluation (PE) samples, or blanks are analyzed. If the % D criteria are not met, it will be necessary to rerun the daily calibration sample.

10.7 Blank Analyses

10.7.1 Summary. To monitor for possible laboratory contamination, laboratory method blanks are analyzed at least once in a 24-hour analytical sequence. All steps in the analytical procedure are performed on the blank

using all reagents, standards, equipment, apparatus, glassware, and solvents that would be used for a sample analysis.

A laboratory method blank (LMB) is an unused, certified canister that has not left the laboratory. The blank canister is pressurized with humidified, ultra-pure zero air and carried through the same analytical procedure as a field sample. The injected aliquot of the blank must contain the same amount of internal standards that are added to each sample.

10.7.2 Frequency. The laboratory method blank must be analyzed after the calibration standard(s) and before any samples are analyzed.

Whenever a high concentration sample is encountered (i.e., outside the calibration range), a blank analysis should be performed immediately after the sample is completed to check for carryover effects.

10.7.3 Procedure. Fill a cleaned and evacuated canister with humidified zero air (RH >20 percent, at 25°C). Pressurize the contents to 2 atm.

The blank sample should be analyzed using the same procedure outlined under Section 10.8.

10.7.4 Calculations. The blanks are analyzed similar to a field sample and the equations in Section 10.5.4 apply.

10.7.5 Technical Acceptance Criteria. A blank canister should be analyzed daily.

The area response for each internal standard (IS) in the blank must be within ±40 percent of the mean area response of the IS in the most recent valid calibration.

The retention time for each of the internal standards must be within ±0.33 minutes between the blank and the most recent valid calibration.

The blank should not contain any target analyte at a concentration greater than its quantitation level (three times the MDL as defined in Section 11.2) and should not contain additional compounds with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.

10.7.6 Corrective Action. If the blanks do not meet the technical acceptance criteria, the analyst should consider the analytical system to be out of control. It is the responsibility of the analyst to ensure that contaminants in solvents, reagents, glassware, and other sample storage and processing hardware that lead to discrete artifacts and/or elevated baselines in gas chromatograms be eliminated. If contamination is a problem, the source of the contamination must be investigated and appropriate corrective measures need to be taken and documented before further sample analysis proceeds.

If an analyte in the blank is found to be out of control (i.e., contaminated) and the analyte is also found in associated samples, those sample results should be "flagged" as possibly contaminated.

10.8 Sample Analysis

10.8.1 Summary. An aliquot of the air sample from a canister (e.g., 500 mL) is preconcentrated and analyzed by GC/MS under conditions stated in Sections 10.1 and 10.2. If using the multisorbent/dry purge approach, adjust the dry purge volume to reduce water effects in the analytical system to manageable levels.

[Note: The analyst should be aware that pressurized samples of high humidity samples will contain condensed water. As a result, the humidity of the sample released from the canister during analysis will vary

in humidity, being lower at the higher canister pressures and increasing in humidity as the canister pressures decreases. Storage integrity of water soluble compounds may also be affected.]

10.8.2 Frequency. If time remains in the 24-hour period in which an initial calibration is performed, samples may be analyzed without analysis of a daily calibration standard.

If time does not remain in the 24-hour period since the injection of the instrument performance check standard in which an initial calibration is performed, both the instrument performance check standard and the daily calibration standard should be analyzed before sample analysis may begin.

10.8.3 Procedure for Instrumental Analysis. Perform the following procedure for analysis.

10.8.3.1 All canister samples should be at temperature equilibrium with the laboratory.

10.8.3.2 Check and adjust the mass flow controllers to provide correct flow rates for the system.

10.8.3.3 Connect the sample canister to the inlet of the GC/MS analytical system, as shown in Figure 15 [Figure 16 shows an alternate two stage concentrator using multisorbent traps followed by a trap cooled by a closed cycle cooler (15)]. The desired sample flow is established through the six-port chromatographic valve and the preconcentrator to the downstream flow controller. The absolute volume of sample being pulled through the trap must be consistent from run to run.

10.8.3.4 Heat/cool the GC oven and cryogenic or adsorbent trap to their set points. Assuming a six-port value is being used, as soon as the trap reaches its lower set point, the six-port chromatographic valve is cycled to the trap position to begin sample collection. Utilize the sample collection time which has been optimized by the analyst.

10.8.3.5 Use the arrangement shown in Figure 13, (i.e., a gastight syringe or some alternate method) introduce an internal standard during the sample collection period. Add sufficient internal standard equivalent to 10 ppbv in the sample. For example, a 0.5 mL volume of a mixture of internal standard compounds, each at 10 ppmv concentration, added to a sample volume of 500 mL, will result in 10 ppbv of each internal standard in the sample.

10.8.3.6 After the sample and internal standards are preconcentrated on the trap, the GC sampling valve is cycled to the inject position and the trap is swept with helium and heated. Assuming a focusing trap is being used, the trapped analytes are thermally desorbed onto a focusing trap and then onto the head of the capillary column and are separated on the column using the GC oven temperature program. The canister valve is closed and the canister is disconnected from the mass flow controller and capped. The trap is maintained at elevated temperature until the beginning of the next analysis.

10.8.3.7 Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic mass range from 35 to 300 amu. At least ten scans per eluting chromatographic peak should be acquired. Scanning also allows identification of unknown compounds in the sample through searching of library spectra.

10.8.3.8 Each analytical run must be checked for saturation. The level at which an individual compound will saturate the detection system is a function of the overall system sensitivity and the mass spectral characteristics of that compound.

10.8.3.9 Secondary ion quantitation is allowed only when there are sample matrix interferences with the primary ion. If secondary ion quantitation is performed, document the reasons in the laboratory record book.

10.8.4 Calculations. The equation below is used for calculating concentrations.

$$C_x = \frac{A_x C_{is} DF}{A_{is} \overline{RRF}}$$

where: C_x = Compound concentration, ppbv.

A_x = Area of the characteristic ion for the compound to be measured, counts.

A_{is} = Area of the characteristic ion for the specific internal standard, counts.

C_{is} = Concentration of the internal standard spiking mixture, ppbv

$\overline{RRF}$ = Mean relative response factor from the initial calibration.

DF = Dilution factor calculated as described in section 2. If no dilution is performed, DF = 1.

[Note: The equation above is valid under the condition that the volume (~500 µL) of internal standard spiking mixture added in all field and QC analyses is the same from run to run, and that the volume (~500 mL) of field and QC sample introduced into the trap is the same for each analysis.]

10.8.5 Technical Acceptance Criteria.

[Note: If the most recent valid calibration is an initial calibration, internal standard area responses and RTs in the sample are evaluated against the corresponding internal standard area responses and RTs in the mid level standard (10 ppbv) of the initial calibration.]

10.8.5.1 The field sample must be analyzed on a GC/MS system meeting the BFB tuning, initial calibration, and continuing calibration technical acceptance criteria at the frequency described in Sections 10.4, 10.5 and 10.6.

10.8.5.2 The field samples must be analyzed along with a laboratory method blank that met the blank technical acceptance criteria.

10.8.5.3 All of the target analyte peaks should be within the initial calibration range.

10.8.5.4 The retention time for each internal standard must be within ±0.33 minutes of the retention time of the internal standard in the most recent valid calibration.

10.8.6 Corrective Action. If the on-column concentration of any compound in any sample exceeds the initial calibration range, an aliquot of the original sample must be diluted and reanalyzed. Guidance in performing dilutions and exceptions to this requirement are given below.

- Use the results of the original analysis to determine the approximate dilution factor required to get the largest analyte peak within the initial calibration range.
- The dilution factor chosen should keep the response of the largest analyte peak for a target compound in the upper half of the initial calibration range of the instrument.

[Note: Analysis involving dilution should be reported with a dilution factor and nature of the dilution gas.]

10.8.6.1 Internal standard responses and retention times must be evaluated during or immediately after data acquisition. If the retention time for any internal standard changes by more than 20 sec from the latest daily (24-hour) calibration standard (or mean retention time over the initial calibration range), the GC/MS system must be inspected for malfunctions, and corrections made as required.

10.8.6.2 If the area response for any internal standard changes by more than ±40 percent between the sample and the most recent valid calibration, the GC/MS system must be inspected for malfunction and

9531961

corrections made as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is necessary.

10.8.6.3 If, after reanalysis, the area responses or the RTs for all internal standards are inside the control limits, then the problem with the first analysis is considered to have been within the control of the Laboratory. Therefore, submit only data from the analysis with SICPs within the limits. This is considered the initial analysis and should be reported as such on all data deliverables.

11. Requirements for Demonstrating Method Acceptability for VOC Analysis from Canisters

11.1 Introduction

11.1.1 There are three performance criteria which must be met for a system to qualify under Compendium Method TO-15. These criteria are: the method detection limit of ≤0.5 ppbv, replicate precision within 25 percent, and audit accuracy within 30 percent for concentrations normally expected in contaminated ambient air (0.5 to 25 ppbv).

11.1.2 Either SIM or SCAN modes of operation can be used to achieve these criteria, and the choice of mode will depend on the number of target compounds, the decision of whether or not to determine tentatively identified compounds along with other VOCs on the target list, as well as on the analytical system characteristics.

11.1.3 Specific criteria for each Title III compound on the target compound list must be met by the analytical system. These criteria were established by examining summary data from EPA's Toxics Air Monitoring System Network and the Urban Air Toxics Monitoring Program network. Details for the determination of each of the criteria follow.

11.2 Method Detection Limit

11.2.1 The procedure chosen to define the method detection limit is that given in the *Code of Federal Regulations* (40 CFR 136 Appendix B).

11.2.2 The method detection limit is defined for each system by making seven replicate measurements of the compound of interest at a concentration near (within a factor of five) the expected detection limit, computing the standard deviation for the seven replicate concentrations, and multiplying this value by 3.14 (i.e., the Student's t value for 99 percent confidence for seven values). Employing this approach, the detection limits given in Table 4 were obtained for some of the VOCs of interest.

11.3 Replicate Precision

11.3.1 The measure of replicate precision used for this program is the absolute value of the difference between replicate measurements of the sample divided by the average value and expressed as a percentage as follows:

$$\text{percent difference} = \frac{|x_1 - x_2|}{\bar{x}} \times 100$$

where:

x_1 = First measurement value.

x_2 = Second measurement value.

$\bar{x}$ = Average of the two values.

11.3.2 There are several factors which may affect the precision of the measurement. The nature of the compound of interest itself such as molecular weight, water solubility, polarizability, etc., each have some effect on the precision, for a given sampling and analytical system. For example, styrene, which is classified as a polar VOC, generally shows slightly poorer precision than the bulk of nonpolar VOCs. A primary influence on precision is the concentration level of the compound of interest in the sample, i.e., the precision degrades as the concentration approaches the detection limit. A conservative measure was obtained from replicate analysis of "real world" canister samples from the TAMS and UATMP networks. These data are summarized in Table 5 and suggest that a replicate precision value of 25 percent can be achieved for each of the target compounds.

11.4 Audit Accuracy

11.4.1 A measure of analytical accuracy is the degree of agreement with audit standards. Audit accuracy is defined as the difference between the nominal concentration of the audit compound and the measured value divided by the audit value and expressed as a percentage, as illustrated in the following equation:

$$\text{Audit Accuracy, \%} = \frac{\text{Spiked Value} - \text{Observed Value}}{\text{Spiked Value}} \times 100$$

11.4.2 Audit accuracy results for TAMS and UATMP analyses are summarized in Table 6 and were used to form the basis for a selection of 30 percent as the performance criterion for audit accuracy.

12. References

1. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air: Method TO-14A, Second Edition,* U. S. Environmental Protection Agency, Research Triangle Park, NC, EPA 600/625/R-96/010b, January 1997.

2. Winberry, W. T., Jr., et al., *Statement-of-Work (SOW) for the Analysis of Air Toxics From Superfund Sites*, U. S. Environmental Protection Agency, Office of Solid Waste, Contract Laboratory Program, Washington, D.C., Draft Report, June 1990.

3. Coutant, R.W., *Theoretical Evaluation of Stability of Volatile Organic Chemicals and Polar Volatile Organic Chemicals in Canisters*, U. S. Environmental Protection Agency, EPA Contract No. 68-DO-0007, Work Assignment No. 45, Subtask 2, Battelle, Columbus, OH, June 1993.

4. Kelly, T.J., Mukund, R., Gordon, S.M., and Hays, M.J., *Ambient Measurement Methods and Properties of the 189 Title III Hazardous Air Pollutants*, U. S. Environmental Protection Agency, EPA Contract No. 68-DO-0007, Work Assignment 44, Battelle, Columbus, OH, March 1994.

5. Kelly T. J. and Holdren, M.W., "Applicability of Canisters for Sample Storage in the Determination of Hazardous Air Pollutants," *Atmos. Environ.*, Vol. 29, 2595-2608, May 1995.

6. Kelly, T.J., Callahan, P.J., Pleil, J.K., and Evans, G.E., "Method Development and Field Measurements for Polar Volatile Organic Compounds in Ambient Air," *Environ. Sci. Technol.*, Vol. 27, 1146-1153, 1993.

9531963

7. McClenny, W.A., Oliver, K.D. and Daughtrey, E.H.., Jr. "Dry Purging of Solid Adsorbent Traps to Remove Water Vapor Before Thermal Desorption of Trace Organic Gases," *J. Air and Waste Manag. Assoc.*, Vol. 45, 792-800, June 1995.

8. Whitaker, D.A., Fortmann, R.C. and Lindstrom, A.B. "Development and Testing of a Whole Air Sampler for Measurement of Personal Exposures to Volatile Organic Compounds," *Journal of Exposure Analysis and Environmental Epidemiology*, Vol. 5, No. 1, 89-100, January 1995.

9. Pleil, J.D. and Lindstrom, A.B., "Collection of a Single Alveolar Exhaled Breath for Volatile Organic Compound Analysis," *American Journal of Industrial Medicine*, Vol. 28, 109-121, 1995.

10. Pleil, J.D. and McClenny, W.A., "Spatially Resolved Monitoring for Volatile Organic Compounds Using Remote Sector Sampling," *Atmos. Environ.*, Vol. 27A, No. 5, 739-747, August 1993.

11. Holdren, M.W., et al., Unpublished Final Report, EPA Contract 68-DO-0007, Battelle, Columbus, OH. Available from J.D. Pleil, MD-44, U. S. Environmental Protection Agency, Research Triangle Park, NC, 27711, 919-541-4680.

12. Morris, C.M., Burkley, R.E. and Bumgarner, J.E., "Preparation of Multicomponent Volatile Organic Standards Using Dilution Bottles," *Anal. Letts.*, Vol. 16 (A20), 1585-1593, 1983.

13. Pollack, A.J., Holdren, M.W., "Multi-Adsorbent Preconcentration and Gas Chromatographic Analysis of Air Toxics With an Automated Collection/Analytical System," in the *Proceedings of the 1990 EPA/A&WMA International Symposium of Measurement of Toxic and Related Air Pollutants*, U. S. Environmental Protection Agency, Research Triangle Park, NC, EPA/600/9-90-026, May 1990.

14. Stephenson, J.H.M., Allen, F., Slagle, T., "Analysis of Volatile Organics in Air via Water Methods" in *Proceedings of the 1990 EPA/A&WMA International Symposium on Measurement of Toxic and Related Air Pollutants*, U. S. Environmental Protection Agency, Research Triangle Park, NC, EPA 600/9-90-026, May 1990.

15. Oliver, K. D., Adams, J. R., Davehtrey, E. H., Jr., McClenny, W. A., Young, M. J., and Parade, M. A., "Techniques for Monitoring Toxices VOCs in Air: Sorbent Preconcentration Closed-Cycle Cooler Cryofocusing, and GC/MS Analysis," *Environ. Sci. Technol.*, Vol. 30, 1938-1945, 1996.

APPENDIX A.

LISTING OF SOME COMMERCIAL WATER MANAGEMENT SYSTEMS USED WITH AUTOGC SYSTEMS

Tekmar Dohrman Company
7143 East Kemper Road
Post Office Box 429576
Cincinnati, Ohio 45242-9576
(513) 247-7000
(513) 247-7050 (Fax)
(800) 543-4461
[Moisture control module]

Entech Laboratory Automation
950 Enchanted Way No. 101
Simi Valley, California 93065
(805) 527-5939
(805) 527-5687 (Fax)
[Microscale Purge and Trap]

Dynatherm Analytical Instruments
Post Office Box 159
Kelton, Pennsylvania 19346
(215) 869-8702
(215) 869-3885 (Fax)
[Thermal Desorption System]

XonTech Inc.
6862 Hayenhurst Avenue
Van Nuys, CA 91406
(818) 787-7380
(818) 787-4275 (Fax)
[Multi-adsorbent trap/dry purge]

Graseby
500 Technology Ct.
Smyrna, Georgia 30082
(770) 319-9999
(770) 319-0336 (Fax)
(800) 241-6898
[Controlled Desorption Trap]

Varian Chromatography System
2700 Mitchell Drive
Walnut Creek, California 94898
(510) 945-2196
(510) 945-2335 (FAX)
[Variable Temperature Adsorption Trap]

9531965

APPENDIX B.

COMMENT ON CANISTER CLEANING PROCEDURES

The canister cleaning procedures given in Section 8.4 require that canister pressure be reduced to <0.05mm Hg before the cleaning process is complete. Depending on the vacuum system design (diameter of connecting tubing, valve restrictions, etc.) and the placement of the vacuum gauge, the achievement of this value may take several hours. In any case, the pressure gauge should be placed near the canisters to determine pressure. The objective of requiring a low pressure evacuation during canister cleaning is to reduce contaminants. If canisters can be routinely certified (<0.2 ppbv for target compounds) while using a higher vacuum, then this criteria can be relaxed. However, the ultimate vacuum achieved during cleaning should always be <0.2mm Hg.

Canister cleaning as described in Section 8.4 and illustrated in Figure 10 requires components with special features. The vacuum gauge shown in Figure 10 must be capable of measuring 0.05mm Hg with less than a 20% error. The vacuum pump used for evacuating the canister must be noncontaminating while being capable of achieving the 0.05 mm Hg vacuum as monitored near the canisters. Thermoelectric vacuum gauges and turbomolecular drag pumps are typically being used for these two components.

An alternate to achieving the canister certification requirement of <0.2 ppbv for all target compounds is the criteria used in Compendium Method TO-12 that the total carbon count be <10ppbC. This check is less expensive and typically more exacting than the current certification requirement and can be used if proven to be equivalent to the original requirement. This equivalency must be established by comparing the total nonmethane organic carbon (TNMOC) expressed in ppbC to the requirement that individual target compounds be <0.2 ppbv for a series of analytical runs.

APPENDIX C.

LISTING OF COMMERCIAL MANUFACTURERS AND RE-SUPPLIERS OF SPECIALLY-PREPARED CANISTERS

BRC/Rasmussen
17010 NW Skyline Blvd.
Portland, Oregon 97321
(503) 621-1435

Meriter
1790 Potrero Drive
San Jose, CA 95124
(408) 265-6482

Restek Corporation
110 Benner Circle
Bellefonte, PA 16823-8812
(814) 353-1300
(800) 356-1688

Scientific Instrumentation Specialists
P.O. Box 8941
815 Courtney Street
Moscow, ID 83843
(208) 882-3860

Graseby
500 Technology Ct.
Smyrna, Georgia 30082
(404) 319-9999
(800) 241-6898

XonTech Inc.
6862 Hayenhurst Avenue
Van Nuys, CA 91406
(818) 787-7380

9531967

APPENDIX D.

LISTING OF COMMERCIAL SUPPLIERS OF PERMEATION TUBES AND SYSTEMS

Kin-Tek
504 Laurel St.
Lamarque, Texas 77568
(409) 938-3627
(800) 326-3627

Vici Metronics, Inc.
2991 Corvin Drive
Santa Clara, CA 95051
(408) 737-0550

Analytical Instrument Development, Inc.
Rt. 41 and Newark Rd.
Avondale, PA 19311
(215) 268-3181

Ecology Board, Inc.
9257 Independence Ave.
Chatsworth, CA 91311
(213) 882-6795

Tracor, Inc.
6500 Tracor Land
Austin, TX
(512) 926-2800

Metronics Associates, Inc.
3201 Porter Drive
Standford Industrial Park
Palo Alto, CA 94304
(415) 493-5632

TABLE 1. VOLATILE ORGANIC COMPOUNDS ON THE TITLE III CLEAN AIR AMENDMENT LIST--MEMBERSHIP IN COMPENDIUM METHOD TO-14A LIST AND THE SOW-CLP LIST OF VOCs

Compound	CAS No.	BP (°C)	v.p. (mmHg)[1]	MW[1]	TO-14A	CLP-SOW
Methyl chloride (chloromethane); CH3Cl	74-87-3	-23.7	3.8 x 10	50.5	X	X
Carbonyl sulfide; COS	463-58-1	-50.0	3.7 x 10	60.1		
Vinyl chloride (chloroethene); C2H3Cl	75-01-4	-14.0	3.2 x 10	62.5	X	X
Diazomethane; CH2N2	334-88-3	-23.0	2.8 x 10	42.1		
Formaldehyde; CH2O	50-00-0	-19.5	2.7 x 10	30		
1,3-Butadiene; C4H6	106-99-0	-4.5	2.0 x 10	54		X
Methyl bromide (bromomethane); CH3Br	74-83-9	3.6	1.8 x 10	94.9	X	X
Phosgene; CCl2O	75-44-5	8.2	1.2 x 10	99		
Vinyl bromide (bromoethene); C2H3Br	593-60-2	15.8	1.1 x 10	107		
Ethylene oxide; C2H4O	75-21-8	10.7	1.1 x 10	44		
Ethyl chloride (chloroethane); C2H5Cl	75-00-3	12.5	1.0 x 10	64.5	X	X
Acetaldehyde (ethanal); C2H4O	75-07-0	21.0	952	44		
Vinylidene chloride (1,1-dichloroethylene); C2H2Cl2	75-35-4	31.7	500	97	X	X
Propylene oxide; C3H6O	75-56-9	34.2	445	58		
Methyl iodide (iodomethane); CH3I	74-88-4	42.4	400	141.9		
Methylene chloride; CH2Cl2	75-09-2	40.0	349	84.9	X	X
Methyl isocyanate; C2H3NO	624-83-9	59.6	348	57.1		
Allyl chloride (3-chloropropene); C3H5Cl	107-05-1	44.5	340	76.5	X	X
Carbon disulfide; CS2	75-15-0	46.5	260	76		
Methyl tert-butyl ether; C5H12O	1634-04-4	55.2	249	86		
Propionaldehyde; C2H5CHO	123-38-6	49.0	235	58.1		
Ethylidene dichloride (1,1-dichloroethane); C2H4Cl2	75-34-3	57.0	230	99	X	

9531968

9531969

TABLE 1. (continued)

Compound	CAS No.	BP (°C)	v.p. (mmHg)[1]	MW[1]	TO-14A	CLP-SOW
Chloroprene (2-chloro-1,3-butadiene); C4H5Cl	126-99-8	59.4	226	88.5		
Chloromethyl methyl ether; C2H5ClO	107-30-2	59.0	224	80.5		
Acrolein (2-propenal); C3H4O	107-02-8	52.5	220	56		X
1,2-Epoxybutane (1,2-butylene oxide); C4H8O	106-88-7	63.0	163	72		
Chloroform; CHCl3	67-66-3	61.2	160	119	X	X
Ethyleneimine (aziridine); C2H5N	151-56-4	56	160.0	43		
1,1-Dimethylhydrazine; C2H8N2	57-14-7	63	157.0	60.0		
Hexane; C6H14	110-54-3	69.0	120	86.2	X	
1,2-Propyleneimine (2-methylaziridine); C3H7N	75-55-8	66.0	112	57.1		
Acrylonitrile (2-propenenitrile); C3H3N	107-13-1	77.3	100	53	X	
Methyl chloroform (1,1,1-trichloroethane); C2H3Cl3	71-55-6	74.1	100	133.4	X	X
Methanol; CH4O	67-56-1	65.0	92.0	32		X
Carbon tetrachloride; CCl4	56-23-5	76.7	90.0	153.8	X	X
Vinyl acetate; C4H6O2	108-05-4	72.2	83.0	86		X
Methyl ethyl ketone (2-butanone); C4H8O	78-93-3	79.6	77.5	72		X
Benzene; C6H6	71-43-2	80.1	76.0	78	X	X
Acetonitrile (cyanomethane); C2H3N	75-05-8	82	74.0	41.0		X
Ethylene dichloride (1,2-dichloroethane); C2H4Cl2	107-06-2	83.5	61.5	99	X	X
Triethylamine; C6H15N	121-44-8	89.5	54.0	101.2		
Methylhydrazine; CH6N2	60-34-4	87. 8	49.6	46.1		
Propylene dichloride (1,2-dichloropropane); C3H6Cl2	78-87-5	97.0	42.0	113	X	X
2,2,4-Trimethyl pentane C8H18	540-84-1	99.2	40.6	114		
1,4-Dioxane (1,4-Diethylene oxide); C4H8O2	123-91-1	101	37.0	88		
Bis(chloromethyl) ether; C2H4Cl2O	542-88-1	104	30.0	115		
Ethyl acrylate; C5H8O2	140-88-5	100	29.3	100		
Methyl methacrylate; C5H8O2	80-62-6	101	28.0	100.1		

TABLE 1. (continued)

Compound	CAS No.	BP (°C)	v.p. (mmgHg)[1]	MW[1]	TO-14A	CLP-SOW
Methyl methacrylate; C5H8O2	80-62-101	101	28.0	100.1		
1,3-Dichloropropene; C3H4Cl2 (cis)	542-75-6	112	27.8	111	X	X
Toluene; C7H8	108-88-3	111	22.0	92	X	X
Trichloroethylene; C2HCl3	79-01-6	87.0	20.0	131.4	X	X
1,1,2-Trichloroethane; C2H3Cl3	79-00-5	114	19.0	133.4	X	X
Tetrachloroethylene; C2Cl4	127-18-4	121	14.0	165.8	X	X
Epichlorohydrin (1-chloro-2,3-epoxy propane); C3H5ClO	106-89-8	117	12.0	92.5		
Ethylene dibromide (1,2-dibromoethane); C2H4Br2	106-93-4	132	11.0	187.9	X	X
N-Nitroso-N-methylurea; C2H5N3O2	684-93-5	124	10.0	103		
2-Nitropropane; C3H7NO2	79-46-9	120	10.0	89		
Chlorobenzene; C6H5Cl	108-90-7	132	8.8	112.6	X	X
Ethylbenzene; C8H10	100-41-4	136	7.0	106	X	X
Xylenes (isomer & mixtures); C8H10	1330-20-7	142	6.7	106.2	X	X
Styrene; C8H8	100-42-5	145	6.6	104	X	X
p-Xylene; C8H10	106-42-3	138	6.5	106.2	X	X
m-Xylene; C8H10	108-38-3	139	6.0	106.2	X	X
Methyl isobutyl ketone (hexone); C6H12O	108-10-1	117	6.0	100.2		
Bromoform (tribromomethane); CHBr3	75-25-2	149	5.6	252.8		
1,1,2,2-Tetrachloroethane; C2H2Cl4	79-34-5	146	5.0	167.9	X	X
o-Xylene; C8H10	95-47-6	144	5.0	106.2	X	X
Dimethylcarbamyl chloride; C3H6ClNO	79-44-7	166	4.9	107.6		
N-Nitrosodimethylamine; C2H6N2O	62-75-9	152	3.7	74		
Beta-Propiolactone; C3H4O2	57-57-8	Decomposes at 162	3.4	72		
Cumene (isopropylbenzene); C9H12	98-82-8	153	3.2	120		

9531970

- 5531971

TABLE 1. (continued)

Compound	CAS No.	BP (°C)	v.p. (mmHg)[1]	MW[1]	TO-14A	CLP-SOW
Cumene (isopropylbenzene); C9H12	98-82-8	153	3.2	120		
Acrylic acid; C3H4O2	79-10-7	141	3.2	72		
N,N-Dimethylformamide; C3H7NO	68-12-2	153	2.7	73		
1,3-Propane sultone; C3H6O3S	1120-71-4	180/30mm	2.0	122.1		
Acetophenone; C8H8O	98-86-2	202	1.0	120		
Dimethyl sulfate; C2H6O4S	77-78-1	188	1.0	126.1		
Benzyl chloride (a-chlorotoluene); C7H7Cl	100-44-7	179	1.0	126.6	X	X
1,2-Dibromo-3-chloropropane; C3H5Br2Cl	96-12-8	196	0.80	236.4		
Bis(2-Chloroethyl)ether; C4H8Cl2O	111-44-4	178	0.71	143		
Chloroacetic acid; C2H3ClO2	79-11-8	189	0.69	94.5		
Aniline (aminobenzene); C6H7N	62-53-3	184	0.67	93		
1,4-Dichlorobenzene (p-); C6H4Cl2	106-46-7	173	0.60	147	X	X
Ethyl carbamate (urethane); C3H7NO2	51-79-6	183	0.54	89		
Acrylamide; C3H5NO	79-06-1	125/25 mm	0.53	71		
N,N-Dimethylaniline; C8H11N	121-69-7	192	0.50	121		
Hexachloroethane; C2Cl6	67-72-1	Sublimes at 186	0.40	236.7		
Hexachlorobutadiene; C4Cl6	87-68-3	215	0.40	260.8	X	X
Isophorone; C9H14O	78-59-1	215	0.38	138.2		
N-Nitrosomorpholine; C4H8N2O2	59-89-2	225	0.32	116.1		
Styrene oxide; C8H8O	96-09-3	194	0.30	120.2		
Diethyl sulfate; C4H10O4S	64-67-5	208	0.29	154		
Cresylic acid (cresol isomer mixture);C7H8O	1319-77-3	202	0.26	108		
o-Cresol; C7H8O	95-48-7	191	0.24	108		
Catechol (o-hydroxyphenol); C6H6O2	120-80-9	240	0.22	110		
Phenol; C6H6O	108-95-2	182	0.20	94		

TABLE 1. (continued)

Compound	CAS No.	BP (°C)	v.p. (mmHg)[1]	MW[1]	TO-14A	CLP-SOW
Catechol (o-hydroxyphenol); C6H6O2	120-80-9	240	0.22	110		
Phenol; C6H6O	108-95-2	182	0.20	94		
1,2,4-Trichlorobenzene; C6H3Cl3	120-82-1	213	0.18	181.5	X	X
nitrobenzene; C6H5NO2	98-95-3	211	0.15	123		

[1]Vapor pressure (v.p.), boiling point (BP) and molecularweight (MW) data from:
(a)D. L. Jones and J. bursey, "Simultaneous Control of PM-10 and Hazardous Air Pollutants II: Rationale for Selection of Hazardous Air Pollutants as Potential Particulate Matter," Report EPA-452/R-93/013, U. S. Environmental Protection Agency, Research Triangle Park, NC. October 1992;
(b)R. C. Weber, P. A. Parker, and M. Bowser. Vapor Pressure Distribution of Selected Organic Chemicals, Report EPA-600/2-81-021, U. S. Environmental Protection Agency, Cincinnati, OH, February 1981; and
(c)R. C. Weast, ed., "CRC Handbook of Chemistry and Physics," 59th edition, CRC Press, Boca Raton, 1979.

9531972

9531973

TABLE 2. CHARACTERISTIC MASSES (M/Z) USED FOR QUANTIFYING THE TITLE III CLEAN AIR ACT AMENDMENT COMPOUNDS

Compound	CAS No.	Primary Ion	Secondary Ion
Methyl chloride (chloromethane); CH3Cl	74-87-3	50	52
Carbonyl sulfide; COS	463-S8-1	60	62
Vinyl chloride (chloroethene); C2H3Cl	7S-01-4	62	64
Diazomethane; CH2N2	334-88-3	42	41
Formaldehyde; CH2O	50-00-0	29	30
1,3-Butadiene; C4H6	106-99-0	39	54
Methyl bromide (bromomethane); CH3Br	74-83-9	94	96
Phosgene; CCl2O	75-44-5	63	65
Vinyl bromide (bromoethene); C2H3Br	593-60-2	106	108
Ethylene oxide; C2H4O	75-21-8	29	44
Ethyl chloride (chloroethane); C2H5Cl	75-00-3	64	66
Acetaldehyde (ethanal); C2H4O	75-07-0	44	29, 43
Vinylidene chloride (1,1-dichloroethylene); C2H2Cl2	75-35-4	61	96
Propylene oxide; C3H6O	75-56-9	58	57
Methyl iodide (iodomethane); CH3I	74-88-4	142	127
Methylene chloride; CH2Cl2	75-09-2	49	84, 86
Methyl isocyanate; C2H3NO	624-83-9	57	56
Allyl chloride (3-chloropropene); C3H5Cl	107-05-1	76	41, 78
Carbon disulfide; CS2	75-15-0	76	44, 78
Methyl tert-butyl ether; C5H12O	1634-04-4	73	41, 53
Propionaldehyde; C2H5CHO	123-38-6	58	29, 57
Ethylidene dichloride (1,1-dichloroethane); C2H4Cl2	75-34-3	63	65, 27
Chloroprene (2-chloro-1,3-butadiene); C4H5Cl	126-99-8	88	53, 90
Chloromethyl methyl ether; C2H5ClO	107-30-2	45	29, 49
Acrolein (2-propenal); C3H4O	107-02-8	56	55
1,2-Epoxybutane (1,2-butylene oxide); C4H8O	106-88-7	42	41, 72
Chloroform; CHCl3	67-66-3	83	85, 47
Ethyleneimine (aziridine); C2H5N	151-56-4	42	43
1,1-Dimethylhydrazine; C2H8N2	57-14-7	60	45, 59
Hexane; C6H14	110-54-3	57	41, 43
1,2-Propyleneimine (2-methylazindine); C3H7N	75-55-8	56	57, 42
Acrylonitrile (2-propenenitrile); C3H3N	107-13-1	53	52
Methyl chloroform (1,1,1 trichloroethane); C2H3Cl3	71-55-6	97	99, 61
Methanol; CH4O	67-56-1	31	29
Carbon tetrachloride; CCl4	56-23-5	117	119
Vinyl acetate; C4H6O2	108-05-4	43	86
Methyl ethyl ketone (2-butanone); C4H8O	78-93-3	43	72

TABLE 2. (continued)

Compound	CAS No.	Primary Ion	Secondary Ion
Benzene; C6H6	71-43-2	78	77,50
Acetonitrile (cyanomethane); C2H3N	75-05-8	41	40
Ethylene dichloride (1,2-dichloroethane); C2H4Cl2	107-06-2	62	64, 27
Triethylamine; C6H15N	121-44-8	86	58, 101
Methylhydrazine; CH6N2	60-34-4	46	31, 45
Propylene dichloride (1,2-dichloropropane); C3H6Cl2	78-87-5	63	41, 62
2,2,4-Trimethyl pentane; C8H18	540-84-1	57	41, 56
1,4-Dioxane (1,4 Diethylene oxide); C4H8O2	123-91-1	88	58
Bis(chloromethyl) ether; C2H4Cl2O	542-88-1	79	49, 81
Ethyl acrylate; C5H8O2	140-88-5	55	73
Methyl methacrylate; C5H8O2	80-62-6	41	69, 100
1,3-Dichloropropene; C3H4Cl2 (cis)	542-75-6	75	39, 77
Toluene; C7H8	108-88-3	91	92
Trichloethylene; C2HCl3	79-01-6	130	132, 95
1,1,2-Trichloroethane; C2H3Cl3	79-00-5	97	83, 61
Tetrachloroethylene; C2Cl4	127-18-4	166	164, 131
Epichlorohydrin (l-chloro-2,3-epoxy propane); C3H5ClO	106-89-8	57	49, 62
Ethylene dibromide (1,2-dibromoethane); C2H4Br2	106-93-4	107	109
N-Nitrso-N-methylurea; C2H5N3O2	684-93-5	60	44, 103
2-Nitropropane; C3H7NO2	79-46-9	43	41
Chlorobenzene; C6H5Cl	108-90-7	112	77, 114
Ethylbenzene; C8H10	100-41-4	91	106
Xylenes (isomer & mixtures); C8H10	1330-20-7	91	106
Styrene; C8H8	100-42-5	104	78, 103
p-Xylene; C8H10	106-42-3	91	106
m-Xylene; C8H10	108-38-3	91	106
Methyl isobutyl ketone (hexone); C6H12O	108-10-1	43	58, 100
Bromoform (tribromomethane); CHBr3	75-25-2	173	171, 175
1,1,2,2-Tetrachloroethane; C2H2Cl4	79-34-5	83	85
o-Xylene; C8H10	95-47-6	91	106
Dimethylcarbamyl chloride; C3H6ClNO	79-44-7	72	107
N-Nitrosodimethylamine; C2H6N2O	62-75-9	74	42
Beta-Propiolactone; C3H4O2	57-57-8	42	43
Cumene (isopropylbenzene); C9H12	98-82-8	105	120
Acrylic acid; C3H4O2	79-10-7	72	45, 55
N,N-Dimethylformamide; C3H7NO	68-12-2	73	42, 44
1,3-Propane sultone; C3H6O3S	1120-71-4	58	65, 122

TABLE 2. (continued)

9531975

Compound	CAS No.	Primary Ion	Secondary Ion
Acetophenone; C8H8O	98-86-2	105	77,120
Dimethyl sulfate; C2H6O4S	77-78-1	95	66,96
Benzyl chloride (a-chlorotoluene); C7H7Cl	100-44-7	91	126
1,2-Dibromo-3-chloropropane; C3H5Br2Cl	96-12-8	57	155, 157
Bis(2-Chloroethyl)ether; C4H8Cl2O	111-44-4	93	63, 95
Chloroacetic acid; C2H3ClO2	79-11-8	50	45, 60
Aniline (aminobenzene); C6H7N	62-53-3	93	66
1,4-Dichlorobenzene (p-); C6H4Cl2	106-46-7	146	148, 111
Ethyl carbamate (urethane); C3H7NO2	51-79-6	31	44, 62
Acrylamide; C3H5NO	79-06-1	44	55, 71
N,N-Dimethylaniline; C8H11N	121-69-7	120	77, 121
Hexachloroethane; C2Cl6	67-72-1	201	199, 203
Hexachlorobutadiene; C4Cl6	87-68-3	225	227, 223
Isophorone; C9H14O	78-59-1	82	138
N-Nitrosomorpholine; C4H8N2O2	59-89-2	56	86, 116
Styrene oxide; C8H8O	96-09-3	91	120
Diethyl sulfate; C4H10O4S	64-67-5	45	59, 139
Cresylic acid (cresol isomer mixture); C7H8O	1319-77-3		
o-Cresol; C7H8O	95-48-7	108	107
Catechol (o-hydroxyphenol); C6H6O2	120-80-9	110	64
Phenol; C6H6O	108-95-2	94	66
1,2,4-Trichlorobenzene; C6H3Cl3	120-82-1	180	182, 184
Nitrobenzene; C6H5NO2	98-95-3	77	51, 123

TABLE 3. REQUIRED BFB KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria[1]
50	8.0 to 40.0 Percent of m/e 95
75	30.0 to 66.0 Percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5.0 to 9.0 Percent of m/e 95 (See note)
173	Less than 2.0 Percent of m/e 174
174	50.0 to 120.0 Percent of m/e 95
175	4.0 to 9.0 Percent of m/e 174
176	93.0 to 101.0 Percent of m/e 174
177	5.0 to 9.0 Percent of m/e 176

[1]All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

9531977

TABLE 4. METHOD DETECTION LIMITS (MDL)[1]

TO-14A List	Lab #1, SCAN	Lab #2, SIM
Benzene	0.34	0.29
Benzyl Chloride	--	--
Carbon tetrachloride	0.42	0.15
Chlorobenzene	0.34	0.02
Chloroform	0.25	0.07
1,3-Dichlorobenzene	0.36	0.07
1,2-Dibromoethane	--	0.05
1,4-Dichlorobenzene	0.70	0.12
1,2-Dichlorobenzene	0.44	--
1,1-Dichloroethane	0.27	0.05
1,2-Dichloroethane	0.24	--
1,1-Dichloroethene	--	0.22
cis-1,2-Dichloroethene	--	0.06
Methylene chloride	1.38	0.84
1,2-Dichloropropane	0.21	--
cis-1,3-Dichloropropene	0.36	--
trans-1,3-Dichloropropene	0.22	--
Ethylbenzene	0.27	0.05
Chloroethane	0.19	--
Trichlorofluoromethane	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane		--
1,2-Dichloro-1,1,2,2-tetrafluoroethane	--	--
Dichlorodifluoromethane	--	--
Hexachlorobutadiene	--	--
Bromomethane	0.53	--
Chloromethane	0.40	--
Styrene	1.64	0.06
1,1,2,2-Tetrachloroethane	0.28	0.09
Tetrachloroethene	0.75	0.10
Toluene	0.99	0.20
1,2,4-Trichlorobenzene	--	--
1,1,1-Trichloroethane	0.62	0.21
1,1,2-Trichloroethane	0.50	--
Trichloroethene	0.45	0.07
1,2,4-Trimethylbenzene	--	--
1,3,5-Trimethylbenzene	--	--
Vinyl Chloride	0.33	0.48
m,p-Xylene	0.76	0.08
o-Xylene	0.57	0.28

[1]Method Detection Limits (MDLs) are defined as the product of the standard deviation of seven replicate analyses and the student's "t" test value for 99% confidence. For Lab #2, the MDLs represent an average over four studies. MDLs are for MS/SCAN for Lab #1 and for MS/SIM for Lab #2.

TABLE 5. SUMMARY OF EPA DATA ON REPLICATE PRECISION (RP) FROM EPA NETWORK OPERATIONS[1]

Monitoring Compound Identification	EPA's Urban Air Toxics Monitoring Program (UATMP)			EPA's Toxics Air Monitoring Stations (TAMS)		
	%RP	#	ppbv	%RP	#	ppbv
Dichlorodifluoromethane	--		--	13.9	47	0.9
Methylene chloride	16.3	07	4.3	19.4	47	0.6
1,2-Dichloroethane	36.2	31	1.6	--	--	--
1,1,1-Trichloroethane	14.1	44	1.0	10.6	47	2.0
Benzene	12.3	56	1.6	4.4	47	1.5
Trichloroethene	12.8	08	1.3	--	--	--
Toluene	14.7	76	3.1	3.4	47	3.1
Tetrachloroethene	36.2	12	0.8	--	--	--
Chlorobenzene	20.3	21	0.9	--	--	--
Ethylbenzene	14.6	32	0.7	5.4	47	0.5
m-Xylene	14.7	75	4.0	5.3	47	1.5
Styrene	22.8	59[2]	1.1	8.7	47	0.2[2]
o-Xylene	--		--	6.0	47	0.5
p-Xylene	--					
1,3-Dichlorobenzene	49.1	06	0.6	--	--	--
1,4-Dichlorobenzene	14.7	14	6.5	--	--	--

[1]Denotes the number of replicate or duplicate analysis used to generate the statistic. The replicate precision is defined as the mean ratio of absolute difference to the average value.
[2]Styrene and o-xylene coelute from the GC column used in UATMP. For the TAMS entries, both values were below detection limits for 18 of 47 replicates and were not included in the calculation.

TABLE 6. AUDIT ACCURACY (AA) VALUES[1] FOR SELECTED COMPENDIUM METHOD TO-14A COMPOUNDS

Selected Compounds From TO-14A List	FY-88 TAMS AA(%), N=30	FY-88 UATMP AA(%), N=3
Vinyl chloride	4.6	17.9
Bromomethane	--	6.4
Trichlorofluoromethane	6.4	--
Methylene chloride	8.6	31.4
Chloroform	--	4.2
1,2-Dichloroethane	6.8	11.4
1,1,1-Trichloroethane	18.6	11.3
Benzene	10.3	10.1
Carbon tetrachloride	12.4	9.4
1,2-Dichloropropane	--	6.2
Trichloroethene	8.8	5.2
Toluene	8.3	12.5
Tetrachloroethene	6.2	--
Chlorobenzene	10.5	11.7
Ethylbenzene	12.4	12.4
o-Xylene	16.2	21.2

[1]Audit accuracy is defined as the relative difference between the audit measurement result and its nominal value divided by the nominal value. N denotes the number of audits averaged to obtain the audit accuracy value. Information is not available for other TO-14A compounds because they were not present in the audit materials.

9531979

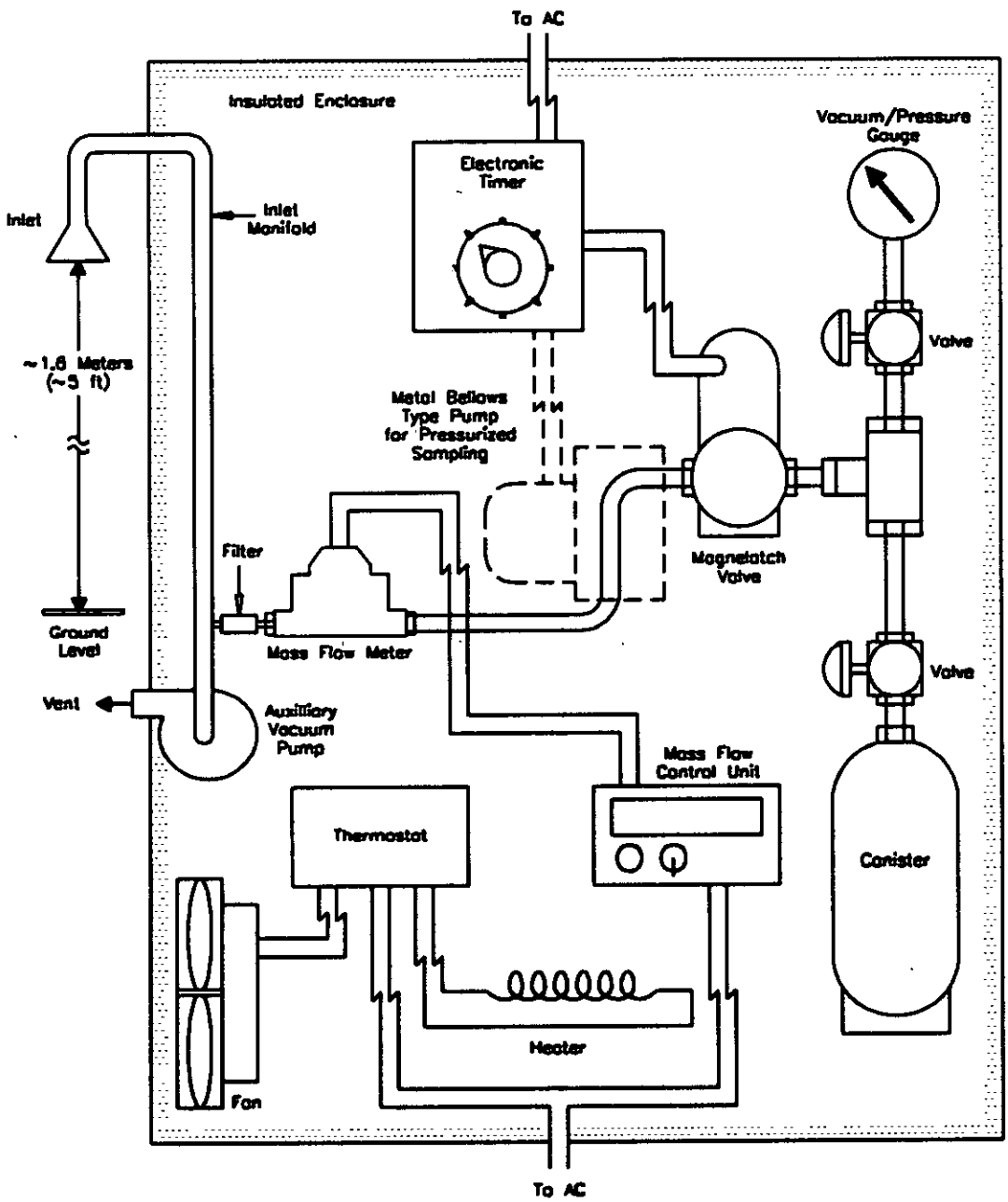
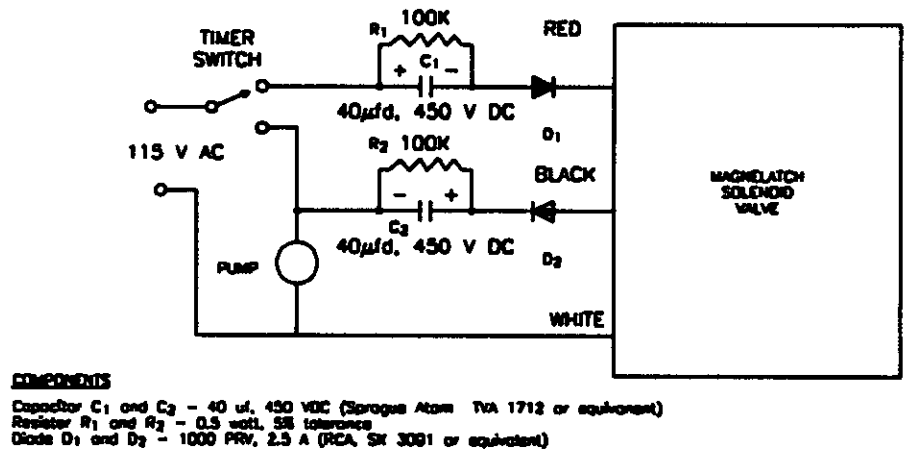


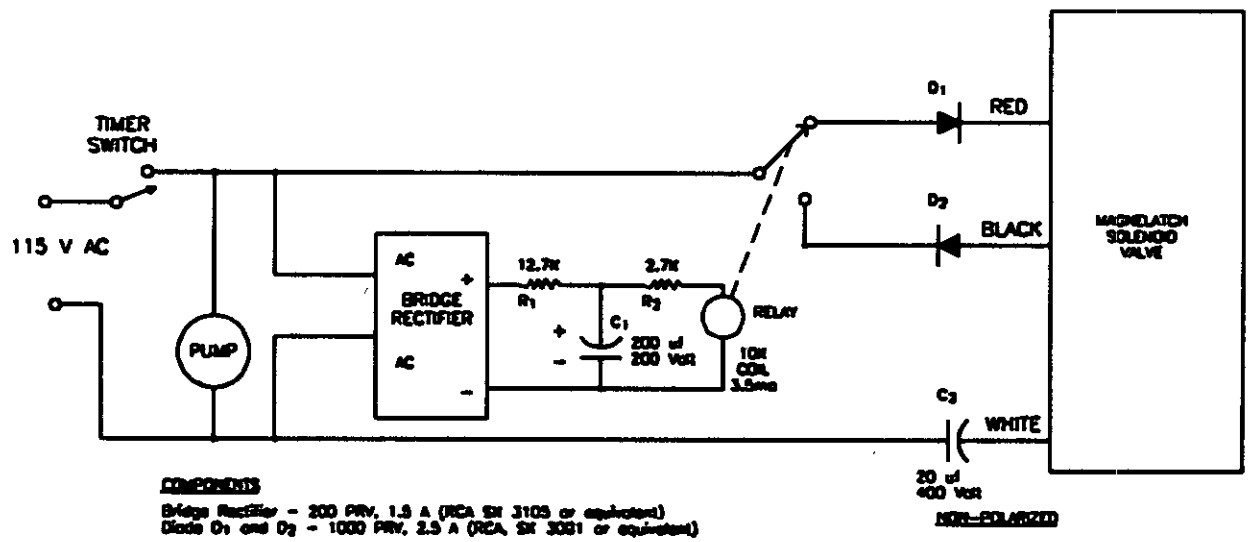
Figure 1. Sampler configuration for subatmospheric pressure or pressurized canister sampling.



COMPONENTS

Capacitor C_1 and C_2 – 40 ufd, 450 VDC (Sprague Atom TVA 1712 or equivalent)
Resistor R_1 and R_2 – 0.5 watt, 5% tolerance
Diode D_1 and D_2 – 1000 PRV, 2.5 A (RCA, SK 3091 or equivalent)

(a). Simple Circuit for Operating Magnelatch Valve



COMPONENTS

Bridge Rectifier – 200 PRV, 1.5 A (RCA SK 3105 or equivalent)
Diode D_1 and D_2 – 1000 PRV, 2.5 A (RCA, SK 3091 or equivalent)
Capacitor C_1 – 200 ufd, 250 VDC (Sprague Atom TVA 1520 or equivalent)
Capacitor C_2 – 20 ufd, 400 VDC Non-Polarized (Sprague Atom TVAH 1632 or equivalent)
Relay – 10,000 ohm coil, 3.5 ma (AMF Potter and Brumfield, KCP 5, or equivalent)
Resistor R_1 and R_2 – 0.5 watt, 5% tolerance

(b). Improved Circuit Designed to Handle Power Interruptions

Figure 2. Electrical pulse circuits for driving Skinner magnelatch solenoid valve with mechanical timer.

9531981

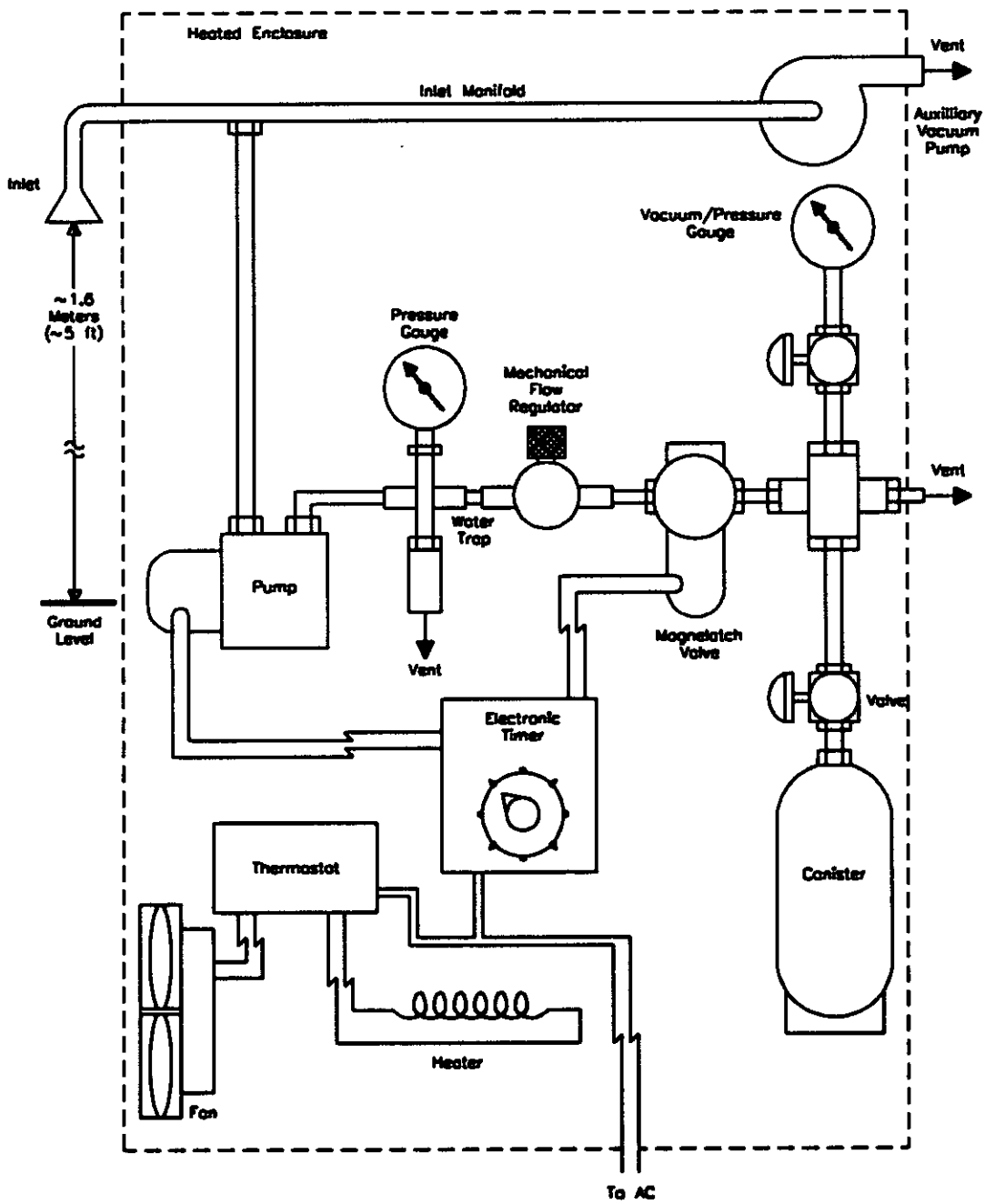


Figure 3. Alternative sampler configuration for pressurized canister sampling.

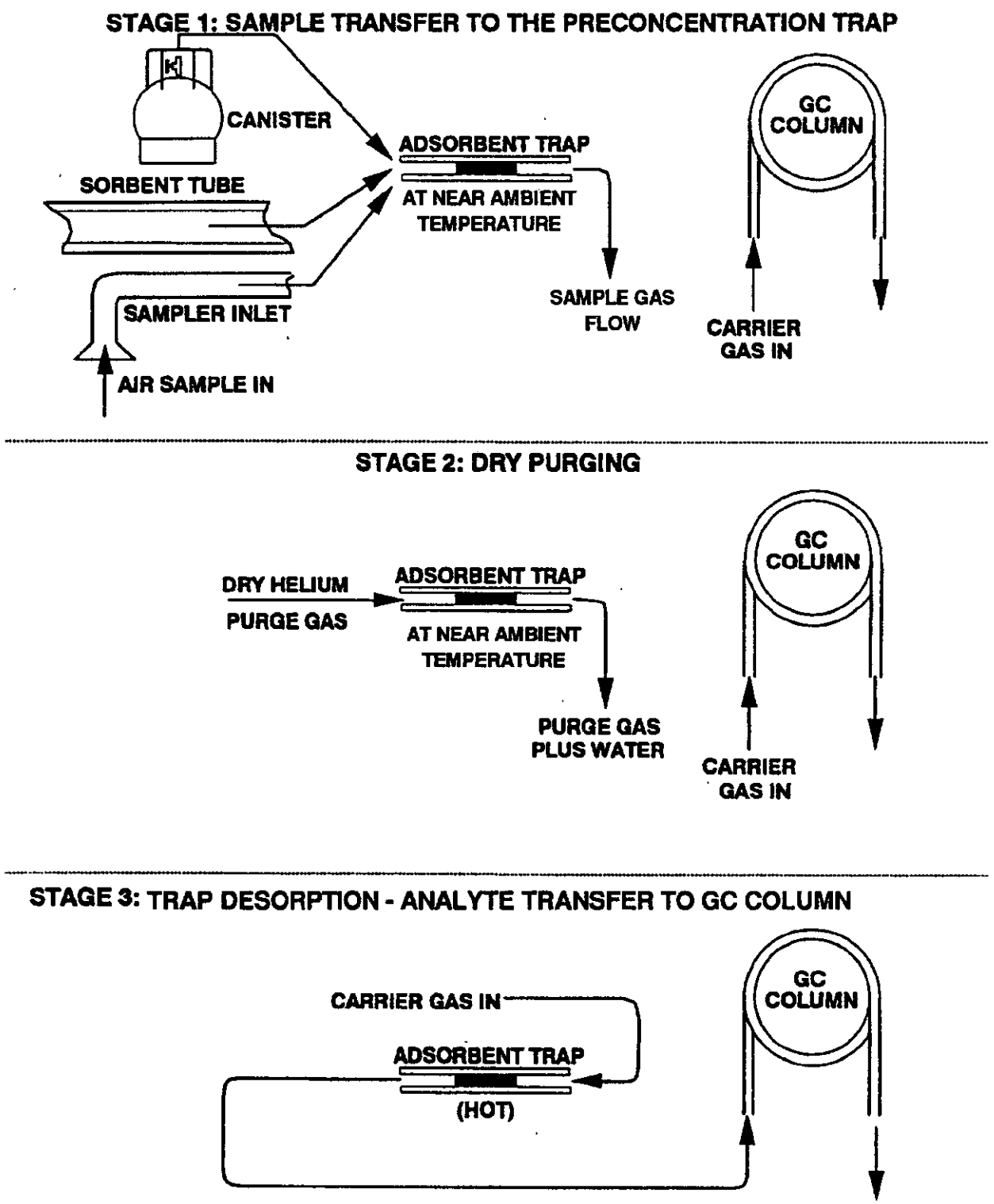


Figure 4. Illustration of three stages of dry purging of adsorbent trap.

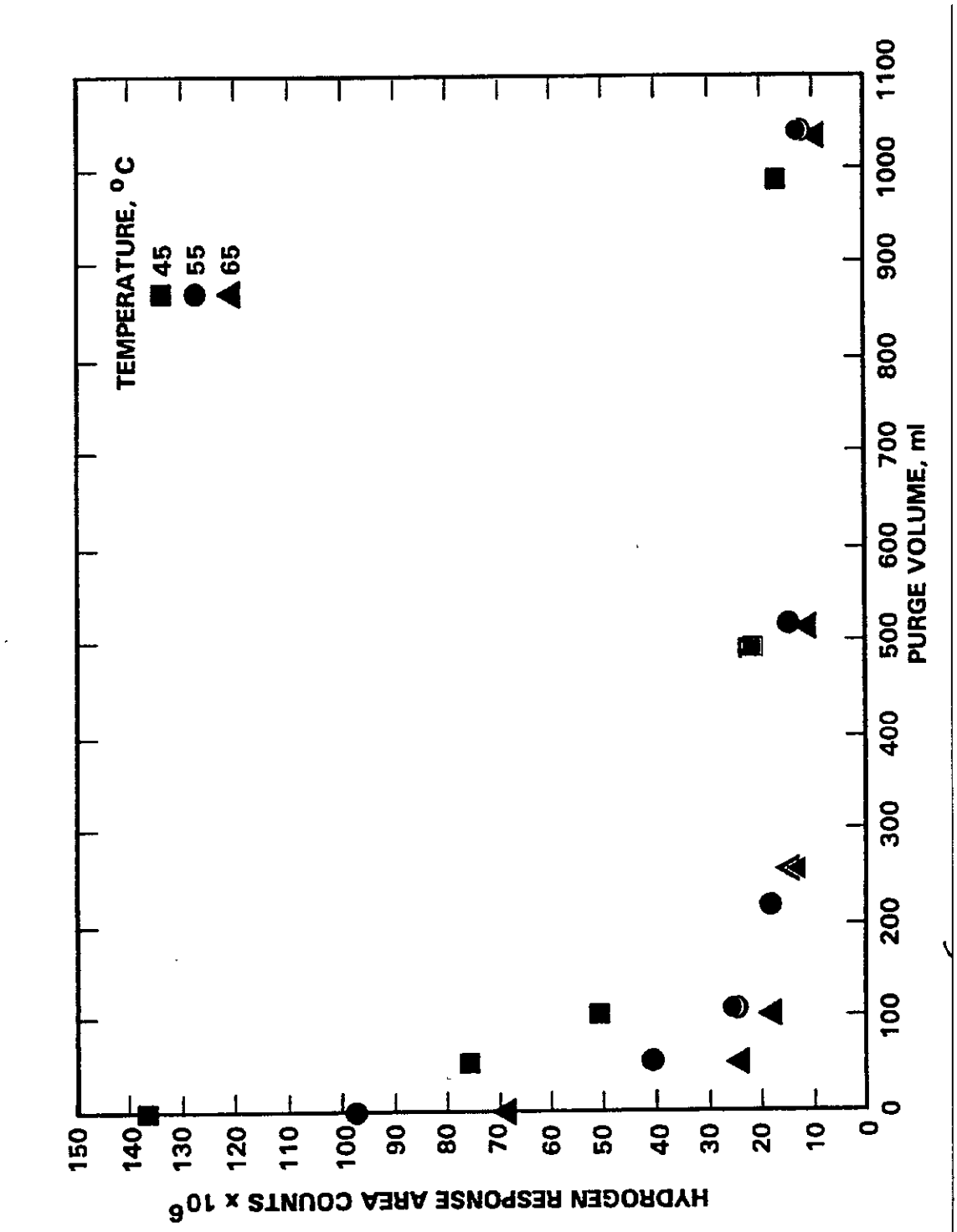


Figure 5. Residual water vapor on VOC concentrator vs. dry He purge volume.

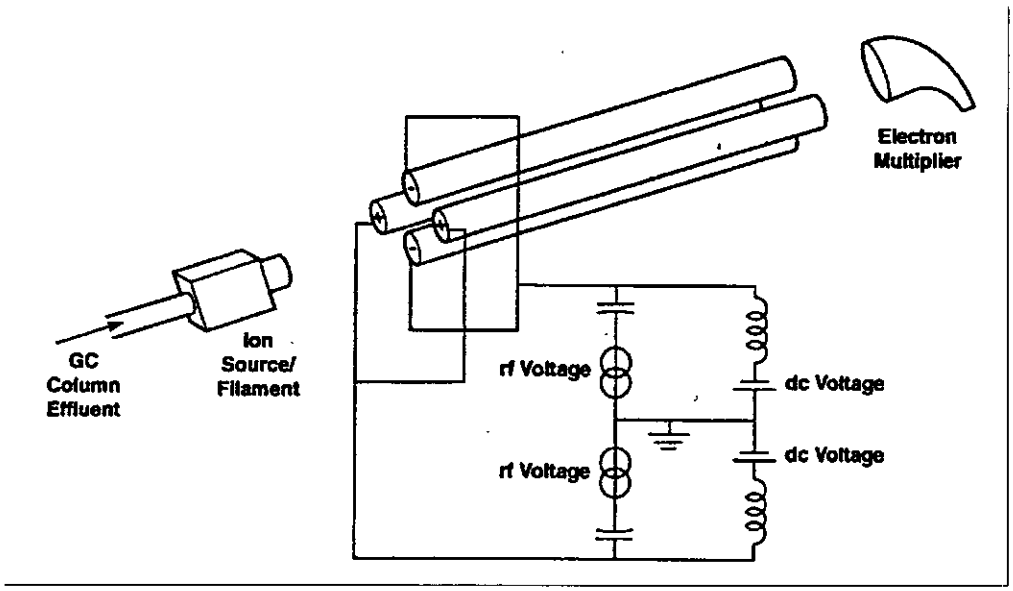


Figure 6. Simplified diagram of a quadrupole mass spectrometer.

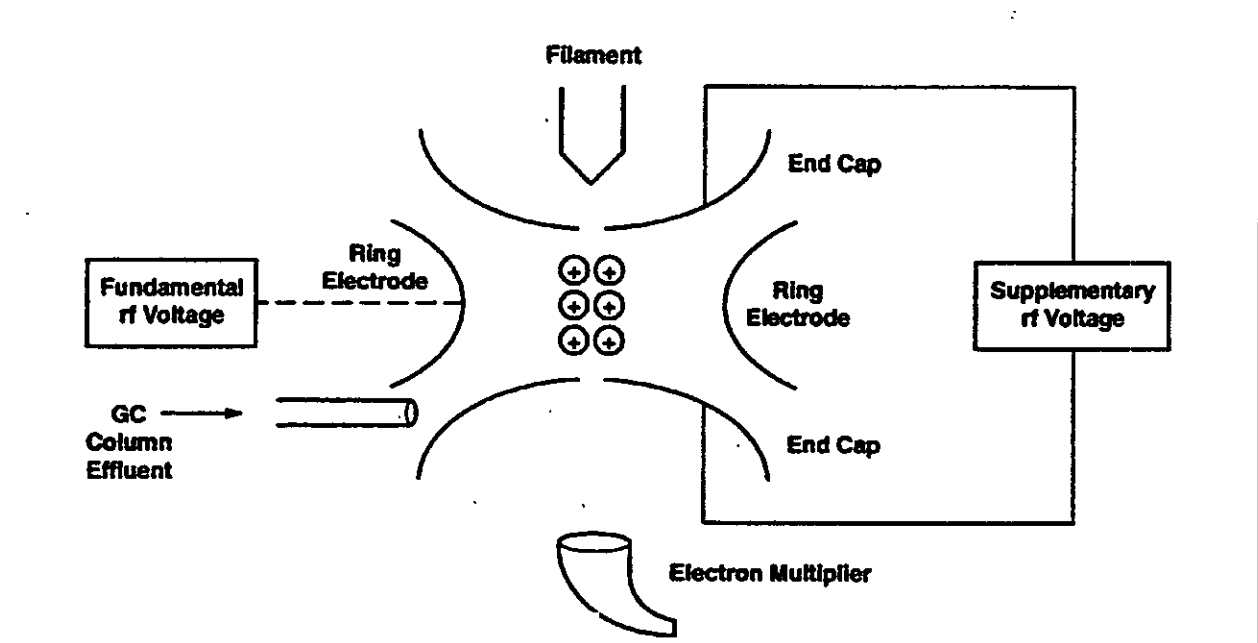


Figure 7. Simplified diagram of an ion trap mass spectrometer.

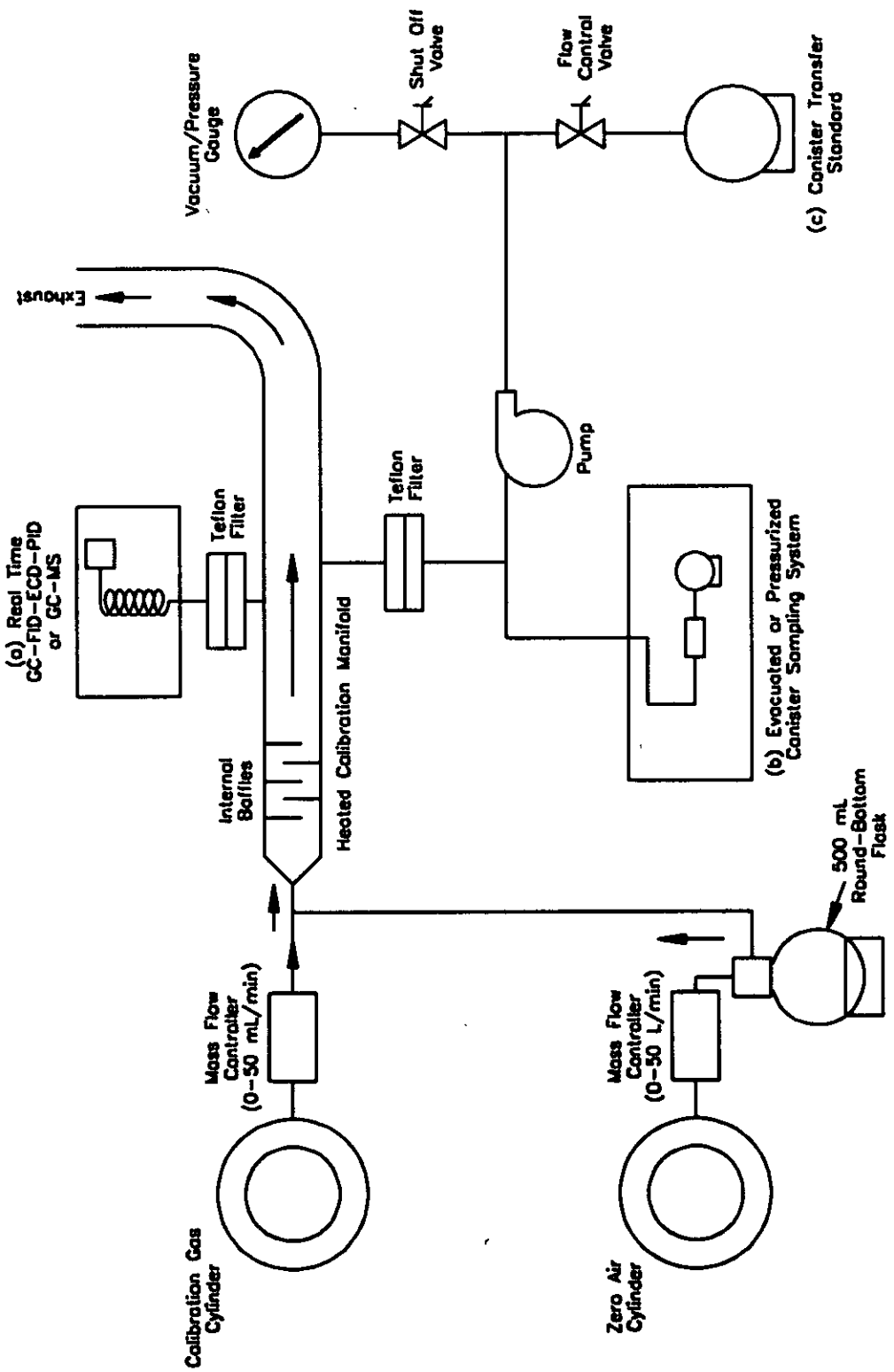


Figure 8. Schematic diagram of calibration system and manifold for (a) analytical system calibration, (b) testing canister sampling system and (c) preparing canister transfer standards.

COMPENDIUM METHOD TO-15
CANISTER SAMPLING FIELD TEST DATA SHEET

A.GENERAL INFORMATION

SITE LOCATION: _____
SITE ADDRESS: _____
_____
SAMPLING DATE: _____

SHIPPING DATE: _____
CANISTER SERIAL NO.: _____
SAMPLER ID: _____
OPERATOR: _____
CANISTER LEAK
CHECK DATE: _____

B. SAMPLING INFORMATION

	TEMPERATURE				PRESSURE	
	INTERIOR	AMBIENT	MAXIMUM	MINIMUM	CANISTER PRESSURE	
START						
STOP						

	SAMPLING TIMES		FLOW RATES		
	LOCAL TIME	ELAPSED TIME METER READING	MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT
START					
STOP					

SAMPLING SYSTEM CERTIFICATION DATE: _____
QUARTERLY RECERTIFICATION DATE: _____

C. LABORATORY INFORMATION

DATA RECEIVED: _____
RECEIVED BY: _____
INITIAL PRESSURE: _____
FINAL PRESSURE: _____
DILUTION FACTOR: _____
ANALYSIS
GC-FID-ECD DATE: _____
GC-MSD-SCAN DATE: _____
GC-MSD-SIM DATE: _____
RESULTS*: _____
_____
GC-FID-ECD: _____
GC-MSD-SCAN: _____
GC-MSD-SIM: _____

_____
SIGNATURE/TITLE

Figure 9. Canister sampling field test data sheet (FTDS).

9531987

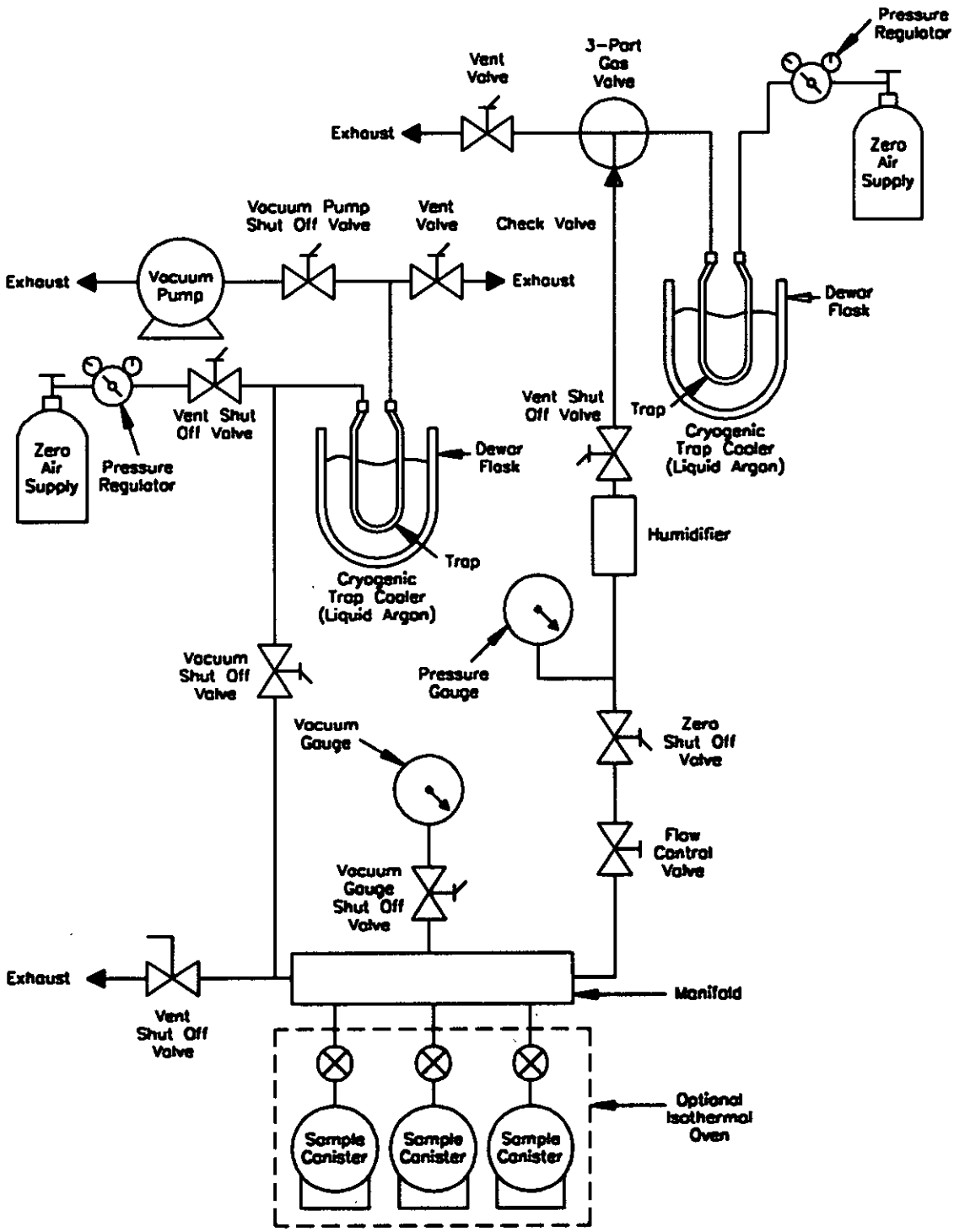


Figure 10. Canister cleaning system.

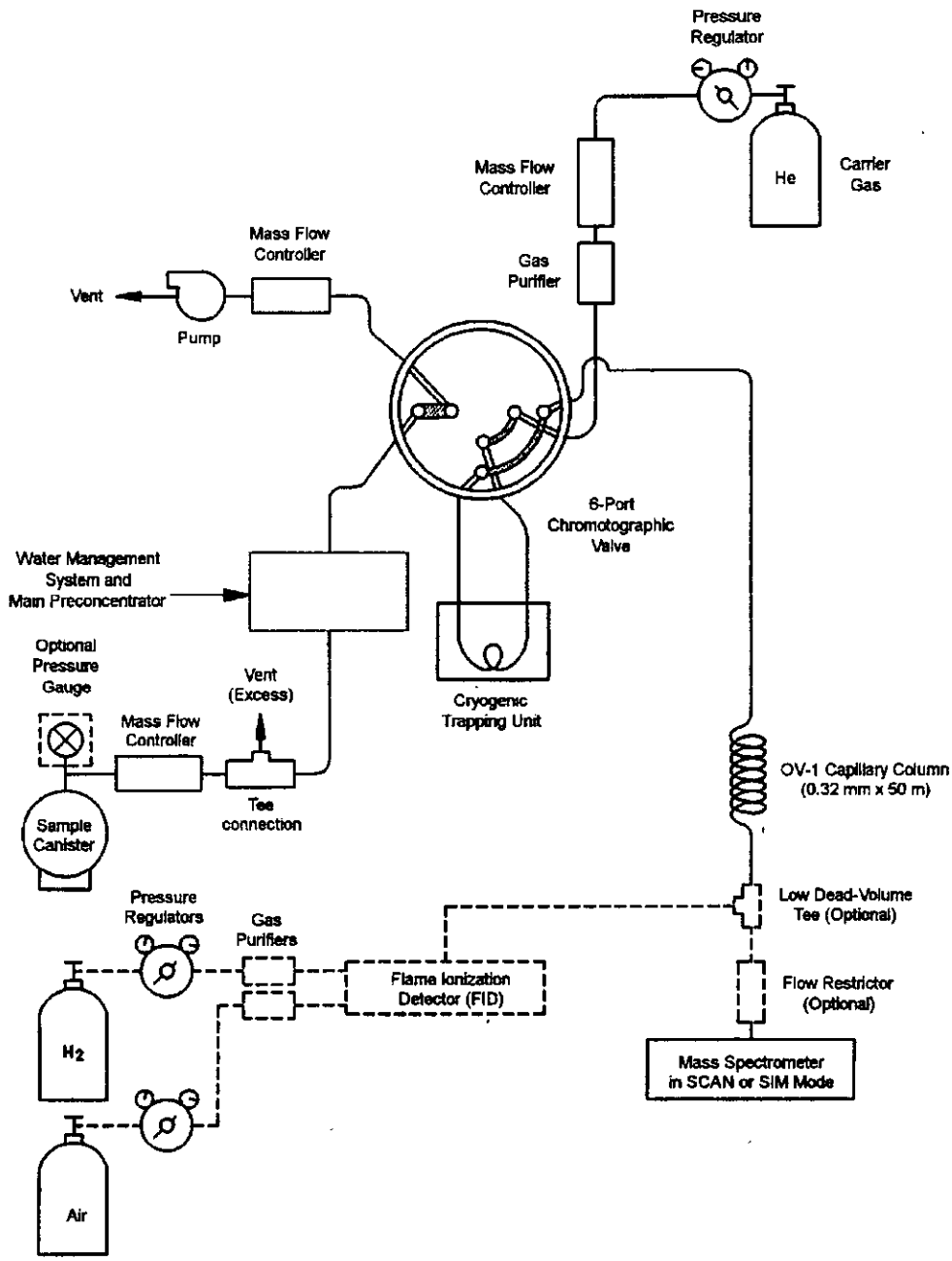
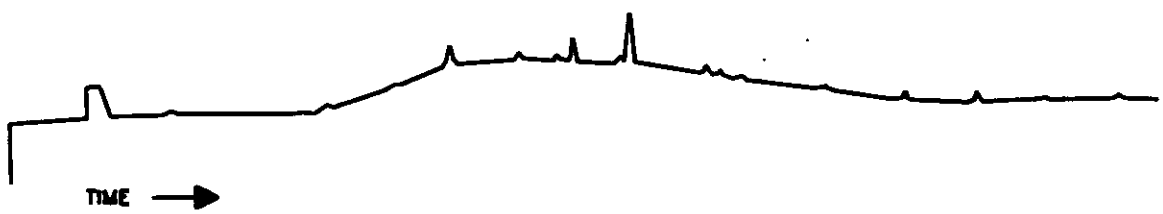
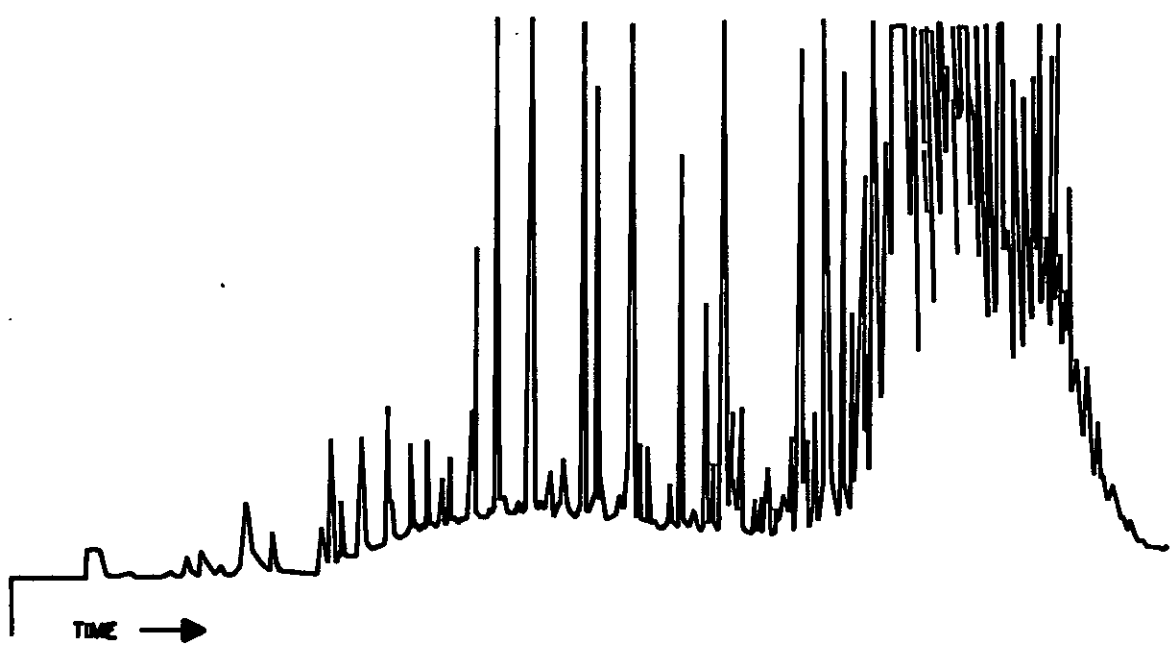


Figure 11. Canister analysis utilizing GC/MS/SCAN/SIM analytical system with optional flame ionization detector with 6-port chromatographic valve in the sample desorption mode.
[Alternative analytical system illustrated in Figure 16.]



(a). Certified Sampler



(b). Contaminated Sampler

Figure 12. Example of humid zero air test results for a clean sample canister (a) and a contaminated sample canister (b).

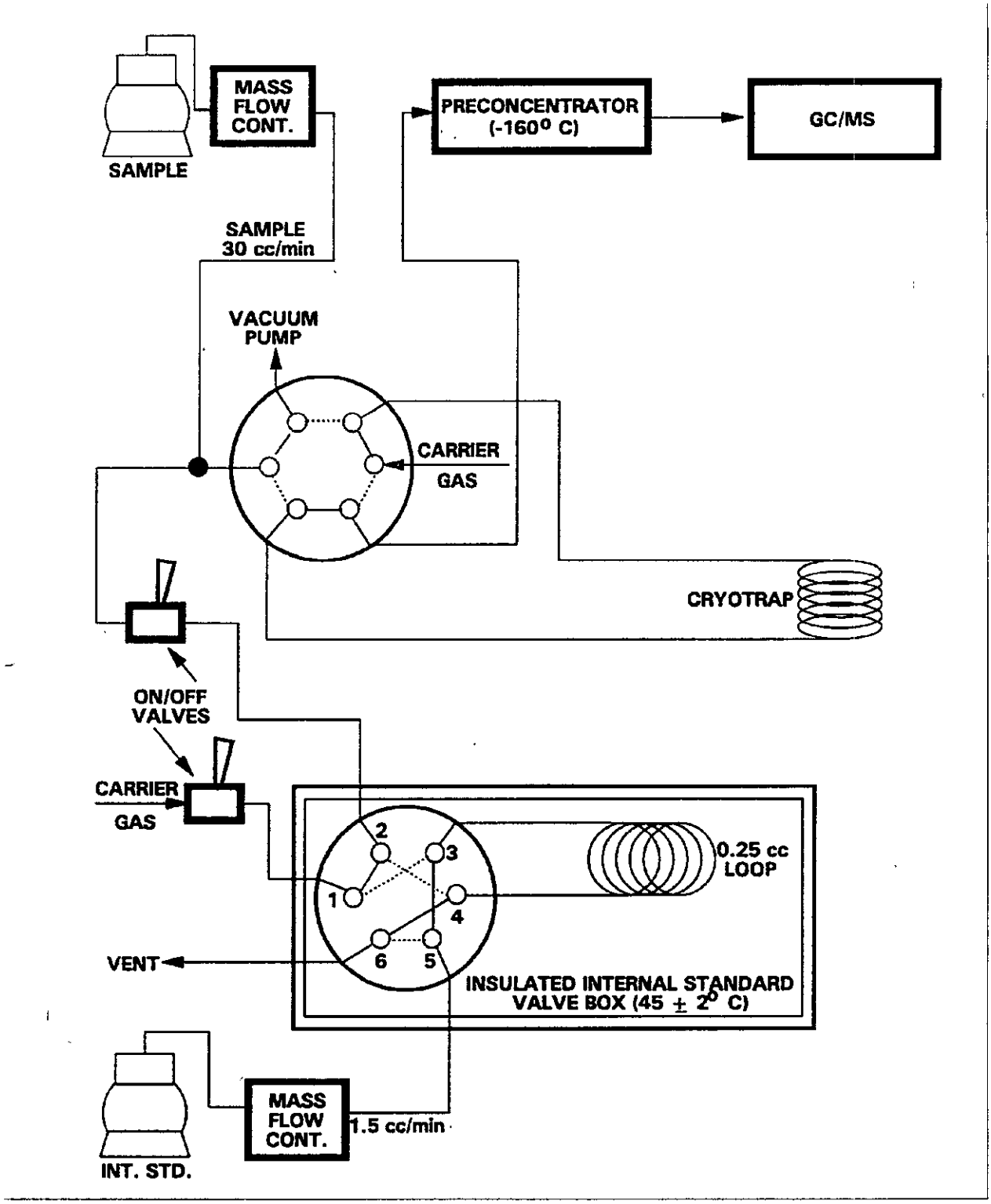


Figure 13. Diagram of design for internal standard addition.

9531991

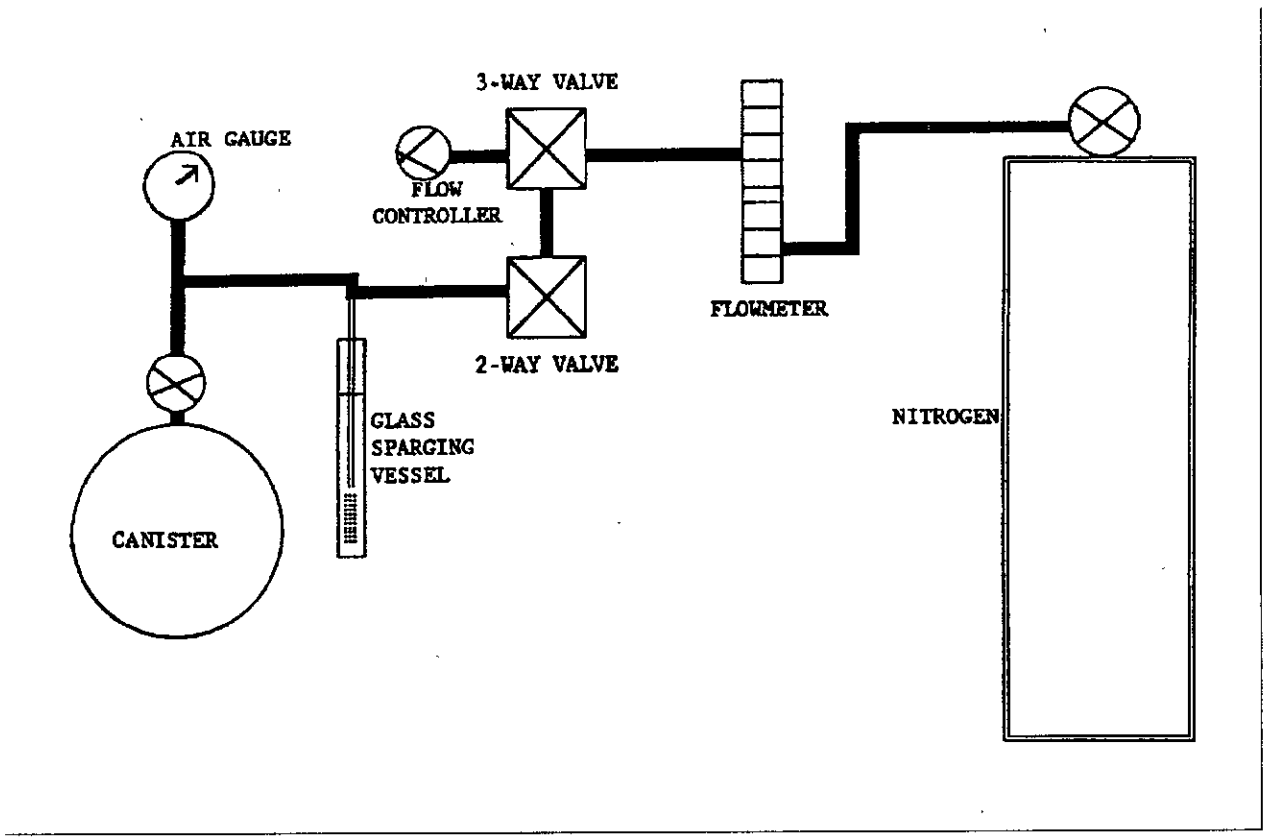


Figure 14. Water method of standard preparation in canisters.

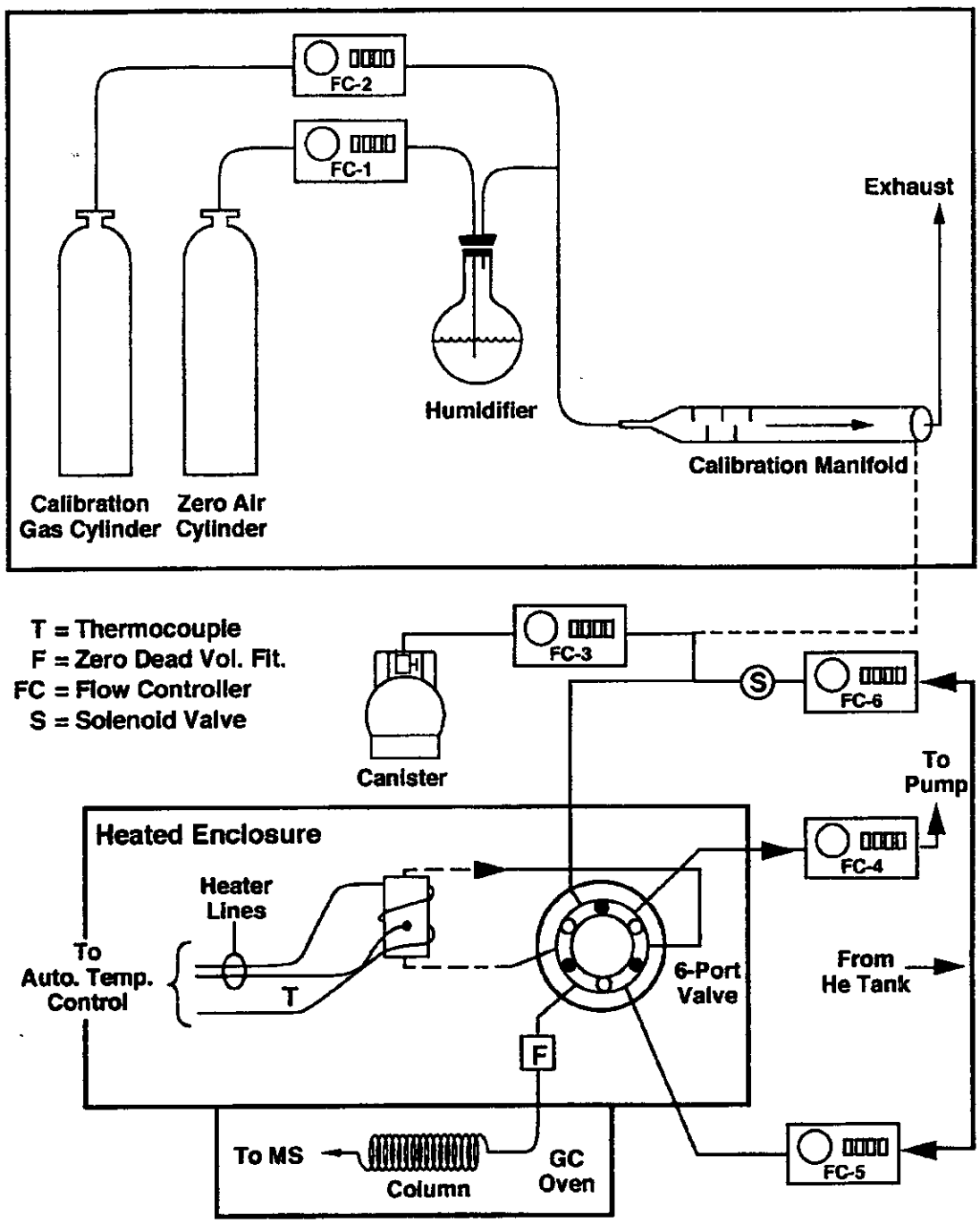


Figure 15. Diagram of the GC/MS analytical system.

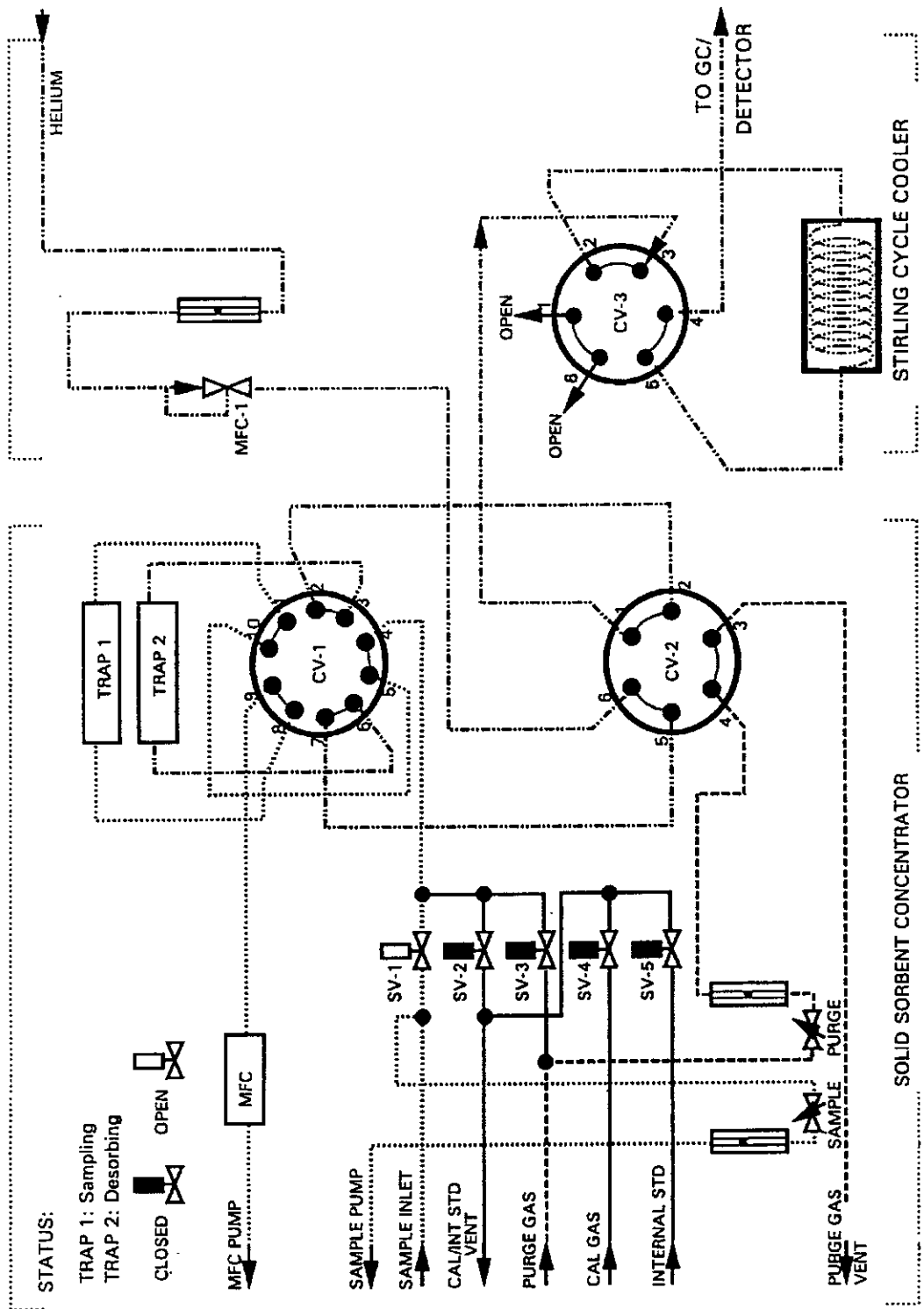


Figure 16. Sample flow diagram of a commercially available concentrator showing the combination of multisorbent tube and cooler (Trap 1 sampling; Trap 2 desorbing).

9531994

ATTACHMENT F-3

Standard Operating Procedures

- Standard Operating Procedure for Collection of Soil and Sub-Slab Vapor Samples Using Summa™ Canisters
- Standard Operating Procedure for Long-Term Measurement of Sub-Slab and Indoor Air Pressures

Standard Operating Procedure for Collection of Sub-Slab Vapor Samples Using Summa™ Canisters

Introduction

This procedure describes methods for the collection of sub slab soil vapor samples in Summa™ canisters. The SOP includes instruction on probe installation, leak checking, gas sampling, and probe abandonment. This SOP should be used in conjunction with project data quality objectives. Only persons trained in the collection of soil gas samples should attempt this procedure.

Materials

Probe Installation

- Hammer drill and 7/8" or 1" and 5/16" or 3/8" bits
- Vacuum cleaner ('shop vac' type or hand held)
- Probe (1/4" stainless steel tube with Swagelok™ or equivalent nut and ferrule)
- Probe seal (1/8" NPT internal wrenching plug)
- Probe union (1/4" male Swagelok™ or equivalent to 1/8" female NPT)
- Nuts and ferrules (1/4" stainless steel Swagelok™ or equivalent)
- Hack saw
- Mortar consisting of portland cement and fine sand mix, mortar mix, or similar
- Large Q-tips or paper towels and water
- Tongue depressor, putty knife, or similar tool
- Tape measure

Leak check

- Leak check enclosure
- Compressed helium tank (balloon grade), helium regulator, flow meter (0-500 mL/min)
- Helium detector, or equal
- (alternative) Isopropyl alcohol and paper towels

Sampling

- Sampling union (1/4" male Swagelok™ or equivalent to 1/4" male NPT)
- Vacuum pump, sampling manifold
- ¼" Teflon tubing, rubber tubing
- Flow controller
- Summa™ canister (sized appropriately for sampling requirements)
- Miscellaneous fitting to connect tubing to sampling union and Summa™ canister)

Probe Abandonment

- Probe removal fitting
- Crowbar

Miscellaneous

- Teflon™ tape
- 9/16", ½", crescent wrench, screw driver
- Extension cord
- Timer/watch
- Tools required to cut carpet, and/or tools needed for removal of other floor coverings

Probe Installation

1. Locate the sampling locations in accordance with the work plan. Check with local utility companies to identify utilities coming into the building from outside. If possible, look for known or suspected utility conduits and note their location on a map or in the field log. Be sure to confirm that the sample locations will not interfere with the known underground utilities. Also note the location of the probe, locations of significant features (walls, cracks, sumps, drains, etc), and conditions of the slab and soil.
2. If needed, expose the concrete by cutting the carpet or other loose floor coverings (Note: Carpet need not be removed, but rather a 'L' shape cut to expose the concrete for drilling and the leak check enclosure). Drill a 7/8" or 1" diameter hole to a depth of 1-3/4" (measured to the center of the hole) to allow room for the installation of the probe nut and probe union (See Figure 2). Remove the cuttings using a vacuum cleaner. Be careful to not compromise the integrity of the slab during drilling (i.e., cracking it), although note if this occurs. It is important that the slab and the probe hole remain air tight for sampling and that cracks are noted.
3. Drill a 5/16" or 3/8" diameter hole through the remainder of the slab and approx. 3" down into the sub-slab material (See Figure 3). Drilling into the sub slab material creates a void that is free of obstructions that might plug the probe during sampling. Record the total depth of the slab and the depth drilled into the sub slab material.
4. Once the total depth of the slab is known, be sure that the probe (1/4" stainless steel tube with Swagelok™ or equivalent nut and ferrule) is cut with a hacksaw so that it does not extend beyond the bottom of the slab. Attach the probe union (1/4" male Swagelok™ to 1/8" female NPT) to the probe and tighten. Wrap the probe seal with Teflon tape and tighten into the union. See Figure 8 for an expanded view of the probe parts.
5. Wet the walls of the hole using the Q-tip or moistened paper towel. This helps the mortar bond to the drilled concrete. Prepare the mortar in accordance with manufacturer's directions to a stiff consistency. Make sure that the consistency is such that the mixture will not run down the sides of the hole and potentially clog the probe or hole. Place sample probe and sample union part way into the hole as shown in Figure 4. The probe tip should be at least one inch into the smaller diameter hole, but not so far that mortar can not be easily placed in the large diameter hole around the probe fittings. It is critical that the mortar mixture does not get into either end of the probe and cause a plug. Using the tongue depressor or similar tool, apply mortar around the base of the sampling probe and sampling union such that it will be sealed once it is in place.
6. Fill the hole with mortar, and press the probe further into the hole until its top is flush with the floor. In doing so, slightly wiggle the probe to create good 'wetting' contact between the probe and the mortar as well as the mortar and the drilled concrete. Scrape off excess and make sure there is clear access to the probe. See Figure 5.
7. Let dry for 24 hours
8. Be sure to never leave the probe hole open to atmosphere for extended periods to minimize the effects of surface infiltration.

Manifold Assembly and leak check

1. Make sure the sampling system is assembled (as shown in Figure 1 or 10) by connecting the sampling manifold to the soil gas probe and the purge system. Do not connect the flow controller or canister at this time.
2. Make sure the gas probe valve (valve #1) is closed.
3. Open the sample valve (valve #2) and the purge valve (valve #3) and turn the vacuum pump on. Make sure that the flow meter on the vacuum pump exhaust is reading 200 mL/min. Let the pump run for 1 minute to allow purging of potential contaminants from the manifold
4. Now close valve #2 to achieve a vacuum gauge reading of 10 inches of mercury or to a vacuum that will be encountered during sampling, which ever is greater. Close the purge valve #3 and shut the vacuum pump off.

5. If the pressure in the manifold has not changed after a minute, then the manifold is considered leak free. If not, repair any leaks prior to use and re-check the manifold.
6. Record the leak check date and time on the field sampling log.

Probe Leak Check and Probe Purging

The sampling system needs to be leak-checked and purged before sampling. Two different methods supported by the available literature/guidance are presented. One method uses helium gas as a tracer and allows for the assessment of potential probe leak prior to sample collection. The other method uses isopropyl alcohol as a tracer and allows for the assessment of potential probe leak after sample collection and analysis. Both these methods are acceptable and are detailed below.

Helium leak checking technique and purge

1. Remove the probe seal insert, wrap the sampling union fitting threads (1/8" male NPT to ¼" male Swagelok™ or equivalent) with Teflon tape (wrap the NPT threads only), and tighten into the exposed probe fitting. Thread the Teflon sample tubing through the rubber grommet in the leak check enclosure from the outside, and attach the tube to the sampling union using a nut and ferrule. Slide the enclosure down so it seals on the concrete slab. Attach the other end of the sample tube to the sampling manifold. See Figure 6 and 7.
2. Attach tubing to the flow meter on the helium tank regulator and the other end to the enclosure. Attach the exhaust tube to the enclosure and position the other end as far away as possible to avoid detection by the helium leak detector. See figure 9.
3. Put the helium detector on the exhaust line from the sample pump. Make sure valve 1 is closed. Open valves 2 and 3. Turn on the sample pump and helium detector.
4. Open the helium tank and set the flow meter for approximately 200 mL/min. Allow it to flow for 1 minute to fill the leak check enclosure before starting the purge. Make sure that the detector is not reading any helium before starting the purge.
5. Two liters of sub slab gas need to be purged before sampling. The purge time is 10 minutes at a flow rate of 200 mL/min. Close valve #2 and open valve #1 simultaneously and start timing for the purge volume. During the purge, observe the helium detector for indication of probe leakage (e.g. infiltration of room air into the probe). If a reading of >5% is observed, then the probe leak check has failed, and corrective action is required – see step 4.2.2.
6. At the end of the purge time, close valves #1 and #3 and turn the pump off. If at any time during the purge the detector read < 5%, then the system is leak free and ready for sampling. If >5% was observed, then check the fittings and try again. If <5% cannot be achieved, then this probe must be abandoned and a new hole drilled. Be sure to record the helium leak check value on the field sheet.
7. Close the helium tank valve.

Isopropyl alcohol leak checking technique and purge

1. Moisten a paper towel with isopropyl alcohol. Wrap the isopropyl alcohol moistened paper towel around probe fittings at the slab surface. Note: It is important to keep the isopropyl alcohol completely away from the sample equipment and Summa™ Canister during the set up phase. The sampler must also change nitrile gloves between setting up the sample equipment and conducting the leak detection test. It is also important to instruct the laboratory to analyze for isopropyl alcohol. If isopropyl alcohol is detected by the laboratory at a concentration greater than 5% (50,000 ppmv) then the sample is deemed to be invalid due to a leak.
2. Two liters of sub slab gas need to be purged before sampling. The purge time is 10 minutes at a flow rate of 200 mL/min. Close valve #2 and open valve #1 simultaneously and start timing for the purge volume.
3. At the end of the purge time, close valves #1 and #3 and turn the pump off.

Sampling

1. The Summa™ canister has been evacuated to near absolute zero pressure. Care should be used at all times to prevent inadvertent loss of canister vacuum. Never open the valve affixed to the canister unless the intent is to collect sample or check the pressure. Use only a canister that has been certified to be clean.
2. Remove the canister valve cap, attach the vacuum gauge to the canister, and open the canister valve. Record the pressure reading and close and remove the valve. The pressure in the canister should be between 28" and 30" of mercury. If not, then the canister has leaked and should not be used for sampling.
3. Connect the flow controller to the manifold (at valve #2) and the Summa™ canister to the flow controller. The port on the flow controller that reads 'HP' or 'In' should be attached to the manifold. The port that reads 'LP' or 'Out' should be attached to the canister. Use only a flow controller that has been cleaned and properly adjusted.
4. To take the sample, confirm valve #3 is closed, and open valves #1 and #2. Slowly open the canister valve approximately one (1) full turn, and start timing. Record the start time on the field sampling log. During the sampling period, record the lowest pressure from the manifold gauge on the field log.
5. There are different sample time and flow rate protocols. These are subject to project requirements.
    - 5 minute sample period, 850 mL canister: The flow controller is set for 150 mL/min. For an 850 cc Summa™ canister, it will take 5 minutes to collect a sample.
    - 24 hour sample period, 6 L canister: The flow controller is set for 3.75 mL/min. For a 6 liter Summa™ canister, it will take 24 hours to collect a sample.
6. At the end of the time, close the sample valve (valve #2) and the valve affixed to the canister. Remove the canister from the apparatus.
7. Re-attach the vacuum gauge and record the final pressure. The canister should only have 750 mL of sample in it based on a 150 mL/min sampling rate for 5 minutes. This should equate to between 2" and 5" final pressure in the canister. Record the sampling date, time, canister ID, flow controller ID, and any other observation pertinent to the sampling event on the field sampling log.
8. Remove the gauge from the can and tighten the cap back on with a wrench. Verify that canister valve is closed.
9. Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).
10. Disconnect the sample tubing from the probe, and remove the sampling union.

Probe Abandonment

1. After sampling, it is critical that the probe either be removed or plugged to prevent the creation of a new pathway for vapor intrusion.
2. If the probe is to be used again in the future, wrap the probe seal insert with Teflon™ tape, and tighten it into the probe opening using a hex key until it is tight and flush with the concrete floor.
3. If the probe is to be removed, insert the removal fitting into the probe. Using a crow bar, remove the entire probe assembly. If the probe can not be removed in this manner, then overdrill the probe with 1" bit. Fill the hole with hydrated concrete mix.

Figure 1 – Sub slab Sampling

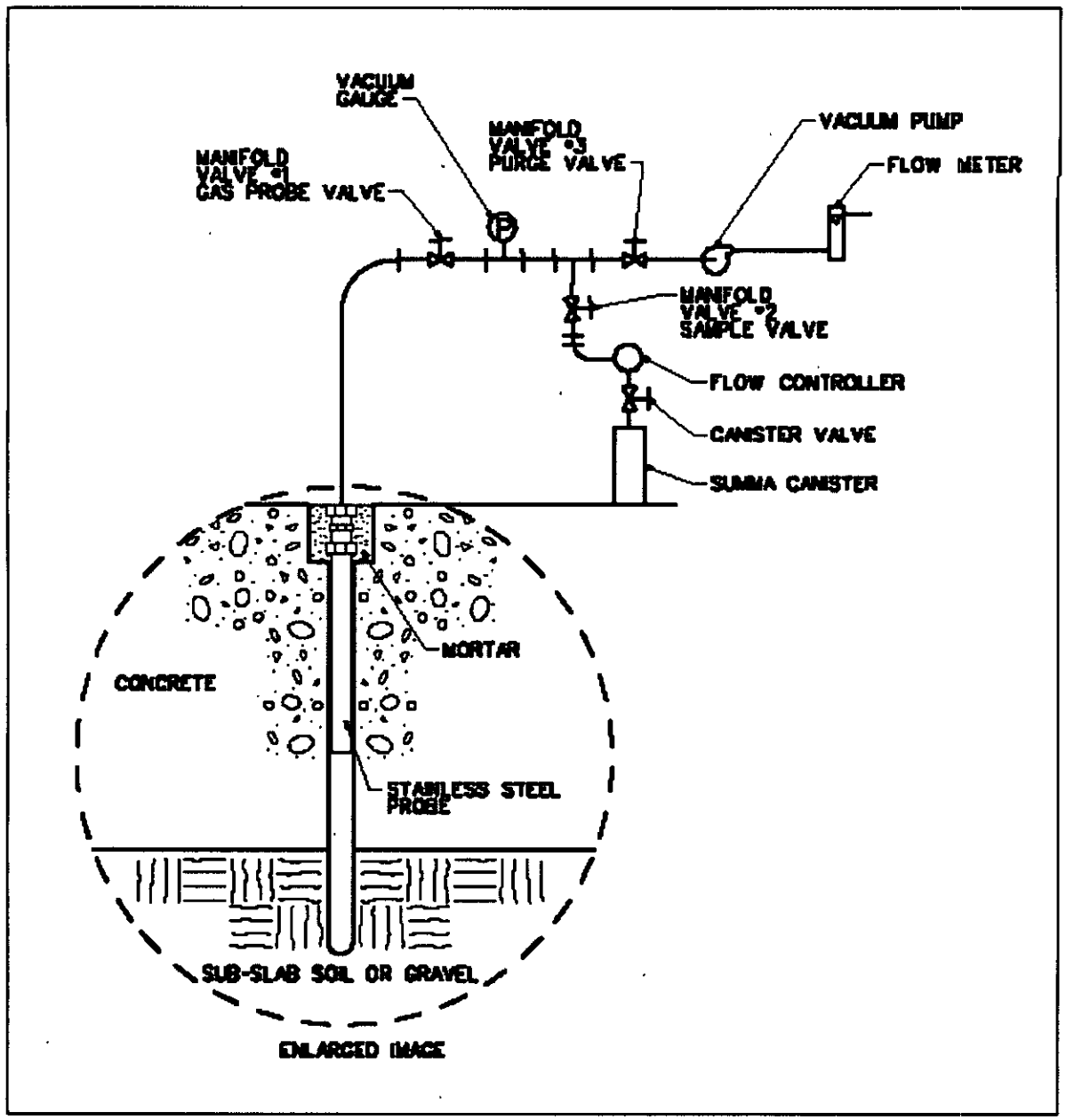


Figure 2 – Drilling 1" mortar hole to a depth of 1 ¾"

Figure 3 – Drilling 3/8" probe hole

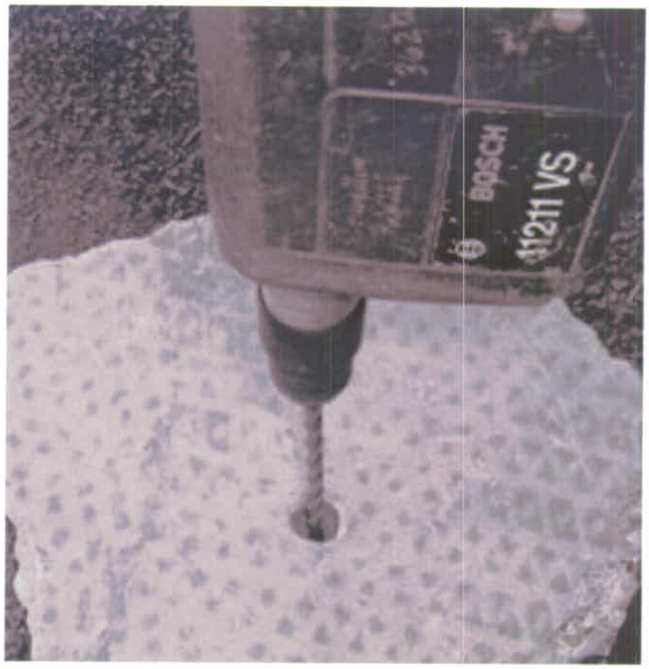


Figure 4 – Installing Probe with mortar

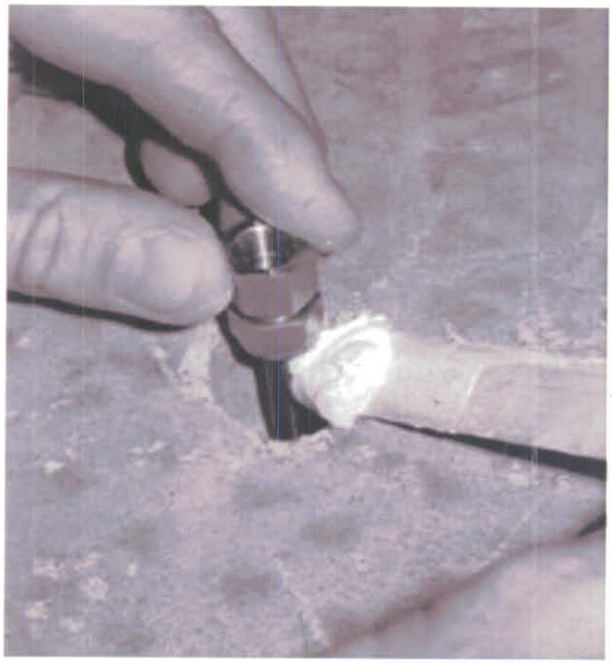


Figure 5 – Installed probe, flush with slab

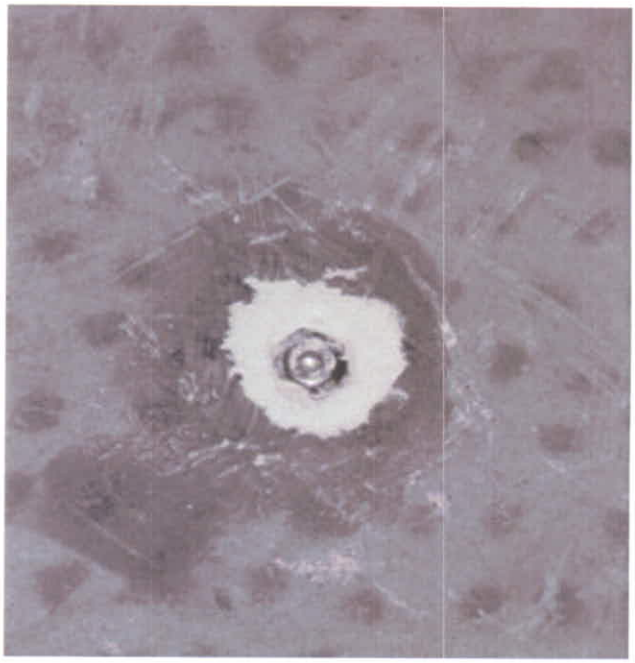


Figure 6 – Installed probe with sample tube

Figure 7 - Installing the helium leak check assembly

Figure 8 – Probe Parts

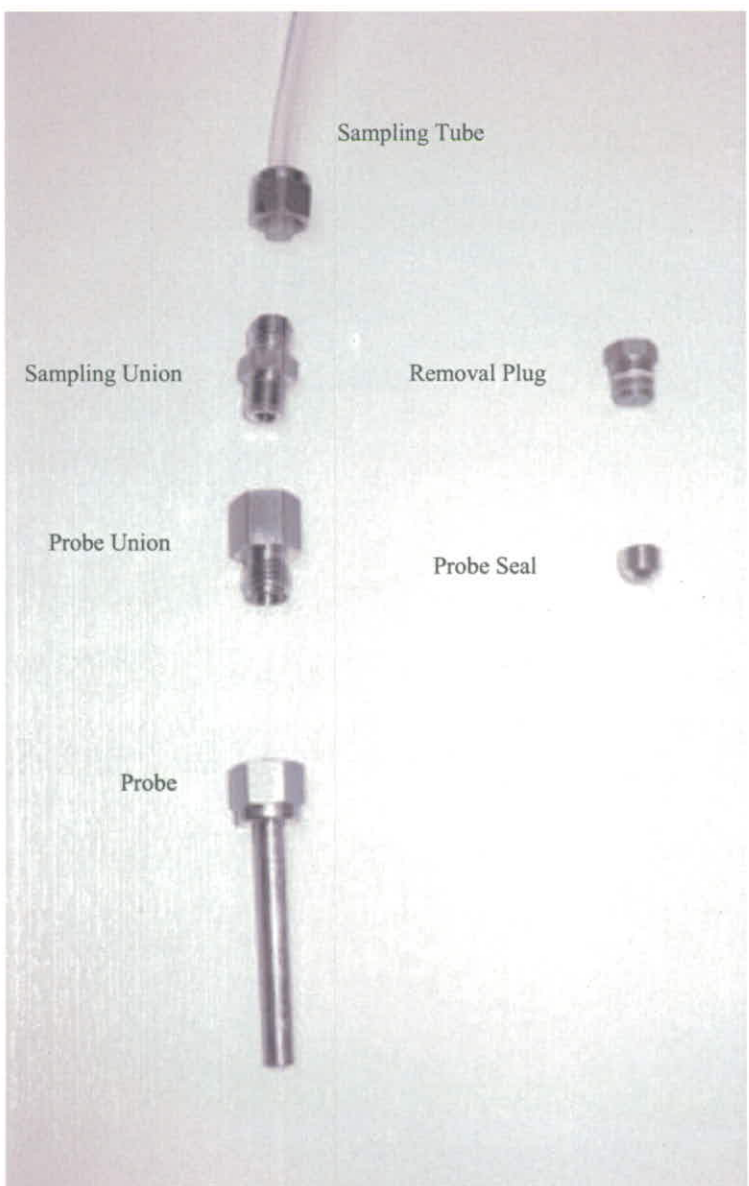


Figure 9 –Helium Leak Check Assembly

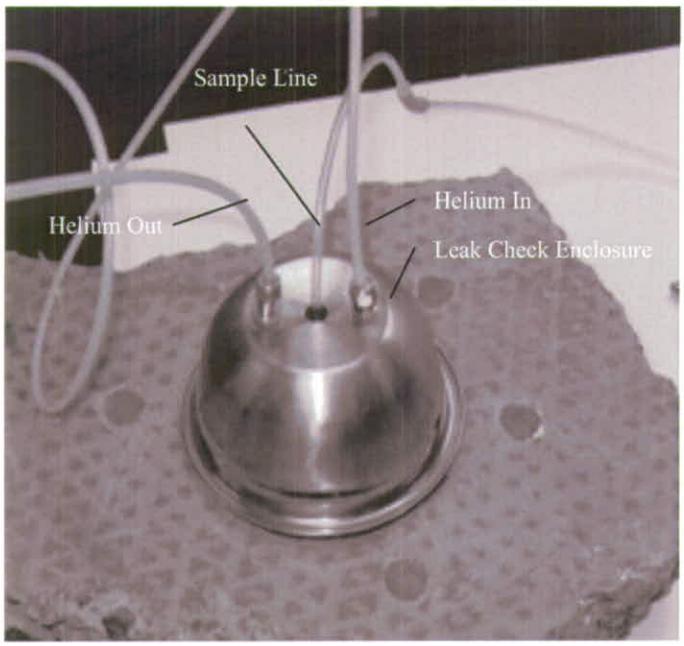
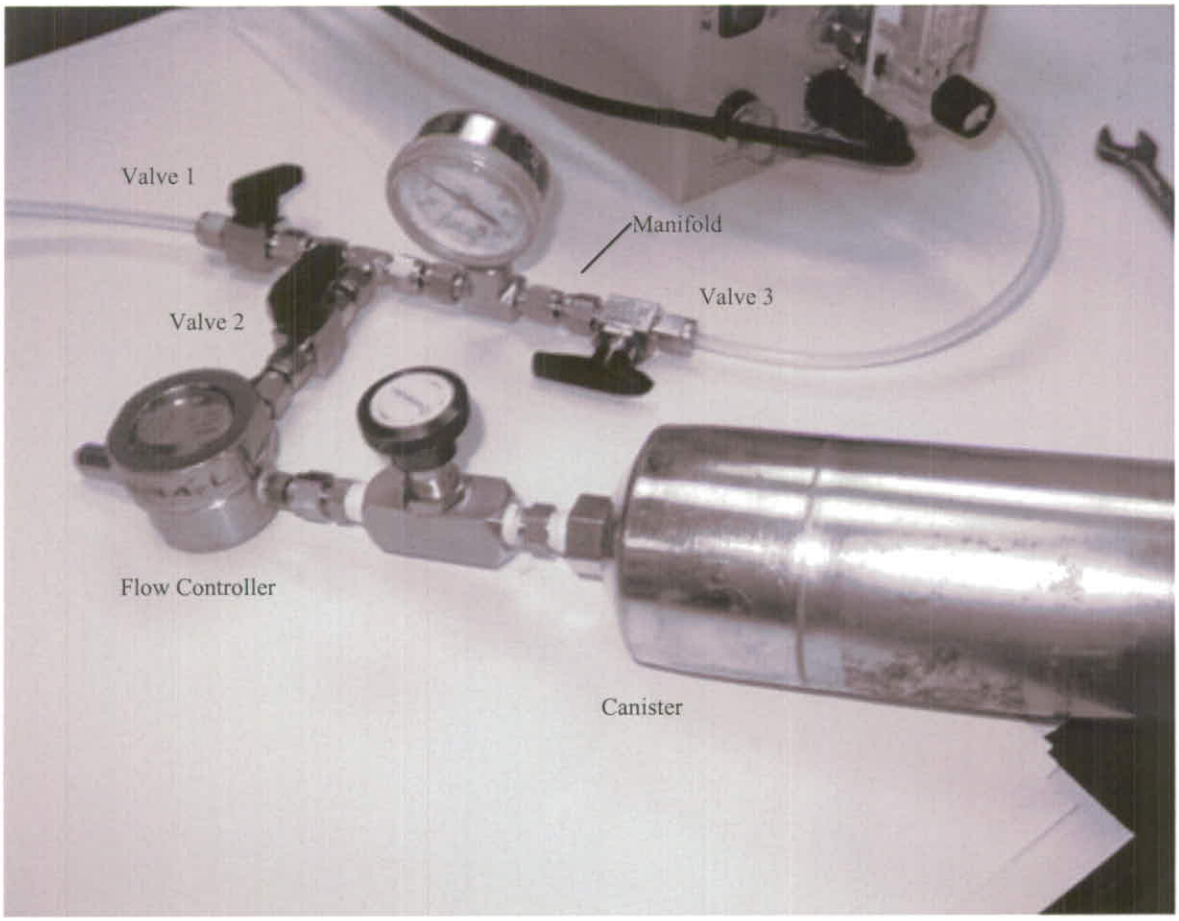


Figure 10 – Sampling Manifold



Standard Operating Procedure for Long-Term Measurement of Sub-slab and Indoor Air Pressures

Background

Indoor air vapor intrusion is often driven by vapor pressure differences between sub-slab soil and indoor air. The movement of vapors located near a building foundation is often affected within an area referred to as the "zone of influence" (a zone approximately within one meter within a foundation). Chemicals in soil gas entering this zone may be drawn into the building via advection and convection resulting from building interiors that exhibit a negative pressure relative to the outdoors and the surrounding soil.

According to regulatory guidance, this pressure differential can occur from one or more factors:

- Operation of HVAC system including inadequate makeup air and unbalanced air supply and exhaust systems;
- The use of fireplaces and other combustion sources, which results in venting of exhaust gases to the exterior;
- Exhaust fans in bathrooms and kitchens that may not be adequately balanced
- Higher temperatures indoors relative to outdoors during the heating season or as a result of solar radiation on rooftops (stack effect); and
- Pressure exerted on the wall of a building caused by wind movement over the building (Bernoulli's principle).

The combination of these actions/conditions results in a net convective flow of soil gas from the subsurface through the building foundation into the building interior. Measurements can be made to evaluate the potential for convective flow of soil gas, and hence evaluate the potential for vapor intrusion into a building.

Purpose and Objectives

This Standard Operating Procedure (SOP) identifies procedures to provide data for understanding pressures differences between building interior and beneath the building slab (i.e. sub-slab). This SOP does not include other procedures for building observation; these are covered in a separate SOP.

Materials

Sub-slab probes should be installed in accordance with SOP for Collection of Sub-Slab Vapor Samples Using Summa™ Canisters. Additional materials include:

- Omniguard 4 differential pressure monitor with data logger (http://www.engsolinc.com/docs/og/OG4broch.pdf).
- Barometric data logger (Solinst http://www.solinst.com/Downloads/3001/3001Manual/Introduction/Barologger.html)
- Hand-held digital micromanometer (TEC DG500 or equivalent http://www.energyconservatory.com/download/dg500brochure.pdf) and Tygon tubing (optional)
- Tools and hardware needed to connect instruments to gas-tight Swagelok™ fittings.

Field Procedures

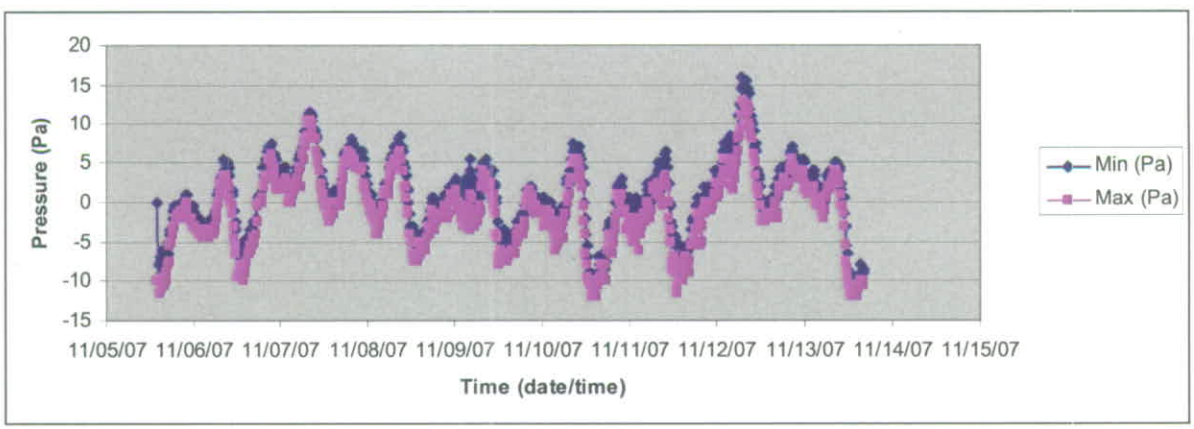
1. Differential pressure data logging (using the Omniguard 4 instrument) is performed at one or more locations within the building (typically a single location). An existing sub-slab probe can be used for these measurements; if needed, install and leak-test a sub-slab probe using the sub-slab probe installation SOP.
2. Set up the pressure monitor in accordance with the manufacturer's instructions. Set the positive and negative pressures triggering the alarms to their maximum and minimum values - this is to disable the alarms (the audible alarm also can be disabled manually - see the manufacturer's instructions).
3. Connect the #2 (Reference) port to the sub-slab probe. This assures that the pressure difference is relative to the subsurface. If the indoor space is depressurized, this will show as a negative pressure measurement.
4. Pressures should be reported in units of Pascals (Pa).
5. After startup, the pressure monitoring will record the minimum and maximum pressures every 15 minutes.
6. Allow the pressure monitor to operate for a minimum of three to five days.
7. Indoor barometric pressure logging should also be performed during the same period as differential pressure logging. Follow the manufacturer's instructions for operation of the Solinst barometric pressure logger.
8. Note that with the Solinst barometric pressure logger, barometric pressures are reported in meters (39.37 inches)
9. After pressure monitoring is complete, download the differential pressure log and the barometric pressure log to a personal computer for data reduction. Data reduction is discussed below.
10. (*Optional*). Long-term differential pressure monitoring can be done only at a limited number of locations (typically, one location). If there is a concern about spatial variation in pressure measurements in large buildings, and if multiple sub-slab probes have been installed, "snapshot" pressure measurements can be made at these locations using a hand-held digital micromanometer. The date, time and location of

these measurements should be recorded on a data form or field notebook, for comparison with the integrated differential pressure measurements.

Data Reduction and Evaluation

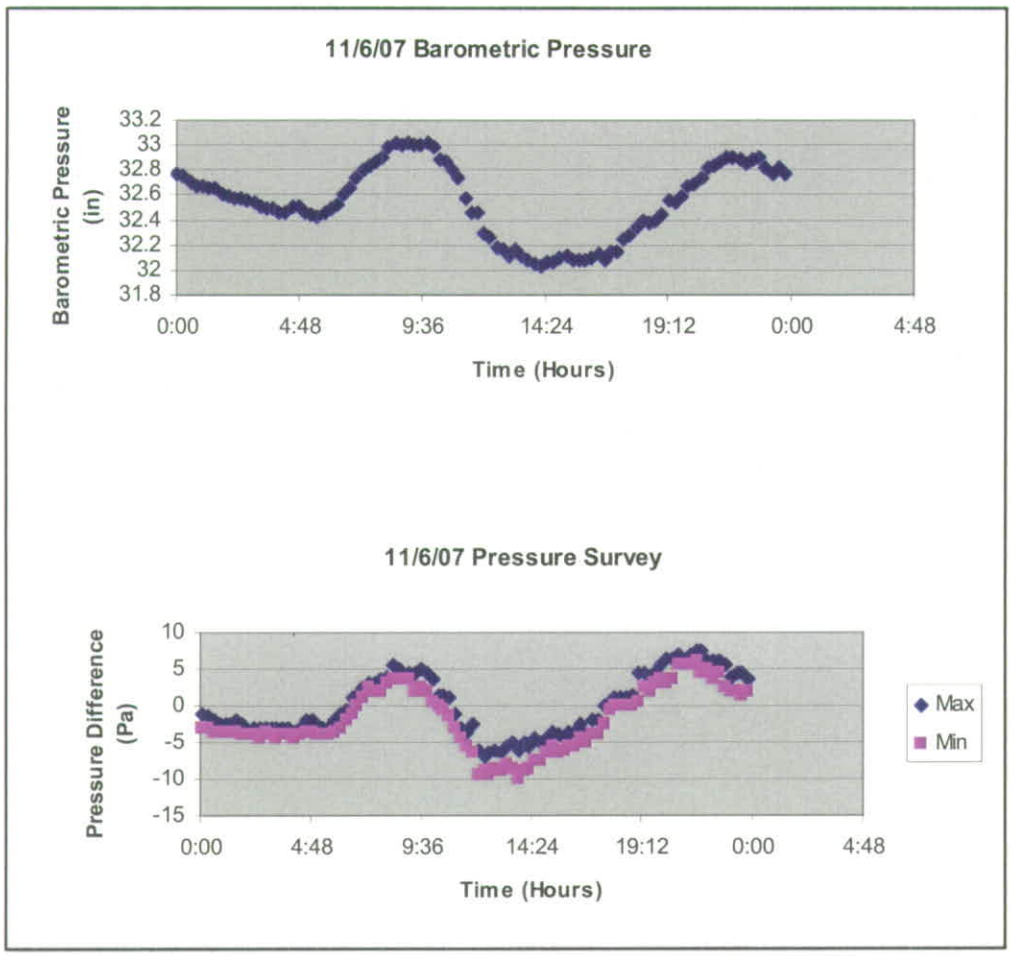
Differential pressure measurements and barometric pressure measurements should be exported to Excel for generating tables and plots.

Individual pressure measurements should be plotted against time. An example of a data plot is presented below:



In addition, the individual measurements can be averaged over a specified time period (for example, a 9-hour work shift) to estimate a longer-period average pressure difference. The longer-term average value can then be used to determine if, overall, a building is positively pressurized (hence vapor resistant) or negatively pressurized (hence prone to vapor intrusion). These measurements can then be used to identify "worst-case" time periods for collecting indoor air samples. It may be useful to collect sub-slab samples for analysis of volatile organic compounds under rising or falling pressure conditions, in order to better understand spatial and temporal variability in sub-slab concentrations.

The plot of pressure differences also can be overlain on barometric pressure measurements as shown below, to observe the effects of atmospheric conditions on potential vapor intrusion pathways:



There are no regulatory screening levels for interpreting differential pressure measurements. However, long-term average pressure differences between indoor air and sub-slab can be interpreted using EPA guidance for radon mitigation.[1] Sub-slab depressurization systems for radon mitigation are designed to achieve a 6 to 9 Pa pressure difference between the subsurface and indoors. This represents the pressure difference needed to prevent soil gas intrusion into a structure where indoor pressures are governed by heating and the operation of appliances or fans. A matrix outlining the levels used to interpret pressure measurements is presented in Table 1. The need for further investigation of the potential vapor intrusion pathway can be assessed based on the magnitude and direction of the pressure measurements (i.e. positive relative to outdoors, or negative relative to outdoors).

[1] U.S. Environmental Protection Agency (USEPA). 1993. *Radon Reduction Techniques for Existing Detached Houses. Technical Guidance (Third Edition) for Active Soil Depressurization Systems.* EPA/625/R-03/011.

Table 1
Suggested Interpretation of Pressure Level Measurements

Condition	Description	Comments	Possible Outcome
Positively Pressurized	Consistent pressure measurements of > 6 to 9 Pa relative to outdoors or subsurface.	Based on the pressure difference needed to prevent soil gas intrusion in a structure with combined heating and appliance or fan operation effects (0 025 to 0.035 in water, based on USEPA, 1993)	No apparent driver for vapor intrusion pathway Further investigation may not be needed
Neutral to Positively Pressurized	Consistent pressure measurements of <2 to 5 Pa relative to outdoors or subsurface. OR Highly variable pressure measurements typically greater than zero.	Minimum acceptable pressure difference needed to prevent in a structure with either heating effects OR appliance/fan effects (0.01 to 0 02 in water, based on USEPA, 1993).	Potential transient (intermittent) driver for vapor intrusion pathway may be present Further investigation may be warranted to identify a potential source for vapor intrusion (i.e. groundwater sampling).
Neutral to Negatively Pressurized	Consistent pressure measurements of -5 to <2 Pa relative to outdoors or subsurface. OR Highly variable pressure measurements <5 Pa	Range of depressurization that could occur either from heating effects OR appliance/fan effects (0.01 to 0.02 in water, based on USEPA, 1993).	Potential transient (intermittent) driver for vapor intrusion pathway may be present Further investigation may be warranted to identify a potential source and transport pathways for vapor intrusion (i e. groundwater and near slab sampling).
Negatively Pressurized	Consistent pressure measurements of > -6 to -9 Pa relative to outdoors or subsurface.	Range of depressurization that could occur from heating effects and appliance/fan effects (0.025 to 0.035 in water, based on USEPA, 1993).	Potential driver for vapor intrusion pathway. Further investigation may be warranted Consideration may need to be given to sub slab and/or indoor air sampling.

Note: 1 Pa = 0 004 inches of water

Adapted from EPA, 1993

S532006A

Table 1
Suggested Interpretation of Pressure Level Measurements

Condition	Description	Comments	Possible Outcome
Positively Pressurized	Consistent pressure measurements of > 6 to 9 Pa relative to outdoors or subsurface	Based on the pressure difference needed to prevent soil gas intrusion in a structure with combined heating and appliance or fan operation effects (0 025 to 0.035 in water, based on USEPA, 1993)	No apparent driver for vapor intrusion pathway. Further investigation may not be needed
Neutral to Positively Pressurized	Consistent pressure measurements of <2 to 5 Pa relative to outdoors or subsurface. OR Highly variable pressure measurements typically greater than zero.	Minimum acceptable pressure difference needed to prevent in a structure with either heating effects OR appliance/fan effects (0.01 to 0 02 in water, based on USEPA, 1993).	Potential transient (intermittent) driver for vapor intrusion pathway may be present. Further investigation may be warranted to identify a potential source for vapor intrusion (i e. groundwater sampling).
Neutral to Negatively Pressurized	Consistent pressure measurements of -5 to <2 Pa relative to outdoors or subsurface OR Highly variable pressure measurements <5 Pa	Range of depressurization that could occur either from heating effects OR appliance/fan effects (0 01 to 0.02 in water, based on USEPA, 1993).	Potential transient (intermittent) driver for vapor intrusion pathway may be present. Further investigation may be warranted to identify a potential source and transport pathways for vapor intrusion (i.e. groundwater and near slab sampling)
Negatively Pressurized	Consistent pressure measurements of > -6 to -9 Pa relative to outdoors or subsurface.	Range of depressurization that could occur from heating effects and appliance/fan effects (0.025 to 0 035 in water, based on USEPA, 1993).	Potential driver for vapor intrusion pathway. Further investigation may be warranted. Consideration may need to be given to sub slab and/or indoor air sampling

Note: 1 Pa = 0.004 inches of water

Adapted from EPA, 1993

5532006

ATTACHMENT F-4

Example Forms

- Example Pre-Sampling Structural Survey
- Example Sampling Log

Preliminary Structural Survey for Vapor Intrusion Pathway Identification
(Prepare One Form for Each Building/Room Surveyed)

Date: _____

Preparer: _____

Facility: _____

Address: _____

Contact Person: _____

Phone Number: _____

e-mail address: _____

Building/Room Description

Building or Room Identifier: _____

Primary Activity within Room (select one):

☐ Manufacturing ☐ Storage ☐ Residential

☐ Instrumentation/Control ☐ Chemical Processing/Storage

☐ Administrative ☐ Other (_____)

Notes: _____

Approximate floor space _____ Number of floors _____

Multi-room building ☐ or Single Room ☐

Floor plan attached? ☐ Yes ☐ No

Ceiling height _____

Aboveground Construction ☐ Wood ☐ Concrete

☐ Brick ☐ Cinderblock

☐ Other _____

Notes: _____

9532008

Preliminary Structural Survey for Vapor Intrusion Pathway Identification
(Prepare One Form for Each Building/Room Surveyed)

9532009

Identification of Site Features

Physical site features that may be present (check all that apply):

Storage tanks and chemical storage areas	☐	Degraded floors or walls (i.e. cracks, holes)	☐
Areas with odors present	☐	Pits, ponds, lagoons	☐
Soil or debris piles	☐	Dry wells or injection wells	☐
Standing pools of liquid	☐	Waste treatment, storage or transfer areas	☐
Unidentified containers	☐	Solvent dip or degreasing tanks	☐
Drains or sumps	☐	Manufacturing	☐
Stained soils or pavement	☐	None of the above present	☐

Notes: _____

_____

Evaluation of Potential Conduits from Soil

Floor/foundation description (check all that apply)

☐ Wood ☐ Concrete ☐ Elevated above grade? ☐ Below grade?

☐ Other (specify) _____

Expansion joints present (if concrete floor)?	☐ Yes	☐ No	☐ N/A
Are expansion joints sealed?	☐ Yes	☐ No	☐ N/A
Are sumps or floor drains present?	☐ Yes	☐ No	☐ N/A
Are basements or subsurface vaults present?	☐ Yes	☐ No	☐ N/A
Are there subsurface drainage problems?	☐ Yes	☐ No	☐ N/A

Notes: _____

_____

Preliminary Structural Survey for Vapor Intrusion Pathway Identification
(Prepare One Form for Each Building/Room Surveyed)

Evaluation of Potential Pathways/Driving Forces

Are there locations with elevated positive or negative pressure (for example: doors not opening/closing properly, perceptible airflow, audible fan noise)?

Is there one air conditioning zone or multiple zones (if in a multi-room building)?

☐ Single zone ☐ Multi-zone ☐ Other

(ask building management; look for presence of multiple thermostats = multiple zones)

Sources of outdoor air:

☐ Mechanical (air handling unit) ☐ Doors

☐ Windows Are windows/doors left openly routinely? ☐ Yes ☐ No

Percent of wall surface area that is doors and/or windows (%)

Est. total airflow delivered to indoor space (cfm)

Percent airflow recirculated (%)

Notes:

Evaluation of Potential Indoor Chemical Sources

List principal solvents or VOC-containing products used (attach MSDSs if available):

9532010

Preliminary Structural Survey for Vapor Intrusion Pathway Identification
(Prepare One Form for Each Building/Room Surveyed)

Description of Vapor Mitigation Systems

Has a radon or vapor mitigation system been installed in this building/room? ☐ Yes ☐ No

Date of installation? _____

Type of system?
- ☐ Passive venting
- ☐ Active sub-slab depressurization
- ☐ Crack/crevice sealing
- ☐ Dilution ventilation control
- ☐ Other (specify) _____

Notes: _____

Additional Notes:

95320111

Preliminary Survey for Vapor Intrusion Pathway Identification
(Prepare One Form for Each Building/Room Surveyed)

Additional Notes:

9532012

Indoor Air Sampling Log (Summa™ Canister)

Sheet 1 of _____

Project Information

Project Name

Project #.

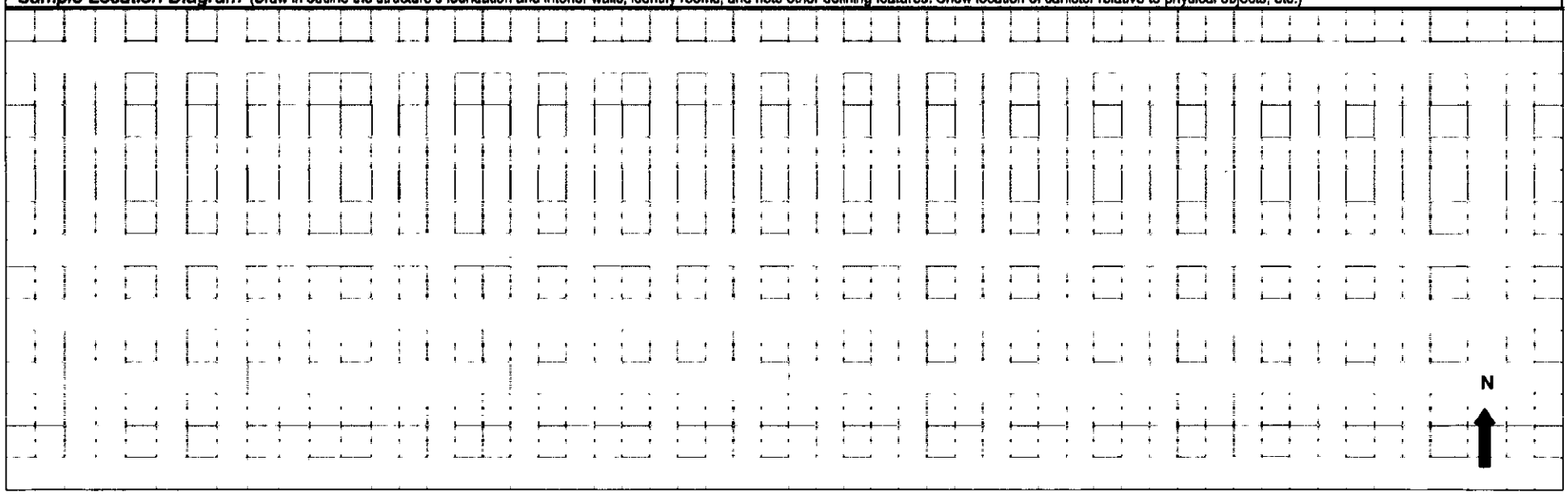
By: _____

Date: _____

Sampling Data Log

Sample Location	Field ID	Canister ID	Flow Controller ID	Initial Pressure (inches Hg)	Initial Flow Controller Rate (mL/min)	Start Date & Time	End Date & Time	Final Pressure (inches Hg)	Final Flow Controller Rate (mL/min)

Sample Location Diagram (Draw in outline the structure's foundation and interior walls, identify rooms, and note other defining features. Show location of canister relative to physical objects, etc.)



Other Observations and Comments (note any unique circumstances).

_____

_____

95320113

Soil/Sub-slab Gas Sampling Log (Summa™ Canister)

Sheet 1 of _____

Project Information

Project Name _____ Project # _____

By. _____ Date. _____

Structure

Identification. _____

Address: _____

Slab Information. ☐ Concrete slab on grade (directly on soil) ☐ Concrete slab on gravel/fill ☐ Other (describe) _____

Condition of slab _____

Type of Sub-Slab Soil _____

Is water present in the soil?

Soil/Sub-slab Probe Installation, Leak Checking, Probe Purging, & Sampling Log

		1	2	3	4
	Sample location (show in diagram)				
	Sample Identification (field ID)				
Probe Installation	Slab Thickness (inches)				
	Depth of hole drilled (feet below ground/slap surface)				
	Depth of installed probe (feet below ground/slab surface)				
Manifold Leak check	Leak check (sampling manifold) – Pass/No Pass				
Probe Purge	Purge rate, cc/min.				
	Purge Start (time of day)				
	Purge vacuum, "Hg				
	Purge completed (time of day)				
Helium Leak Check (optional)	Leak check (Helium) - %				
Canister Sampling	Canister & flow controller ID (if used)				
	Initial Canister Pressure (inches Hg)				
	Sampling rate, cc/min				
	Time sampling period started				
	Sampling vacuum (inches Hg)				
	Time sampling period ended				
	Final Canister Pressure (inches Hg)				

Observations and Comments. _____

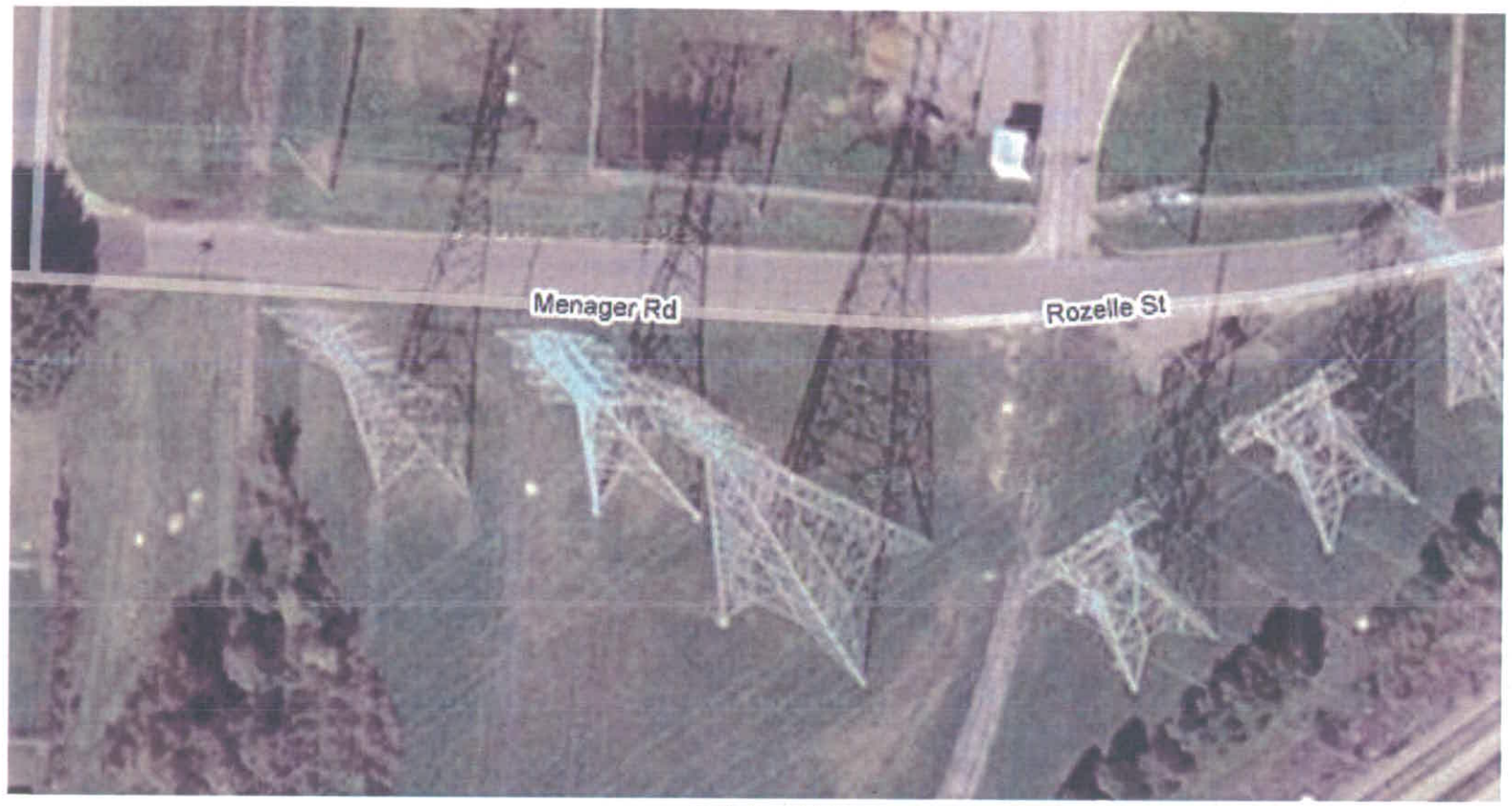
9532014

APPENDIX G

Construction Drawings and Statements of Work

9532016

OFF-DEPOT DUNN FIELD
GROUNDWATER REMEDIAL DESIGN
MEMPHIS, TENNESSEE



SITE MAP
NTS

LOCATION MAP
NTS

U.S. Army Engineering and Support Center, Huntsville

INDEX TO DRAWINGS

SHEET No.	DRAWING No.	TITLE
1	G-1	TITLE SHEET, LOCATION MAP, AND INDEX TO DRAWINGS
2	G-2	GENERAL SITE MAP
3	F-1	AIR SPARGE AND SOIL VAPOR EXTRACTION LAYOUT
4	F-2	FLUVIAL AS/SVE EXISTING GROUND PROFILES
5	F-3	FLUVIAL SAND AS/SVE PROCESS FLOW DIAGRAMS
6	F-4	FLUVIAL SANDS AS/SVE EQUIPMENT COMPOUND ELEVATION DETAILS
7	F-5	FLUVIAL SANDS AS/SVE EQUIPMENT COMPOUND PLAN VIEW
8	F-6	BUILDING DETAILS
9	F-7	CHAIN LINK FENCE DETAILS
10	F-8	FLUVIAL SANDS AS/SVE DETAILS
11	F-9	FLUVIAL SANDS AS/SVE COMPOUNDS ELECTRIC RISER DIAGRAM

N

MICHAEL WILLIAM PERLMUTTER
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 00107709
STATE OF TENNESSEE

VICINITY MAP
NTS

NO.	DATE	DSGN	DR	CHK	APVD
REVISION		M. PERLMUTTER	E. GRIGGS	M. STRONG	APVD
BY					M. PERLMUTTER

CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

GENERAL
TITLE SHEET, LOCATION
MAP,
AND INDEX TO DRAWINGS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTEMBER, 2008
PROJ	334469
DWG	G-1
SHEET	1

©CH2M HILL 2008. ALL RIGHTS RESERVED.
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.
RELISE OF DOCUMENTS:

USER: EGRIGGS TAB: LAYOUT1

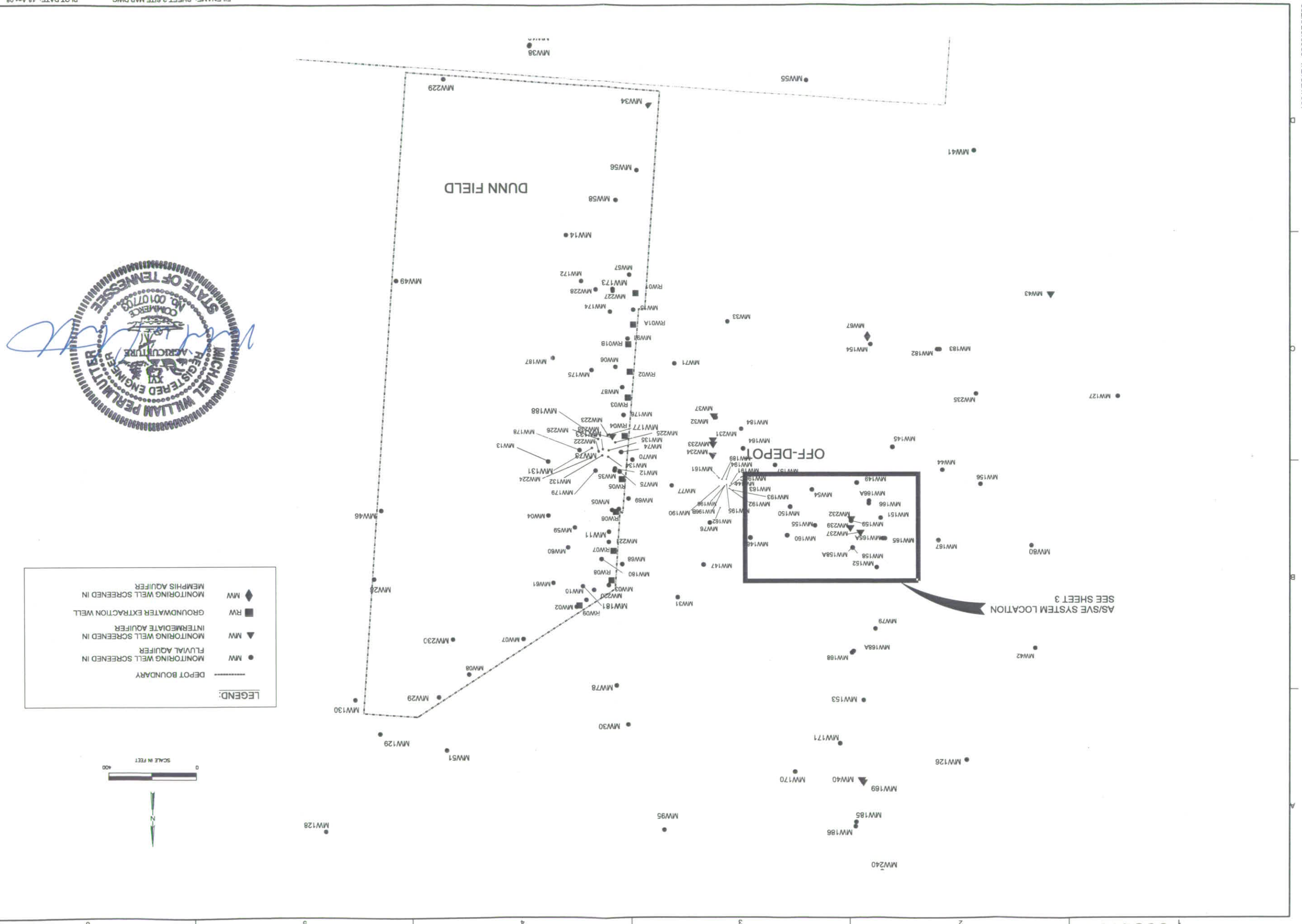
ATL/PROJ/148071 DDMT/ODRD2007/DRAWINGS

FILENAME: SHEET 1 (COVER).DWG PLOT DATE: 17-Apr-08 PLOT TIME: 11:04:23 AM

USER: EGRIGGS TAB: DLAYOUT

A:\TL/PROJ/148071 DDMT/ODDR2007/DRAWINGS

FILENAME: SHEET 2 SITE MAP.DWG PLOT DATE: 18-Apr-08 PLOT TIME: 3:15:32 PM



STATE OF TENNESSEE
No. 001070S
COMMERCE
MICHAEL WILLIAM PERLMUTTER
REGISTERED ENGINEER
AGRICULTURE

CH2MHILL

GENERAL
SITE MAP

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
		M. STRONG	E. GRIGGS	M. PERLMUTTER	M. PERLMUTTER		

REVISION

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	SEPTEMBER, 2008
PROJ	334469
DWG	G-2
SHEET	2

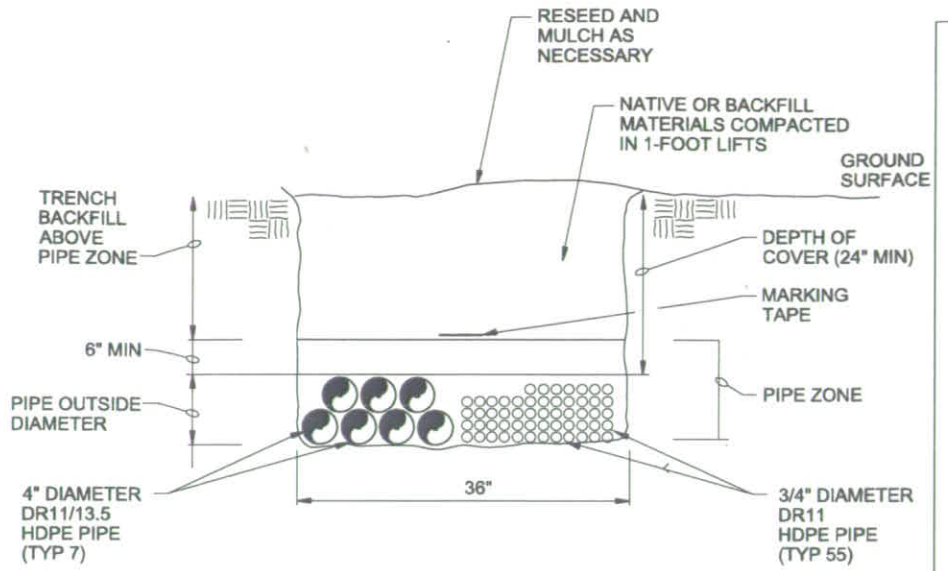
REUSE OF DOCUMENTS: THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2MHILL AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL. ©CH2M HILL ALL RIGHTS RESERVED.

9532017

9532018

0 25 50

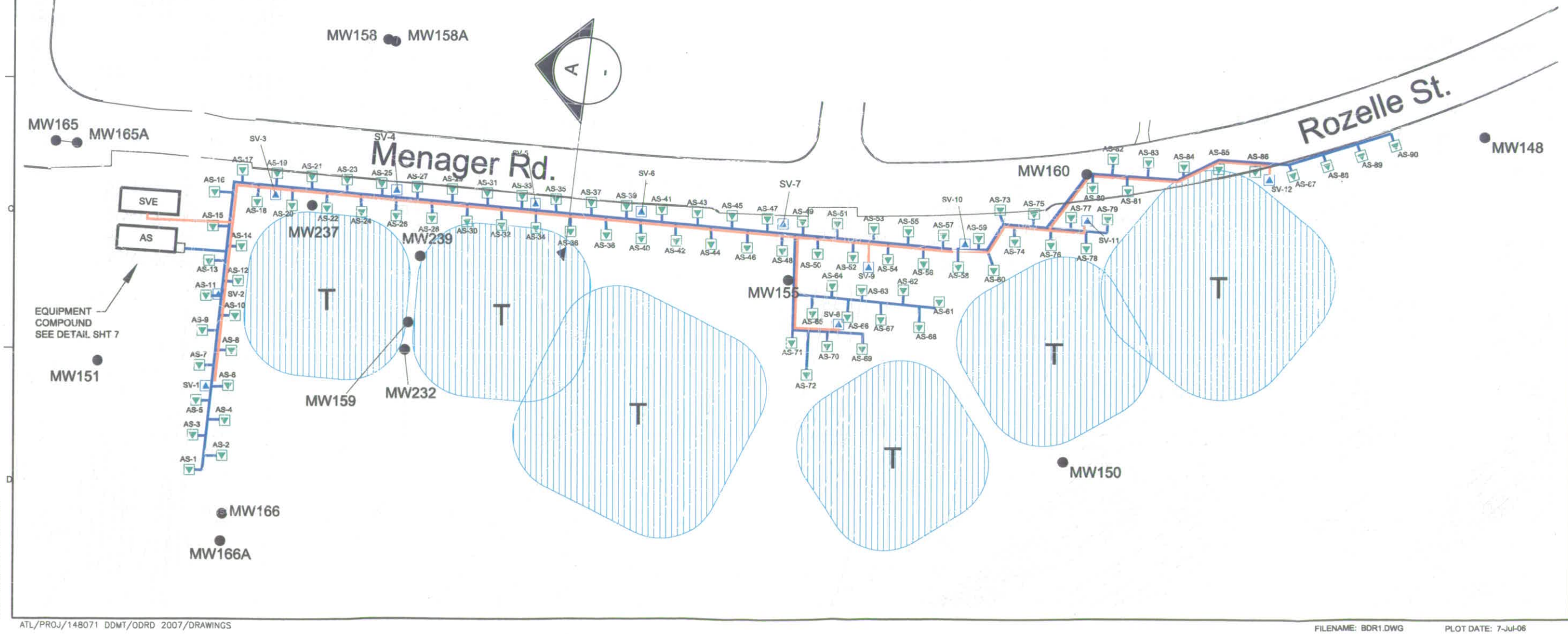
TOWERS LEFT TO RIGHT:
Tower 1 = N281302.33 E800955.21
Tower 2 = N281297.48 E801040.50
Tower 3 = N281257.07 E801092.53
Tower 4 = N281236.16 E801202.65
Tower 5 = N281275.55 E801269.90
Tower 6 = N281316.00 E801339.26



A PIPE SECTION
NTS

LEGEND:
- 4" DIAMETER HDPE CONVEYANCE LINES (SVE)
- 3/4" DIAMETER HDPE CONVEYANCE LINES (AIR SPARGE)
- MW — MONITORING WELL SCREENED IN FLUVIAL AQUIFER
- MW — MONITORING WELL SCREENED IN INTERMEDIATE AQUIFER
- MW — MONITORING WELL SCREENED IN MEMPHIS AQUIFER
- AS-1 — AIR SPARGE WELL
- SV-1 — SOIL VAPOR EXTRACTION WELL
- MLGW TRANSMISSION TOWER WITH 20-FOOT NO CONSTRUCTION BUFFER
- TRANSMISSION LINES
- RAILROAD
- 292 — GROUND CONTOURS

MLG&W Substation



CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

AIR SPARGE AND SOIL
VAPOR EXTRACTION LAYOUT

NO.	DATE	DSGN	DR	CHK	APVD
		M. STRONG	E. GRIGGS	M. PERLMUTTER	M. PERLMUTTER

REVISION BY APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-1
SHEET	3

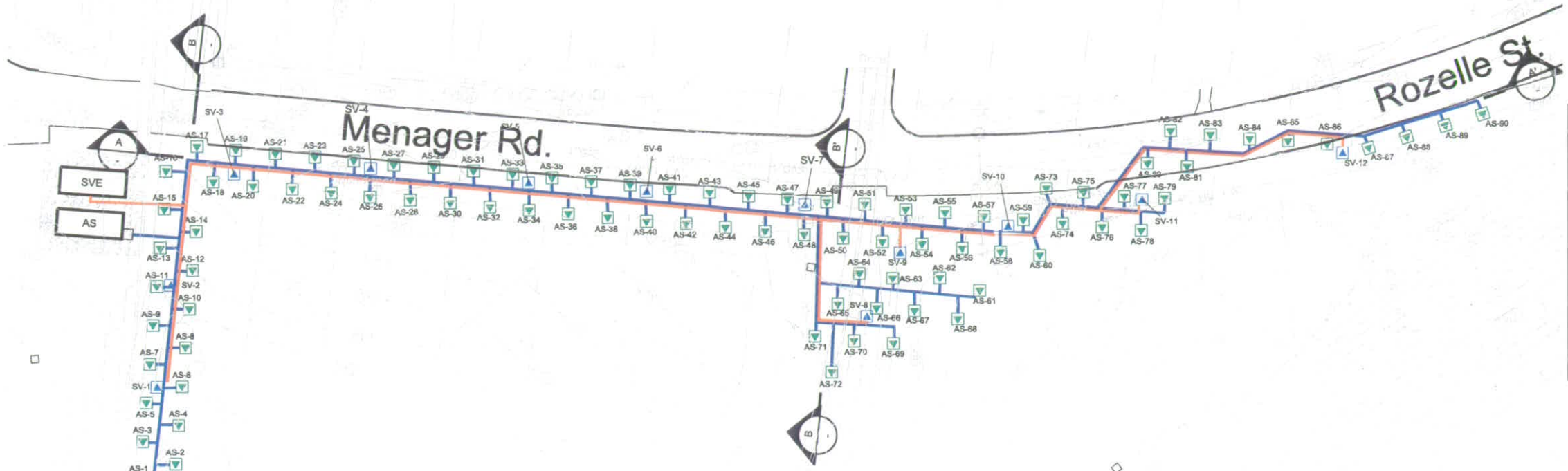
REUSE OF DOCUMENTS: THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL.
©CH2M HILL 2008. ALL RIGHTS RESERVED.

USER: EGRIGGS TAB: MODEL

ATL/PROJ/148071 DDMT/ODRD 2007/DRAWINGS

FILENAME: BDR1.DWG PLOT DATE: 7-Jul-06 PLOT TIME: 1:10:40 PM

9532019

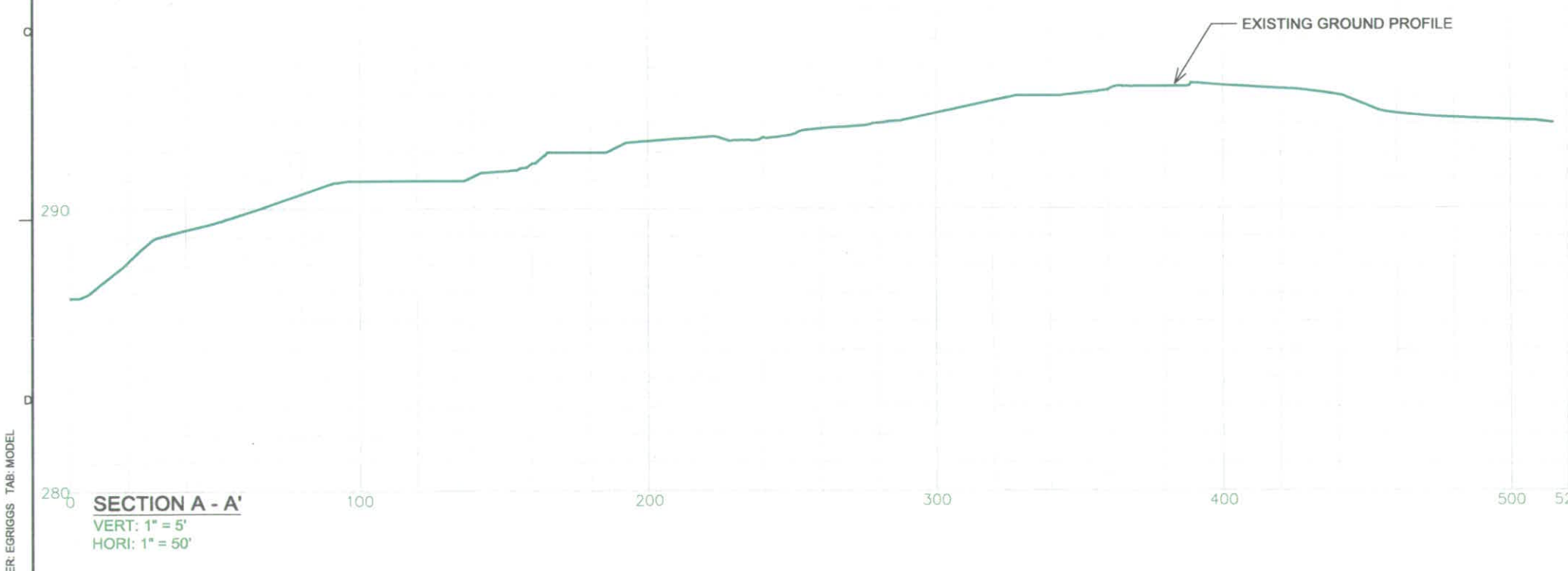


0 25 50

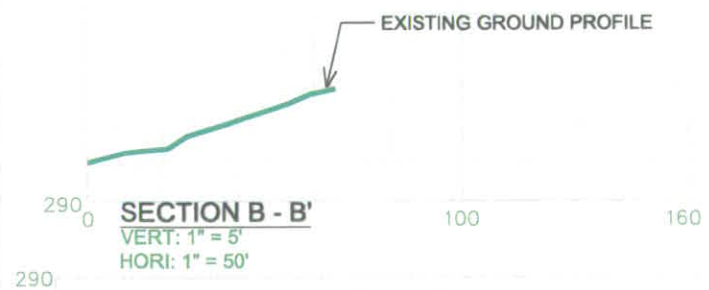
LEGEND:

- 4" DIAMETER HDPE CONVEYANCE LINES (SVE)
- 3/4" DIAMETER HDPE CONVEYANCE LINES (AIR SPARGE)
- AS-1 AIR SPARGE WELL
- SV-1 SOIL VAPOR EXTRACTION WELL
- TRANSMISSION LINES
- RAILROAD
- 292 GROUND CONTOURS

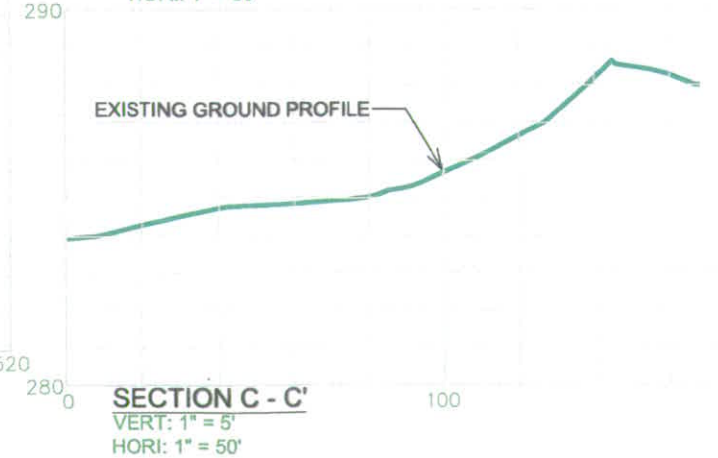
MICHAEL WILLIAM PERLMUTTER
REGISTERED ENGINEER
XVI
AGRICULTURE
COMMENCE
No. 0010779
STATE OF TENNESSEE



SECTION A - A'
VERT: 1" = 5'
HORI: 1" = 50'



SECTION B - B'
VERT: 1" = 5'
HORI: 1" = 50'



SECTION C - C'
VERT: 1" = 5'
HORI: 1" = 50'

NO.	DATE	REVISION	BY	APVD
DSGN	M. STRONG	DR E. GRIGGS	CHK M. PERLMUTTER	APVD M. PERLMUTTER

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL AS/SVE
EXISTING GROUND PROFILE

CH2MHILL

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-2
SHEET	4

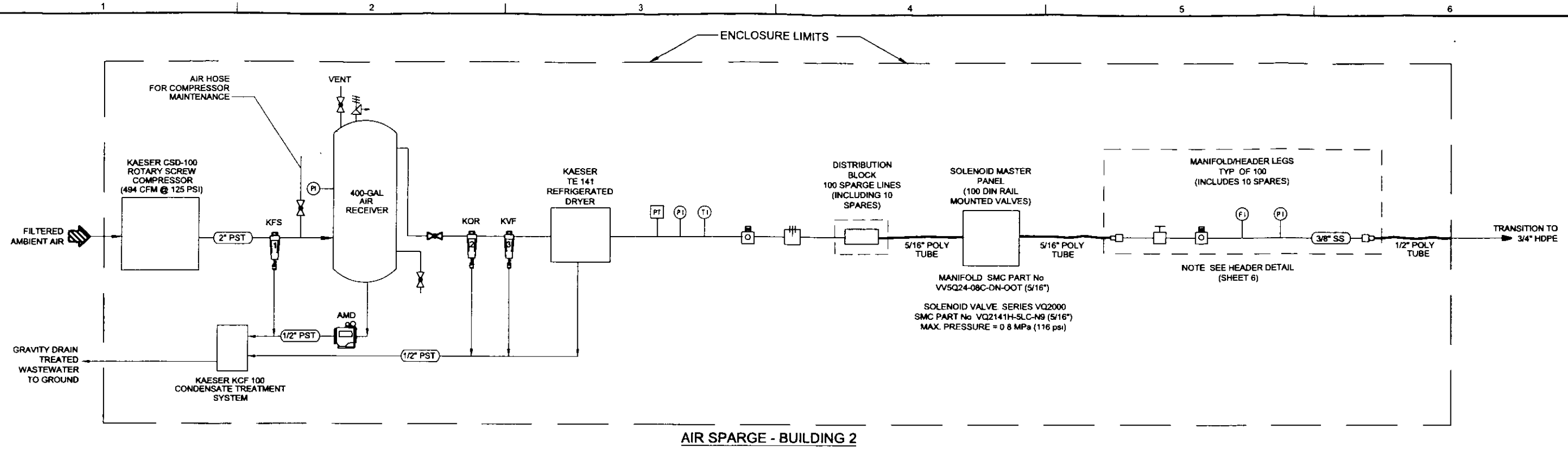
© CH2M HILL. ALL RIGHTS RESERVED.
THIS DOCUMENT, AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL.
REUSE OF DOCUMENTS:

USER: EGRIGGS TAB: MODEL

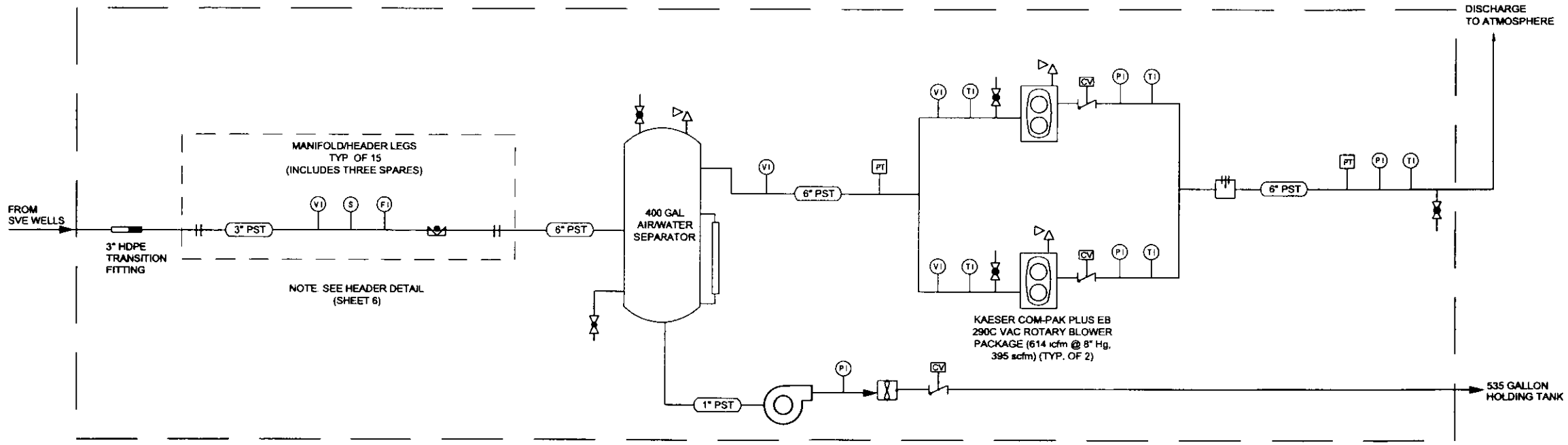
ATL/PROJ/148071 DDMT/ODRD 2007/DRAWINGS

FILENAME: BDR1.DWG PLOT DATE: 7-Jul-06 PLOT TIME: 1:10:40 PM

9532020



AIR SPARGE - BUILDING 2



SOIL VAPOR EXTRACTION - BUILDING 1

LEGEND

- BALL VALVE
- CHECK VALVE
- COMPRESSION FITTING
- DIAPHRAGM VALVE
- PRESSURE RELIEF VALVE
- ADAPTER
- PRESSURE REGULATOR
- KAESER AUTOMATIC MAGNETIC DRAIN (AMD)
- TUBING
- DISTRIBUTION BLOCK
- SPEED CONTROL VALVE
- KAESER FILTERED SEPARATOR (KFS) w/ FILTER MONITOR & ECO-DRAIN
- KAESER OIL REMOVAL FILTER (KOR) w/ FILTER MONITOR & ECO-DRAIN
- KAESER VAPOR ADSORBER (KVF) w/ FILTER MONITOR & ECO-DRAIN
- (1/2" PST) PAINTED/COATED STEEL PIPE
- PRESSURE INDICATOR
- TEMPERATURE INDICATOR
- FLOW INDICATOR
- VACUUM INDICATOR
- PRESSURE TRANSMITTER
- WATER FLOWMETER
- THERMAL MASS FLOW SENSOR/TRANSMITTER
- VACUUM RELIEF VALVE
- CENTRIFUGAL PUMP

NOTE REFER TO FIGURE 11 FOR I&C DETAIL

MICHAEL WILLIAM PERLMUTTER REGISTERED ENGINEER XVI AGRICULTURE COMMERCE No. 0010775 STATE OF TENNESSEE

REVISION

NO	DATE	DSGN	DR	CHK	APVD	BY	APVD
		M. STRONG	E. GRIGGS	M. PERLMUTTER	M PERLMUTTER		

© CH2M HILL 2008 ALL RIGHTS RESERVED
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL
REUSE OF DOCUMENTS

CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER AREAS
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS AS/SVE
PROCESS FLOW DIAGRAMS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

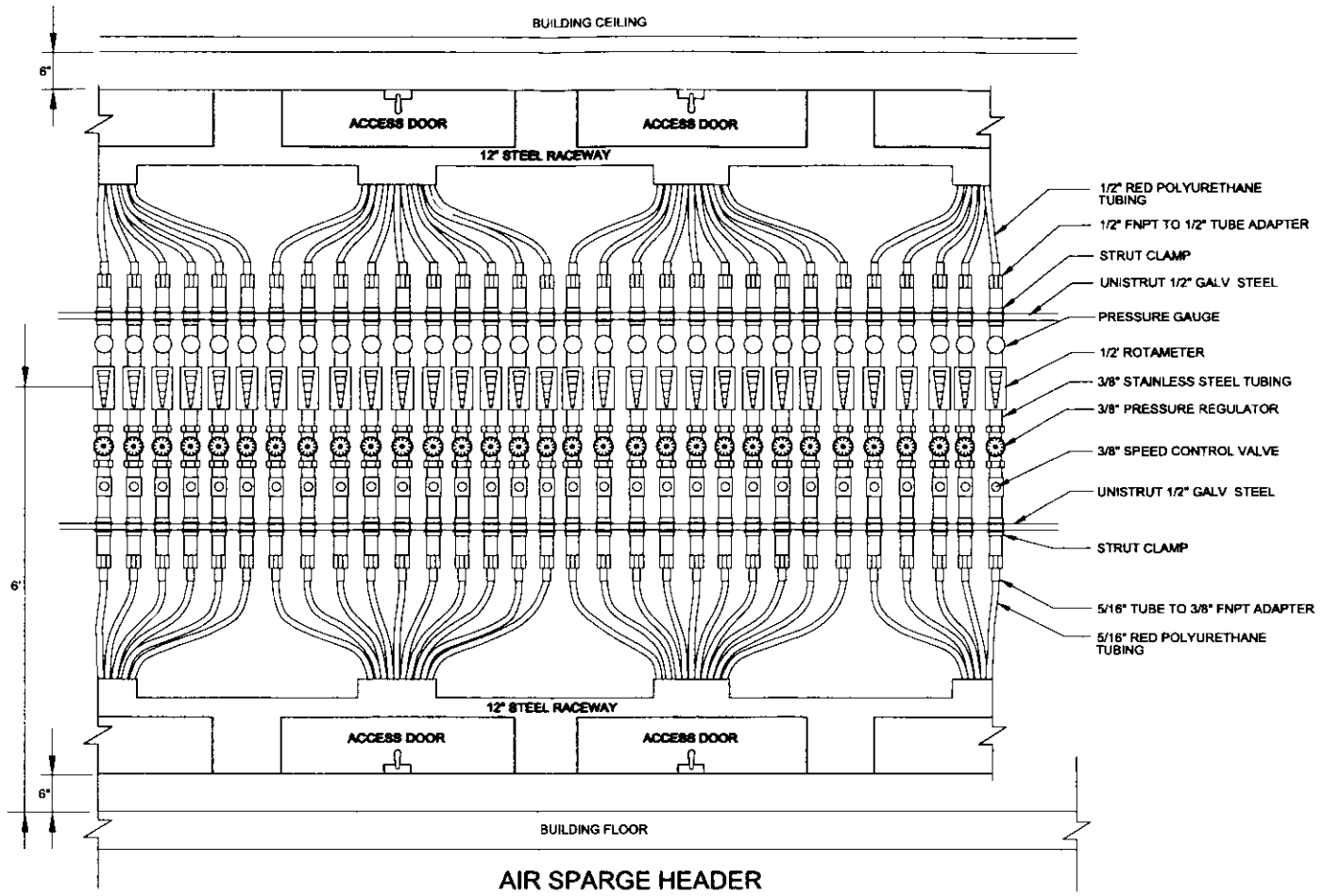
DATE	SEPTEMBER,2008
PROJ	334469
DWG	F-3
SHEET	5

USER EGRIGGS TAB LAYOUT1

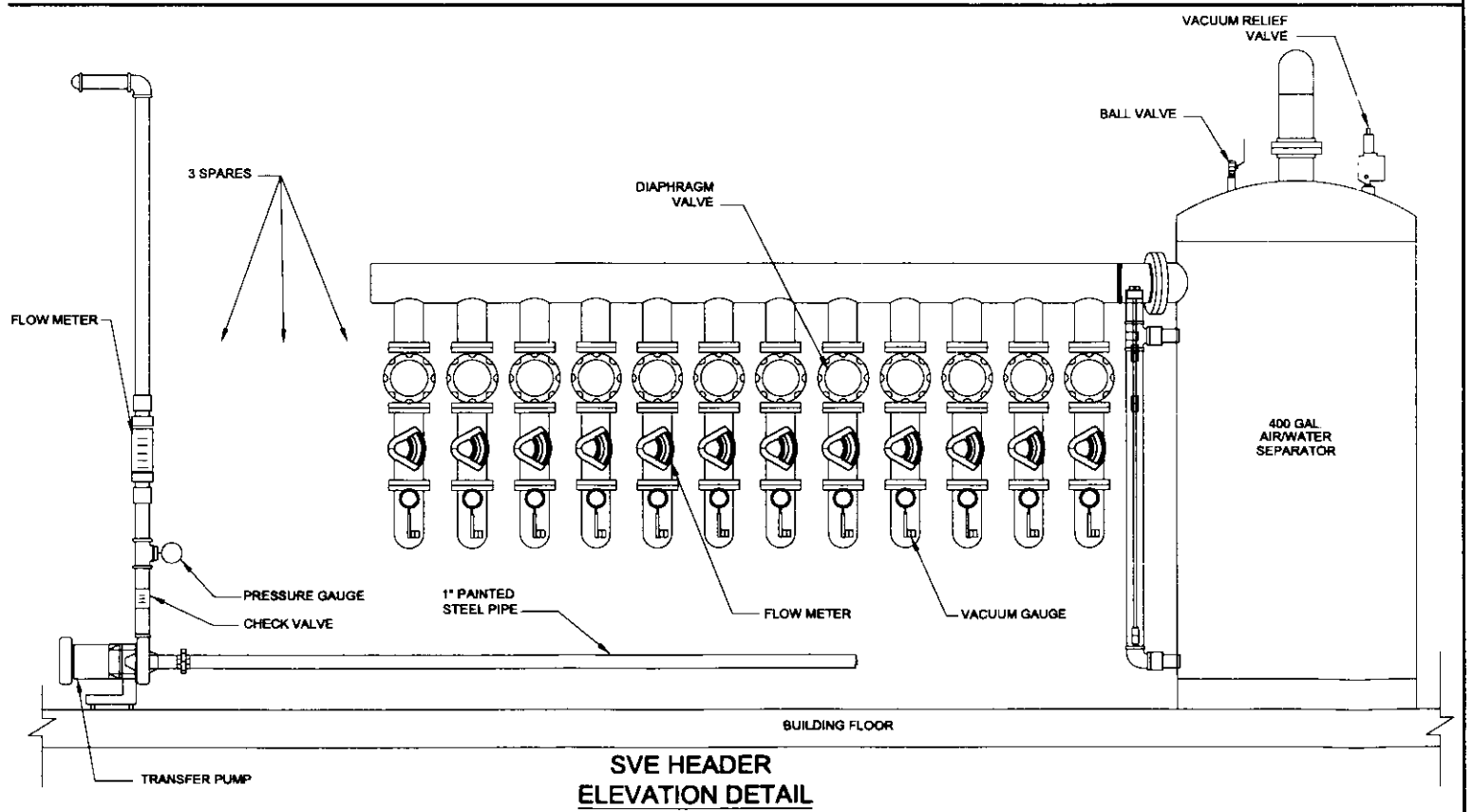
ATL/PROJ/148071 DDMT/ODRD2007/DRAWINGS

FILENAME SHEET 5 (P ROCESS FLOW DIA) DWG PLOT DATE 10-Sep-08 PLOT TIME 12:10:42 PM

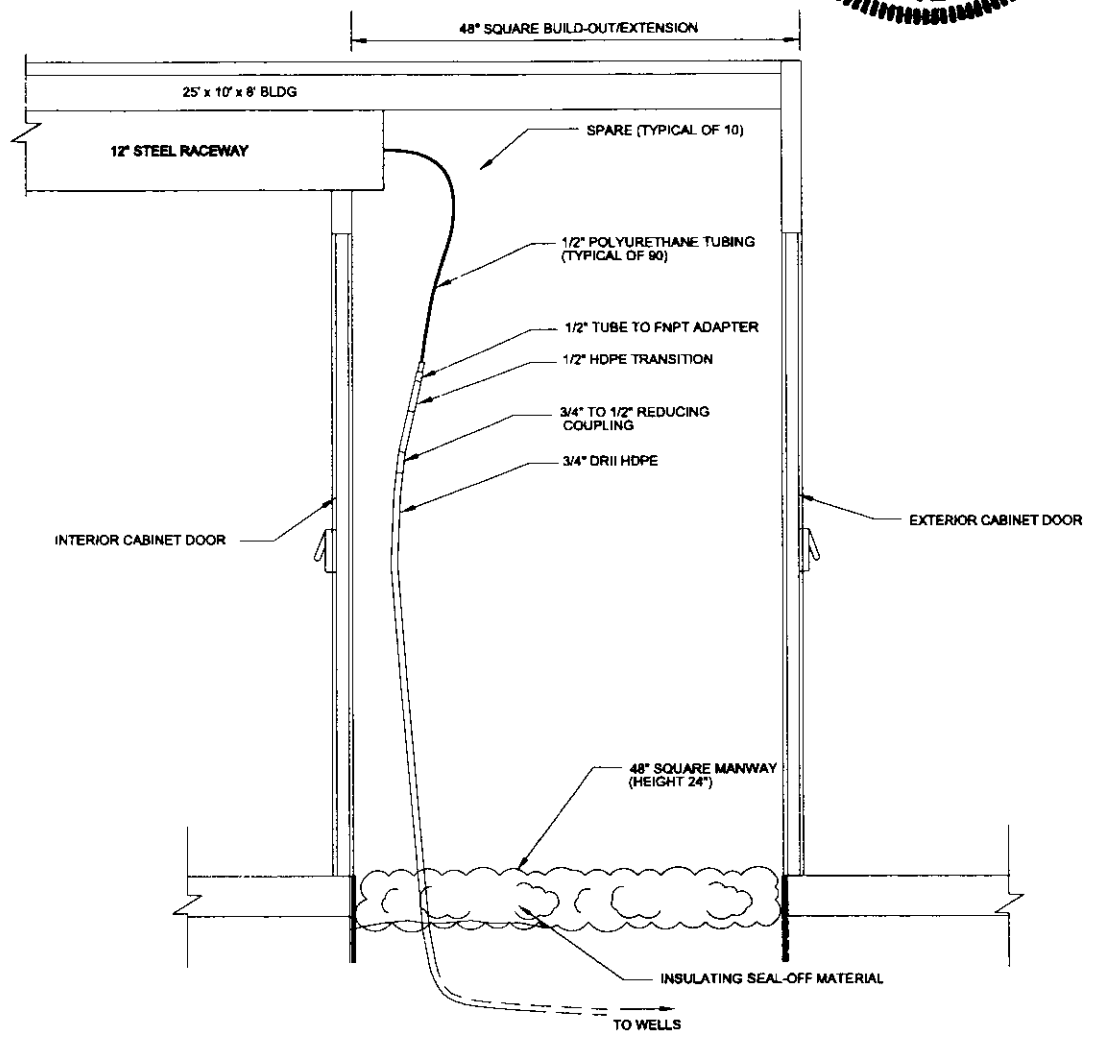
9532021



AIR SPARGE HEADER
ELEVATION DETAIL
N.T.S.



SVE HEADER
ELEVATION DETAIL
N.T.S.



EQUIPMENT ENCLOSURE
BUILD-OUT DETAIL
N.T.S.

MICHAEL WILLIAM PERLMUTTER
REGISTERED ENGINEER
XVI
AGRICULTURE
COMMERCE
No. 00107703
STATE OF TENNESSEE

NO.	DATE	REVISION	BY	APVD
DSGN	M. STRONG			
DR	G. HARTLEY		CHK	M. PERLMUTTER
			APVD	M. PERLMUTTER

THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2MHILL. ©CH2M HILL ALL RIGHTS RESERVED
REUSE OF DOCUMENTS THIS DOCUMENT AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2MHILL. ©CH2M HILL ALL RIGHTS RESERVED. IT SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL

CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS AS/SVE
EQUIPMENT COMPOUND
ELEVATION DETAILS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"

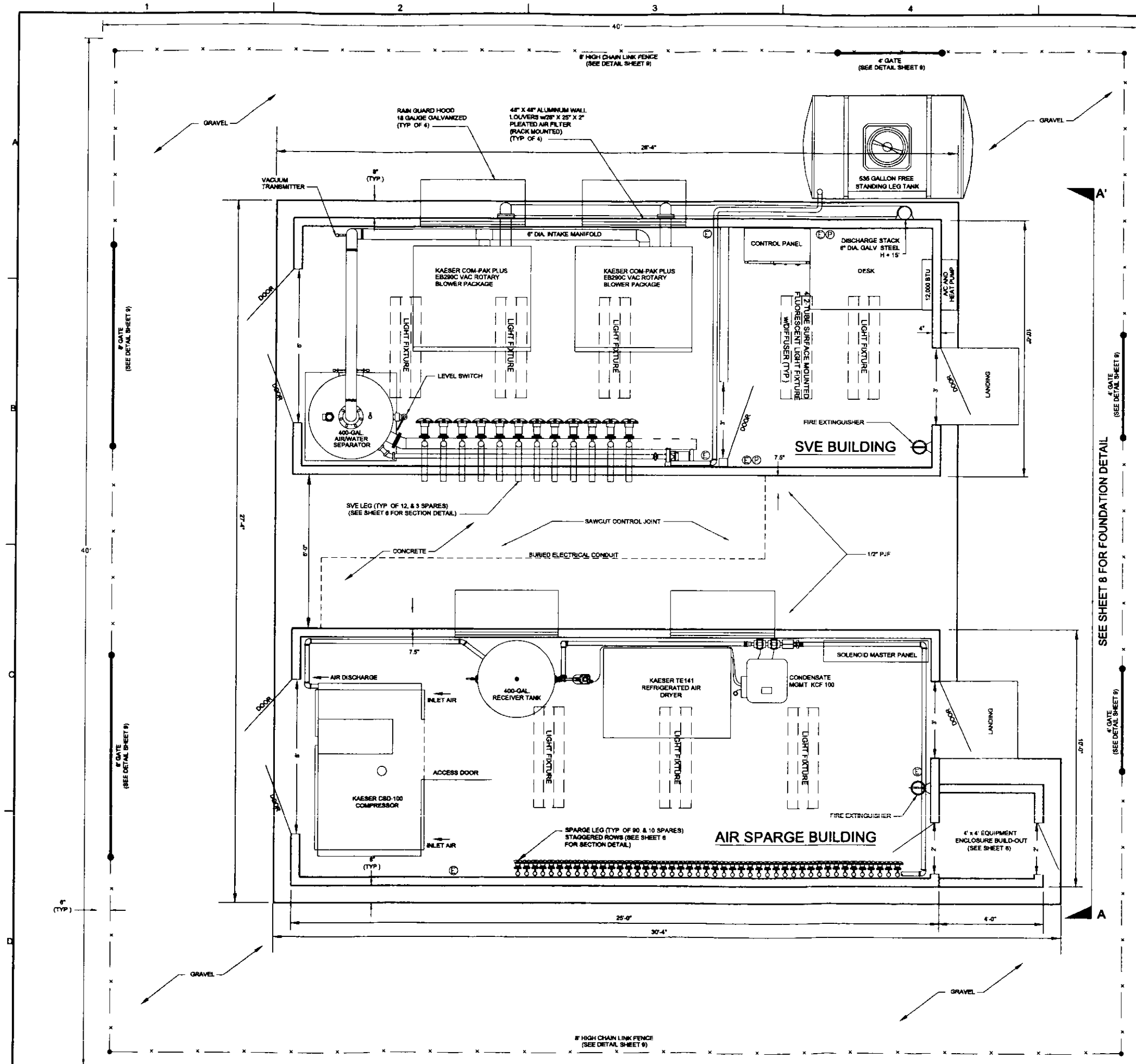
DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-4
SHEET	6

USER EGRIGGS TAB LAYOUT1

ATL/PROJ/148071 DDMT/ODRD2007/DRAWINGS

FILENAME SHEET_6_(EQUIPMNT_COMPD_ELEV).DWG PLOT DATE 9-Sep-08 PLOT TIME: 4:34:42 PM

9532022



BUILDING SPECIFICATIONS

1. PERIMETER FRAME: Perimeter tubular 2" x 6" frame members (13 ga.) with structural steel "C" channel 2" x 6" set perpendicular to and inlelled into side tubular members. Channel is utilized as forklift slots for handling. All frame parts are coated with a corrosive resistant (black in color) paint. Anchor bldg. to concrete foundation per manufacturer's recommendations.

2. METAL WEATHER SHIELD: Galvanized steel construction. The shield covers the entire floor assembly and is located between frame and underside of floor joists.

3. FLOOR JOISTS: joists are nominal 2 x 4 steel joists spaced in a lateral configuration, 12" O.C.

4. FLOOR INSULATION: Fiberglass batt-type insulation between floor joists is R-11 and entirely fills any and all voids.

5. FLOOR COVERING: 3/16" smooth steel floor (painted black).

6. WALL STUDS: Studs are 3 ½" 20 ga. Galvanized steel studs spaced 16" O.C. Top and bottom runners are 3 ½" x 18 ga.

7. WALL INSULATION: Fiberglass batt-type insulation between studs is R-11 and entirely fills any and all voids.

8. INTERIOR WALL COVERING: 5/16" thick gypsum board with laminated vinyl covering is fastened to the inside of the studs with screws and gypsum adhesive; material has a class "A" flame spread rating. 4" vinyl base cove is applied at the base. Sound loss for this unit will be approximately 20 decibels from outside to inside.

9. EXTERIOR WALL SHEATHING: Under steel siding structural sheathing is secured to entire exterior, per manufacturer's recommendations. Sheathing is 1/8" foil laminated on both sides.

10. ROOF FRAMING: Rafters are nominal 4" 18 ga. galvanized steel spaced in lateral configuration 12" O.C.

11. INTERIOR CEILING: Ceiling material is 1/2" gypsum with a white stucco pre-finish fastened securely to roof rafters with screws. Material has a class "A" flame spread rating.

12. ROOF INSULATION: Fiberglass batt-type insulation between roof rafters is R-11 and entirely fills any and all voids.

13. EXTERIOR ROOF SHEATHING: The top side of the rafter has 18 ga. Smooth steel sheathing fastened securely to roof rafters. Covered completely with a minimum 4 mil. polyvinyl vapor barrier

14. ROOF COVERING: 30 ga. galvanized steel construction. Roof metal covers entire roof assembly

15. EXTERIOR SIDING: Galvanized steel siding is 29 ga. pre-finished (on both sides) commercial type with appropriate top and bottom trim fastened securely to studs. Seven standard colors are available. 20-year guarantee.

16. EXTERIOR DOORS: Doors are a steel door with steel jamb. Jambs will have ball bearing hinges. Door will have a tempered ½ lite and a heavy duty closer

17. FULL DEPTH FORK POCKETS: All sizes 2 1/2" x8" structural "C" channel (3 7/2" x 7" opening).

18. INTERIOR LIGHT FIXTURES: All light fixtures are 4' - 0" (four foot) twin tube with an acrylic wrap-around type diffuser cover

19. INTERIOR CEILING HEIGHT: The dimension from the finished floor surface to the finished ceiling surface is 8'-0"

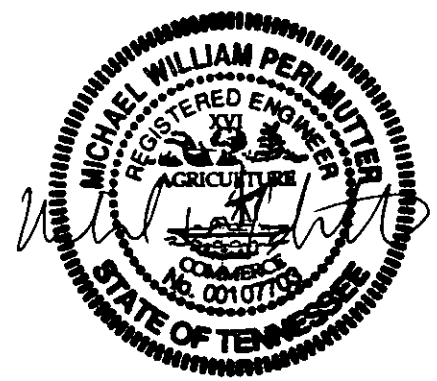
20. ELECTRIC SERVICE PANEL: Pravaire service entrance panel is equipped with a 400-amp main breaker, a 15-amp breaker (for lights), a 20-amp breaker (for receptacles), and any additional breakers necessary. Entrance conduit is through the exterior wall for ease of hook-up. All electric components U.L. listed and wired to National Electrical Code. Standard service is 240/120v, single phase, 60 cycle.

21. HVAC: One thru the wall G.E. 12,000 BTU air conditioner

LEGEND

(E) ELECTRICAL OUTLET

(P) PHONE JACK



N

1 inch = 20 ft.

NO	DATE	DSGN	DR	CHK	APVD	BY	REVISION
		M. STRONG	G. HARTLEY	M. PERLMUTTER	APVD	M. PERLMUTTER	

©CH2M HILL 2008 ALL RIGHTS RESERVED
THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL
REUSE OF DOCUMENTS. THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL

CH2MHILL

OFF- DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS AS/SVE
EQUIPMENT COMPOUND
PLAN VIEW

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

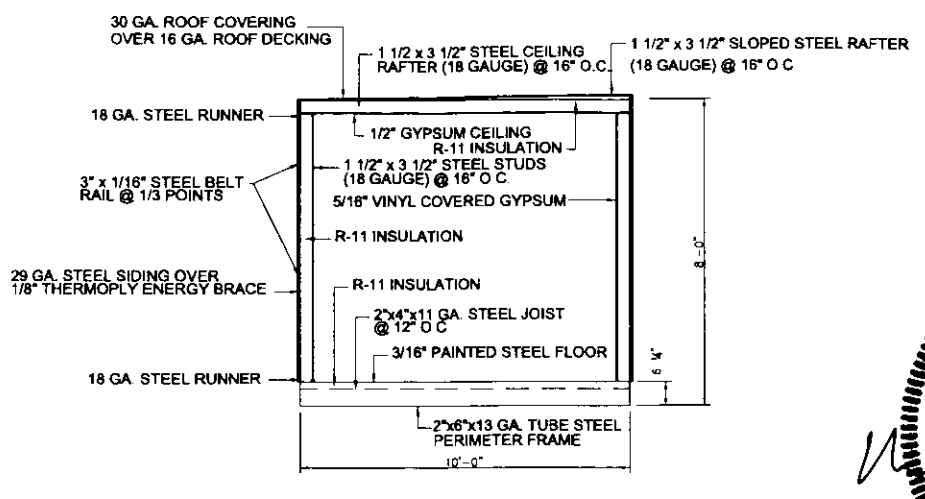
DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-5
SHEET	7

USER: EGRIGGS TAB: LAYOUT2

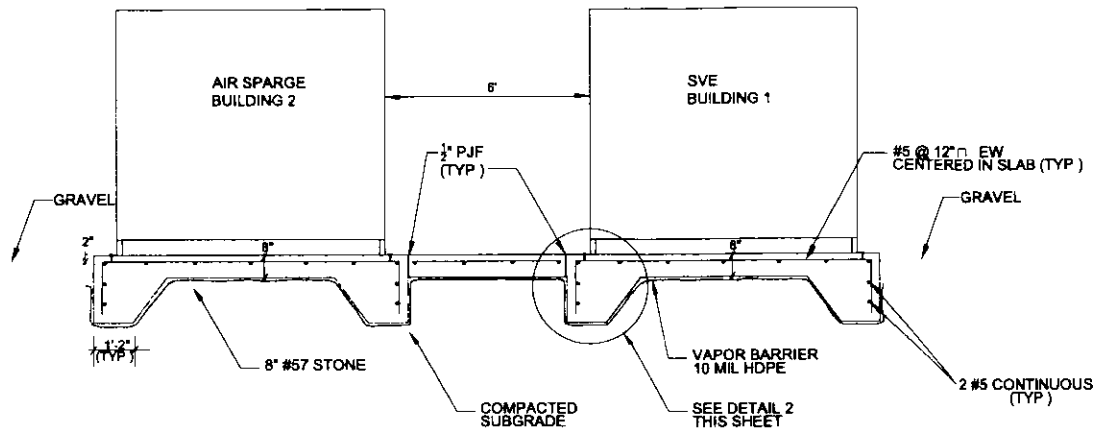
ATL/PROJ/148071 DDMT/SARD 2006/memphisDepotBldgLayout.dwg

FILENAME: SHEET 7 (EQUIPMENT COMP PLAN).DWG PLOT DATE: 15-Aug-08 PLOT TIME: 3:04:50 PM

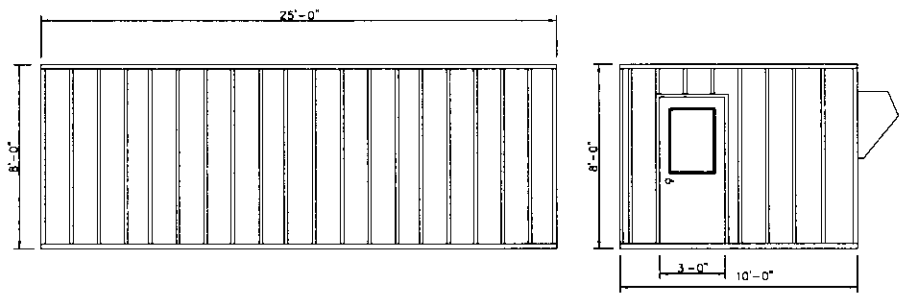
9532023



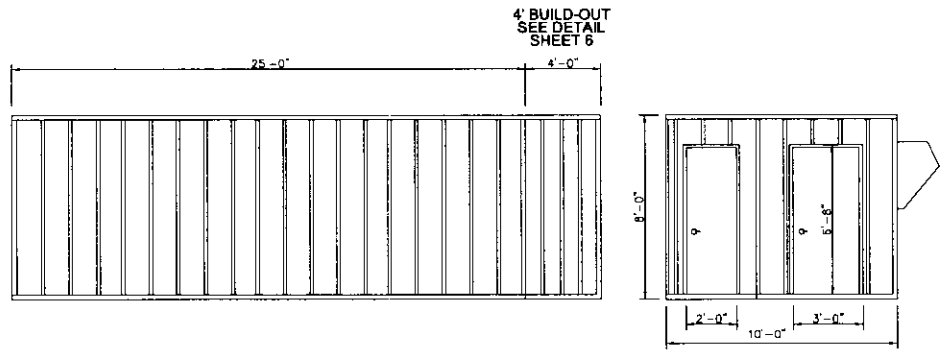
CROSS SECTION



1 BUILDING FOUNDATION DETAIL A - A'
NTS

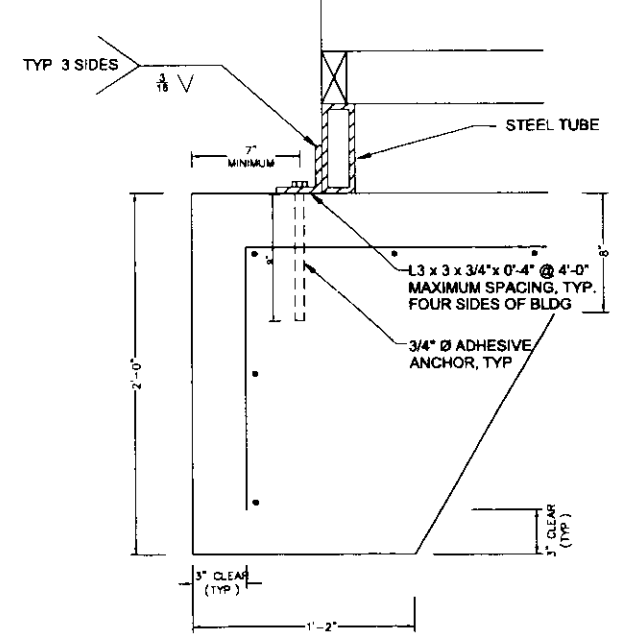


SVE EQUIPMENT COMPOUND
FRAME DETAIL
NTS



AIR SPARGE EQUIPMENT COMPOUND
FRAME DETAIL
NTS

NOTES
1. DOORS MAY REQUIRE ADJUSTMENT DUE TO SHIFTING DURING TRANSPORT
2 ALL STEEL CONSTRUCTION, ALL DOORS KEYED ALIKE, 3/16 PAINTED STEEL FLOOR
3. OVERALL DIMENSIONS ARE OUTSIDE OF FRAME TO OUTSIDE OF FRAME DIMENSIONS DO NOT INCLUDE SHEATHING, SIDING, OR ANY OTHER PROTRUSION SUCH AS DOOR KNOBS, A/C SLEEVES, SPRINKLERS, ETC.



2 ATTACHMENT DETAIL
NTS

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
REVISION		M. STRONG	E. GRIGGS	M. PERLMUTTER	M. PERLMUTTER	M. PERLMUTTER	M. PERLMUTTER

© CH2M HILL ALL RIGHTS RESERVED
THIS DOCUMENT, AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL
REUSE OF DOCUMENTS

CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

BUILDING
DETAILS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"

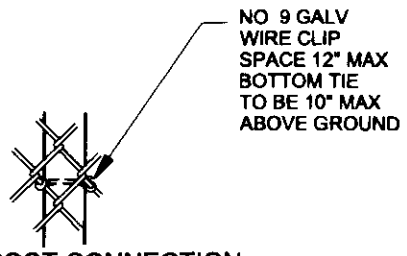
DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-6
SHEET	8

USER: EGRIGGS TAB: LAYOUT1

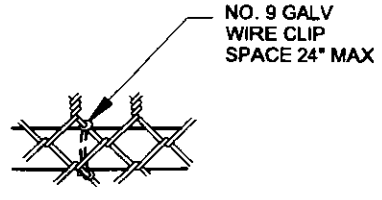
ATL/PROJ/148071 DDMT/SARD 2006

FILENAME SHEET 8 (BLDG DETAILS).DWG PLOT DATE: 5-Sep-08 PLOT TIME: 3:13:33 PM

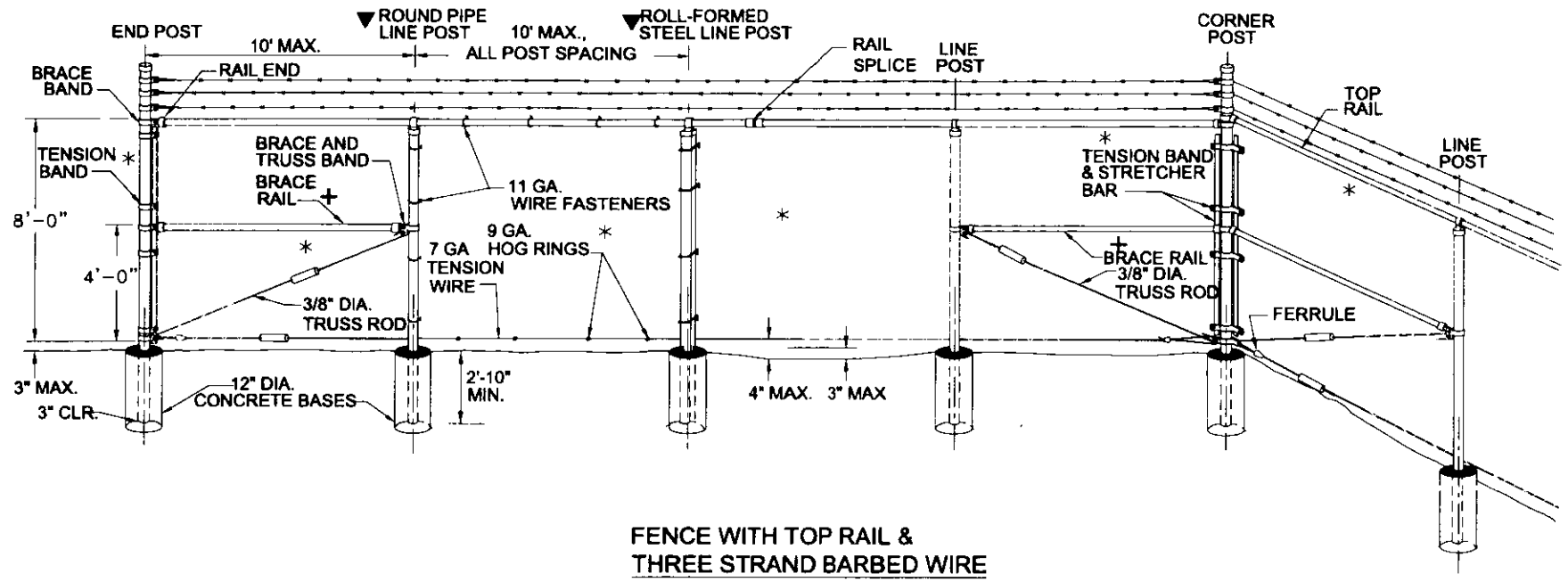
9532024



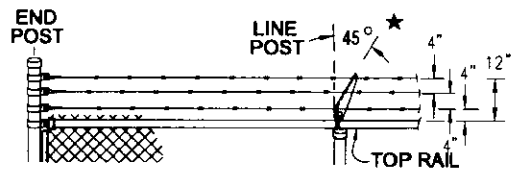
LINE POST CONNECTION



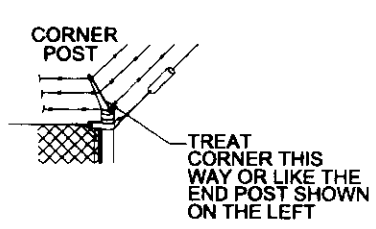
TOP RAIL CONNECTION

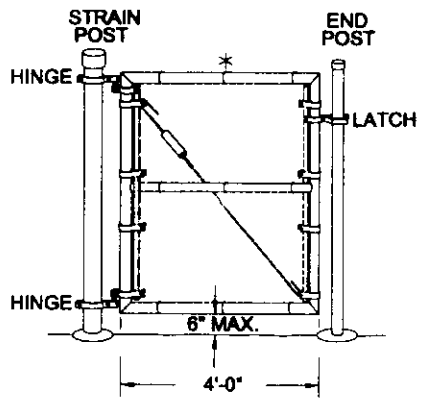


FENCE WITH TOP RAIL &
THREE STRAND BARBED WIRE

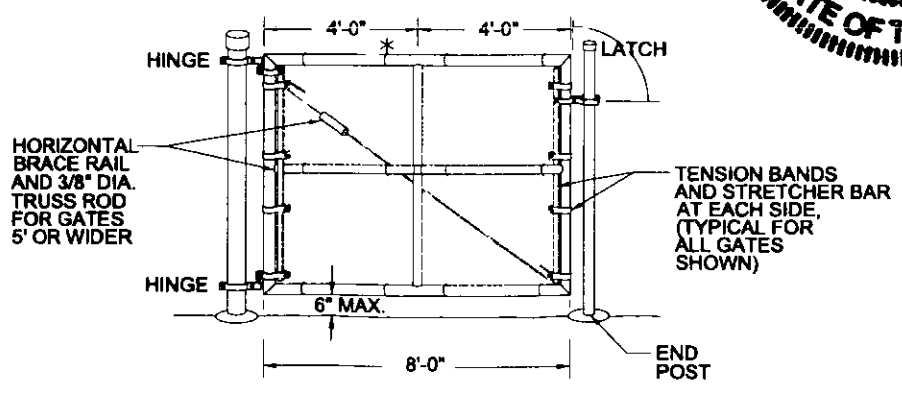


BARBED WIRE TOP





WALK GATE



SINGLE GATE

GENERAL NOTES

1. AT EACH LOCATION WHERE AN ELECTRIC TRANSMISSION, DISTRIBUTION, OR SECONDARY LINE CROSSES A FENCE, THE CONTRACTOR SHALL FURNISH AND INSTALL A GROUND CONFORMING TO ARTICLE 250 OF THE NATIONAL ELECTRIC CODE. A GROUND SHALL ALSO BE INSTALLED A MAXIMUM OF EVERY 500 FT. ALONG THE FENCE. THE GROUND ROD SHALL BE A MINIMUM DIAMETER OF 1/2 IN. AND 8 FT. IN LENGTH, AND DRIVEN AT LEAST 7 1/2 FT. INTO THE GROUND. THE ROD SHALL BE CONNECTED TO EACH WIRE WITH A MINIMUM AWG NO. 8 STRANDED COPPER WIRE. GROUNDING WILL NOT BE PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE COST OF THE FENCE.
2. H (HEIGHT OF FABRIC) SHALL BE AS SHOWN ON THE PLANS. FABRIC IS AVAILABLE IN THE FOLLOWING HEIGHTS: 36 IN., 42 IN., 48 IN., 60 IN., 72 IN., 84 IN., 96 IN., 108 IN , 120 IN., AND 144 IN.
3. CHAIN LINK FENCE SHALL CONFORM TO AASHTO M 181.
4. CHAIN LINK FABRIC SHALL BE 2 IN. MESH NO. 9 GAGE GALVANIZED OR ALUMINUM COATED WIRE SECURELY FASTENED TO TENSION WIRE, LINE POSTS, RAILS, BRACES AND STRETCHER BARS SPACED AS SHOWN HEREON. WIRE FASTENERS AND TIE CLIPS SHALL BE NO. 11 GAGE (W&M) GALVANIZED STEEL WIRE OR NO. 7 GAGE (B&S) ALUMINUM WIRE, AND HOG RINGS SHALL BE NO. 9 GAGE, ALL IN CONFORMANCE WITH ASTM F 626.
5. STEEL POSTS, RAILS AND GATE FRAMES SHALL CONFORM TO AASHTO M 181 TYPE 1, GRADE 1 OR GRADE 2.
6. AT THE CONTRACTOR'S OPTION, PIPE USED FOR FENCE CONSTRUCTION SHALL CONFORM TO THE DIMENSIONS AND WEIGHTS FOR EITHER "ORDINARY PIPE" OR "ALTERNATIVE PIPE" AS SHOWN ON SHEET 2. "ALTERNATIVE PIPE" SHALL BE HIGH STRENGTH STEEL PIPE CONFORMING TO FEDERAL SPECIFICATION RR-F-191/3C
7. TENSION WIRE SHALL BE CONTINUOUS BETWEEN END OR CORNER POST AND LINE BRACE POST. A TURNBUCKLE OR OTHER APPROVED TIGHTENING DEVICE SHALL BE USED FOR EACH CONTINUOUS SPAN OF TENSION WIRE
8. TENSION WIRE SHALL CONFORM TO AASHTO M 181.
9. CONCRETE FOOTINGS SHALL HAVE TOPS CROWNED AT GROUND LEVEL AND SHALL BE CLASS B. CONCRETE WITH LIGHTWEIGHT AGGREGATE CONFORMING TO AASHTO M 195, MAY BE SUBSTITUTED.
10. TERMINATION OF FENCE AT BRIDGES OR OTHER STRUCTURES SHALL BE AS SHOWN ON THE PLANS.
11. CHAIN LINK FABRIC UP TO 5 FT. HIGH SHALL BE KNUCKLED AT THE TOP AND BOTTOM SELVAGES. FABRIC OVER 5 FT. HIGH SHALL BE TWISTED AND BARBED ON THE TOP SELVAGE AND KNUCKLED ON THE BOTTOM SELVAGE.
12. FENCE MAY BE CONSTRUCTED WITH EITHER ROUND PIPE OR ROLL-FORMED STEEL COMPONENTS. THE CONTRACTOR SHALL STATE AT THE PRECONSTRUCTION CONFERENCE, THE TYPE OF CONSTRUCTION AND TYPE OF LINE POST TO BE USED THROUGHOUT THE PROJECT
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RE-ESTABLISHING DISTURBED OR DESTROYED SURVEY MONUMENTS TO THE APPROPRIATE ACCURACY IN ACCORDANCE WITH SUBSECTION 625.08 OF THE STANDARD SPECIFICATIONS.

LEGEND

- ✳ ATTACH FABRIC TO ALL FENCE & GATE STRUCTURES AT 12 IN. INTERVALS VERTICALLY AND AT 20 IN. HORIZONTALLY.
- TIGHTENER OR TURNBUCKLE SYMBOL
- ▼ TYPE OF LINE POST (ROUND PIPE OR ROLL-FORMED STEEL) SHALL BE AT THE OPTION OF THE CONTRACTOR UNLESS OTHERWISE SHOWN ON THE PLANS.
- + BRACE RAIL IS NOT REQUIRED FOR 36 IN., 42 IN., OR 48 IN. FABRIC HEIGHTS. BRACE RAIL FOR FENCE WITH ROLL-FORMED STEEL ELEMENTS IS 12 IN. BELOW THE TOP RAIL.

NO	DATE	DSGN	DR	CHK	BY	APVD
REVISION		M. STRONG	G. HARTLEY	M. PERLMUTTER	M. PERLMUTTER	APVD

© CH2M HILL 2008 ALL RIGHTS RESERVED
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL
REUSE OF DOCUMENTS

CH2MHILL

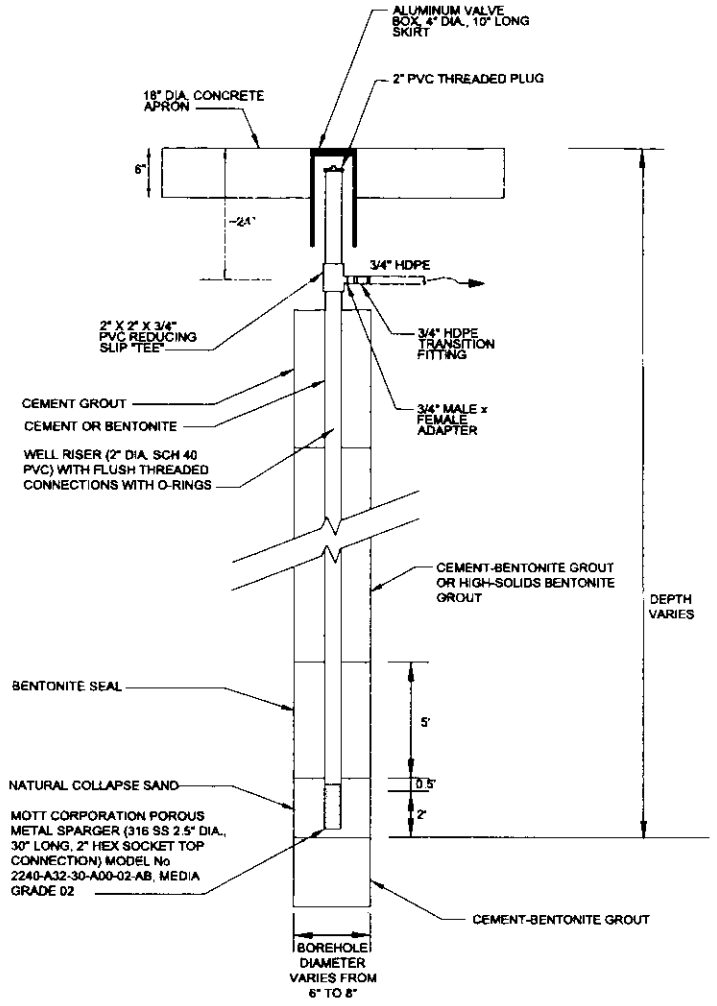
OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

CHAIN LINK
FENCE DETAILS

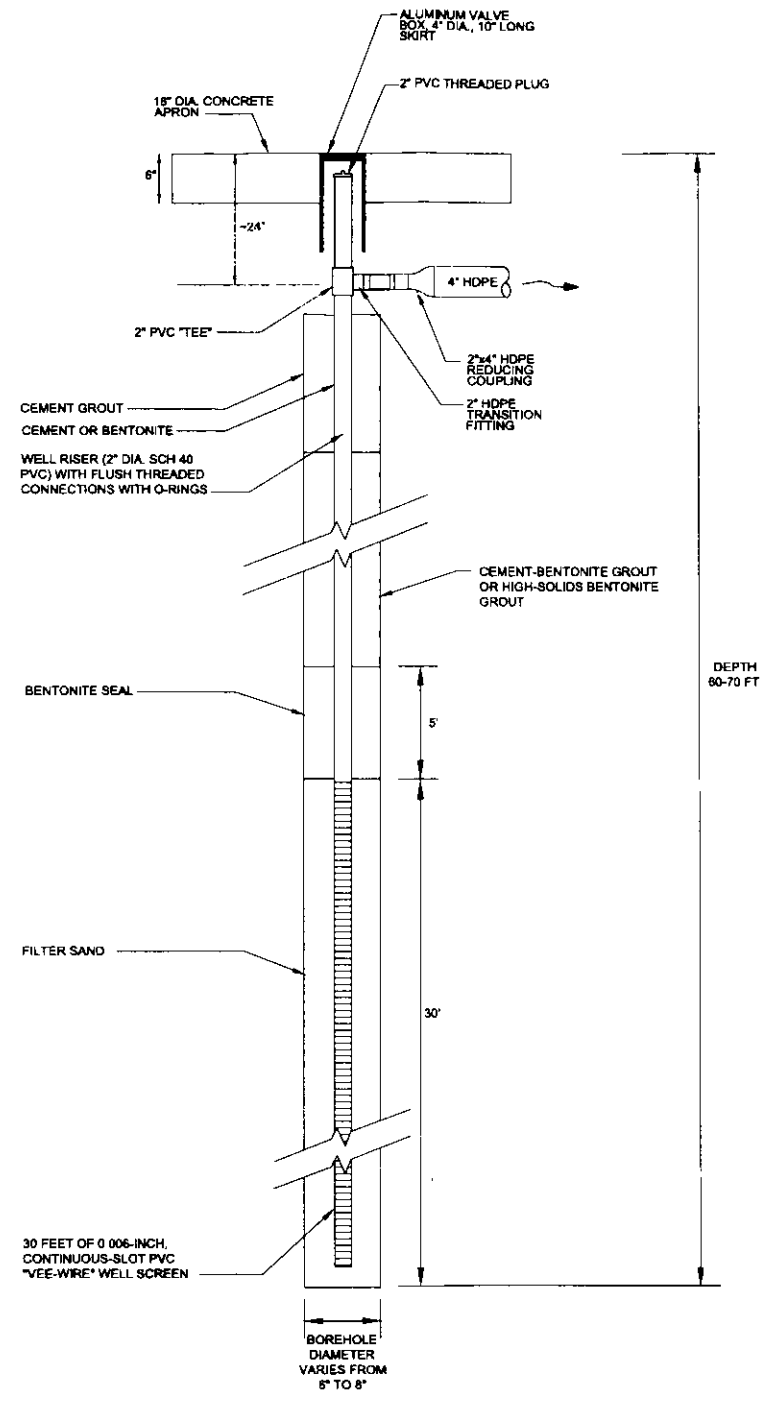
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	MAY, 2008
PROJ	334469
DWG	F-7
SHEET	9

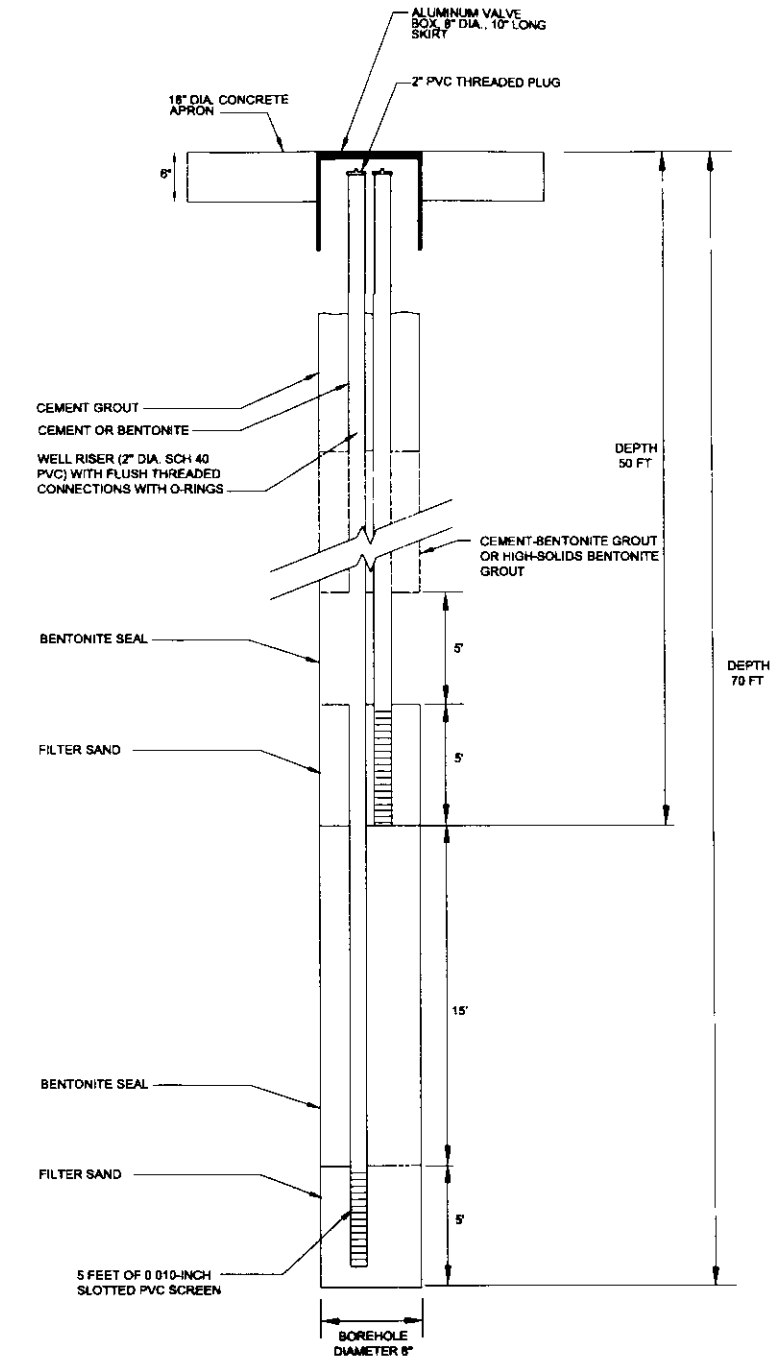
9532025



4 AIR SPARGE WELLHEAD DETAIL DIRECT BURIAL
NTS



5 SVE WELLHEAD DETAIL DIRECT BURIAL
NTS



6 VAPOR MONITORING POINT
NTS

MICHAEL WILLIAM PERLMUTTER
REGISTERED ENGINEER
XVI
AGRICULTURE
COMMERCE
No. 00107709
STATE OF TENNESSEE

NO	DATE	DSGN	DR	REVISION	CHK	APVD	BY	APVD
		M. STRONG	E. GRIGGS		M. PERLMUTTER	M. PERLMUTTER		M. PERLMUTTER

© CH2M HILL. ALL RIGHTS RESERVED
THIS DOCUMENT, AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL.
REUSE OF DOCUMENTS

CH2MHILL

OFF-DEPOT DUNN FIELD GROUNDWATER REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS AS/SVE DETAILS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

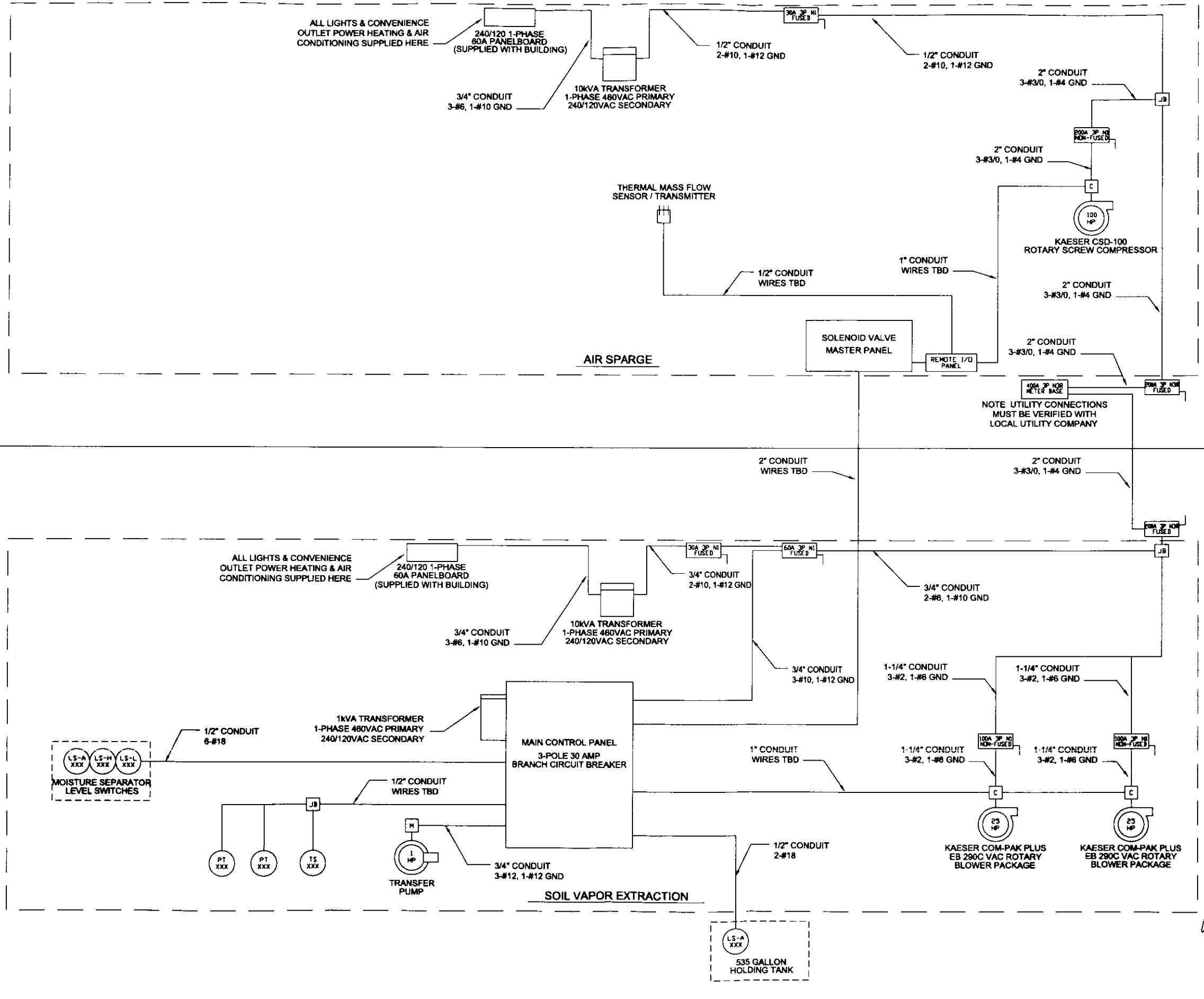
DATE	SEPTEMBER, 2008
PROJ	334469
DWG	F-8
SHEET	10

USER: EGRIGGS TAB: LAYOUT1

ATL/PROJ/148071 DDMT/ODRD2007/DRAWINGS

FILENAME: SHEET 10 (SVE DETAILS).DWG PLOT DATE: 9-Sep-08 PLOT TIME: 9:32 13 AM

9532026



PROCESS EQUIPMENT LEGEND

- M — MOTOR
- C — CONTROL BOX
- BLOWER
- TRANSFER PUMP
- XX XXX — INSTRUMENT FIELD MOUNTED
- DISCONNECT SWITCH
- JB — JUNCTION BOX

PROCESS ABBREVIATIONS

LS-A — LEVEL SWITCH - HIGH-HIGH ALARM
LS-H — LEVEL SWITCH - HIGH LEVEL
LS-L — LEVEL SWITCH - LOW LEVEL
PT — PRESSURE TRANSDUCER
TS — TEMPERATURE SWITCH

MICHAEL WILLIAM PERLMUTTER REGISTERED ENGINEER XVI AGRICULTURE COMMERCE No. 00107709 STATE OF TENNESSEE

NO.	DATE	DSGN
		M. STRONG

REVISION | BY | APVD
CHK M. PERLMUTTER APVD
DR G. HARTLEY M. PERLMUTTER

©CH2M HILL 2006 ALL RIGHTS RESERVED
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2MHILL.
REUSE OF DOCUMENTS.

CH2MHILL

OFF-DEPOT DUNN FIELD
GROUNDWATER
REMEDIAL DESIGN
MEMPHIS, TN

FLUVIAL SANDS AS/SVE
COMPOUNDS
ELECTRICAL RISER DIAGRAM

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"

DATE	APRIL, 2008
PROJ	334469
DWG	F-9
SHEET	11

USER: EGRIGGS TAB: MODEL

FILENAME: SHEET 11 FLUVIALSANDSAS_SVEELECTRIALRISERDIAGRAM.DWG PLOT DATE 22-May-08 PLOT TIME: 1:51:24 PM

9532027

APPENDIX H

Cost Estimate Details and Cut Sheets

Remedy: Off-Depot AS/SVE System

Element: Performance Monitoring - Monitoring Well Sampling

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2006-2010

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included Unit Costs are per sample per event.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	35	SAMPLE	$95	$3,325	
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	
Nitrate/Nitrite - 352.2 or 300	0	SAMPLE	$50	$0	
Sulfide	0	SAMPLE	$20	$0	
Sulfate	0	SAMPLE	$20	$0	
Manganese - SW6010B	0	SAMPLE	$20	$0	
Potassium - SW6010B	0	SAMPLE	$20	$0	
Bromide	0	SAMPLE	$20	$0	
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160 1	0	SAMPLE	$20	$0	
Total Suspended Solids E160 2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	4	SAMPLE	$95	$380	VOCs Only
SUBTOTAL				**$3,705**	
Equipment & Labor					
Sampling Supplies	1	EA	$500	$500	
Equipment Rental	8	days	$280	$2,240	Includes YSI 6500 and Grunfos Pump
Sample Shipment	1	EA	$350	$350	CH2M HILL Estimate
Labor - Technicians	160	HR	$115	$18,400	2 techs for 8 days
Travel/miscellaneous	1	LS	$1,200	$1,200	
SUBTOTAL				**$22,690**	
Data Validation	16	HR	$100	$1,600	
Data Management	16	HR	$100	$1,600	
Project Management	5%	of	$22,690	$1,135	
Technical Support	10%	of	$22,690	$2,269	
Project Delivery	10%	of	$22,690	$2,269	
Subcontractor General Requirements	5%	of	$22,690	$1,135	
SUBTOTAL				**$10,007**	
TOTAL UNIT COST				**$36,400**	

9532029

Remedy: Off-Depot AS/SVE System

Element: LTM Sampling During Performance Monitoring Period - YR1

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2009

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included Unit Costs are per sample per event

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	33	SAMPLE	$95	$3,135	31 MWs sampled once; 1
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	MW sampled semiannually
Nitrate/Nitrite - 352 2 or 300	0	SAMPLE	$50	$0	
Sulfide	0	SAMPLE	$20	$0	
Sulfate	0	SAMPLE	$20	$0	
Manganese - SW6010B	0	SAMPLE	$20	$0	
Potassium - SW6010B	0	SAMPLE	$20	$0	
Bromide	0	SAMPLE	$20	$0	
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160 1	0	SAMPLE	$20	$0	
Total Suspended Solids E160 2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	4	SAMPLE	$95	$380	
SUBTOTAL				**$3,515**	
Equipment & Labor					
Sampling Supplies	1	EA	$500	$500	
Equipment Rental	8	days	$280	$2,240	Includes YSI 6500 and Grunfos Pump
Sample Shipment	1	EA	$350	$350	CH2M HILL Estimate
Labor - Technicians	160	HR	$115	$18,400	2 techs for 8 days
Travel/miscellaneous	1	LS	$1,200	$1,200	
SUBTOTAL				**$22,690**	
Data Validation	16	HR	$100	$1,600	
Data Management	16	HR	$100	$1,600	
Project Management	5%	of	$22,690	$1,135	
Technical Support	10%	of	$22,690	$2,269	
Project Delivery	10%	of	$22,690	$2,269	
Subcontractor General Requirements	5%	of	$22,690	$1,135	
SUBTOTAL				**$10,007**	
TOTAL UNIT COST				**$36,200**	

Remedy: Off-Depot AS/SVE System

Element: LTM Sampling During Performance Monitoring Period - YR2

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2010

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included. Unit Costs are per sample per event

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	59	SAMPLE	$95	$5,605	57 MWs sampled once, 1
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	MW sampled semiannually
Nitrate/Nitrite - 352 2 or 300	0	SAMPLE	$50	$0	
Sulfide	0	SAMPLE	$20	$0	
Sulfate	0	SAMPLE	$20	$0	
Manganese - SW6010B	0	SAMPLE	$20	$0	
Potassium - SW6010B	0	SAMPLE	$20	$0	
Bromide	0	SAMPLE	$20	$0	
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160.1	0	SAMPLE	$20	$0	
Total Suspended Solids E160 2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	6	SAMPLE	$95	$570	VOCs Only
SUBTOTAL				**$6,175**	
Equipment & Labor					
Sampling Supplies	1	EA	$1,000	$1,000	
Equipment Rental	15	days	$280	$4,200	Includes YSI 6500 and Grunfos Pump
Sample Shipment	3	EA	$350	$1,050	CH2M HILL Estimate
Labor - Technicians	300	HR	$115	$34,500	2 techs for 15 days
Travel/miscellaneous	1	LS	$2,500	$2,500	
SUBTOTAL				**$43,250**	
Data Validation	32	HR	$100	$3,200	
Data Management	32	HR	$100	$3,200	
Project Management	5%	of	$43,250	$2,163	
Technical Support	10%	of	$43,250	$4,325	
Project Delivery	10%	of	$43,250	$4,325	
Subcontractor General Requirements	5%	of	$43,250	$2,163	
SUBTOTAL				**$19,375**	
TOTAL UNIT COST				**$68,800**	

Remedy: Off-Depot AS/SVE System

Element: LTM Sampling - YR3-10

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2011-2018

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included Unit Costs are per sample per event

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	90	SAMPLE	$95	$8,550	
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	Average number of samples
Nitrate/Nitrite - 352 2 or 300	0	SAMPLE	$50	$0	collected per year based on
Sulfide	0	SAMPLE	$20	$0	semiannual, annual, and
Sulfate	0	SAMPLE	$20	$0	biennial schedule in LTM
Manganese - SW6010B	0	SAMPLE	$20	$0	-- 15 semiannually
Potassium - SW6010B	0	SAMPLE	$20	$0	-- 50 annually
Bromide	0	SAMPLE	$20	$0	-- 27 biennially
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160.1	0	SAMPLE	$20	$0	
Total Suspended Solids E160 2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	9	SAMPLE	$95	$855	VOCs Only
SUBTOTAL				**$9,405**	
Equipment & Labor					
Sampling Supplies	1	EA	$1,000	$1,000	
Equipment Rental	20	days	$280	$5,600	Includes YSI 6500 and Grunfos Pump
Sample Shipment	4	EA	$350	$1,400	CH2M HILL Estimate
Labor - Technicians	400	HR	$115	$46,000	2 techs for 20 days
Travel/miscellaneous	1	LS	$5,000	$5,000	
SUBTOTAL				**$59,000**	
Data Validation	32	HR	$100	$3,200	
Data Management	32	HR	$100	$3,200	
Project Management	5%	of	$59,000	$2,950	
Technical Support	10%	of	$59,000	$5,900	
Project Delivery	10%	of	$59,000	$5,900	
Subcontractor General Requirements	5%	of	$59,000	$2,950	
SUBTOTAL				**$24,100**	
TOTAL UNIT COST				**$92,500**	

Remedy: Off-Depot AS/SVE System

Element: LTM Sampling - YR11-20

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2019-2028

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included Unit Costs are per sample per event.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	50	SAMPLE	$95	$4,750	
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	Average number of samples
Nitrate/Nitrite - 352 2 or 300	0	SAMPLE	$50	$0	collected per year based on
Sulfide	0	SAMPLE	$20	$0	semiannual, annual, and
Sulfate	0	SAMPLE	$20	$0	biennial schedule in LTM
Manganese - SW6010B	0	SAMPLE	$20	$0	-- 5 semiannually
Potassium - SW6010B	0	SAMPLE	$20	$0	-- 40 annually
Bromide	0	SAMPLE	$20	$0	
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160 1	0	SAMPLE	$20	$0	
Total Suspended Solids E160.2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	9	SAMPLE	$95	$855	VOCs Only
SUBTOTAL				**$5,605**	
Equipment & Labor					
Sampling Supplies	1	EA	$1,000	$1,000	
Equipment Rental	12	days	$280	$3,360	Includes YSI 6500 and Grunfos Pump
Sample Shipment	3	EA	$350	$1,050	CH2M HILL Estimate
Labor - Technicians	240	HR	$115	$27,600	2 techs for 12 days
Travel/miscellaneous	1	LS	$3,500	$3,500	
SUBTOTAL				**$36,510**	
Data Validation	24	HR	$100	$2,400	
Data Management	24	HR	$100	$2,400	
Project Management	5%	of	$36,510	$1,826	
Technical Support	10%	of	$36,510	$3,651	
Project Delivery	10%	of	$36,510	$3,651	
Subcontractor General Requirements	5%	of	$36,510	$1,826	
SUBTOTAL				**$15,753**	
TOTAL UNIT COST				**$57,900**	

Remedy: Off-Depot AS/SVE System

Element: LTM Sampling - YR21-30

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2029-2039

WORK STATEMENT

Costs associated with water sample collection from monitoring wells only, shipment and analysis for annual monitoring are included Unit Costs are per sample per event

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Sample Analysis					
VOCs - SW8260 - Level III	30	SAMPLE	$95	$2,850	
Carbon Dioxide - RSK-175	0	SAMPLE	$135	$0	Average number of samples
Nitrate/Nitrite - 352.2 or 300	0	SAMPLE	$50	$0	collected per year based on
Sulfide	0	SAMPLE	$20	$0	semiannual, annual, and
Sulfate	0	SAMPLE	$20	$0	biennial schedule in LTM
Manganese - SW6010B	0	SAMPLE	$20	$0	-- 30 annually
Potassium - SW6010B	0	SAMPLE	$20	$0	
Bromide	0	SAMPLE	$20	$0	
Alkalinity - SM 2320-B	0	SAMPLE	$15	$0	
Chloride - SW9056	0	SAMPLE	$20	$0	
Iron - SW6010B	0	SAMPLE	$20	$0	
Iron II - SM3500 - Fe	0	SAMPLE	$20	$0	
Iron III (calculated)	0	SAMPLE	$0	$0	
Total Organic Carbon - SW9060	0	SAMPLE	$25	$0	
Total Dissolved Solids E160 1	0	SAMPLE	$20	$0	
Total Suspended Solids E160 2	0	SAMPLE	$20	$0	
Hexavalent Chromium	0	SAMPLE	$25	$0	
Methane/Ethene/Ethane	0	SAMPLE	$150	$0	
Trip Blanks- VOCs	0	SAMPLE	$95	$0	
Dehalococcoides etheneogenes	0	SAMPLE	$275	$0	
Volatile Fatty Acids	0	SAMPLE	$100	$0	
Phospholipid Fatty Acids	0	SAMPLE	$265	$0	
QA/QC Samples	9	SAMPLE	$95	$855	VOCs Only
SUBTOTAL				**$3,705**	
Equipment & Labor					
Sampling Supplies	1	EA	$1,000	$1,000	
Equipment Rental	8	days	$280	$2,240	Includes YSI 6500 and Grunfos Pump
Sample Shipment	2	EA	$350	$700	CH2M HILL Estimate
Labor - Technicians	160	HR	$115	$18,400	2 techs for 8 days
Travel/miscellaneous	1	LS	$2,500	$2,500	
SUBTOTAL				**$24,840**	
Data Validation	16	HR	$100	$1,600	
Data Management	16	HR	$100	$1,600	
Project Management	5%	of	$24,840	$1,242	
Technical Support	10%	of	$24,840	$2,484	
Project Delivery	10%	of	$24,840	$2,484	
Subcontractor General Requirements	5%	of	$24,840	$1,242	
SUBTOTAL				**$10,652**	
TOTAL UNIT COST				**$39,200**	

Remedy: **Off-Depot AS/SVE System**

Element: **Soil Gas Monitoring**

Site: Memphis Depot Dunn Field
Location: Memphis, TN
Phase: Remedial Action
Period: 2006-2010

WORK STATEMENT

Costs associated with soil gas field screening.

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Equipment & Labor per Event					
Equipment & Labor					
Sampling Supplies	1	EA	$500	$500	
Equipment Rental	5	days	$300	$1,500	
Labor - Technicians	80	HR	$115	$9,200	2 techs for 4 days
Travel/miscellaneous	1	LS	$1,200	$1,200	
SUBTOTAL				**$12,400**	
Data Validation	0	HR	$100	$0	
Data Management	4	HR	$100	$400	
Project Management	5%	of	$12,400	$620	
Technical Support	10%	of	$12,400	$1,240	
Project Delivery	10%	of	$12,400	$1,240	
Subcontractor General Requirements	5%	of	$12,400	$620	
SUBTOTAL				**$4,120**	
TOTAL UNIT COST				**$16,500**	

Series VQ2000

Body Ported

Plug Lead Unit: Flip Type

How to Order Manifold

VV5Q 2 4 — 08 F S1 — D

Series

2	VQ2000

Manifold

4	Plug lead unit/Flip

Stations

01	1 station
:	:

The number of max stations differs from kit to kit (Refer to the table below)

Simple specials are available with SMC Simple Specials System For details about applicable models, please contact SMC

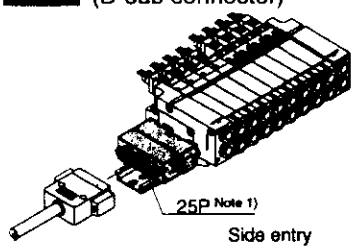
Kit/Electrical entry/Cable length

Option

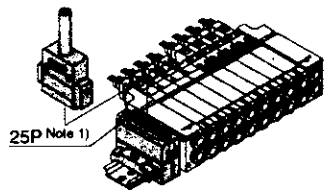
Nil	None (C kit only)
D (2)	DIN rail mounting style
K (3)	Special wiring specifications (Except double wiring)
N	With name plate
S (4)	Built-in silencer, direct exhaust

Note 1) When two or more symbols are specified, indicate them alphabetically Example) -DNS
Note 2) F, P, T, and S kits are of DIN rail include suffix -D
Note 3) Specify the wiring specifications in the manifold specification sheet. (Except C kit)
Note 4) F, P, T and S kits are provided with an exhaust on one side, while C kits are with an exhaust on both sides

F kit (D-sub connector)



Side entry

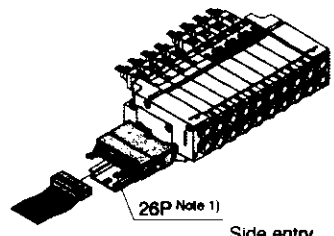


Top entry

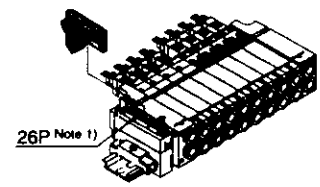
P. 2-4-38

Connector entry direction					
Top entry		Side entry			
Kit F	U0	Kit F	S0	Without cable	Max. 16 (2) stations
	U1		S1	With cable (1.5 m)	
	U2		S2	With cable (3 m)	
	U3		S3	With cable (5 m)	

P kit (Flat ribbon cable connector)



Side entry

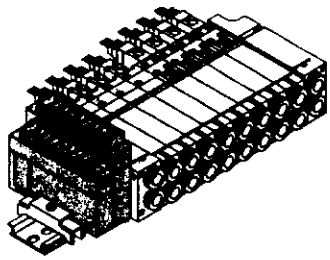


Top entry

P. 2-4-42

Connector entry direction					
Top entry		Side entry			
Kit P	U0	Kit P	S0	Without cable	Max. 16 (2) stations
	U1		S1	With cable (1.5 m)	
	U2		S2	With cable (3 m)	
	U3		S3	With cable (5 m)	

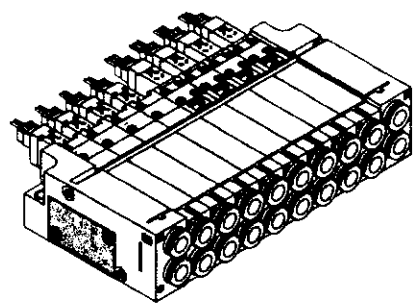
T kit (Terminal block)



P. 2-4-46

Kit			
T	1	No. of terminals: 8, 1 row	Applicable stations 1 to 8
	2	No. of terminals: 16, 2 rows	Applicable stations 5 to 16

C kit (Connector)

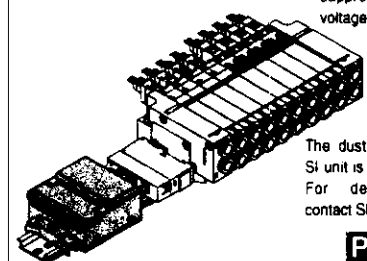


P. 2-4-50

C	Connector kit	Max. 16

S kit (Serial transmission unit)

The valve is equipped with an indicator light/surge voltage suppressor and the voltage is 24 VDC



The dust-protected type SI unit is applicable, too For details, please contact SMC.

P. 2-4-54

Kit S (3)			
	0	Without SI unit	Max. 16 (2) stations
	A	With general type SI unit (Series EX300)	
	B	Mitsubishi Electric Corp. MELSECNET/MINI-S3 Data Link System	
	C	OMRON Corp.: SYSBUS Wire System	
	D	SHARP Corp. Satellite I/O Link System	
	F1	NKE Corp. Uni-wire System (16 output points)	
	H	NKE Corp : Uni-wire H System	

Note 1) Besides the above, F and P kits with different number of pins are available. For details, refer to page 2-4-68.
Note 2) See page 2-4-69 for details
Note 3) Please consult with SMC for the following serial transmission kits: Matsushita Electric Works, Ltd , Rockwell Automation, Inc , SUNX Corporation; Fuji Electric Co , Ltd., OMRON Corporation.

How to Order Valves

VQ 2 1 4 0 Y 5 L □ C6

Series

2	VQ2000

Type of actuation

1	2 position single
2	2 position double (latching)

Seal

0	Metal seal
1	Rubber seal

Coil voltage

1	100 VAC (50/60 Hz)
2 Note)	200 VAC (50/60 Hz)
3	110 VAC (50/60 Hz)
4 Note)	220 VAC (50/60 Hz)
5	24 VDC
6	12 VDC

Note) The C kits is applicable to 200/220 VAC

Function

Symbol	Specifications	DC	AC
Nil	Standard type	(1.0 W) ○	○ (1)
H (2)	High pressure type	(1.5 W) ○	—
Y (2)	Low wattage type	(0.5 W) ○	—

Note 1) For power consumption of AC type, refer to page 2-4-36
Note 2) Except double (latching)

Electrical entry

	VQ2000
G: Grommet C kit single only (Except AC)	
L: L plug connector With lead wire	With light/ surge voltage suppressor
LO: L plug connector Without connector	With light/ surge voltage suppressor
M: M plug connector With lead wire	With light/ surge voltage suppressor
MO: M plug connector Without connector	With light/ surge voltage suppressor

Note) LO and MO valves are used for F, P, T, and S kits. The plug connector and lead wire are attached to the manifold

Cylinder port

Symbol	Port size
C4	With One-touch fitting for ø4
C6	With One-touch fitting for ø6
C8	With One-touch fitting for ø8

Note) For inch-size One-touch fittings, refer to "Option" on page 2-4-69

Manual override

Nil Non-locking push type (Tool required)	B Locking type (Tool required)	C Locking type (Manual)

Note) A manual override for pilot valve is provided to the standard model for double type

Manual override body side
Pilot valve Manual override

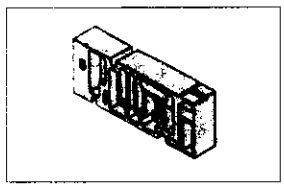
Note 1) For negative common specifications, refer to "Option" on page 2-4-69
Note 2) Connector assembly will be required when the F, P, T, S kits add a valve. For part nos., refer to "Option" on page 2-4-69

VQC
SQ
VQ0
VQ4
VQ5
VQZ
VQD

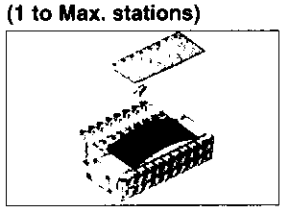
Manifold Option

P. 2-4-59

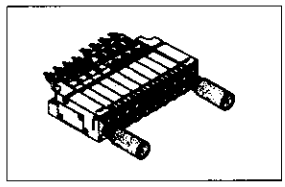
Blanking plate assembly
VVQ2000-10A-4



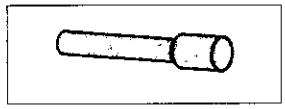
Name plate [-N4]
VVQ2000-N4-Station
(1 to Max. stations)



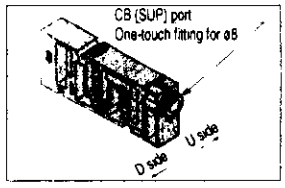
Silencer (For EXH port)
AN200-KM8



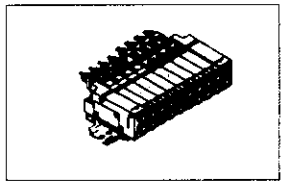
Blanking plug **KQP2-$^{06}_{08}$**



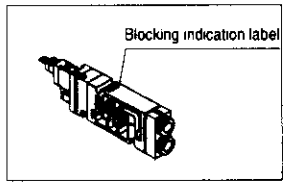
Individual SUP spacer
VVQ2000-P-4-C8



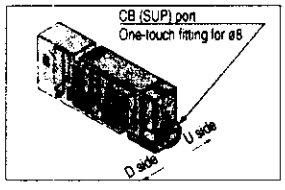
DIN rail mounting bracket
VVQ2000-57A-4



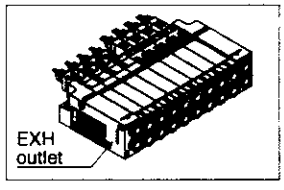
P R PR Block valve VQ2$^{1}_{2}$4$^{0}_{1}$-□-□□- P R PR



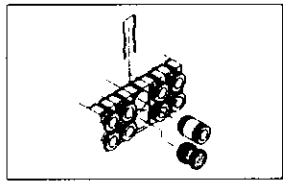
Individual EXH spacer
VVQ2000-R-4-C8



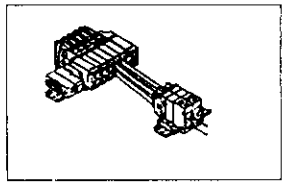
Built-in silencer,
direct exhaust [-S]



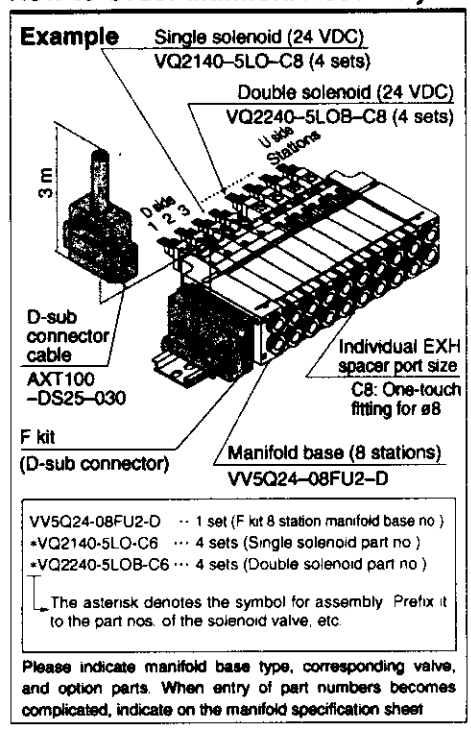
Port plug
VVQ1000-58A



Double check block
VQ2000-FPG-□□



How to Order Manifold Assembly



VV5Q24-08FU2-D ··· 1 set (F kit 8 station manifold base no.)
*VQ2140-5LO-C6 ··· 4 sets (Single solenoid part no.)
*VQ2240-5LOB-C6 ··· 4 sets (Double solenoid part no.)
The asterisk denotes the symbol for assembly. Prefix it to the part nos. of the solenoid valve, etc.

Please indicate manifold base type, corresponding valve, and option parts. When entry of part numbers becomes complicated, indicate on the manifold specification sheet

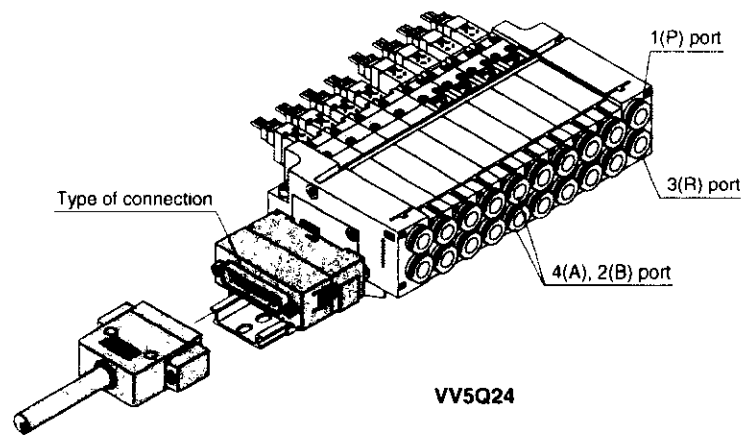
• For replacement parts, refer to page 2-4-109.

Manifold Specifications

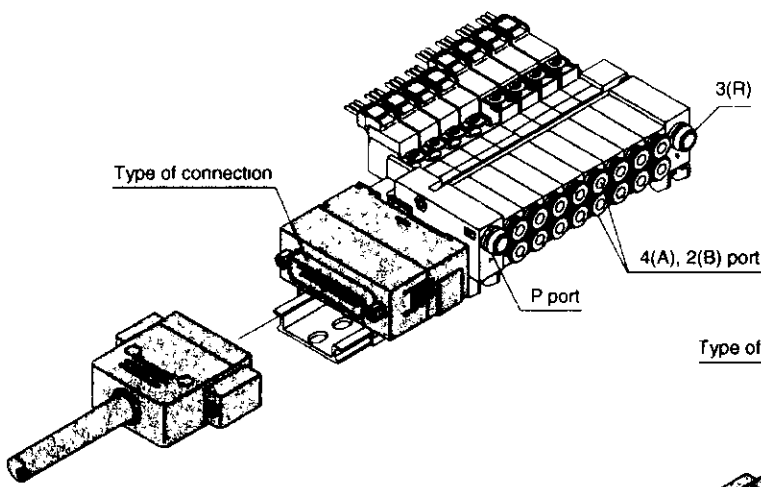
Series	Base model	Type of connection	Porting specifications			Applicable (2) stations	Applicable solenoid valve	5 station weight (g)
			Port location	Port size (1)				
				1(P), 3(R)	4(A), 2(B)			
VQ0000	**VV5Q04-□□□**	■ F kit–D-sub connector ■ P kit–Flat cable connector ■ T kit–Terminal block ■ C kit–Individual connector ■ S kit–Serial transmission unit	Side	C6 (ø6) Option Built-in silencer, direct exhaust	C3 (ø3.2) C4 (ø4) M5 (M5 thread)	1 to 16 stations	VQ0□40 VQ0□41	225
VQ1000	**VV5Q14-□□□**	■ F kit–D-sub connector ■ P kit–Flat cable connector ■ T kit–Terminal block ■ C kit–Individual connector ■ S kit–Serial transmission unit	Side	C6 (ø6) Option Built-in silencer, direct exhaust	C3 (ø3.2) C4 (ø4) C6 (ø6) M5 (M5 thread)		VQ1□40 VQ1□41	380
VQ2000	**VV5Q24-□□□**	■ F kit–D-sub connector ■ P kit–Flat cable connector ■ T kit–Terminal block ■ C kit–Individual connector ■ S kit–Serial transmission unit	Side	C8 (ø8) Option Built-in silencer, direct exhaust	C4 (ø4) C6 (ø6) C8 (ø8)		VQ2□40 VQ2□41	671

Note 1) Inch-size One-touch fittings are also available. For details, refer to page 2-4-69.
Note 2) See page 2-4-69 for details.

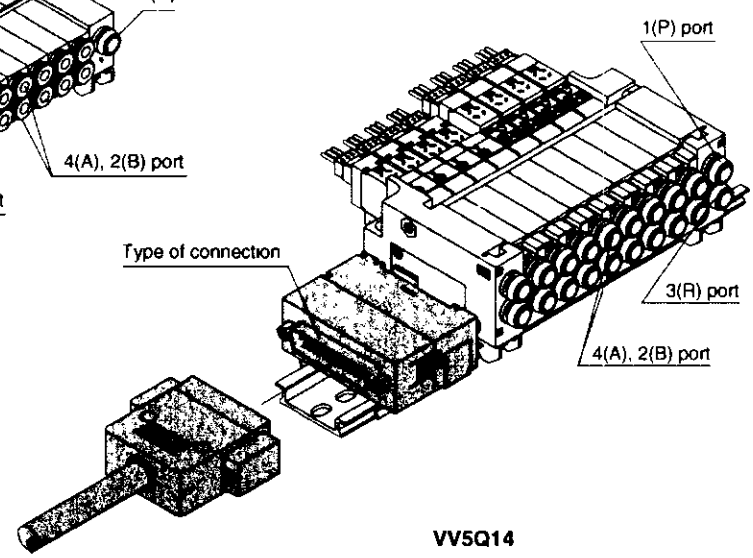
VQC
SQ
VQ0
VQ4
VQ5
VQZ
VQD



VV5Q24



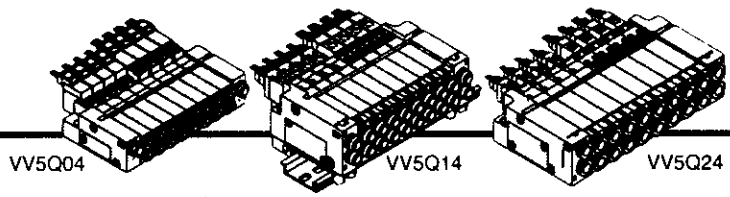
VV5Q04



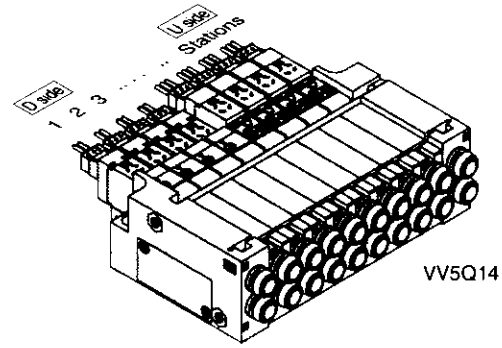
VV5Q14

9532038

C VQ0000/1000/2000 Kit (Connector)



- Standard with lead wires connected to each valve individually
- Maximum stations are 16.



Manifold Specifications

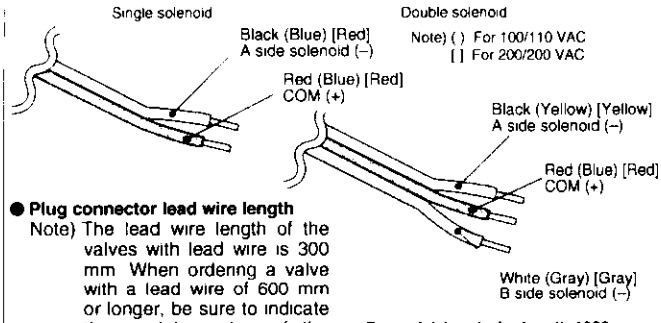
Series	Porting specifications			Applicable stations
	Port location	Port size 1(P), 3(R)	Port size 4(A), 2(B)	
VQ0000	Side	C6	C3, C4, M5	Max. 16 stations
VQ1000	Side	C6	C3, C4, C6, M5	Max. 16 stations
VQ2000	Side	C8	C4, C6, C8	Max 16 stations

● Wiring specifications: Positive COM

● The lead wires are connected to the valve as shown below. Connect each to the power supply side.

	Lead wire color 24 VDC	100 VAC 110 V	200 VAC 220 V
SOL A (-)	Black	(Blue)	[Red]
COM (+)	Red	(Blue)	[Red]
SOL B (-)	White	(Gray)	[Gray]

	Lead wire color 24 VDC	100 VAC 110 V	200 VAC 220 V
SOL A (-)	Black	(Yellow)	[Yellow]
COM (+)	Red	(Blue)	[Red]



● Plug connector lead wire length

Note) The lead wire length of the valves with lead wire is 300 mm. When ordering a valve with a lead wire of 600 mm or longer, be sure to indicate the model number of the valve without connector and connector assembly.

Example) Lead wire length 1000 mm
VQ1140-5LO-C6 3 pcs
AXT661-14A-10 3 pcs

Connector Assembly Part No. (For DC)

Lead wire length	Single/3 position part no.	Double solenoid part no.
Socket only (3 pcs.)	AXT661-12A	
300 mm	AXT661-14A	AXT661-13A
600 mm	AXT661-14A-6	AXT661-13A-6
1000 mm	AXT661-14A-10	AXT661-13A-10
2000 mm	AXT661-14A-20	AXT661-13A-20
3000 mm	AXT661-14A-30	AXT661-13A-30

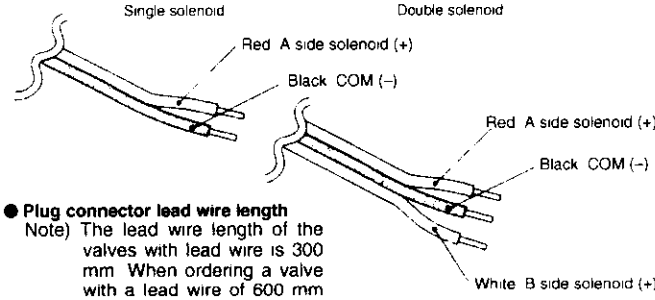
Note 1) 100/110 VAC for single AXT661-31A-*; for double AXT661-32A-* 200/220 VAC for single. AXT661-34A-*, for double: AXT661-35A-* * are in accordance with the above table.
Note 2) 3 position type requires 2 sets for A side and B side

● Wiring specifications: Negative COM (Option)

● The lead wires are connected to the valve as shown below. Connect each to the power supply side.

	Lead wire color 24 VDC	100 VAC 110 V	200 VAC 220 V
SOL A (+)	Red		
COM (-)	Black		
SOL B (+)	White		

	Lead wire color 24 VDC	100 VAC 110 V	200 VAC 220 V
SOL A (+)	Red		
COM (-)	Black		



● Plug connector lead wire length

Note) The lead wire length of the valves with lead wire is 300 mm. When ordering a valve with a lead wire of 600 mm or longer, be sure to indicate the model number of the valve without connector and connector assembly.

Example) Lead wire length 1000 mm
VQ1140-5LO-C6 3 pcs
AXT661-14A-10 3 pcs

Connector Assembly Part No.

Lead wire length	Single/3 position part no.	Double solenoid part no.
Socket only (3 pcs.)	AXT661-12A	
300 mm	AXT661-14AN	AXT661-13AN
600 mm	AXT661-14AN-6	AXT661-13AN-6
1000 mm	AXT661-14AN-10	AXT661-13AN-10
2000 mm	AXT661-14AN-20	AXT661-13AN-20
3000 mm	AXT661-14AN-30	AXT661-13AN-30

Note 1) When using the negative common specifications, use valves for negative common
Note 2) 3 position type requires 2 sets for A side and B side

How to Order Manifold

VV5Q 1 4 – 08 C – N

Series

0	VQ0000
1	VQ1000
2	VQ2000

Manifold

4	Plug lead unit/Flip

Stations

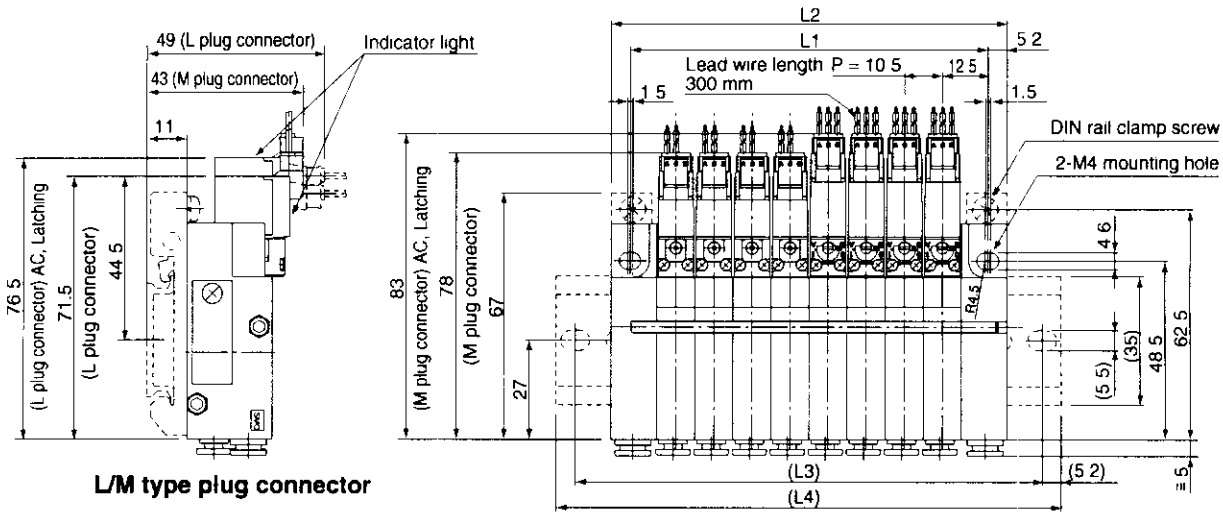
01	1 station
⋮	⋮
16	16 stations

Option

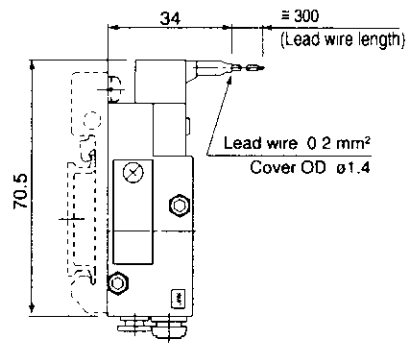
Nil	None
D	DIN rail mounting style
N	With name plate
S	Built-in silencer, direct exhaust

Note 1) When two or more symbols are specified, indicate them alphabetically.
Example) -DNS

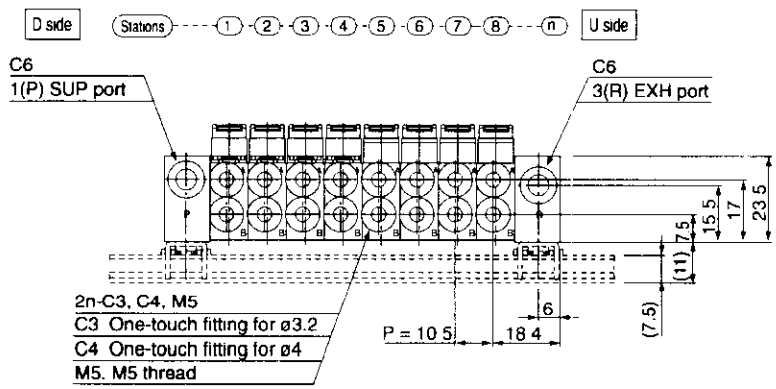
VQ0000



L/M type plug connector



Grommet



The broken lines indicate the DIN rail mounting style [-D].

Note 1) Built-in silencer types are equipped with a 1 (P) SUP port on both D and U sides.

Note 2) 3 position needs two stations.
Cylinder port is located at U side of body

Dimensions

Formula L1 = 10.5n + 14.5, L2 = 10.5 n + 25 n Station (Maximum 16 stations)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L1	25	35.5	46	56.5	67	77.5	88	98.5	109	119.5	130	140.5	151	161.5	172	182.5
L2	35.5	46	56.5	67	77.5	88	98.5	109	119.5	130	140.5	151	161.5	172	182.5	193
(L3)	62.5	75	87.5	87.5	100	112.5	125	137.5	150	150	162.5	175	187.5	200	212.5	212.5
(L4)	73	85.5	98	98	110.5	123	135.5	148	160.5	160.5	173	185.5	198	210.5	223	223

How to Order Valves

VQ 1 1 4 0 Y – 5 L [ ] – C6

Series

0	VQ0000
1	VQ1000
2	VQ2000

Seal

0	Metal seal
1	Rubber seal

Function

Symbol	Specifications	DC	AC
Nil	Standard type	(1.0 W) ○	○ (1)
H (2)	High pressure type	(1.5 W) ○	—
Y (2)	Low wattage type	(0.5 W) ○	—

Note 1) For power consumption of AC type, refer to page 2-4-36

Note 2) Except double (latching)

Type of actuation

		VQ0000	VQ1000	VQ2000
1	2 position single	●	●	●
2	2 position double (Latching)	●	●	●
3	3 position closed center	● (1)	● (2)	—
4	3 position exhaust center	● (1)	● (2)	—
5	3 position pressure center	—	● (2)	—

Note 1) 2 stations space are occupied
Note 2) L plug connector is used for AC

Coil voltage

1	100 VAC (50/60 Hz)
2	200 VAC (50/60 Hz)
3	110 VAC (50/60 Hz)
4	220 VAC (50/60 Hz)
5	24 VDC
6	12 VDC

Note 1) For negative common specifications, refer to "Option" on page 2-4-69

How to Order Manifold Assembly

Specify the part numbers for valves and options together beneath the manifold base part number.

Cylinder port

Symbol	Port size	VQ0000	VQ1000	VQ2000
C3	With One-touch fitting for ø3.2	●	●	—
C4	With One-touch fitting for ø4	●	●	●
C6	With One-touch fitting for ø6	—	●	●
C8	With One-touch fitting for ø8	—	—	●
M5	M5 thread	●	●	—

Note) For inch-size One-touch fittings, refer to "Option" on page 2-4-69.

Manual override

Nil	Non-locking push type (Tool required)
B	Locking type (Tool required)
C	Locking type (Manual)

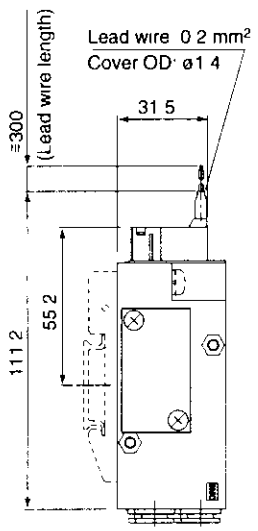
Note 1) All double latching valves of VQ0000 are non-locking push type.

Note 2) A manual override for pilot valve is provided to the standard model for double type

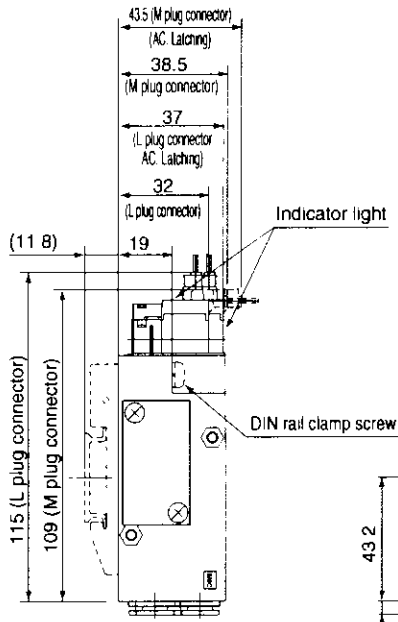
Electrical entry

G	Grommet (Except latching and 100/110 VAC type)
L	L plug connector with lead wire
LO	L plug connector without connector
M	M plug connector with lead wire
MO	M plug connector without connector

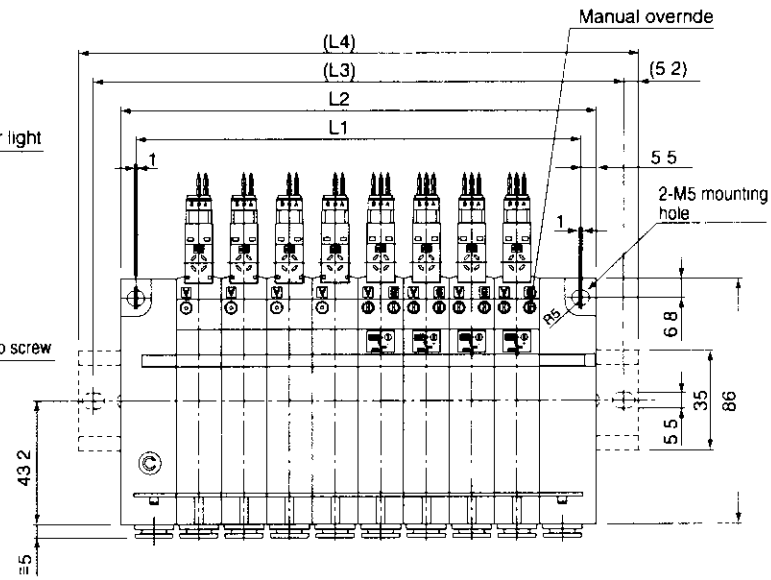
VQ2000

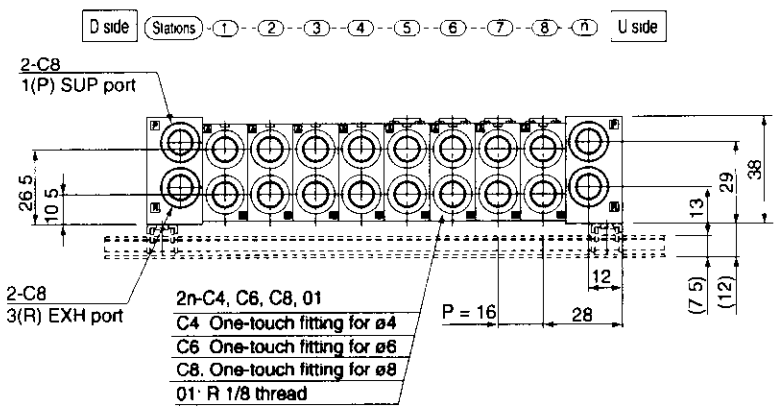


Grommet



L/M type plug connector





Dimensions

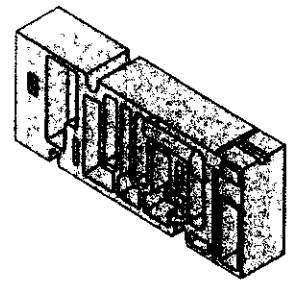
Formula L1 = 16n + 29, L2 = 16n + 40 n: Station (Maximum 16 stations)

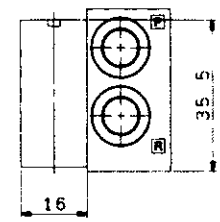
L \ n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L1	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
L2	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280	296
(L3)	87.5	100	112.5	125	150	162.5	175	187.5	212.5	225	237.5	262.5	275	287.5	300	325
(L4)	98	110.5	123	135.5	160.5	173	185.5	198	223	235.5	248	273	285.5	298	310.5	335.5

Manifold Option Parts for VQ2000

Blanking plate assembly
VVQ2000-10A-4

It is used when a blanking plate is mounted to amanifold in advance for possible valve mounting, etc



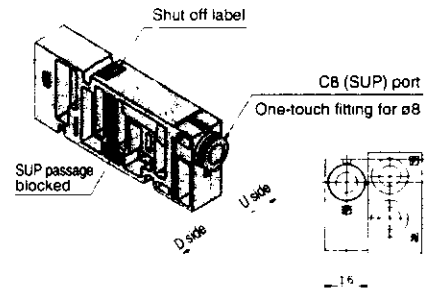


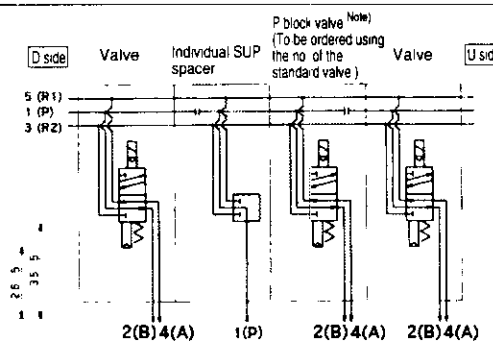
Individual SUP spacer
VVQ2000-P-4-C8

When the same manifold is to be used for different pressures, individual SUP spacers are used as SUP ports for different pressures (One station space is occupied)

Since the SUP passage on the spacer's D side is blocked in advance, it is mounted on the D side the valves U side. (Refer to the application example)

* Specify the spacer mounting position and SUP block plate mounting position on the manifold specification sheet





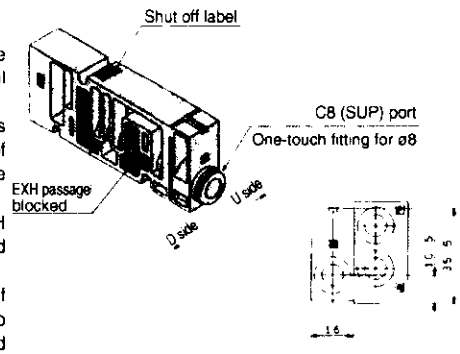
Note) P block valve is mounted in the blocking position when ordering an individual SUP spacer incorporated with a manifold. When separately ordering an individual SUP spacer, separately order a P block valve

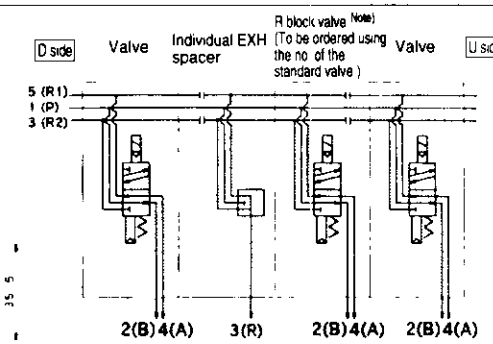
Individual EXH spacer
VVQ2000-R-4-C8

When valve exhaust affects other stations due to the circuit configuration, this spacer is used for individual valve exhaust (1 station space is occupied)

Since the EXH passage on the spacer's D side is blocked in advance, it is mounted on the D side of the valve for individual supply while blocking the valves U side (Refer to the application example.)

* Specify the spacer mounting position and EXH block plate mounting position on the manifold specification sheet
* When the electrical entry is F, P, T, S kit, and if you choose the option with built-in silencer, no exhaust port will be supplied on the D side end plate. In this case, mount a spacer for individual EXH on the 1st station





Note) R block valve is mounted in the blocking position when ordering an individual EXH spacer incorporated with a manifold. When separately ordering an individual EXH spacer, separately order a R block valve

P / R / PR Block valve

VQ2 1/4 0/1 -□-□□- P/R/PR

Valve no.

For a flip plug-in unit, block plate is built in the valve for blocking SUP and EXH passages. Since the no is classified by the passage to be blocked, specify it by attaching the option no. to the valve no. The block valve is constructed so that U sides of SUP and EXH passages are blocked.

* Specify the number of stations on the manifold specification sheet.

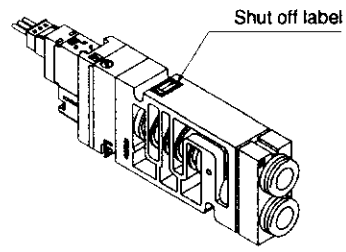
<Shut off label>

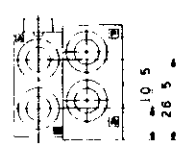
When using block plates for SUP, EXH passage, indication label for confirmation of the blocking position from outside is attached.

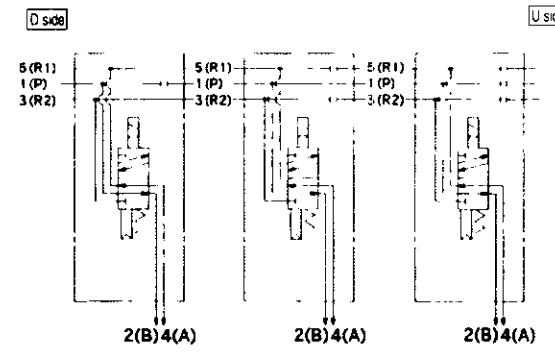
(One label for each)

* When ordering a block plate incorporated with the manifold no., a block indication label is attached to the manifold.
* Caution on handling P/RP block valve

  When the electrical entry is F, P, T, S kit, and if you choose the option with built-in silencer, no exhaust port will be supplied on the D side end plate. In this case, mount a spacer for individual EXH on the 1st station.







For SUP passage block	VQ2 1/4 0/1 -□-□□-P
For EXH passage block	VQ2 1/4 0/1 -□-□□-R
For SUP/EXH passage block	VQ2 1/4 0/1 -□-□□-PR

SUP passage blocked

EXH passage blocked

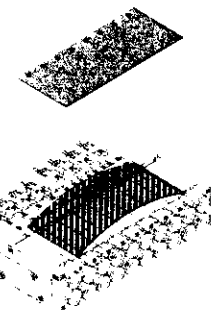
SUP/EXH passage blocked

9532042

Manifold Option Parts for VQ2000

Name plate [-N4]
VVQ2000-N4-Station (1 to Max. stations)

It is a transparent resin plate for placing a label that indicates solenoid valve function, etc
Insert it into the groove on the side of the end plate and bend it as shown in the figure

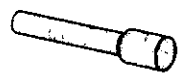


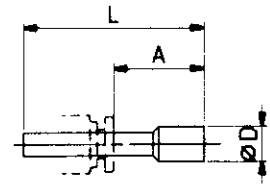
* When ordering assemblies incorporated with a manifold, add suffix N to the manifold no

Blanking plug

KQ2P-$^{04}_{06}_{08}$

It is inserted into an unused cylinder port and SUP/EXH ports.
Purchasing order is available in units of 10 pieces



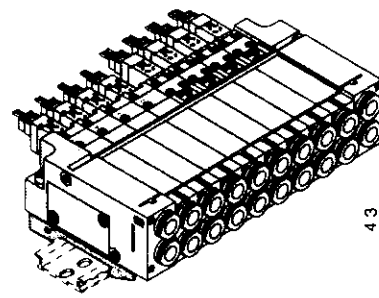


Dimensions

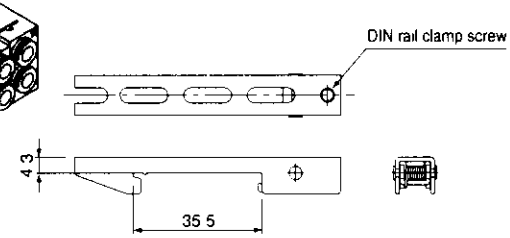
Applicable fittings size ød	Model	A	L	D
4	**KQ2P-04**	16	32	6
6	**KQ2P-06**	18	35	8
8	**KQ2P-08**	20 5	39	10

DIN rail mounting bracket
VVQ2000-57A-4

It is used for mounting a manifold on a DIN rail The DIN rail mounting bracket is fixed to the manifold end plate. (The specification is the same as that for the option -D)
1 set of DIN rail mounting bracket is used for 1 manifold (2 DIN rail mounting brackets)



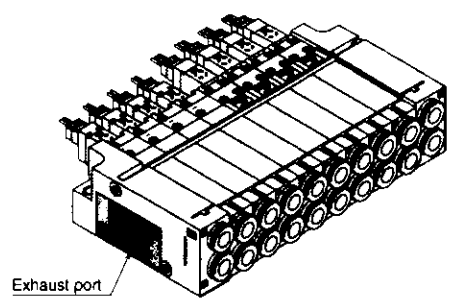
* When ordering assemblies incorporated with a manifold, add suffix -D to the manifold no



Built-in silencer, Direct exhaust [-S]

This is type with an exhaust port atop the manifold endplate The built-in silencer exhibits an excellent noise suppression effect
F, P, T and S kits are provided with exhaust on one side
Note) A large quantity of drainage generated in the air source results in exhaust of air together with drainage

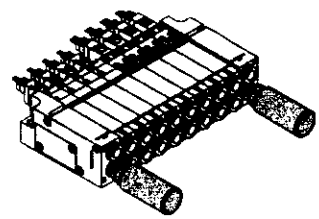
* For maintenance, refer to page 2-4-67.

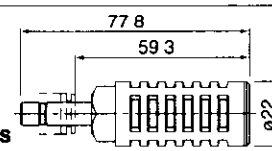


* When ordering assemblies incorporated with a manifold, add suffix -S to the manifold no

Silencer (For EXH port)

This silencer is to be inserted into the EXH port (One-touch fittings) of the common exhaust





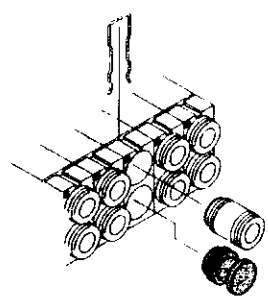
Dimensions

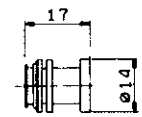
Series	Applicable fittings size ød	Model	A	L	D	Effective area (mm²)	Noise reduction (dB)
VQ2000	8	AN200-KM8	59 3	77.8	22	20	30

Port plug
VVQ1000-58A

The plug is used to block the cylinder port when usinga 4 port valve as a 3 port valve
When ordering it incorporated with a manifold, suffix A or B, the symbol of the plug port, to the valve no

Example) **VQ2140-5L-C8-A**
└●A port, Plug



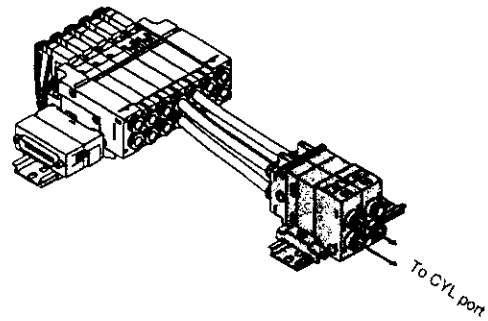


Manifold Option

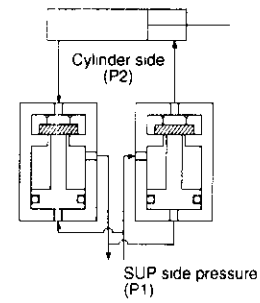
Double check block (Separated type)

VQ2000-FPG-□□-□

It is used on the outlet side piping
Combining the double check block with built-in pilot double check valve and a two-position single/double solenoid valve will prevent the dropping at the cylinder stroke end when the SUP residual pressure is released.



<Check valve operation principle>



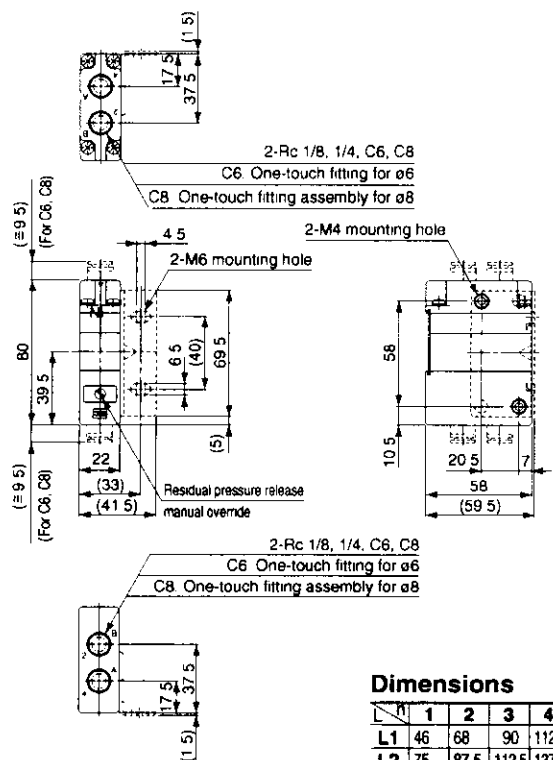
Specifications

Maximum operating pressure	0 8 MPa
Ambient and fluid temperature	0 15 MPa
Ambient and fluid temp.	–5 to 50° C
Flow characteristics: C	3 0 dm³/(s bar)
Max. operating frequency	180 c p.m

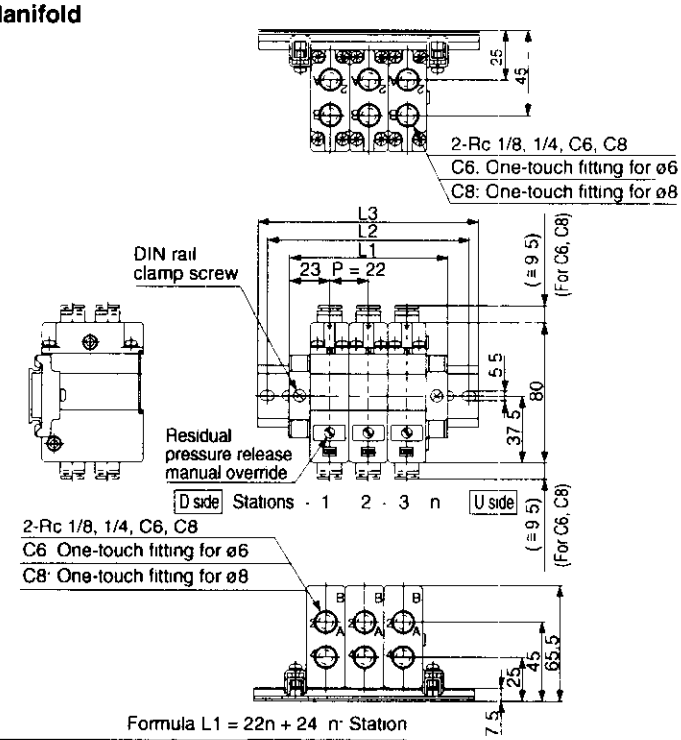
Note) Based on JIS B 8375-1981 (Supply pressure 0 5 MPa)

Dimensions

Single unit



Manifold



Dimensions

Formula L1 = 22n + 24 n: Station

n /	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L1	46	68	90	112	134	156	178	200	222	244	266	288	310	332	354	376
L2	75	87.5	112.5	137.5	162.5	175	200	225	250	262.5	287.5	312.5	337.5	362.5	375	400
L3	85.5	98	123	148	173	185.5	210.5	235.5	260.5	273	298	323	348	373	385.5	410.5

How to Order

Double check block

VQ2000-FPG- [01] [01] [F]

IN side port size

01	Rc 1/8
02	Rc 1/4
C6	One-touch fitting for ø6
C8	One-touch fitting for ø6

OUT side port size

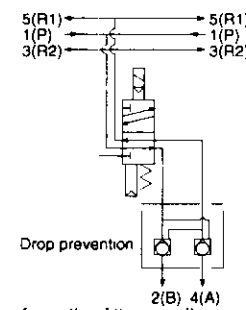
01	Rc 1/8
02	Rc 1/4
C6	One-touch fitting for ø6
C8	One-touch fitting for ø6

Option

Nil	None
D	DIN rail mounting style (For manifold)
F	With bracket
N	Name plate

Note) When two or more symbols are specified, indicate them alphabetically
Example) -DN

<Example>



Manifold

VVQ2000-FPG- [06]

Stations

01	1 station
⋮	
16	16 stations

<Ordering Example>
VVQ2000-FPG-06 ··6 stations manifold
*VQ2000-FPG-C6C6-D 3 sets
*VQ2000-FPG-C8C8-D· 3 sets } Double check block

⚠ Caution

- Air leakage from the pipe between the valve and cylinder or from the fittings will prevent the cylinder from stopping for a long time Check the leakage using neutral household detergent, such as dish washing soap
  Also check the cylinder's tube gasket, piston packing and rod packing for air leakage
- Since One-touch fittings allow slight air leakage, screw piping (with M5 thread) is recommended when stopping the cylinder in the middle for a long time
- When screwing the fittings in the double check block, proper tightening torque is as shown below
- If the exhaust of the double check block is throttled too much, the cylinder may not operate properly and may not stop intermediately
- Set the cylinder load so that the cylinder pressure will be within two times that of the supply pressure

Connection threads	Proper tightening torque (N·m)
Rc 1/8	7 to 9
Rc 1/4	12 to 14

9532044

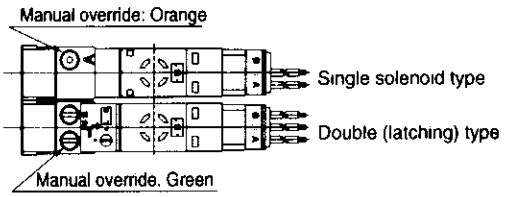
⚠ Precautions

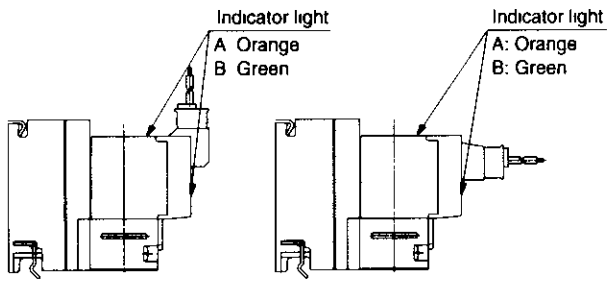
Be sure to read before handling. For Safety Instructions and Solenoid Valve Precautions, refer to page 2-9-2.

Light/Surge Voltage Suppressor

⚠ Caution

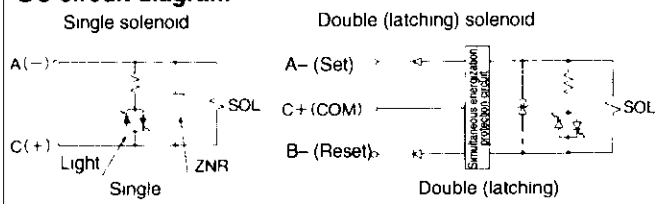
The lighting positions are concentrated on one side for both single solenoid and double (latching) type. In the double (latching) type, A side and B side energization are indicated by two colors which match the colors of the manual overrides.





M plug connector **L plug connector**

DC circuit diagram



Note 1) • A-side energization A light (orange) illuminates.
• B-side energization B light (green) illuminates
• Equipped with a wiring error prevention (stop diode) mechanism and a surge absorption (ZNR/surge absorption diode) machanism

Note 2) Applicable to negative COM specification models.

Note 3) In the case of double (latching), the electromagnetic valve channel is, A–(set) P → A, B → R, B–(reset) P → B, A → R

Double (Latching solenoid) Type

⚠ Caution

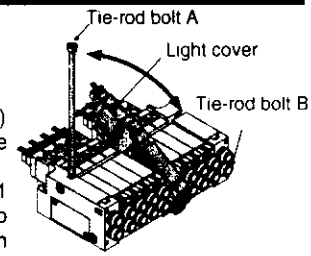
Different from the conventional double solenoid, the double type uses a latching (self-holding system) solenoid. Although the appearance is the same as the single solenoid, it is constructed so that the movable iron core in the solenoid is held in the ON position on A and B sides by instantaneous energization (20 ms or more).
The usage and function is the same as the double solenoid.

<Special Cautions for Latching Solenoid>

1. Select the circuit in which ON and OFF signals are not energized simultaneously.
2. 20 ms energization time is necessary for self-holding.
3. Avoid using the latching solenoid valves in environments where impact or collisions with the valve might occur. Also, do not use in places where strong magnetic fields are present.
4. Even though the armature in the solenoid of this valve is held on to B side, ON position (Reset), verify either A side, ON position or B side, ON position by energizing prior to use.
5. After manual operation, the main valve will return to its original position. Manual override on the pilot valve side can retain its switching position after manipulation.
6. Please contact SMC for long-term energization applications.
7. If the metal seal type goes down below the minimum operating pressure of supply air (0.1 MPa or less), the main valve will get back the home position. (B side ON position) Therefore, in the event of shutting the supply air or applying the air with being A side ON position remained, cylinder may be pulsated. In the event of manipulating the supply air, the valve's switching position has to be set in the home position side (B side ON position side).

How to Mount/Remove Solenoid Valve

⚠ Caution



<Procedure>

How to Remove

1. Loosen tie-rod bolt B (Two to four turns)
2. After fully loosening the tie-rod bolt, take off bolt A upward as shown above
3. Slide the valves aside to make a 1 mm clearance between the valve to be taken off and the others. As shown above, remove the whole valve while holding up the (a) side (Avoid rough handing of the connector)

Mounting

Reverse the sequence of steps above to remount

Tighten the tie-rod bolts with the tightening torque at the right table while using caution not to tighten the only one side unevenly.

Torque Applied to Tie-rod Bolt	
VQ0000	0.5 to 0.7 N·m
VQ1000	1.0 to 1.4 N·m
VQ2000	1.0 to 1.4 N·m

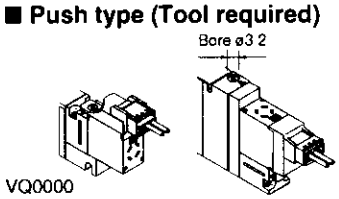
Note) Be careful not to push on the light cover while mounting/removing the valve.

Double (Latching solenoid) Type

⚠ Warning

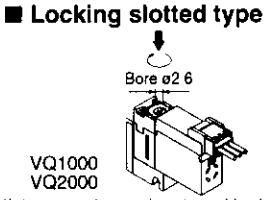
Without an electric signal for the solenoid valve the manual override is used for switching the main valve.

■ Push type (Tool required)

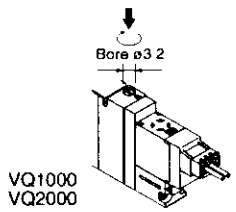


Push down on the manual override button with a small screwdriver until it stops. Release the screwdriver and the manual override will return

■ Locking slotted type

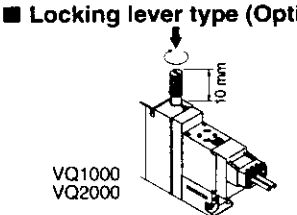


If the manual override is turned by 180° clockwise and the ▶ mark is adjusted to 1, then pushed in the direction of an arrow (↓), it will be locked in the ON state. If the manual override is turned by 180° counterclockwise and ▶ mark is adjusted to 0, locking will be released and the manual override will return.



Push down completely on the manual override button with a small screwdriver. While down, turn clockwise 90° to lock it. Turn it counterclockwise to release it.

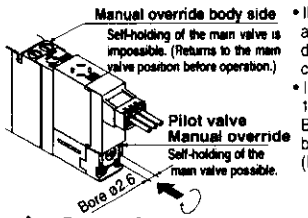
■ Locking lever type (Option)



Push down completely on the manual override button with a small screwdriver. While down, turn clockwise 90° to lock it. Turn it counterclockwise to release it.

■ Manual override for double (latching) type

In the case of a double (latching) type, a manual override is provided not only on the body side but to the pilot as a standard (VQ0000 Pilot valve only). After manual operation, the main valve of the manual on the body side returns to the position before the manual operation, however, the pilot valve manual override maintains the change-over position



- If the manual override is turned by 180° clockwise and the ▶ mark is adjusted to A, then pushed in the direction of an arrow (↓), it will be back to the reset condition (passage P → A)
- If the manual override is turned by 180°counterclockwise and the ▶ mark is adjusted to B, then pushed in the direction of an arrow (↓), it will be back to the reset condition (passage P → B) (It is in the reset state at the time of shipment)

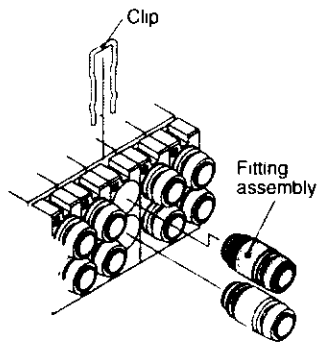
⚠ Caution

Do not apply excessive torque when turning the locking type manual override (0.1 N·m or less)

Replacement of Cylinder Port Fittings

⚠ Caution

The cylinder port fittings are a cassette for easy replacement. (Except VQ1000)
The fittings are blocked by a clip inserted from the top of the valve. Remove the clip with a screwdriver to remove fittings. For replacement, insert the fitting assembly until it strikes against the inside wall and then re-insert the clip to the specified position.



Applicable tubing O.D	Fitting assembly part no.	
	VQ1000	VQ2000
Applicable tubing ø3.2	VVQ1000-50A-C3	—
Applicable tubing ø4	VVQ1000-50A-C4	VVQ1000-51A-C4
Applicable tubing ø6	VVQ1000-50A-C6	VVQ1000-51A-C6
Applicable tubing ø8	—	VVQ1000-51A-C8

Purchasing order is available in units of 10 pieces

Caution

1. Protect O-rings from scratches and dust to prevent air leakage.
2. The tightening torque for inserting fittings to the M5 thread assembly should be 0.8 to 1.4 N·m

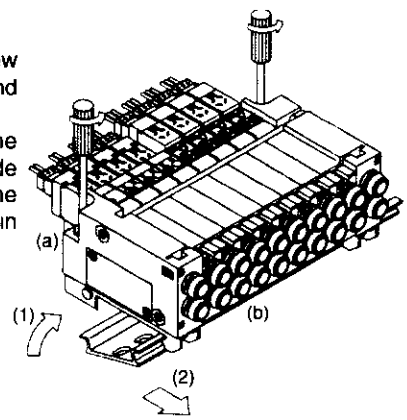
Mounting/Removing from the DIN Rail

⚠ Caution

<Procedure>

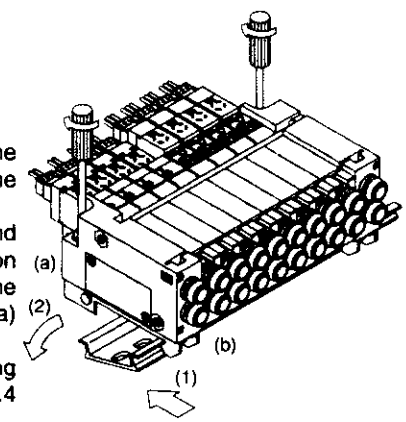
How to Remove

1. Loosen the clamp screw on side (a) of the end plate on both sides.
2. Lift side (a) of the manifold base and slide the end plate in the direction of (2) shown in the figure to remove.



Mounting

1. Hook side (b) of the manifold base on the DIN rail.
2. Press down side (a) and mount the end plate on the DIN rail. Tighten the clamp screw on side (a) of the end plate.
   The proper tightening torque for screws is 0.4 to 0.6 N·m.



How to Calculate the Flow Rate

For obtaining the flow rate, refer to pages 2-1-8 to 2-1-11.

Built-in Silencer Replacement Element

⚠ Caution

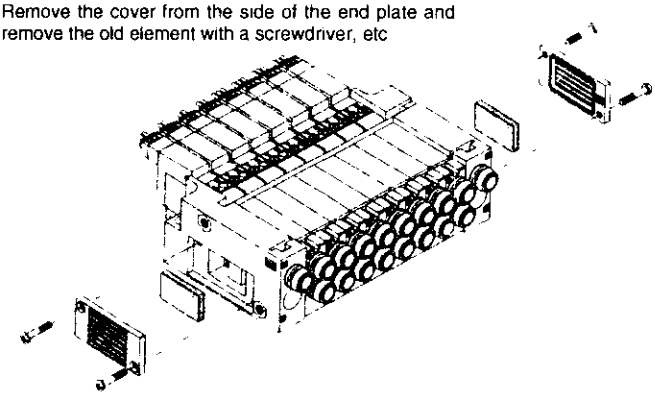
A silencer element is incorporated in the end plate on both sides of the manifold base. A dirty and choked element may reduce cylinder speed or cause malfunction. Clean or replace the dirty element.

Element Part No.

Type	Element part no.		
	VQ0000	VQ1000	VQ2000
Built-in silencer, direct exhaust (-S)	VVQ0000-82A-4	VVQ1000-82A-4	VVQ2000-82A-4

* The minimum order quantity is 10 pcs.

Remove the cover from the side of the end plate and remove the old element with a screwdriver, etc

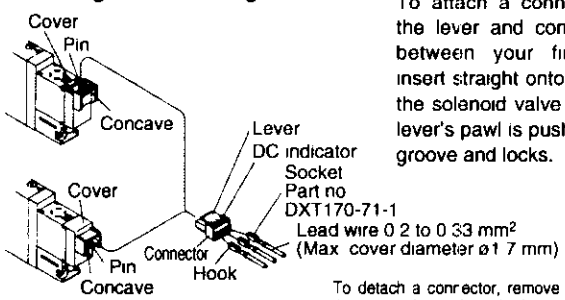


VQC
SQ
VQ0
VQ4
VQ5
VQZ
VQD

How to Use Plug Connector

⚠ Caution

Attaching and detaching connectors

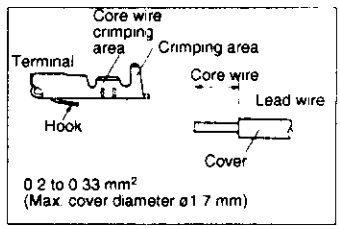


To attach a connector, hold the lever and connector unit between your fingers and insert straight onto the pins of the solenoid valve so that the lever's pawl is pushed into the groove and locks.

To detach a connector, remove the pawl from the groove by pushing the lever downward with your thumb, and pull the connector straight out

Crimping the lead wire and socket

Peel 3.2 to 3.7 mm of the tip of lead wire, enter the core wires and press contact it by a press tool. Be careful so that the cover of lead wire does not enter into the core press contacting part.



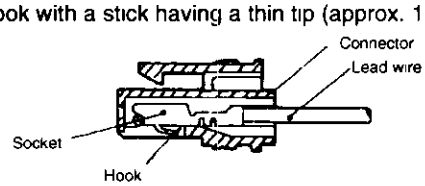
Attaching and detaching lead wires with sockets

Attaching

Insert a socket in the square hole (Indicated as +, −) of connector, push in the lead wire and lock by hanging the hook of socket to the seat of connector. (Pushing-in can open the hook and lock it automatically.) Then confirm the lock by lightly pulling on the lead wire.

Detaching

To detach a socket from a connector, pull out the lead wire while pressing the socket's hook with a stick having a thin tip (approx. 1 mm). If the socket will be used again, first spread the hook outward.



9532046

Special Wiring Specifications

In the internal wiring of F kit, P kit, T kit and S kit, double wiring (connected to SOL. A and SOL. B) is adopted for each station regardless of the valve and option types.
Mixed single and double wiring is available as an option.

1. How to order valves

Indicate an option symbol, -K, for the manifold no. and be sure to specify the mounting position and number of stations of the single and double wiring by means of the manifold specification sheet.

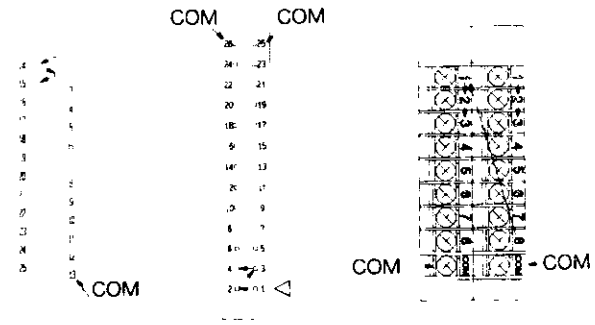
Example)

VV5Q14-09FS0-D K S

Others, option symbols: to be indicated alphabetically.

2. Wiring specifications

Connector terminal numbers are connected from solenoid station 1 on the A side in the order indicated by the arrows without skipping any terminal numbers.



F kit
D-sub connector (25P)

P kit
Flat ribbon cable connector (26P)

T kit
Terminal block (16 terminals)

3. Max. number of stations

The maximum number of stations depends upon the number of solenoids. Assuming one for a single and two for a double, determine the number of stations so that the total number is not more than the maximum number given in the following table.

kit	F kit (D-sub connector)		P kit (Flat ribbon cable connector)				T kit (Terminal block)		S kit (Serial)
Type	F⅀□ 25P	F⅀A 15P	P⅀□ 26P	P⅀C 20P	P⅀B 16P	P⅀A 10P	T1	T2	S□
Max. points	Note) 16	14	Note) 16	Note) 16	14	8	8	16	16

Note) Due to the limitation of internal wiring.

Negative Common Specifications

Specify the valve model no. as shown below for negative COM specification. The standard manifold no. can be used Please contact SMC for negative COM S kit.

How to order negative COM valves

VQ1140 N−5LO−C6

Negative common specifications

Inch-size One-touch Fittings

Refer to following model no. for inch-size One-touch fittings.

How to order manifold

VV5Q14−08FSO−DN−00T

P, R port size

VQ0000	ø1/4"
VQ1000	ø1/4"
VQ2000	ø5/16"

How to order valves

VQ1140−5M−N7

Cylinder port

Symbol		N1	N3	N7	N9
Applicable tubing O.D. (Inch)		ø1/8"	ø5/32"	ø1/4"	ø5/16"
A, B port	VQ0000	○	○	—	—
	VQ1000	—	○	○	—
	VQ2000	—	○	○	○

Plug Connector Assembly Model

Connector assembly will be required when the F, P, T, S kits add a valve.
Specify the type of valve and connector assembly.

Connector Assembly Part No.

Specifications		Part no.
Single (2-wire)	Positive common	AXT661-14A-F
	Negative common	AXT661-14AN-F
Double (latching) (3-wire)	Positive common	AXT661-13A-F
	Negative common	AXT661-13AN-F

Note) Lead wire length 300 mm
Note) The parts numbers above are applicable to VQ0000/1000 (2 to 16 stations) and VQ2000 (2 to 10 stations) VQ2000 (11 to 16 stations) uses AXT661-$\frac{13}{14}$A(N) -F425

Option

DIN Rail Mounting

Each manifold can be mounted on a DIN rail.
Order it by indicating an option symbol for DIN rail mounting style, -D. In this case, a DIN rail which is approx. 30 mm longer than the manifold with the specified number of stations is attached. Besides, it is also available in the following cases.

● **When DIN rail is unnecessary (C kit only.)**
(DIN rail mounting brackets only are attached.)
Indicate the option symbol, -DO, for the manifold no

Example)

VV5Q14-08C-DOS

Others, option symbols: to be indicated alphabetically.

● **When using DIN rail longer than the manifold with specified number of stations**
Clearly indicate the necessary number of stations next to the option symbol, -D, for the manifold no.

Example)

VV5Q14-08FS1-D09S

DIN rail for 9 stations

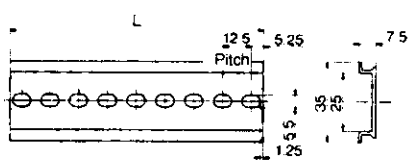
Others, option symbols: to be indicated alphabetically.

● **When changing the manifold style into a DIN rail mount**
Order brackets for mounting a DIN rail. (Refer to "Option" on pages 2-4-60, 61 and 64.)

No. VQ0000-57A4 (For VQ0000)
VQ1000-57A-4 (For VQ1000)
VQ2000-57A-4 (For VQ2000)
2 pcs. per one set

● **When ordering DIN rail only**
DIN rail no.: AXT100-DR-n

* Refer to the DIN rail dimension table for determining the length.



L Dimension

L = 12.5 x n + 10.5

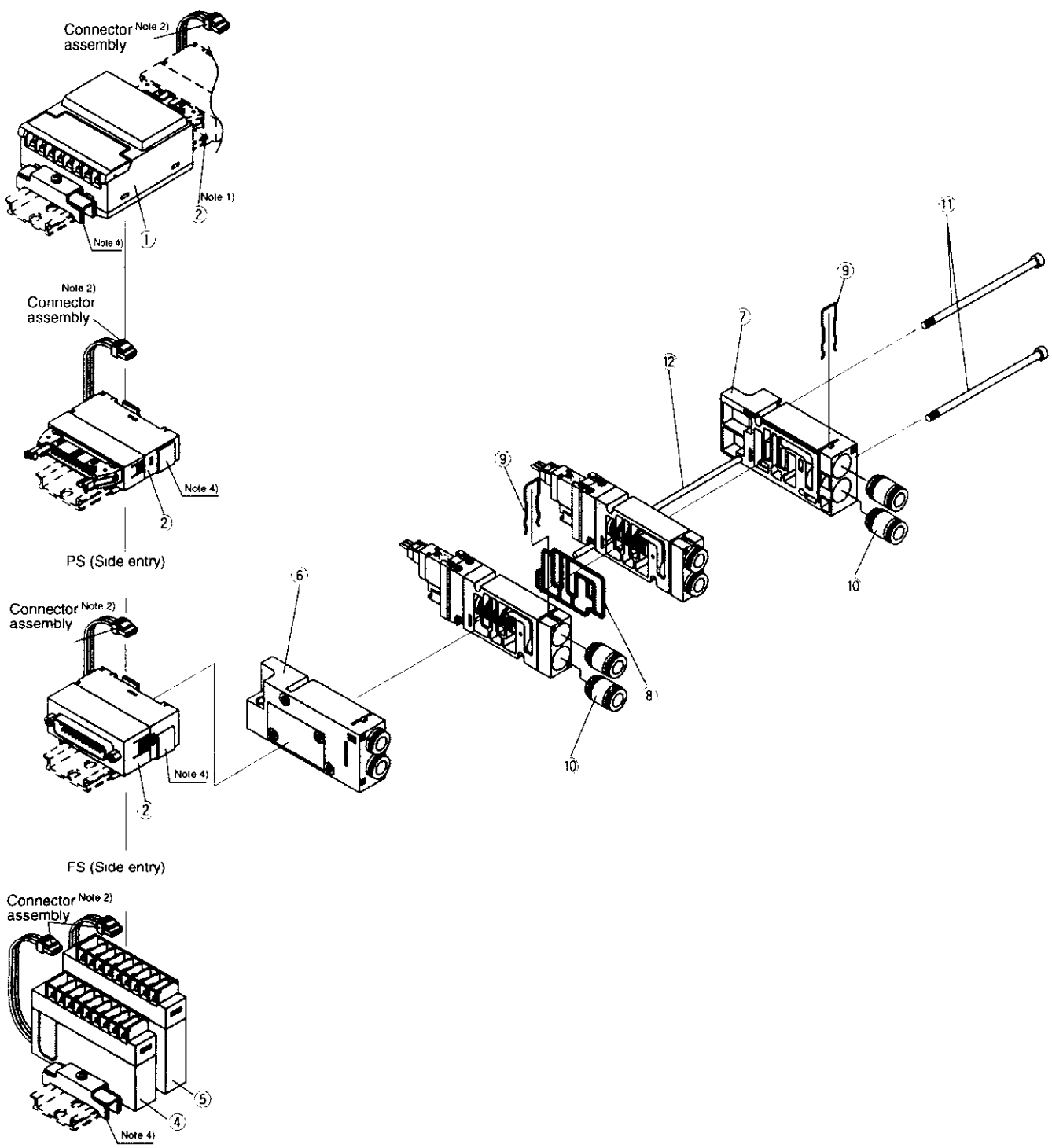
No.	1	2	3	4	5	6	7	8	9	10
L dimension	23	35.5	48	60.5	73	85.5	98	110.5	123	135.5
No.	11	12	13	14	15	16	17	18	19	20
L dimension	148	160.5	173	185.5	198	210.5	223	235.5	248	260.5
No.	21	22	23	24	25	26	27	28	29	30
L dimension	273	285.5	298	310.5	323	335.5	348	360.5	373	385.5
No.	31	32	33	34	35	36	37	38	39	40
L dimension	398	410.5	423	435.5	448	460.5	473	485.5	498	510.5

VQ2000 (VV5Q24)/Plug Lead Unit, Flip Type

(F, P, T, S kit)

* For how to increase the stations, refer to the instruction manual

	Housing assembly and SI unit (3)	U side end plate assembly	Valve	D side end plate assembly	Station increase parts



Note 1) S kit is composed of a flat ribbon cable housing assembly (AXT100-2-PU20) of ① SI unit and ② P kit (20 pins)
Note 2) Since no connector assembly is included, order it separately (Refer to page 2-4-69)
Note 3) A housing assembly is not used for a C kit.
Note 4) A DIN rail clamping bracket is attached to each

<Housing Assembly and SI Unit>

Housing assembly and SI unit no.

No.	Manifold	Part no.	Description
①[1]	(SA kit)	EX330-S001	General type SI unit (Series EX300)
	(SB kit)	EX130-SMB1	SI unit for MELSECNET/MINI-S3 Data Link System (Mitsubishi Electric Corporation)
	(SC kit)	EX130-STA1	SI unit for SYSBUS Wire System (OMRON Corporation)
	(SD kit)	EX130-SSH1	SI unit for Satellite I/O Link System (SHARP Corporation)
	SF1 kit	EX130-SUW1	SI unit for 16 point Uni-wire System (NKE Corporation)
	SH kit	EX130-SUH1	SI unit for 16 point Uni-wire H System (NKE Corporation)
②	P^{U}_{S} kit	AXT100-2-P^{U}_{S}□[2]	Flat ribbon cable housing assembly □ = Number of pins. 26, 20, 16, 10
③	F^{U}_{S} kit	AXT100-2-F^{U}_{S}□[2]	D-sub connector housing assembly □ = Number of pins: 25, 15
④[3]	T kit	AXT100-2-TB1	Terminal block assembly (8 terminals)
⑤[3]	T kit	AXT100-2-TB2	Terminal block assembly (8 terminals)

Note 1) S kit is composed of a flat ribbon cable housing assembly (AXT100-2-PS20) of ① SI unit and ② P kit (20 pins). Place an order for AXT100-2-PS20 separately.
Note 2) Top/vertical entry connector for FU and PU while side (horizontal) entry connector for FS and PS
Note 3) Since no connector assembly is included, order it separately. (Refer to page 2-4-93)
Note 4) In the case of standard specifications and double wiring, ④ is for 1 to 4 stations and ⑤ is for 5 to 8 stations

<D Side End Plate Assembly>

⑥ D side end plate assembly no.

VVQ2000-3A-4-□

Option
Nil: Common exhaust
S: Built-in silencer, direct exhaust
(Applicable for C kit only)

Note) The ⑩'s fitting assembly is included

<U Side End Plate Assembly No.>

⑦ U side end plate assembly no.

VVQ2000-2A-4-□

Option
Nil: Common exhaust
S: Built-in silencer, direct exhaust

Note) The ⑩'s fitting assembly is included

<Replacement Parts>

No.	Part no.	Description	Material	Number
⑧	VVQ2000-80A-3-2	Seal	HNBR	12
⑨	VVQ2000-80A-3-4	Clip	Stainless steel	12

Note) A set of parts containing 12 pcs. each is enclosed

<Fittings Assembly>

⑩ Fittings assembly part no.

VVQ1000-51A-□

Port size
C4: Applicable tubing ø4
C6: Applicable tubing ø6
C8: Applicable tubing ø8[1]

Note 1) Standard SUP/EXH port is C8.
Note 2) Purchasing order is available in units of 10 pieces

<Station Increase Parts>

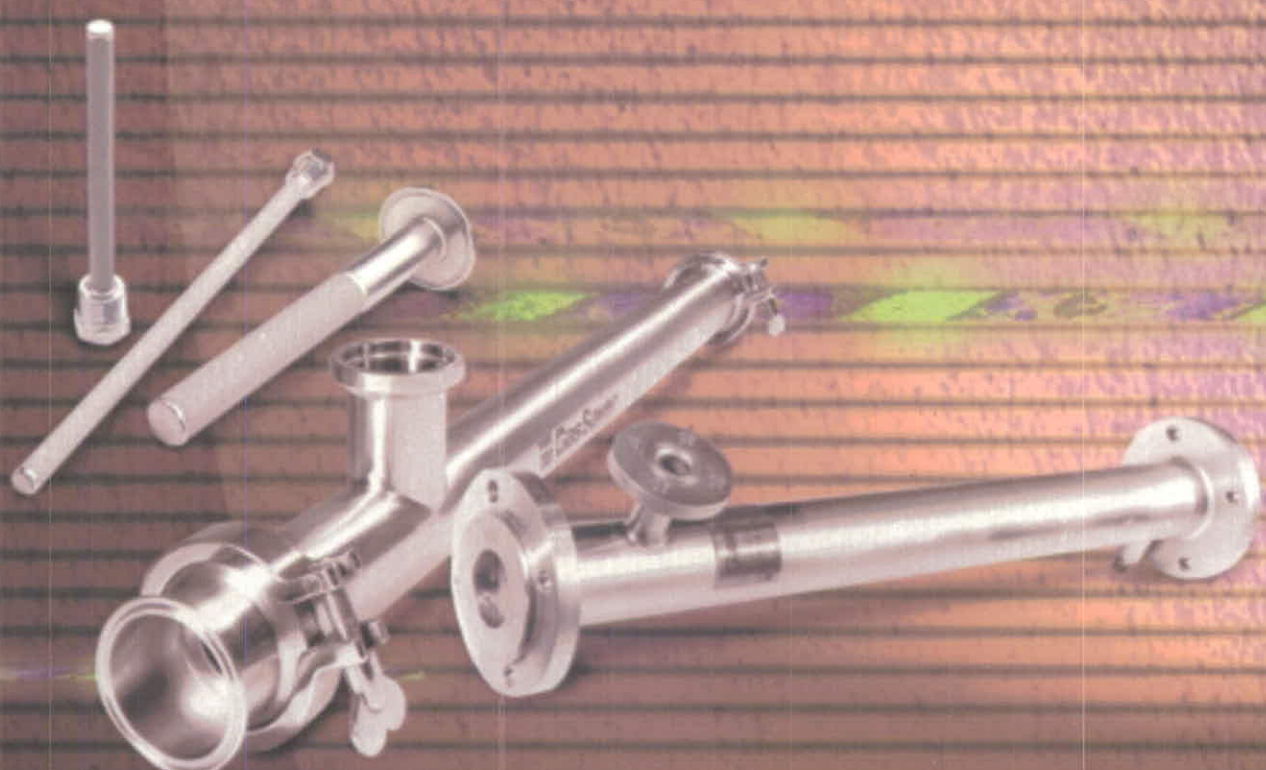
No.[3]	Part no.	Description	Material	Number[1]
⑪	VVQ2000-105A-4-□[2]	Tie-rod bolt	Carbon steel	2
⑫		Guide rod	Stainless steel	1

Note 1) Each number of replacement parts are included in one set.
Note 2) □ Number of stations (01 to 16)
Note 3) ⑪ and ⑫ are in one set

9532050

mott corporation
Porous Metal Products

High-efficiency gas/liquid contacting.



9532051

The best media for gas/liquid contacting.

Mott porous metal. There's no better media for producing miniature, slow-moving bubbles – the best method of achieving high-efficiency gas/liquid contacting. For decades, Mott porous metal spargers have been the fast, reliable, cost-effective choice for gas/liquid contacting in all sorts of industries. Here are a few reasons why:

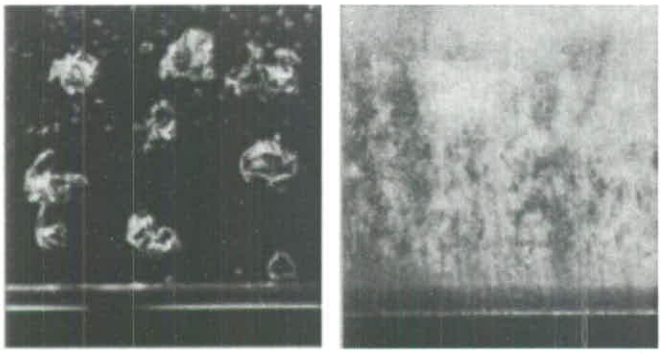
Small bubbles transfer gases faster, more efficiently.

Mott spargers introduce gases into liquids through thousands of tiny pores, creating bubbles far smaller and more numerous than with drilled pipe and other sparging methods. The result is greater gas/liquid contact area, which reduces the time and volume required to dissolve gas into liquid.

With thousands of pores over the surface, large volumes of gas can be passed with very high specific area. For example, with equal volumes of gas, 1mm bubbles would have 6.35 times more gas/liquid contact surface area than 6.35mm (1/4") bubbles.

All-metal construction lasts for years.

Mott spargers are constructed entirely of metal, to provide long-lasting operation even in the midst of temperatures as high as 1450°F under oxidizing conditions. And for inert and corrosive media, Mott offers a wide range of materials including 316L stainless steel (standard), Nickel 200, Monel® 400, Inconel® 600, Hastelloy® C-22/C-276/X and Alloy 20.



Conventional drilled pipe spargers (left) produce poorly dispersed, large, fast-rising bubbles with very low surface area.

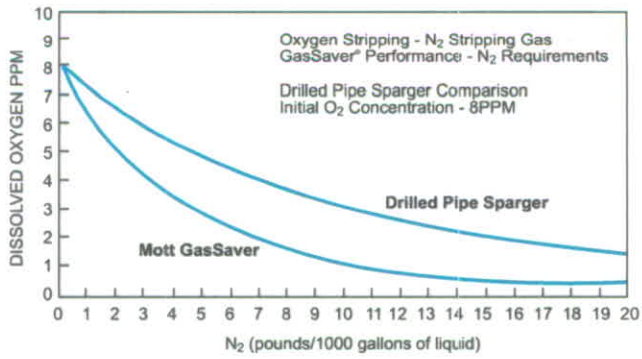
Mott porous metal spargers (right) create millions of small, slowly rising bubbles, with significantly more surface area, resulting in more complete and rapid mass transfer.

Simple, cost-effective, easy-to-install.

Mott spargers typically consist of a porous metal element, a threaded fitting and, in longer units, a reinforcement rod. The design is simple, without moving parts. Installation is easy, and requires no special tools. From single elements to manifolded systems, Mott spargers are among the simplest, most affordable and most efficient gas/liquid contacting solutions available anywhere.

All sizes and configurations.

Mott spargers are designed, manufactured and finished at Mott. So if you need a non-standard size, or a special fitting, Mott has the capability to accommodate your request.



Oxygen stripping, using nitrogen. Actual performance data shows the superiority of Mott porous metal spargers, compared to drilled pipe spargers. Much higher performance levels with significantly lower gas consumption.

Hastelloy is a registered trademark of Haynes International, Inc.
Inconel and Monel are registered trademarks of International Nickel Co., Inc.

9532052

Static spargers.

Tank spargers.

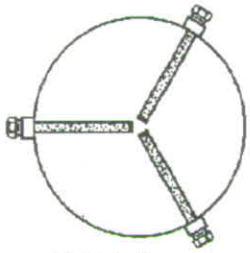
In-tank sparging applications can be for batch or continuous operation, with or without agitation within the vessel. Mott sparging technology provides performance-proven designs to assure optimum process operation.

Mott spargers are arranged in the bottoms of tanks and vessels in a variety of ways. For smaller tanks, one sparger will often suffice. For larger tanks, several Mott spargers may be manifolded together using a linear or radial pattern to achieve optimal gas diffusion.

Mott offers a wide variety of standard tank sparger elements and manifolded assemblies to accommodate most applications. Custom designs are also available by request.

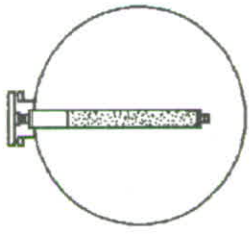
Typical tank sparger arrangements

Single Element
Type 6400 Element
Side Mounted



Multiple Elements
Type 6400 Elements
Side Mounted

Single Element
Type CD Element
Dip Leg Mounted



Single Element
Type CD Element
Flanged Side Mounted

Manifolded (Cross)
Type A Elements
Dip Leg Mounted

Cross Tank
Type A Elements
Flanged Side Mounted

Sparger elements.

Type A
Hex Nipple
From 0.375" up to 2.5" diameter

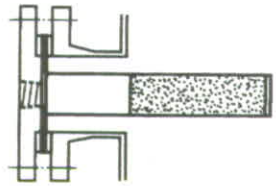
Type CD
Reinforced 1.5", 2" and 2.5" diameter

Type G
Plain Tube
From 0.375" up to 2.5" diameter

Type 6400
Reducer Mounted
From 0.375" up to 1" diameter

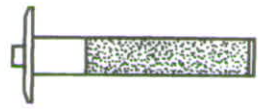
Type 850
Reducer Mounted
Impingement Tube
From 0.375" up to 1" diameter

Type R
Trapped Flange Mounted
From 0.375" up to 2.5" diameter



Type RF
Full Flange Mounted
From 0.375" up to 2.5" diameter

Type RS
Sanitary Flange Mounted
From 0.375" up to 2.5" diameter



Elements larger than 2.5" diameter are available on special order.

Support Studs or Centering Rods on the closed end of elements available if required.

Reinforced elements are recommended for agitated vessels.

Standard materials are 316L stainless steel porous media with 316 stainless steel hardware. Other materials are available on special order.

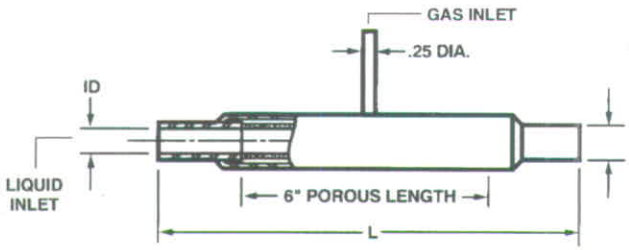
9532053

Dynamic pipeline spargers.

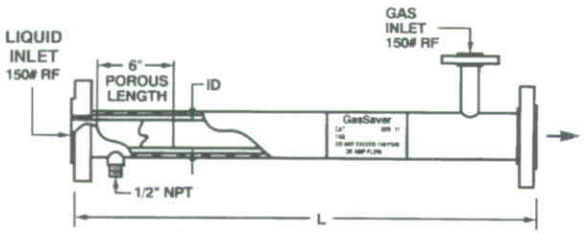
Non-intrusive (in-line) sparging.

Mott GasSavers® are unique, high-efficiency gas/liquid contacting devices for in-line mounting in process systems. As liquid moves through the inside of a porous metal tube, gas is introduced into the annulus – the area between the porous tube wall and the outer GasSaver housing. The gas moves through the porous metal into the liquid, creating bubbles which are quickly sheared. This action results in very fine bubbles, ideal for gas introduction as well as absorption.

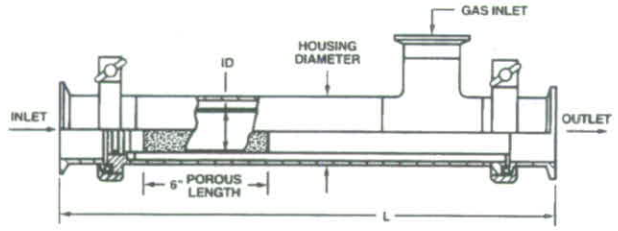
Mott Laboratory GasSavers
All Welded Construction



Mott Industrial GasSavers



Mott Sanitary GasSavers



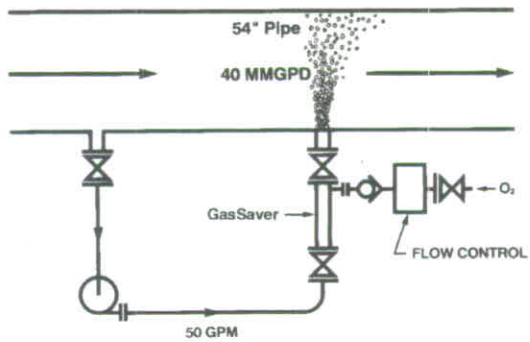
All Welded GasSaver®

Industrial GasSaver®

Sanitary GasSaver®

Side stream sparging.

In large installations where access to the main pipeline is difficult, a "side stream" GasSaver installation often proves to be the best configuration for optimum process performance. Units can be valved to allow maintenance without interfering with the main pipeline.



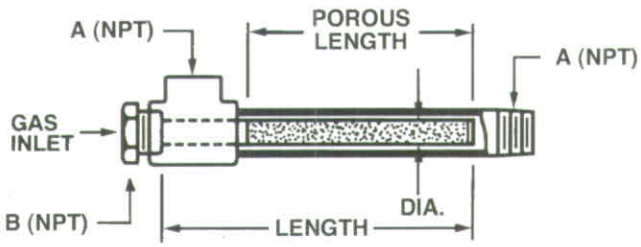
9532054

Intrusive (tangential) sparging.

A sparging element located in a pipeline constitutes an intrusive sparger. The element can be mounted in an elbow or tee in the pipeline. Liquid passes through the annulus between the pipeline and the element. Gas exits from the outside of the element where bubbles are sheared by the liquid, resulting in fine bubbles for superior performance.

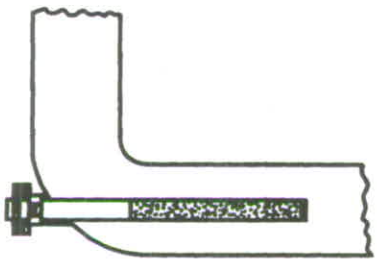
Intrusive Pipeline Spargers

Series 8501

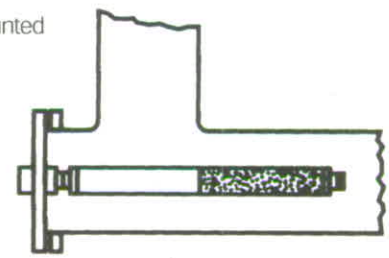


Pipe Mounted Intrusive Sparger Elements

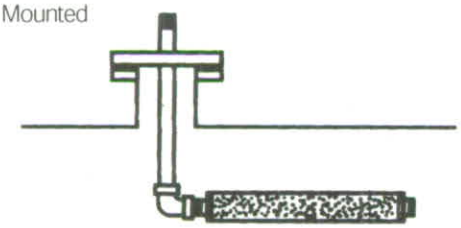
Elbow Mounted



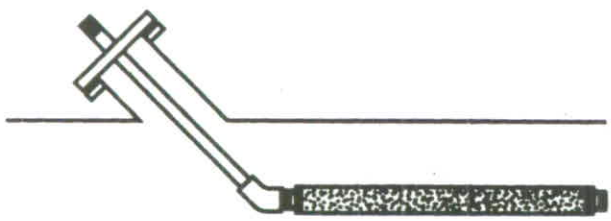
Tee Mounted



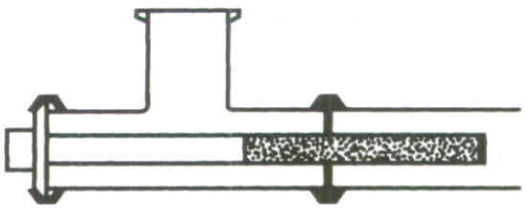
Side Mounted



Side Angle Mounted



Sanitary Tee Mounted



9532055

Typical applications.

Aeration – Air sparging to meet BOD (Biological Oxygen Demand) on waste stream.

Agitation – Air injection for mixing liquids in a vessel.

Bioremediation – Air sparging to stimulate growth of bacteria for hazardous waste treatment.

Carbonation – CO_2 sparging for carbonated beverages and beer.

Chlorine bleaching – Chlorine sparging for bleaching pulp in manufacture of paper.

Column flotation – Air sparging for coal flotation, and other separations of solids.

Dewatering – Nitrogen sparging to remove entrained water from motor oil.

Fermentation – Oxygen or air sparging to enhance cell growth in fermentation reactions.

Gas/liquid reactions – Sparging air, oxygen, or other gases into reactors for improved performance.

Hydrogenation – Hydrogen sparging for a broad spectrum of chemical hydrogenation reactions.

Oil flotation – Air or natural gas sparging for oil removal from produced water from oil wells.

Oxygen bleaching – Oxygen sparging for bleaching pulp in manufacture of paper.

Oxygen stripping – Nitrogen sparging to remove oxygen from edible oils, wine, and juices.

Oxygenation – Oxygen sparging in fish farming for significant stimulation of fish growth.

Ozonation – Ozone sparging to sanitize ultrapure water systems in pharmaceutical plants.

pH control – CO_2 or NH_3 sparging to adjust pH in waste or process streams.

Steam injection – Direct steam injection for efficient heating, and to eliminate "steam hammer."

Volatiles stripping – Air sparging for removal of VOC (Volatile Organic Compounds) from waste streams.

Call for a recommendation and a quote.

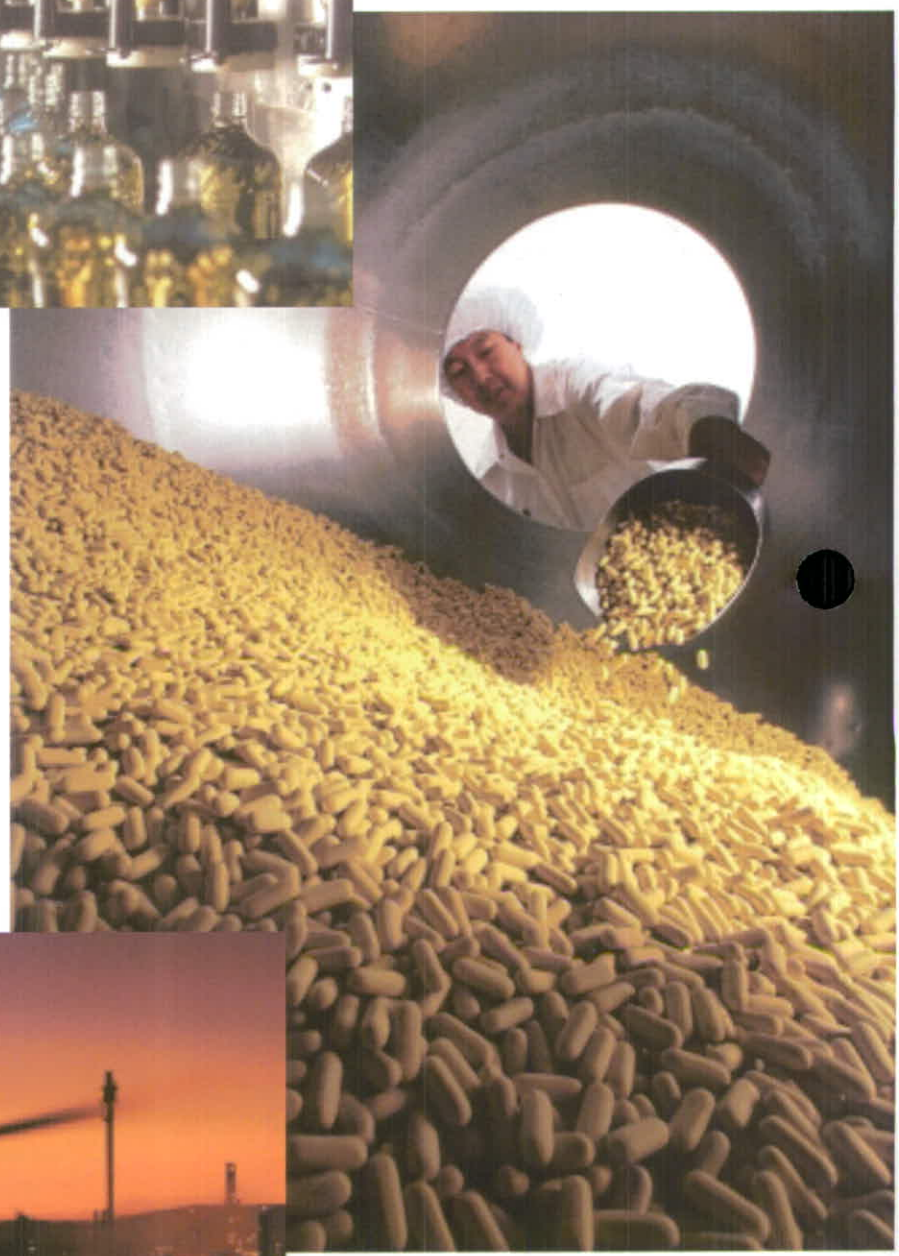
Let Mott identify the right sparger for you, so you can compare performance and cost to what you're using now. Just tell us the answers to these basic questions:

1. Application
2. Type of containment (tank or pipeline)
3. Gas information
   a. Type
   b. Flow rate (ft^3/min for all gases; lbs/hr for steam)
4. Liquid information
   a. Type
   b. Temperature

9532056

Industries served by Mott sparger products.

- Food and beverage
- Pharmaceutical
- Chemical
- Industrial
- Pulp and paper
- Petrochemical
- Power
- Waste treatment



9532057

www.mottcorp.com

Established in 1959, Mott Corporation coordinates engineering, sales, service and manufacturing from two adjacent facilities totalling 90,000 square feet. Mott's skilled workforce, along with strategically located overseas affiliates, services thousands of customers all over the world, in virtually every major segment of industry.

Need a product? Need advice?

Call us either way. Whether you need a stock solution, a customized design, or simply guidance, we welcome your call. Contact the experts at Mott Corporation today.

mott *corporation*

84 Spring Lane, Farmington, CT 06032-3159
860-747-6333 Fax 860-747-6739

ISO 9001 CERTIFIED

PMSPARG Rev 0 0201 5M

KAESER
OMEGA BLOWERS

Built for a lifetime.™

9532058

Com-paK Plus™ Rotary Blower Packages

BB-C, DB-C, EB-C, FB-C, HB-C SERIES

Flow Capacities to 3125 cfm
Pressures up to 15 psig
Vacuum down to 15 in. Hg

9532059

What do you expect from a rotary blower?

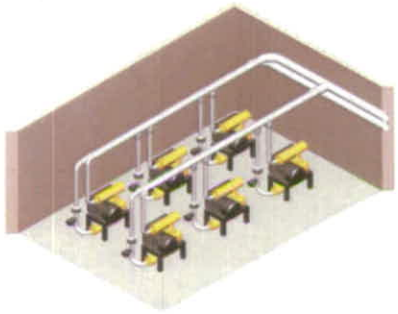
The Com-paK Plus™ design means the lowest possible operating costs, minimum power consumption and simple maintenance. The unique design minimizes space requirements and installation labor.

Low noise emissions means safer work environments and reduces or eliminates requirements for additional sound-proofing.

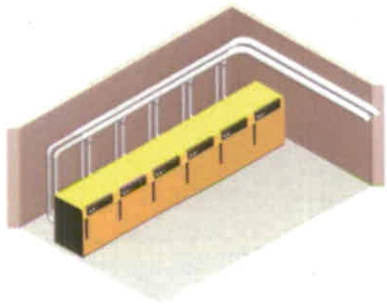
Compact blower package with modest footprint

The Com-paK Plus is designed with a unique component layout to minimize floor space.

All routine maintenance points are accessible from the front while all service and utility connections are located on the back. This enables multiple packages to be installed adjacent to each other.



Traditional layout



Com-paK Plus™ layout

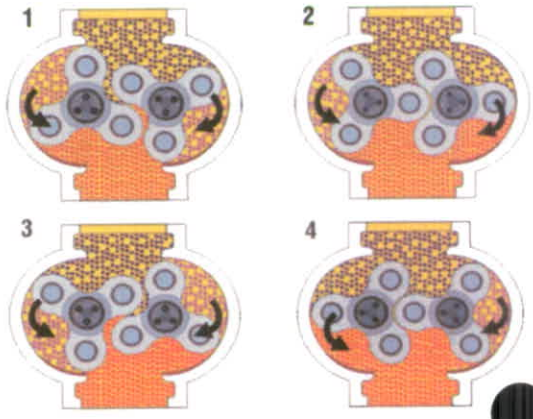
Kaesers' tri-lobe blower with exclusive equalization channel — smooth running, durable and quiet

Function

Air is drawn in and filtered through the inlet filter-silencer 1. The air enters the Omega blower 2 where it is trapped between the lobes of the rotors and the casing and transported to the discharge port. The tri-lobe design minimizes pulsations and the casing has proprietary porting for pressure equalization. The auto tensioner 3 maintains proper belt tension on the v-belts 4 to help prolong electric motor 5 life. The discharge silencer absorbs any residual pulsations over a wide frequency band. An optional unloaded start valve 6 allows the motor to accelerate before the system is pressurized and reduces shock to downstream equipment and processes. A pressure relief valve 7 protects the blower from over-pressurization.

Operating principles

The inlet air is trapped between rotor and casing and delivered to the discharge side. The two rotors intermesh, but do not touch, and therefore need no lubrication. The heat generated by compression dissipates with the flow medium. The proprietary casing channel equalizes the internal pressure to reduce pulsations and minimize noise.



9532060

Com-Pak Plus™ Features

(shown without standard enclosure)

1 Inlet silencer with integral filter

Washable and reusable polyester filter protects the blower from damaging particulates. Filter media has low flow resistance to minimize pressure drop.

2 Omega Plus tri-lobe blower

Tri-lobe design offers efficient operation with low noise and reduced pulsation.

3 Automatic belt tensioning

Visual indication and easy maintenance. Maintains tension and efficiency with infrequent adjustments. Prevents over-tensioning which prolongs belt, pulley, and bearing life.

4 V-belt drive

Allows for versatile performance. Belt guard protects user from physical harm.

5 High efficiency motor

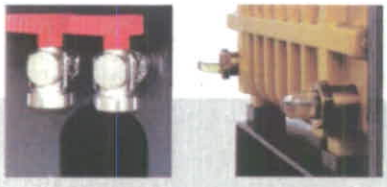
TEFC, inverter-ready, EPAct compliant motor.

6 7 Pre-mounted valves

Check valve, relief valve, and optional unloaded start valve are pre-mounted saving on installation costs.

Effective cooling

Enclosures are power ventilated to ensure sufficient cooling air to the blower and motor.



Simple maintenance

High visibility oil sight glasses allow the oil levels to be checked from the front of the package while drain valves with gasketed caps simplify oil changes.

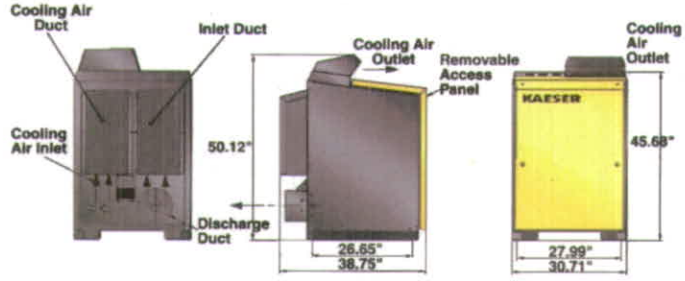
Instrumentation

Standard instrumentation includes pressure or vacuum gauges, discharge temperature gauge with shut-down switch and inlet filter differential pressure gauge.

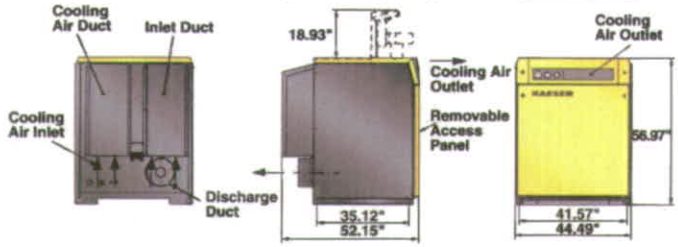
Dimensions and Specifications

9532061

Series BB-C

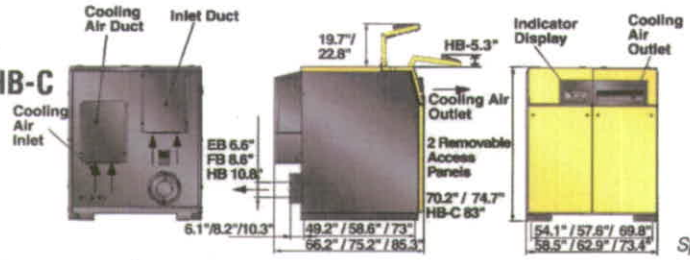


Series DB-C



Series EB-C/FB-C/HB-C

(Excluding FB 790C)



Specifications are subject to change without notice.

Com-paK Plus Model	Omega Plus Blower Model	Maximum Ratings Flow (icfm)	Pressure (psig)	Speed (rpm)	Motor (hp)	Connection Size (in.)	Maximum Estimated Weight (lbs.)
BB 53C	Omega 21P	152	15	6200	15	2	593
BB 68C	Omega 22P	194		6000	20	2½	637
BB 88C	Omega 23P	265		5800	20	2½	653
DB 130C	Omega 41P	410		5000	40	3	1115
DB 165C	Omega 42P	526		4800	50	4	1390
DB 235C	Omega 43P	752		4500	50	4	1450
EB 290C	Omega 52P	946		4400	75	6	2800
EB 420C	Omega 53P	1358		4200	100	6	3200
FB 440C	Omega 62P	1374		3700	125	8	3740
FB 620C	Omega 63P	1955		3500	150	8	4140
FB 790C	Omega 64P	2585	12	3400	150	10	5000
HB 950C	Omega 82P	3125	15	2960	250	10	7720

KAESER COMPRESSORS

Built for a lifetime.™

Corporate Headquarters:
P.O. Box 946
Fredericksburg, Virginia 22404
Phone 540-898-5500
Fax 540-898-5520
www.kaeser.com

Member of CAGI Compressed Air and Gas Institute www.cagi.org

The Air Systems Specialist

With over 85 years of experience, Kaeser is the air systems specialist. Our extensive 100,000 square foot facility allows us to provide unequaled product availability. With service centers nationwide and our 24-hour emergency parts guarantee, Kaeser customers can rely on the best after-sales support in the industry. Kaeser stands committed to providing the highest air system for your specific compressed air needs.

© 2005 Kaeser Compressors, Inc. All rights reserved. 05/05
USCOMPAK

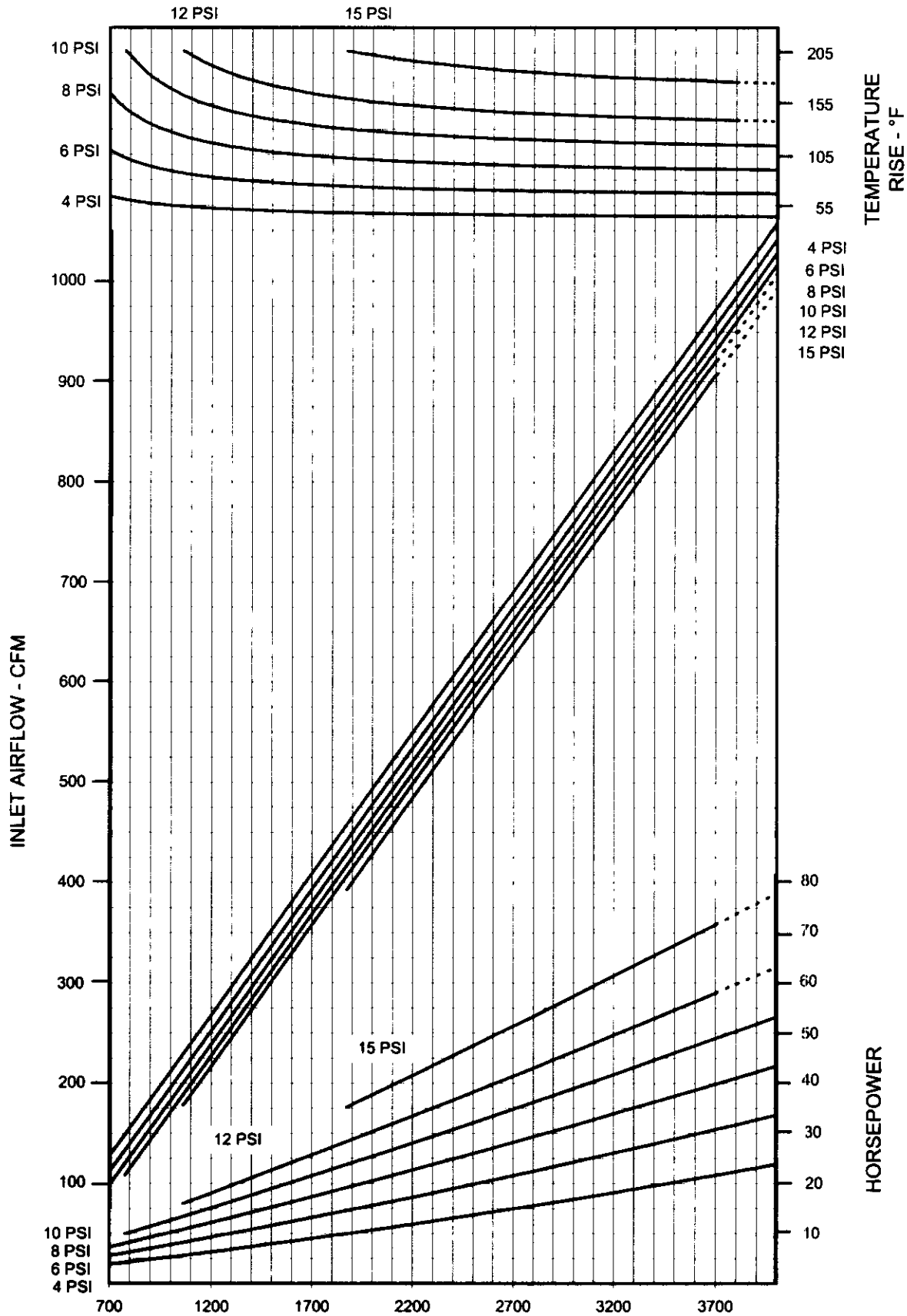
KAESER COMPRESSORS

OMEGA 52

9532062

Date: 06-02-98
Page: 1 of 1

PRESSURE PERFORMANCE
14,7 PSIA and 68° F



over 10 PSI factory approval required
if near to max. speed and belt drive

TD.BDS-002.10
Version: 2.0

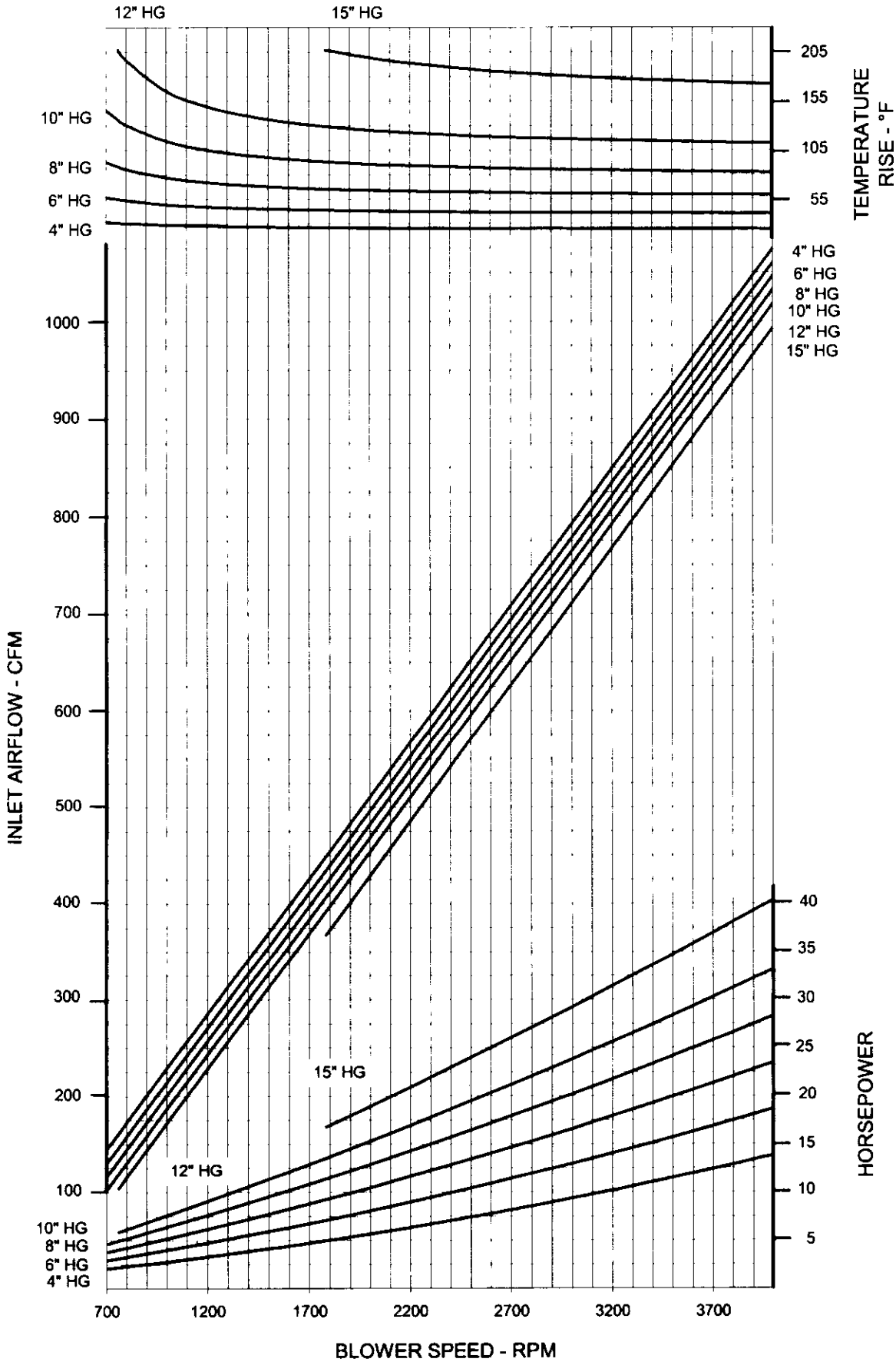
KAESER COMPRESSORS

OMEGA 52

9532063

Date: 06-02-98
Page: 1 of 1

VACUUM PERFORMANCE
14,7 PSIA and 68° F



TD.BDS-005.10
Version: 2.0

KAESER COMPRESSORS

Built for a lifetime.™

9532061

Screw Compressors

CSD Series

Capacities from: 188 to 592 cfm
Pressures from: 80 to 217 psig

9532065

Equipment

Compressor

Single stage, flooded rotary screw airend with the power-saving, proprietary Sigma Profile delivers pressures up to 217 psig.

Electric Motor

TEFC, high efficiency, 460 or 575 V, 3-phase, 60 Hz, 3600 rpm, class F insulation, and EPAct compliant. Other voltages are available.

Starter

Magnetic Wye-Delta reduced voltage starter ensures low starting current and smooth acceleration.

Drive

Direct drive with maintenance-free coupling provides maximum transmission efficiency.

Sigma Control System

Sigma Control is a modern, compact, PC-based control system with Intel™ processor and real-time operating system. Sigma Control monitors all critical compressor and control system functions and compressor maintenance items. History memory offers easy troubleshooting and record keeping. Integrated database offers plain text display in up to 30 languages. Sigma Control has three communication ports built-in (RS 232, RS 485, Profibus) with open architecture for integration into master control systems.

Cooling System

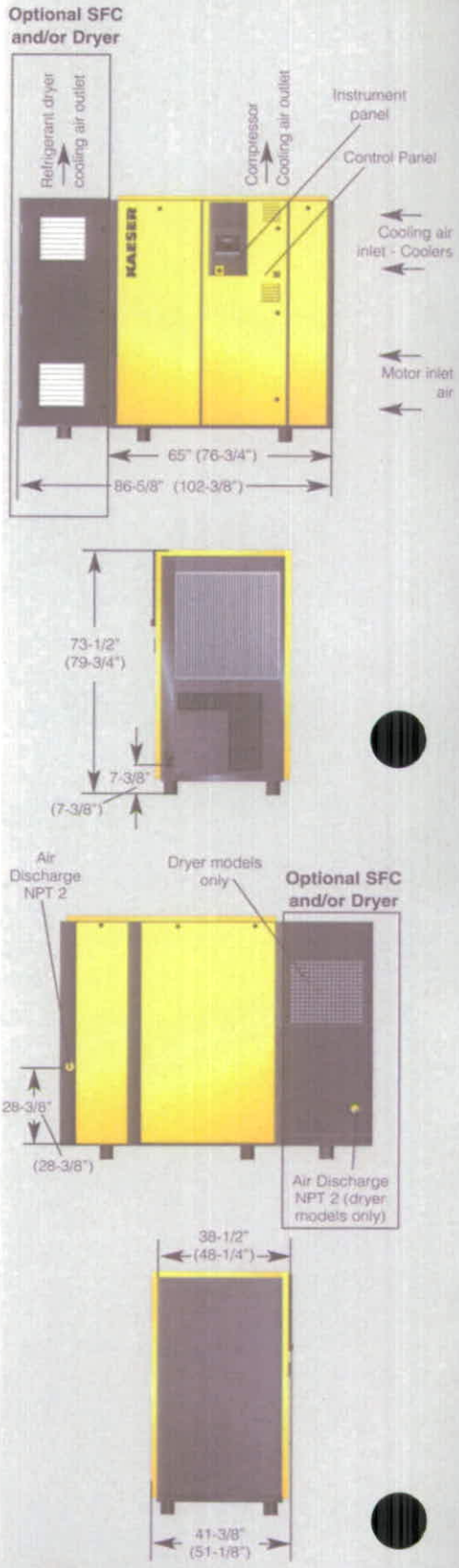
- Three separate cooling air inlet zones for the aftercooler, compressor, and drive motor ensure optimum cooling. Drawing ambient air across the coolers and motor through separate zones avoids preheating and results in lower approach temperatures, longer lubricant life, and cooler motor temperatures.
- Radial cooling fan reduces package noise and produces greater static pressure across the coolers.
- High-efficiency coolers are included.
- Combination valve incorporates a thermostatically controlled valve, cooler by-pass, and micro fluid filter. The thermostatically controlled valve ensures perfect fluid temperature regulation. The micro fluid filter utilizes a spin-on cartridge.
- All units are filled with Kaeser Premium Fluid to cool, clean, and lubricate airend.
- Combined reservoir and separator tank with 3-stage separation system ensures minimal fluid carry over of 2 ppm or less (by weight). Quick change devices on the separator and cooler allow complete, fast, and easy fluid changes.
- ASME or CRN separator tank is equipped with quick disconnect fittings for manual verification of separator element contamination.
- Main air lines are made of rigid pipe and incorporate flexible pipe connections.
- Standard units are air-cooled, optional water-cooling is available.

Enclosure

Compact unit is soundproofed by a sheet metal enclosure with mineral wool and plastic liners. Enclosure features a durable powder-coated finish. Compressor is mounted on base frame with a solid steel floor and vibration isolation mounts. Additional vibration isolation for airend, motor, and separator tank is standard.

Dimensions

Dimensions are for reference only — please contact Kaeser for dimensional drawings.

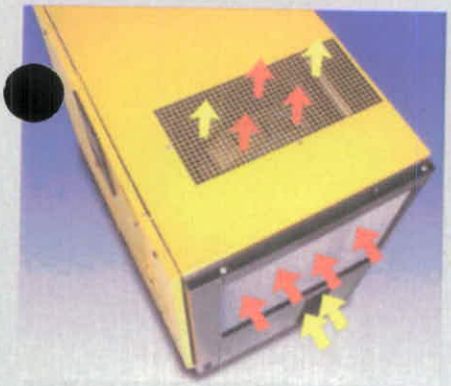


Note: ( ) represents CSD 100/125 measurements

6 Improved Cooling and Air Flow Design

To increase operational reliability and reduce maintenance costs, the coolers are conveniently located on the outside of the unit. A powerful radial fan draws cool ambient air through the cooler. This radial fan is extremely quiet and consumes less power than conventional axial fans, providing additional energy savings. It provides higher static pressure and is ideally suited for ducting and heat recovery applications.

Cooling air (shown by red arrows below) is drawn directly from ambient air through the coolers and exhausted upwards through the cooler box. The cooling air is not preheated which provides optimum cooling, thus significantly lowering air drying requirements. Also, any airborne dirt and debrris will build up on the outside of the cooler where it is easily monitored and removed.



Cooling air for the motor and cabinet inside (shown by yellow arrows) is also drawn directly from ambient air and is exhausted through the same top exhaust opening. This allows easier ducting for heat recovery and energy management.

Inlet air for compression enters through two opposing slots on either side of the inlet air plenum. Each opening is large enough for all needed inlet airflow, greatly reducing the potential for pressure drop across the inlet.

Extremely Quiet

While the low noise radial fan and the one-to-one drive considerably reduce noise levels, the new "split cooling air flow" design provides superior sound proofing without cooling efficiency losses. With noise levels as low as 70 dB(A), the CSD is nearly 10 dB(A) quieter than comparable compressors.

7 Sigma Control

Developed by Kaeser in conjunction with Siemens AG, this patented compressor control features an industrial based PC with an Intel® microprocessor inside. Five different compressor control configurations are available to precisely match compressor performance to air demand and increase energy savings.

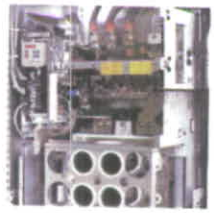
With Sigma Control and Kaeser's proprietary software, compressor systems can be monitored and adjusted from any location worldwide. Sigma Control also features extensive capabilities for maintenance trending and air demand tracking.

Available Options

All units are available with optional refrigerated dryer and/or SFC variable frequency drive.

SFC Option

- Superior part load efficiency
- Stable system pressure
- Siemens drive system technology for reliability and efficiency
- Drive includes EMI filter, contactor for galvanic separation and a line reactor
- Drive cabinet cooling fans



Optional SFC shown

Refrigerated Dryer Option

- Single point hook-up integrated dryer
- CFC-free R134a refrigerant
- 38°F pressure dew point
- Moisture separators and Eco-Drains
- Completely piped and ready for installation
- Stainless steel plate type heat exchangers

9532067

4 One-to-One Direct Drive

In CSD packages, one-to-one drive reduces the number of components needed compared to a gear drive unit thus increasing reliability and service life. Some compressors are called direct drive but are really gear driven units. In Kaeser's CSD package, the motor is directly connected to the airend with a maintenance-free coupling, providing maximum transmission efficiency. The airend and motor are connected by a casting which is doweled and pinned to assure perfect alignment.

5 Motor

EPAct compliant, high-efficiency, TEFC electric drive motor with class F insulation. Easily accessible grease fittings make maintenance a breeze.

Airend RPM = Motor RPM

One-to-One Direct Drive

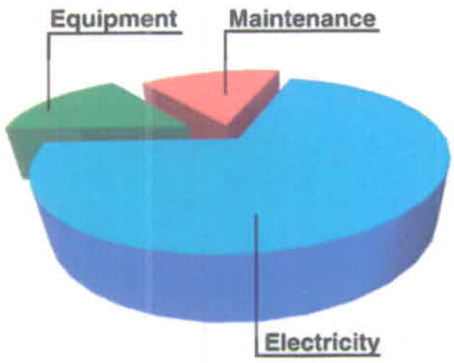
9532068

Direct Drive Rotary Screw Compressor

Maximum Efficiency and Reliability

For years, customers have relied on Kaeser for energy efficient equipment and complete compressed air system solutions. Our research and development team continues to produce industry leading compressor technology to meet virtually any compressed air application requirement. The new CSD series rotary screw compressor is no exception.

Kaeser's new CSD compressors combine our proprietary optimized Sigma Profile airend and Sigma Control system with the latest one-to-one drive technology. They also incorporate optimized designs for reducing maintenance, attenuating noise, and providing superior aftercooling. Manufactured according to strict ISO 9001 quality standards and designed for easy maintenance, our compressors provide exceptional energy savings and years of reliable service.

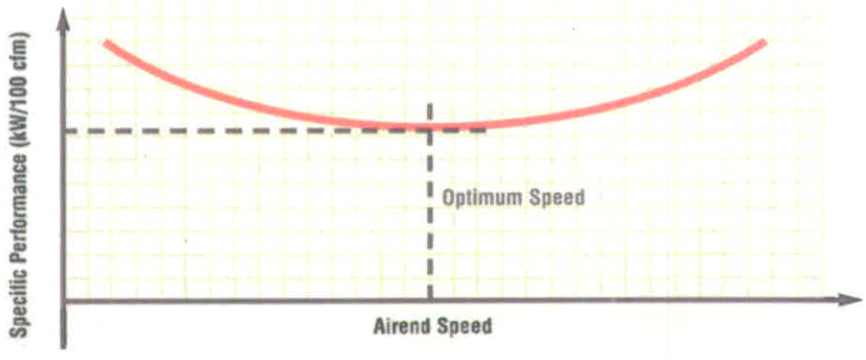


70% of Your Long Term Compressor Cost is Electricity

Analyze the total cost of a compressed air system and you'll realize that power cost is significant. In just one year it could exceed the price of the compressor itself. Over a period of ten years, this could consume 70% of your overall air system costs. That's why it is important to investigate energy efficiency when considering a new compressor.

Kaeser's proprietary Sigma Profile compresses air efficiently. It delivers up to 20% more cfm per horsepower than other airend designs.

A Perfect Match



1 Inlet Filter

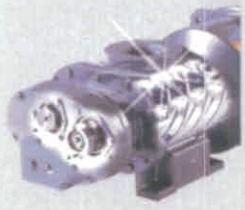
Two-stage 4 micron air intake filter extends airend life and is easily serviced.

2 Efficient Separator System

CSD packages are fitted with an optimized, high-efficiency separation system. Most of the cooling fluid is initially separated from the air by centrifugal force in the separator tank. Any remaining fluid is separated by a 2-stage filter in the separator cartridge. This *triple* action doubles the cartridge service life and reduces fluid carry over to 2 ppm or less. The fluid level is quickly verified by the easy-to-read level indicator.

3 Optimized Airend for Increased Efficiency

Kaeser has selected oversized airends specifically matched to produce the required output in flow and pressure. Compared to compressors using small, high speed gear-driven airends, the CSD one-to-one drive provides triple savings: no-loss power transmission, improved power consumption, and reduced maintenance and related downtime costs.



9532069

Compressed Air System Design

Engineering expertise

With decades of combined experience in compressed air systems and design, our entire team of qualified engineers is always at your service. For specialized systems or unique requirements, Kaeser's highly trained engineers provide expert applications assistance. From complex installations and challenging environments to facilities with limited space, Kaeser can design and lay out a system to meet the specified requirements for performance and reliability.

Using specialized tools such as our Power Cost Analysis and Air Demand Analysis, we can provide an accurate assessment of the existing installation as well as a contrasting view of the proposed system's performance.

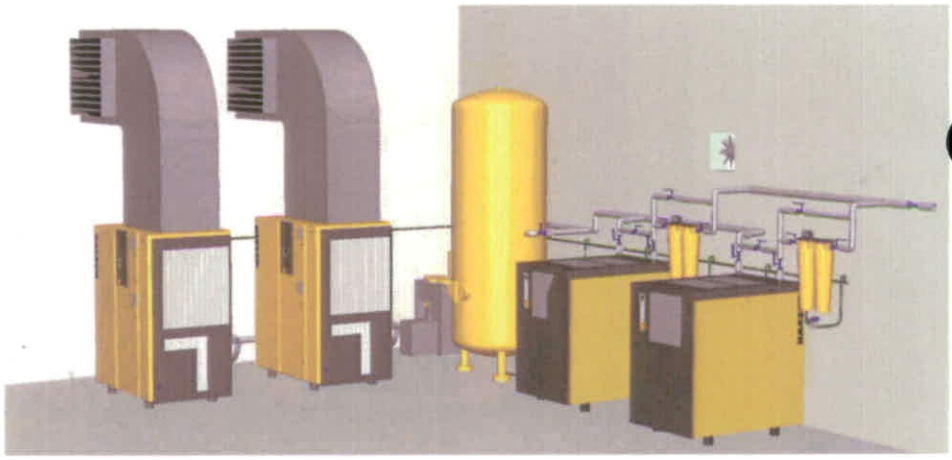
Kaeser uses state-of-the-art CAD systems to lay out the proposed system and produce traditional two-dimensional drawings for project execution. Plus, a three dimensional, virtual walk-through tour of the proposed system allows the end user to see the complete installation. The virtual modeling allows all options to be considered. Variables such as distance, diameters, equipment order, location, accessories and connections can be reviewed and modified, if necessary, prior to installation.

CSD Series - Technical Specifications for Standard Units*

Model	Pressure Range (psig)	Capacity (cfm) (1)	Rated Motor Power (hp)	Dimensions (in.)	Noise Level dB(A)(2)	Weight (lb.) (3)
CSD 60	125 175 217	298 234 188	60	65 x 41 3/8 x 73 1/2	70	2780
CSD 75	125 175 217	361 292 229	75	65 x 41 3/8 x 73 1/2	70	2870
CSD 100S	125 175 217	425 348 288	100	65 x 41 3/8 x 73 1/2	72	2930
CSD 100	125 160 217	503 417 337	100	76 3/4 x 51 1/8 x 79 3/4	73	4190
CSD 125	125 160 217	581 494 406	125	76 3/4 x 51 1/8 x 79 3/4	74	4410

(1) Performance rated in accordance with CAGI/PNEUROP PN2CPTC2 test code. (2) Measured at 3 feet according to CAGI. (3) Weights may vary slightly depending on airend model.
NOTE: Other pressures available from 80 to 217 psig.
* For units with SFC and/or dryer, please contact your local authorized Kaeser distributor.

Specifications are subject to change without notice.



KAESER COMPRESSORS

Built for a lifetime.™

The Air Systems Specialist

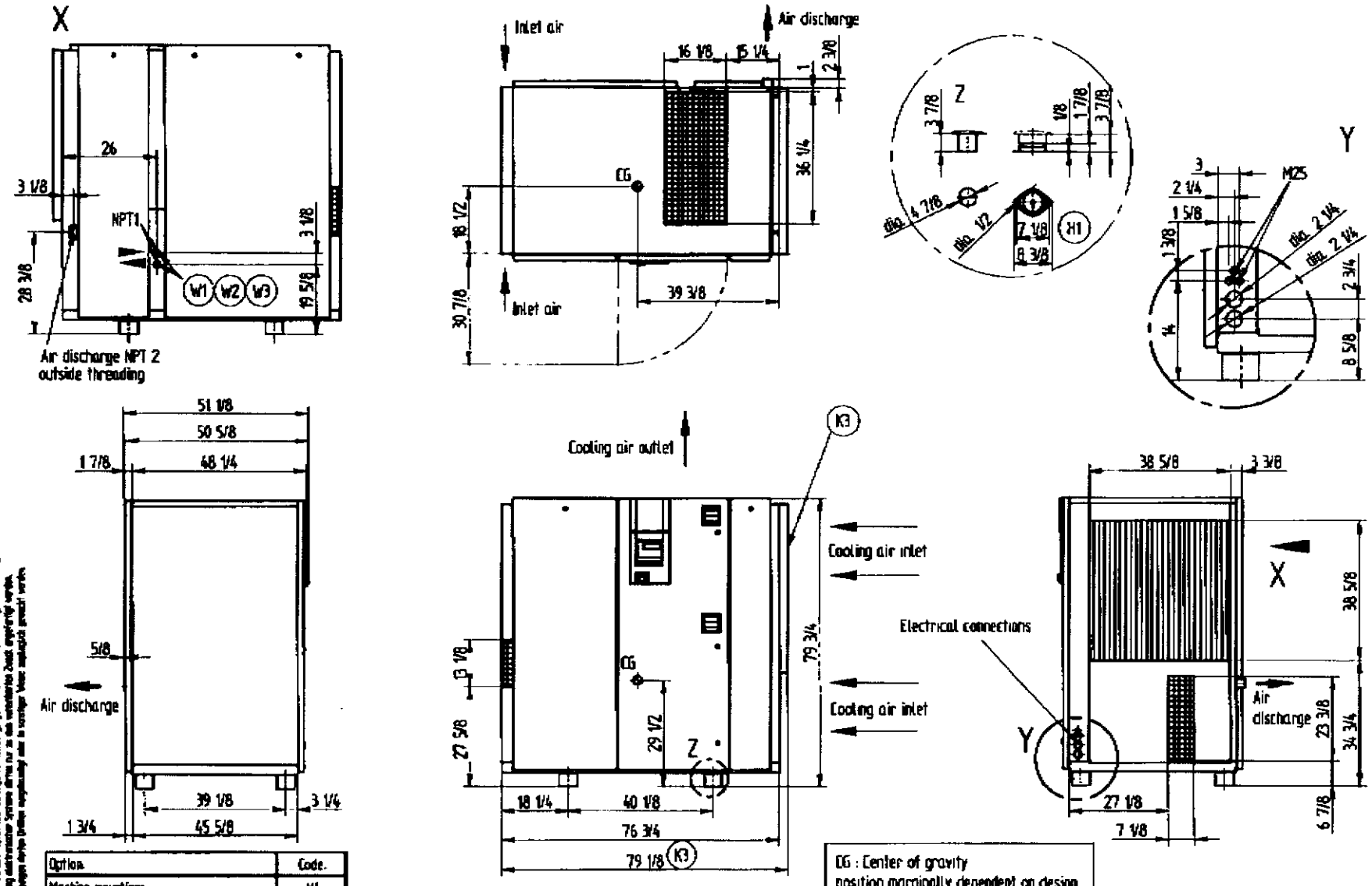
With over 85 years of experience, Kaeser is the air systems specialist. Our extensive 100,000 square foot facility allows us to provide unequaled product availability. With service centers nationwide and our 24-hour emergency parts guarantee, Kaeser customers can rely on the best after-sales support in the industry. Kaeser stands committed to providing the highest quality air system for your specific compressed air needs.

Corporate Headquarters:
P.O. Box 946
Fredericksburg, Virginia 22404
Phone 540-898-5500
Fax 540-898-5520
www.kaeser.com

Certified Management Systems

Member of CAGI

© 2005 Kaeser Compressors, Inc. All rights reserved. 11/05
USCSD



Option	Code
Machine mountings	H1
Air cooling	K1
Cooling air filter mat	K3
Prepared for heat recovery	W1
Internal heat recovery Δt=25K	W2
Internal heat recovery Δt=55K	W3

All dimensions are in inches!

ATTENTION
Allow 4" clearance in narrow passages and doorways
Grating has not been considered

CG : Center of gravity
position marginally dependent on design

	Tag	Name
Gez.	04.10.2006	Duerdoth
Gepr.		
Freigeg.	05.10.2006	Schubert P.
Maßstab		Ersatz für

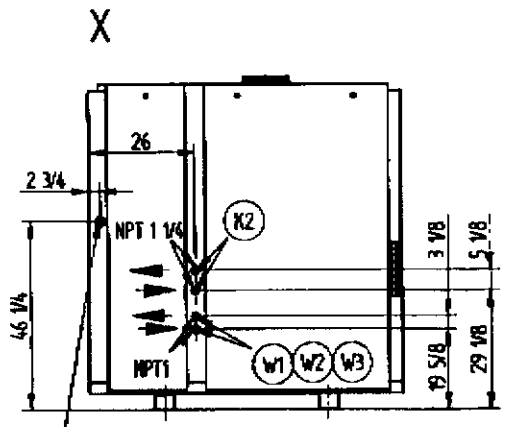
CSD 100 125 (K1)

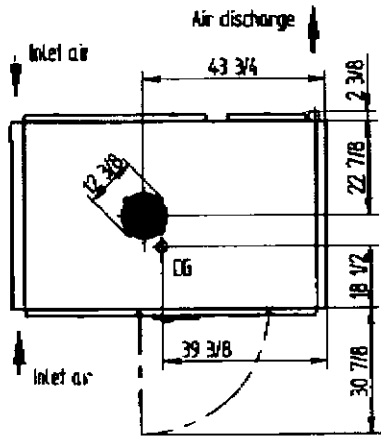
KAESER KOMPRESSOREN

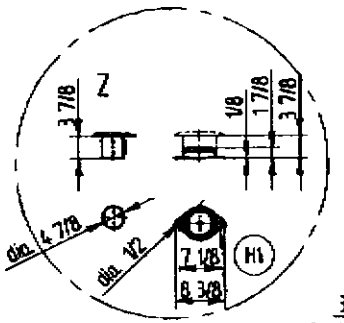
T 1017100 use 06

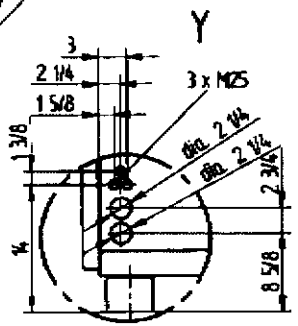
CSD 100 #30,875.00

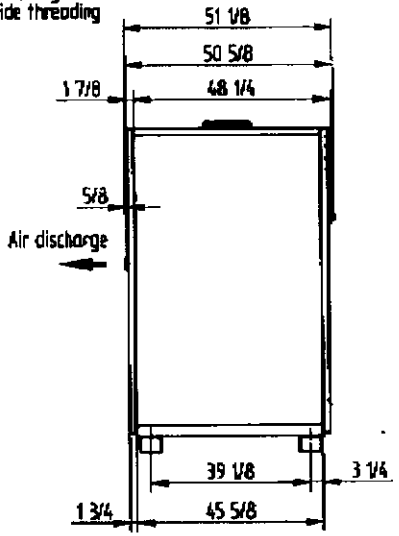
9532070

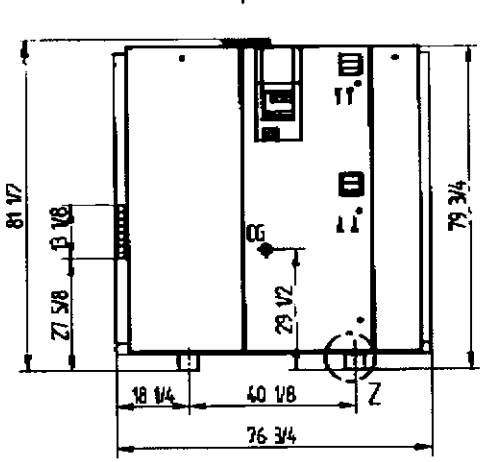


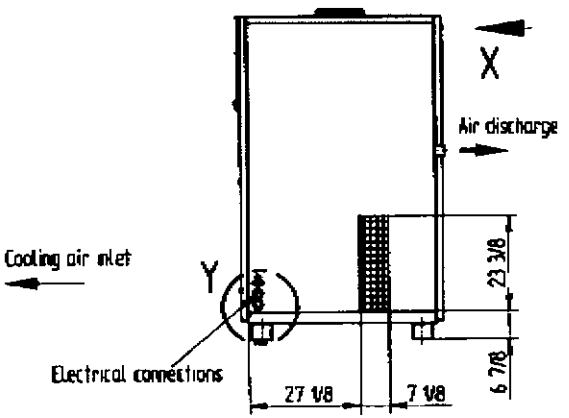












Option	Code
Machine mountings	H1
Water cooling	K2
Prepared for heat recovery	W1
Internal heat recovery Δt=25K	W2
Internal heat recovery Δt=55K	W3

All dimensions are in inches!

ATTENTION!
Allow 4" clearance in narrow passages and doorways
Crating has not been considered

CG Center of gravity
position marginally dependent on design

	Tag	Name
Bez.	05.10.2006	Jundley
Gepr.		
Freigeg.	06.10.2006	Schubert F.
Maßstab		Ersatz für

CSD 100/125 (K2)

KAESER KOMPRESSOREN

T10292.00 ese

Ä-Index 06

95320711

INSTALLATION DATA SHEET

Doc. No.: TI.IDS-022 Version 1.6	CSD 100 - 125	Date: 02-12-08

MODEL	CSD 100	CSD 125
COOLING DATA:		
Cooling System Available	A/C, W/C	A/C, W/C
Type of heat exchangers for water-cooled units	stainless steel, plate type	stainless steel, plate type
Standard Ambient Temp. Range [F]	40 - 115	40 - 115
Air inlet opening [sq. ft.] (A/C)	20	17.2
Air inlet opening [sq. ft.] (W/C)	3.2	3.2
Cooling Fan Capacity [cfm] (forced ventilation with exhaust fan) (A/C)	14714	17657
Cooling Fan Capacity [cfm] (forced ventilation with exhaust fan) (W/C)	2354	2766
Internal Cooling Fan Capacity [cfm] (exhaust air used for space heating) (A/C)	7652	7652
oil & air coolers | motor	6122 | 1530	6122 | 1530
Internal Cooling Fan Capacity [cfm] (exhaust air used for space heating) (W/C)	1001	1001
Max. Additional Pressure Drop for Ducts [inch Water Column]	1/4	1/4
Recommended Heating Duct (W x H) [in]	40 X 40	40 X 40
Approach Temp. (A/C)[°F]***	10.8	12.6
Approach Temp. (W/C)[°F]***	5.4	5.4
Typical Heat Rejected (A/C) [BTU / HR]	319,801	360,177
oil & air coolers | motor	289,182 | 30,619	325,892 | 34,485
Typical Heat Rejected (W/C) [BTU/HR] (into Cooling Water)	283,387	319,897
Typical Heat Rejected (W/C) [BTU/HR] (into Cooling Air)	36,674	41,398
CONNECTIONS [in.]:		
A/C Air Discharge with NPT Adapter	2	2
W/C Air Discharge with NPT Adapter	2	2
Cooling Water Connection(s) [NPT]	1	1
Power Input Conduit Opening(s)	2 X 2 ¼	2 X 2 ¼
NOISE LEVEL DATA (Measured in dB(A) at 1 m (approx. 40 in.) According to CAGI):		
A/C With Super Soundproofing	73	74
W/C With Super Soundproofing	73	74
ENVELOPE DIMENSIONS & WEIGHT		
Length [in.]	79 1/8	79 1/8
Width [in.]	51 1/8	51 1/8
Height [in.]	79 ¾	79 ¾
Floor Space [sq. ft.]	28.09	28.09
Weight [lb] #	4200	4400
Estimated Shipping Weight [lb]	4354	4554

*+++ Reference conditions. 14.5 psia, 30% relative humidity and 68°F inlet air temperature

9532072

Copyright 2008 Kaeser Compressors, Inc.

KAESER COMPRESSORS

INSTALLATION DATA SHEET

Doc. No.: TI.IDS-022 Version 1.6	*CSD 100 - 125*	Date: 02-12-08

MODEL	CSD 100	CSD 125
ELECTRICAL DATA[1]:		
DRIVE MOTOR		
NEMA Nominal Efficiency [%]	93.6%	95.0%
Full Load Amps @ 208V/3ph/60 Hz/YD [FLA]	308	343
Full Load Amps @ 230V/3ph/60 Hz/YD [FLA]	278	310
Full Load Amps @ 460V/3ph/60 Hz/YD [FLA]	141	155
Full Load Amps @ 575V/3ph/60 Hz/YD [FLA]	111	124
Drive Motor Nominal Power [HP]	100	125
Drive Motor Insulation Class	F	F
Drive Motor Enclosure Type	TEFC	TEFC
Drive Motor Overload Set Point [A] @ 230V/3ph/60Hz/YD	117	198
Drive Motor Overload Set Point [A] @ 460V/3ph/60Hz/YD	90	100
Drive Motor Overload Set Point [A] @ 575V/3ph/60Hz/YD	71	80
FAN MOTOR (A/C)		
Enclosure Type	TEFC	TEFC
Insulation Class	F	F
Fan Motor [HP], Single Speed	3	3
Nominal Efficiency [%]	84%	84%
Full Load Amps [FLA] @ 208V/3ph/60 Hz/YD	12	12
Full Load Amps [FLA] @ 230V/3ph/60 Hz/YD	11	11
Full Load Amps [FLA] @ 460V/3ph/60 Hz/YD	5.4	5.4
Full Load Amps [FLA] @ 575V/3ph/60 Hz/YD	4.3	4.3
Fan Motor Overload Set Point @208V/3 ph/60 Hz/YD	13	13
Fan Motor Overload Set Point @230V/3 ph/60 Hz/YD	12	12
Fan Motor Overload Set Point @460V/3 ph/60 Hz/YD	6	6
Fan Motor Overload Set Point @575V/3 ph/60 Hz/YD	5	5
FAN MOTOR (W/C)		
Enclosure Type	Totally Enclosed (IP 44)	Totally Enclosed (IP 44)
Insulation Class	F	F
Fan Motor [HP], Single Speed	0.13	0.13
Nominal Efficiency [%]	60%	60%
Full Load Amps [FLA] @ 115V/1ph/60 Hz	1.45	1.45

9532073

ght 2008 Kaeser Compressors, Inc.

KAESER COMPRESSORS

INSTALLATION DATA SHEET

Doc. No.: TI.IDS-022 Version 1.6	*CSD 100 - 125*	Date: 02-12-08

MODEL	CSD 100		CSD 125	
PACKAGE DATA				
Control Cabinet Class (NEMA)	12		12	
Continuous Duty [Hours / Day]	24		24	
Package Full Load Amps @ 208V/3ph/60 Hz/YD (A/C) [FLA]	320		354	
Package Full Load Amps @ 230V/3ph/60 Hz/YD (A/C) [FLA]	289		321	
Package Full Load Amps @ 460V/3ph/60 Hz/YD (A/C) [FLA]	146		160	
Package Full Load Amps @ 575V/3ph/60 Hz/YD (A/C) [FLA]	115		128	
Package Full Load Amps @ 208V/3ph/60 Hz/YD (W/C) [FLA]	309		344	
Package Full Load Amps @ 230V/3ph/60 Hz/YD (W/C) [FLA]	279		311	
Package Full Load Amps @ 460V/3ph/60 Hz/YD (W/C) [FLA]	142		156	
Package Full Load Amps @ 575V/3ph/60 Hz/YD (W/C) [FLA]	112		125	
	A/C	W/C	A/C	W/C
Recommended Disconnect Fuse Size [Amps] @ 208V/3ph/60Hz/YD *	450	450	500	500
Recommended Disconnect Fuse Size [Amps] @ 230V/3ph/60Hz/YD *	400	400	450	450
Recommended Disconnect Fuse Size [Amps] @ 460V/3ph/60Hz/YD *	200	200	225	225
Recommended Disconnect Fuse Size [Amps] @ 575V/3ph/60Hz/YD *	150	150	175	175
Recommended Disconnect Wire Size [AWG/kcmil] @ 208V/3ph/60Hz/YD **	4/0 x 2	4/0 x 2	250 x 2	250 x 2
Recommended Disconnect Wire Size [AWG/kcmil] @ 230V/3ph/60Hz/YD **	4/0 x 2	3/0 x 2	4/0 x 2	4/0 x 2
Recommended Disconnect Wire Size [AWG/kcmil] @ 460V/3ph/60Hz/YD **	4/0	4/0	4/0	4/0
Recommended Disconnect Wire Size [AWG/kcmil] @ 575V/3ph/60Hz/YD **	2/0	2/0	3/0	3/0
OIL SYSTEM DATA:				
Oil System Capacity (A/C) [gal.]	14		14	
Oil System Capacity (W/C) [gal.]	11		11	
Typical Oil Consumption [fl. oz./100 h]	27.4		31.8	
MAINTENANCE PARTS:				
Air Inlet Filter	6.4148.0		6.4148.0	
Filter Mat (optional)	6.1945.0		6.1945.0	
Filter Mat for Control Cabinet	6.3572.0		6.3572.0	
Fluid Filter	6.3465.0		6.3465.0	
Fluid Separator Kit	6.3623.0		6.3623.0	
Maintenance Kit for Optional 5-year Warranty	AN5YRKT-CSD2		AN5YRKT-CSD2	
Maintenance Kit for Optional 5-year Warranty, with food-grade lubricant	AN5YRKITCSD2F		AN5YRKITCSD2F	

1. Electrical data may vary in accordance with motor manufacturer's specifications. Motors are EPACT compliant.
   Main power supply and overcurrent protection must be installed by a qualified electrician in accordance with NEC, OSHA, and any applicable local codes
* Dual-element time-delay fuse; based on 2005 NEC 240.6, 430.52, and Tables 430.52, 430.148,and 430.150.
** Based on 2005 NEC 110.14(C), 220.3, 310.15, Table 310.16, 430.6, 430.22, 430.24 and Tables 430.148 and 430.150.
   Multi-strand copper core wire at 40° C ambient temperature, with 75° temperature rating, and an insulation rating of 90° C.
Weights will vary depending on airend used.

Copyright 2008 Kaeser Compressors, Inc.

9532074

KAESER COMPRESSORS

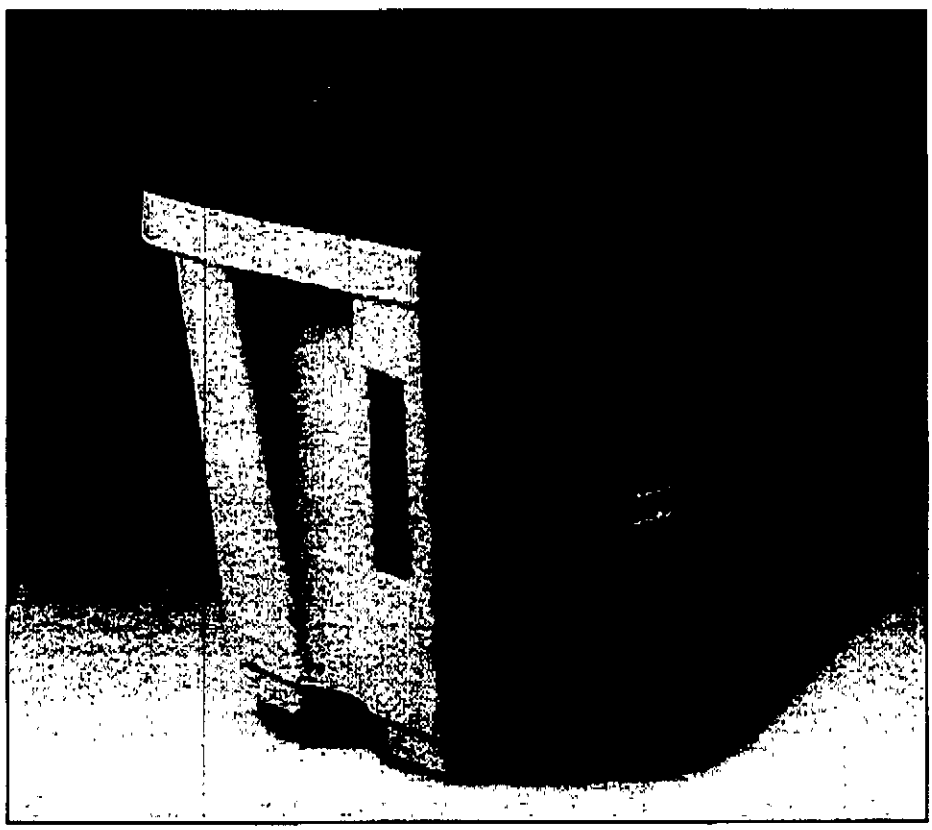
Built for a lifetime.

9532075

Condensate Filtration

$915.00

KCF Series



The KCF Advantage

- Works with most compressor fluids and lubricants*
- Simple, reliable operation
- Quick and clean filter cartridge change-out
- Single point connection
- No electricity required
- Connect multiple units for larger flows

*Check with Kaeser's Project Support department for compatibility

Convenient and clean

The Kaeser Condensate Filter (KCF) offers a convenient, economical and reliable method of condensate treatment. With today's stringent environmental guidelines, treating air compressor condensate is extremely important.

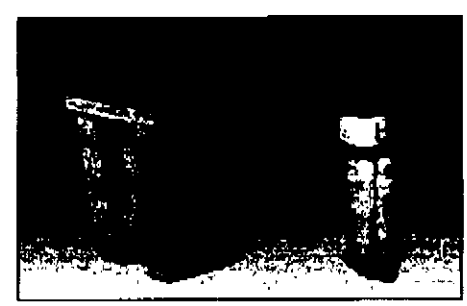
Condensate is a by-product of all compressors. This mixture of oil and water with ambient particulates and hydrocarbons is concentrated during the compression process. It is often classified as hazardous waste. Federal and local environmental laws often prohibit discharging untreated compressor condensate into surface drains.

Easy condensate filtration

Collecting and storing large volumes of contaminated condensate requires disposal by a waste collection service and can be very expensive. The KCF filters the oil from the water. The water can then be safely discharged into a drain. The KCF cartridge is designed to last 4-6 months depending on the type of compressor, type of lubricant, and ambient conditions. Each cartridge is supplied with a bag for easy disposal.

The KCF is easy to install and easy to maintain. Simply connect the unit to the condensate lines and it is ready to work. Multiple lines can be connected to a single KCF using an optional manifold.

Two sizes are available to fit most applications. For larger flow requirements, simply connect multiple units using an optional flow splitter.



9532076

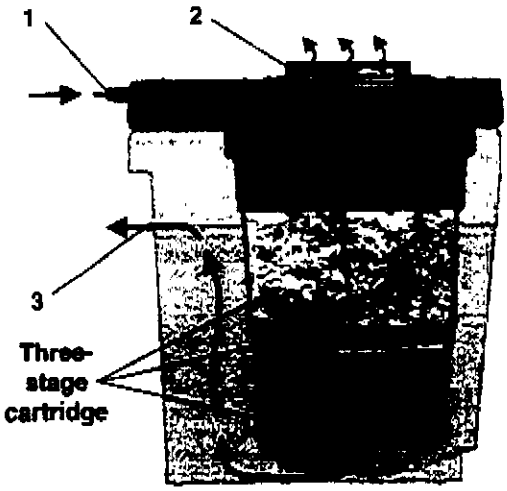
Operation

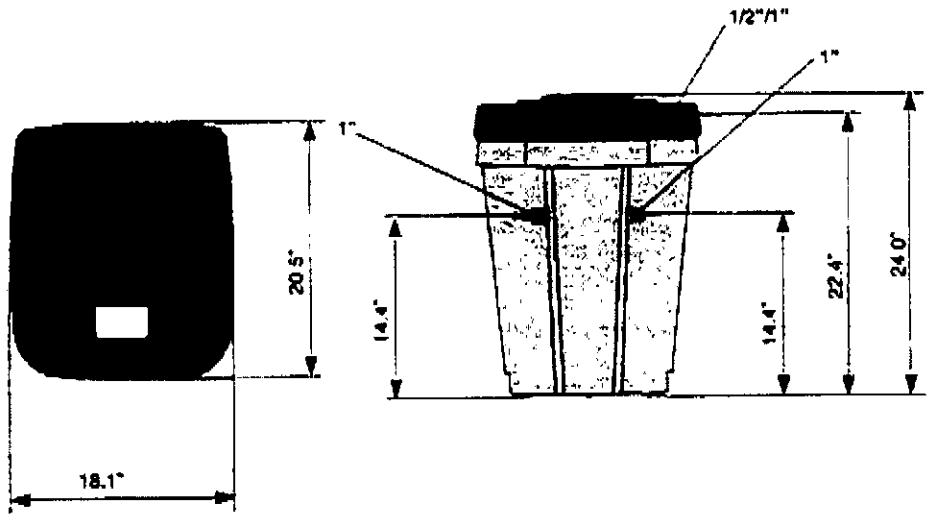
The condensate is fed under pressure into the inlet (1) and then into the pressure relief chamber (2) where the condensate is allowed to separate from the air. The settled condensate then flows into the cartridge where the oil is captured by a three-stage filtration process. The treated water then flows out the discharge pipe (3).

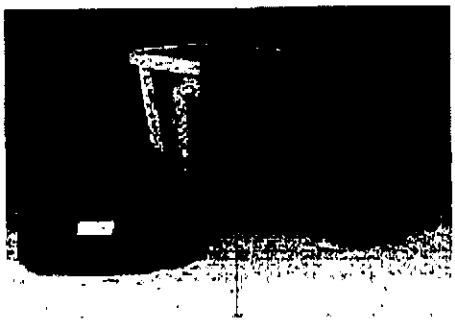
Specifications

Model	Capacity		Dimensions L x W x H (in.)	Dry Weight (lbs.)	Options
	Flow (cfm)	Compressor (hp)			
KCF 20	100	20	8 x 8 x 21	10	Flow Splitter / Manifold
KCF 100	500	100	18 x 21 x 24	25	Flow Splitter / Manifold

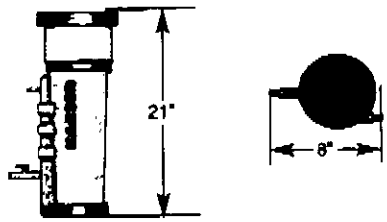
Flow rates are based on 70°F and 70% relative humidity and may vary depending on compressor type, lubricant type, and ambient conditions. For best results use no air loss drains.
Specifications are subject to change without notice.







Disposing of compressed air condensate is a major environmental concern. This oil/water mixture is classified as hazardous waste and cannot be discharged into municipal wastewater systems unless the oil and contaminants are removed. The Kaeser Condensate Filter (KCF) is designed to filter out oil and other contaminants making the water safe for disposal. The key to the KCF function is the three-state, self-contained plastic filter cartridge, which is extremely convenient for replacement and disposal. Check local regulations for proper disposal method.



KAESER COMPRESSORS

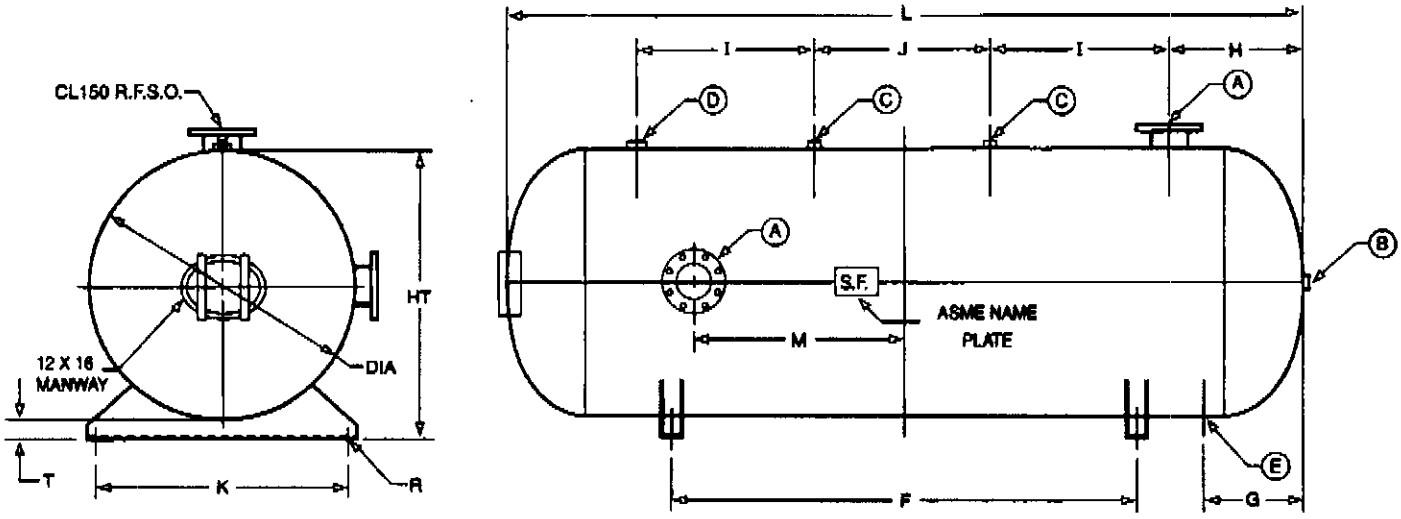
Built for a lifetime.

Corporate Headquarters:
P.O. Box 946
Fredericksburg, Virginia 22404
Phone 540-898-5500
Fax 540-898-5520
www.kaeser.com

© 2006 Kaeser Compressors, Inc. All rights reserved. 04/06
USKCF

9532077

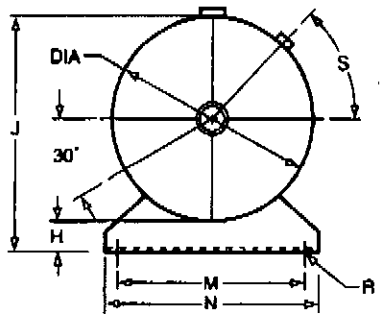
INDUSTRIAL HORIZONTAL AIR RECEIVERS

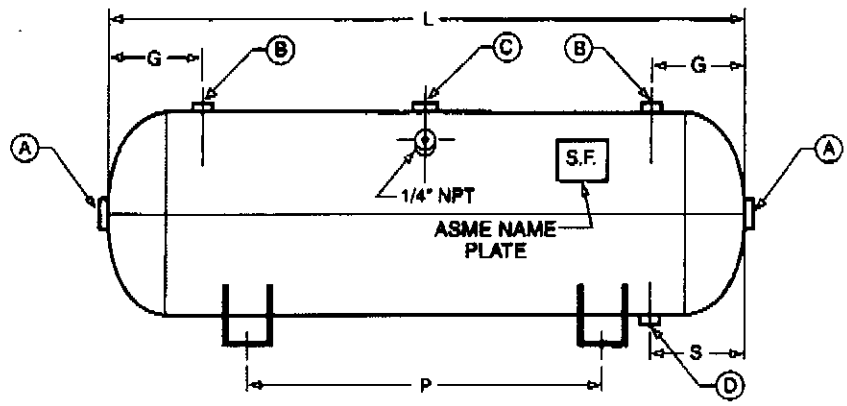


					OPENINGS (NPT)"					DIMENSIONS "									
P/N	PSI	GAL	DIA	L	A	B	C	D	E	F	G	H	I	J	K	R	M	HT	T
A10358	150	660	42	120	4	2	1/2	1-1/2	1	70	16	17	18	27	40	3/4	31	50	4
A10368	155	1060	48	144	6	2	1/2	2	1	84	18	24	32	32	44	3/4	38	56	4
A10370	137																		
A10376	137	1550	54	166	6	2	1/2	2	1	98	19	26	39	40	52	3/4	50	62	4
C102888	137	1350	54	148	6	2	1/2	2	1	80	19	26	33	30	52	3/4	41	62	4
C102889	165																		
A10376	137	1550	54	166															
C102890	150	1660	60	150	6	2	1/2	3	1	74	21	27	30	36	56	3/4	38	71	4
A10665	150	2000	60	174	6	2	1/2	3	1	98	21	27	39	40	56	3/4	50	68	4
A10392	150	2580	60	220	6	2	1/2	3	1	112	21	27	55	56	56	3/4	74	68	4
A10400	137	3000	66	214	6	2	1/2	3	1	110	23	29	52	56	56	3/4	71	74	4
A10402	125	3800	72	228	6	2	1/2	3	1	114	25	31	54	56	56	3/4	78	80	4
A10404	150																		
C101567	125	4500	78	235	6	2	1/2	3	1	114	26	34	54	56	58	3/4	82	88	4
C101568	150																		
C101569	125	5200	84	238	6	2	1/2	3	1	114	28	34	54	56	64	3/4	85	94	4
C101570	150																		
C101571	125	6000	90	241	6	2	1/2	3	1	114	30	36	54	56	70	3/4	88	100	4
C101572	150																		
C101573	125	7000	96	244	6	2	1/2	3	1	114	31	38	54	56	76	3/4	88	106	4
C101574	150																		
C101575	125	8000	102	247	6	2	1/2	3	1	114	33	40	54	56	82	3/4	90	112	4
C101576	150																		

9532078

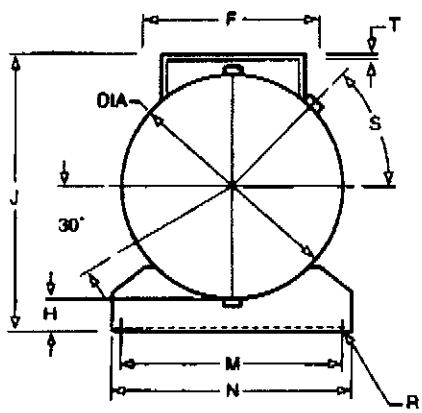
HORIZONTAL AIR RECEIVERS WITH FEET ONLY

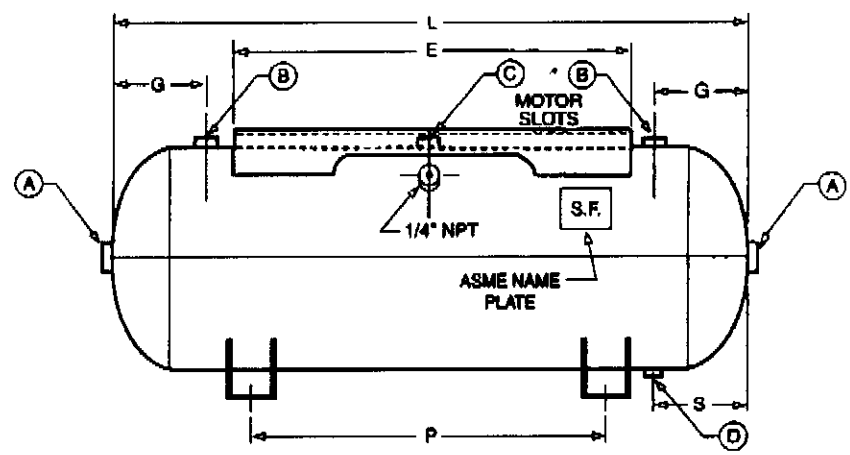




				OPENINGS (NPT)"				DIMENSIONS"										
P/N	GAL	DIA	L	A	B	C	D	E	F	G	H	J	T	M	N	P	R	S
A10023*	12	12	27	3/4	1/2	1/2	1/4	-	-	5-1/2	1-3/16	13-3/16	-	11	12	14	1/2	5-1/2
A10025*	20	14	33	1-1/2	1/2	1/2	1/4	-	-	6	2	16	-	14	15-1/2	18	1/2	6
A10027	30	16	38	1-1/2	1/2	3/4	1/4	-	-	6	2-1/2	18-1/2	-	15	19	18	9/16x1	6
A10029	60	20	48	2	3/4	1	1/2	-	-	7-3/4	3-3/16	23-3/16	-	18-3/4	21	26	9/16x1	7-1/4
A10031	80	20	63	2	1	1-1/2	3/4	-	-	9	3-3/16	23-3/16	-	18-3/4	21	36	9/16x1	9
A10033	120	24	69	2	1-1/2	1-1/2	3/4	-	-	10	3-1/2	27-1/2	-	23-3/4	26-1/2	42	9/16x1	9
A10035	200	30	72	2	2	2	1	-	-	12	4	34	-	27-1/2	30	42	9/16x1	10-1/4
A10037	240	30	84	2	2	2	1	-	-	12	4	34	-	27-1/2	30	54	9/16x1	10-5/8

HORIZONTAL AIR RECEIVERS WITH FEET AND TOPPLATE



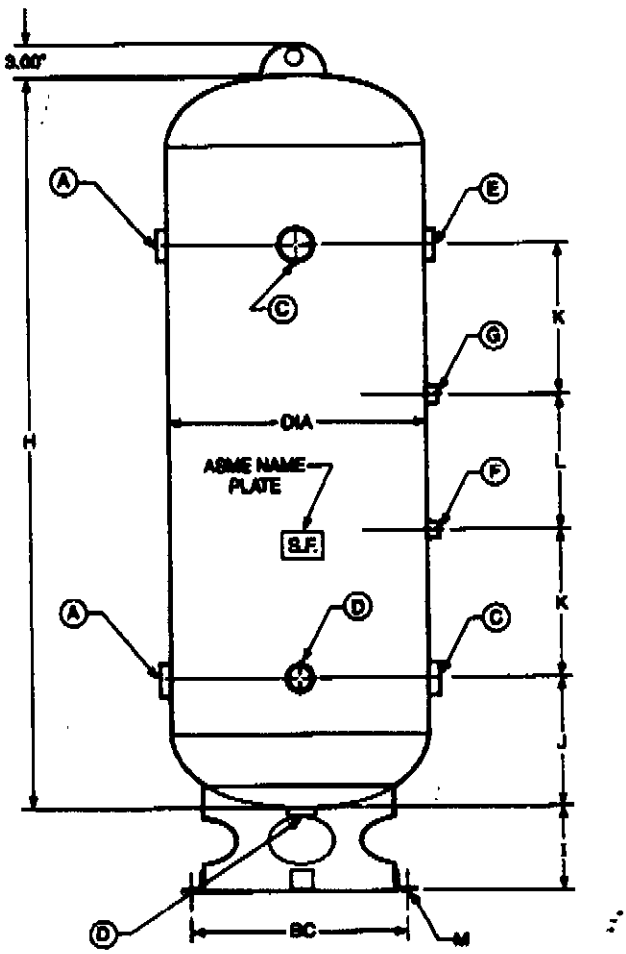


				OPENINGS (NPT)"				DIMENSIONS"										
P/N	GAL	DIA	L	A	B	C	D	E	F	G	H	J	T	M	N	P	R	S
A10024*	12	12	27	3/4	1/2	1/2	1/4	15	9	5-1/2	1-3/16	14-5/8	3/16	11	12	14	1/2	5-1/2
A10026*	20	14	33	1-1/2	1/2	1/2	1/4	19	10	6	2	17-1/2	3/16	14	151/2	18	1/2	6
A10028	30	16	38	1-1/2	1/2	3/4	1/4	24	12	6	2-1/2	20	3/16	15	19	18	9/16x1	6
A10030	60	20	48	2	3/4	1	1/2	30	14	7-3/4	3-3/16	24-3/4	3/16	18-3/4	21	26	9/16x1	7-1/4
A10032	80	20	63	2	1	1-1/2	3/4	36	14	9	3-3/16	24-3/4	3/16	18-3/4	21	36	9/16x1	9
A10034	120	24	69	2	1-1/2	1-1/2	3/4	44	16	10	3-1/2	29-1/4	1/4	23-3/4	26-1/2	42	9/16x1	9
A10036	200	30	72	2	2	2	1	44	18	12	4	35-13/16	1/4	27-1/2	30	42	9/16x1	10-1/4
A10038	240	30	84	2	2	2	1	48	18	12	4	35-13/16	1/4	27-1/2	30	54	9/16x1	10-5/8

*12 and 20 Gal. receivers have 4 pressed steel feet. All others have channel as shown.
Note: Receivers listed above are available without feet and topplate (slick receivers).
• All volume capacities listed in this brochure are U.S gallons. • All dimensions listed in this brochure are subject to change without notice
For installation dimensions consult factory.

INDUSTRIAL VERTICALS

20" to 36' Diameter



500g => #2075.00
400g => #1410.00
240g => #975.00
200g => #935.00

						OPENINGS (NPT)"						DIMENSIONS "					
	P/N	PSI	GAL	DIA	H	A	C	D	E	F	G	I	J	K	L	M	BC
	A10025	200	80	20	63	2	2	1/2	3/4	1/2	1/4	6	10	11	21	11/16	17
	A10049	200	120	24	69	2	2	1	1-1/2	1/2	1/4	8	12	14	13	11/16	20
*	A10051	200	200	30	72	2	2	1	2	1/2	1/4	8	12	16	15	11/16	26
*	A10053	200	240	30	84	2	2	1	2	1/2	1/4	8	12	20	19	11/16	26
	A10054	137	400	36	93	2	3	1	2-1/2	1/2	1/4	8	16	20	20	11/16	32
*	A10055	165															
	A10056	200															
	A10129	165	500	36	117	2	3	1	3	1/2	1/4	8	18	26	25	11/16	32
	A10130	200															

Note: Other sizes and pressures are available upon request.

9532080

KAESER COMPRESSORS

Built for a lifetime.

Cycling Refrigerated Air Dryers

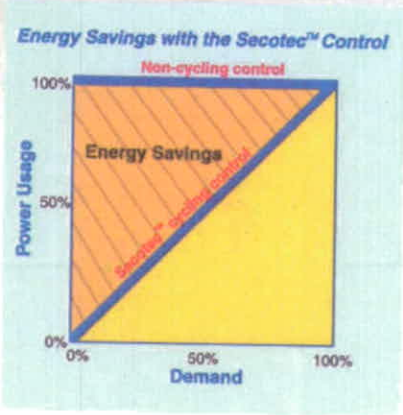
Secotec™

20 - 885 cfm

9532081

Why Do We Need Dry Air?

As atmospheric air is drawn into a compressor, water vapor is introduced as well. During compression, air heats up and is able to hold more water vapor. Mechanical separators and filters are used to remove liquid water, yet air remains saturated with water vapor. As air travels through the piping, the vapor cools, condenses and may pass into production tools and equipment. Refrigerated dryers condense water vapor and remove the condensed liquid from the air system.



Why Secotec™?

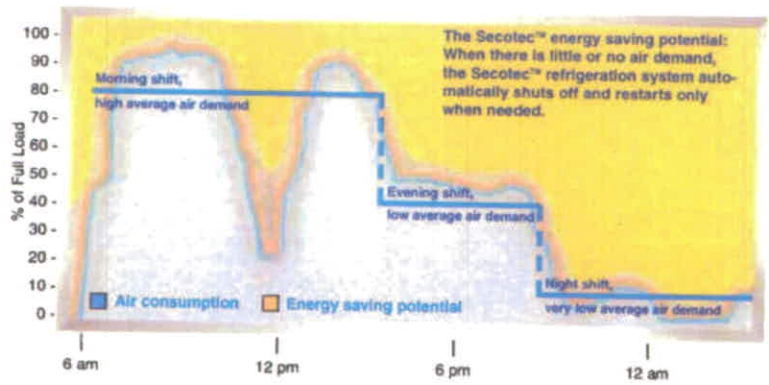
The Secotec™ cycling control provides maximum efficiency by operating the refrigerant compressor only when necessary. This is achieved by utilizing a thermal storage medium. The refrigerant system cools the medium to a certain temperature, cuts off, and then stands by until the temperature rises to a predetermined level before switching on again. Therefore, the dryer is not wasting energy when the demand is low. A non-cycling dryer continues to operate even during low demand periods.

Energy Savings

The Secotec™ cycling control provides the greatest savings during low demand periods such as evening and night shift. As shown in the chart, significant savings are possible on a daily basis. During breaks, low demand periods, and shut down, the Secotec™ dryers save energy because the refrigerant system is shut off.

In a three-shift operation with 100%, 75% and 50% loads, respectively, and power costs of $.08 per kWh, the Secotec TF203 costs under $1500 per year to operate. A similarly sized non-cycling dryer costs nearly $2400. The Secotec solution's 40% power savings pays back in 3 years.

Air Consumption Over a 24-Hour Period



Operation

Warm compressed air entering the dryer is initially cooled in the air-to-air heat exchanger by the cold compressed air leaving the evaporator. This increases

efficiency by reducing the heat load on the refrigeration system.

The air is then cooled to the dew point temperature by a refrigerant* circuit with a thermal storage medium. The chilled air leaving the evaporator is reheated in the air-to-air heat exchanger before exiting the dryer. Reheating the compressed air recovers energy and eliminates pipe sweating down-stream.

The condensate formed by the cooling action is collected by a multi-stage, stainless steel moisture separator. Then an automatic condensate drain reliably removes the water without wasting valuable compressed air.

** All Kaeser Secotec dryers use environmentally-friendly R 134a refrigerant.*

Convenient Features

Dryer Construction

All components such as heat exchangers, refrigerant circuit, condensate separator, and drain are conveniently accessible when the side panels are removed. Service connections are provided at the suction and discharge lines to check the refrigerant circuit. The dryer construction and component arrangement minimize the floor space required for installation.

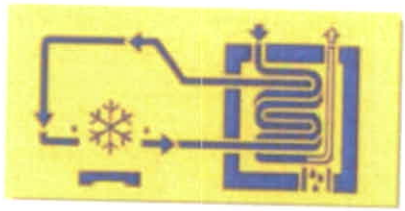
1 Easy and Reliable Controls

Control panel includes dew point indicator, on/off switch, and LED's indicating "power on" (active thermal storage) and "compressor on." LED's for "high dew point" are standard on models TE 91 and up and drain alarm LED is standard on TE 121 thru TF 251.

2 Heat Exchangers

Air-to-air and thermal storage-to-refrigerant heat exchangers are fitted with oversized copper tubing that provides low pressure drop. The smooth inner walls of the tubing also prevent fouling.

Three-year warranty on heat exchangers.
Two-year warranty on all other parts and labor.



3 Thermal Storage

Solid media acts as storage for efficient cooling and eliminates the possibility of leakage.

5 Separator

Highly efficient multistage, stainless steel separator uses centrifugal force and a stainless steel wire mesh to separate 99.9% of liquid water.

4 Electronic Demand Drain

Once condensate fills the collection chamber, a level sensor opens a diaphragm valve to drain the condensate. The valve then shuts before costly air can escape.

Specifications

Model	Flow rate @ 100 psig (scfm)	Pressure Drop (psid)	Max. Working Pressure (psig)	Voltage	Connection Size (in.)	Drain Conn. Size (in.)	Dimensions H x W x D (in.)	Weight (lb.)
TA 5	20	0.8	230	115/1/60	3/4	1/4	30 x 20 x 25	175
TA 8	30	1.8				3/8	30 x 19 x 25	176
TA 11	45	2.3						
TB 19	70	2.6			1		38 x 22 x 25	255
TB 26	95	2.6						
TC 31	115	2.3		115/1/60	1-1/4		40 x 26 x 32	342
TC 36	135	2.9		230/1/60				375
TC 44	170	1.5		230/1/60				440
TD 51	200	1.5		230/3/60	1-1/2		47 x 30 x 46	553
TD 61	240	1.5		460/3/60				632
TD 76	285	1.5			2		62 x 42 x 59	1256
TE 91	360	1.5				1/2		1455
TE 121	460	2.3		460/3/60				
TE 141	520	3.4			2-1/2	Two 1/4	75 x 42 x 70	1755
TF 173	600	2.5						
TF 203	720	2.3			3			2152
TF 251	885	2.8						2174

Specifications table based on: 100°F air inlet, 100 psig, 100°F ambient temperature, and 38°F pdp

- Minimum ambient temperature: 40°F
- Maximum ambient temperature: 110°F
- Maximum inlet temperature: 130°F
- Connection locations vary. Consult factory for dimensional drawing
- Kilowatt

Specifications are subject to change without notice.

Nominal flows for Secotec dryers are based on fully saturated air at 100 psig and 100°F, with ambient air temperature of 100°F. To correct the rated capacity of a Secotec dryer for actual conditions, find the capacity correction factor corresponding to inlet and ambient conditions. Multiply these factors to find your "overall" correction factor and multiply the dryer's rated capacity by the overall factor to determine the dryer's capacity at your operating conditions. Select the smallest dryer having enough capacity to meet your requirement.

Temperature and pressure capacity correction factors for Secotec dryers

Pressure (psig)	Temperature (°F) 75	80	85	90	95	100	105	110	115	120	130
20	1.03	0.89	0.79	0.70	0.67	0.64	0.53	0.48	0.45	0.40	0.33
40	1.19	1.02	0.91	0.81	0.77	0.74	0.60	0.55	0.51	0.46	0.38
60	1.37	1.18	1.05	0.93	0.88	0.85	0.69	0.64	0.59	0.53	0.44
75	1.47	1.26	1.12	1.00	0.95	0.91	0.75	0.68	0.64	0.56	0.47
100	1.61	1.39	1.23	1.10	1.04	1.00	0.82	0.75	0.70	0.62	0.52
110	1.65	1.42	1.26	1.12	1.06	1.02	0.84	0.77	0.71	0.63	0.53
125	1.72	1.48	1.31	1.17	1.11	1.06	0.87	0.80	0.74	0.66	0.55
145	1.77	1.53	1.36	1.21	1.14	1.10	0.90	0.83	0.77	0.68	0.57
175	1.85	1.60	1.42	1.26	1.20	1.15	0.94	0.86	0.80	0.71	0.60
200	1.92	1.65	1.47	1.31	1.24	1.19	0.98	0.90	0.83	0.74	0.62
230	1.99	1.71	1.52	1.36	1.29	1.23	1.01	0.93	0.86	0.77	0.64

Ambient air capacity correction factors for Secotec dryers

	Ambient Air Temperature (°F) 75	80	85	90	95	100	105	110
Factor	1.15	1.12	1.09	1.06	1.03	1.00	0.97	0.94

KAESER COMPRESSORS

Built for a lifetime.

Corporate Headquarters:
P.O. Box 946
Fredericksburg, Virginia 22404
Phone 540-898-5500
Fax 540-898-5520
www.kaeser.com

Certified Management Systems ISO 9001:2000 Quality 14001:2004 Environmental

Member of Compressed Air and Gas Institute CAGI www.cagi.org

The Air Systems Specialist

With over 85 years of experience, Kaeser is the air systems specialist. Our extensive 100,000 square foot facility allows us to provide unequaled product availability. With service centers nationwide and our 24-hour emergency parts guarantee, Kaeser customers can rely on the best after-sales support in the industry. Kaeser stands committed to providing the highest quality air system for your specific compressed air needs.

© 2007 Kaeser Compressors, Inc. All rights reserved. 10/07
USSECOTEC

9532084

KAESER COMPRESSORS
Built for a lifetime.

Kaeser Compressors, Inc.
1920 E. Starita Road
Charlotte, NC 28206-4222
Sales Rep: Tim Outen
Phone:(704) 494-4100
Fax:(704) 494-4160

CH2M HILL
Attn: Mr. Strong
9013 Blueshot Court
Charlotte NC 28273
Phone: 1 704-329-0073

PROPOSAL

Your ref.	Customer No.	Quotation No.	Date
	783671	843603301	08/07/2008

Quoted by: Tim Outen
Phone: (704) 494-4100 Fax: (704) 494-4160

Dear Mr. Strong:

Thank you for allowing us to submit this detailed quotation for our premium quality compressed air products.

Kaeser is a global organization committed to complete customer satisfaction. Each and every product we offer is backed by our written performance guarantee and our replacement parts guarantee is the most comprehensive in the industry.

We trust this quotation meets your requirements and we look forward to earning your business. If you have any questions or require additional information, please contact me directly at (704) 494-4100.

With best regards,

Tim Outen
Sales Representative

9532085

CH2M HILL
Attn: Mr. Strong
9013 Blueshot Court
Charlotte NC 28273

Date: 08/07/2008

KAESER COMPRESSORS
Built for a lifetime.

PRICE QUOTATION

843603301

Item	Quantity	Material name Material No.	Net Price/each	Price (USD)
10	1.00 PC	**Refrig. dryer TE 141 460/3/60** 1.8039.00010 **Net price**	**7,930.59**	**7,930.59**
TOTAL NET PRICE				**7,930.59**

Terms of payment: Within 30 days net

Terms of delivery: Ex works Shipping point

Terms and conditions: This Quote is effective and expressly conditional on Buyer's assent to all terms and conditions incorporated in this Quote that are additional to or different from those stated in Buyer's purchase order or other documents. Buyer's assent to this provision will be manifested by ordering, paying for, or receiving any portion of the goods designated herein. Seller's terms and conditions are available on request, and at www.kaeser.com/terms.

Validity: 10/07/2008

Estimated Delivery: 1-2 Weeks ARO

Kaeser Compressors, Inc. ■ P.O.Box 946 ■ Fredericksburg, Virginia 22404 ■ Phone (540) 898-5500 ■ Fax (540) 898-5520 ■ www.kaeser.com

9532086

CH2M HILL
Attn: Mr. Strong
9013 Blueshot Court
Charlotte NC 28273

Date: 08/07/2008

KAESER COMPRESSORS
Built for a lifetime.

KAESER Refrigeration Secotec Dryer
Model: TE141

Pressures and temperatures

Flow rate @ 100 PSIG	520	scfm
Inlet air pressure	100	psi
Inlet air temperature	100°	F
Maximum permissible working pressure	230	psi
Permissible ambient temperature range	40 -100°	F
Pressure drop	3.4	psi
Pressure dew point	35°	F
Refrigerant compressor horsepower	2.7	hp
Refrigerant	R 134a	

Voltage

- Power supply	460v/3ph/60Hz

Connections

- Compressed air connection	2 " NPT
- Compressed air discharge connection	2 " NPT
- Drain connection	1/2 inch

Dimensions and weight

- Dimensions in inches (H x W x D)	62 x 42 x 59 inches
- Weight	1455 lbs.

Kaeser Compressors, Inc. ■ P.O.Box 946 ■ Fredericksburg, Virginia 22404 ■ Phone (540) 898-5500 ■
Fax (540) 898-5520 ■ www.kaeser.com

CH2M HILL
Attn: Mr. Strong
9013 Blueshot Court
Charlotte NC 28273

Date: 08/07/2008

KAESER COMPRESSORS
Built for a lifetime.

Construction

- Space saving, easy access tower layout with removable side panels
- Powder coated panels with galvanized interior cabinet for corrosion free surfaces
- Environmentally friendly-CFC-free materials
- Multi-stage, stainless steel, Zentri-dry high performance separator system
- Supplied with charge of refrigerant and oil ready for operation
- According to ISO 7183

Installation recommendation

- Place a filter separator (KFS) and a receiver tank before the dryer to remove the bulk liquid condensate and sold particles. An oil removal filter (KOR) after the dryer removes oil aerosols.

Kaeser Compressors, Inc. ■ P.O.Box 946 ■ Fredericksburg, Virginia 22404 ■ Phone (540) 898-5500 ■
Fax (540) 898-5520 ■ www.kaeser.com

Excelled Custom Tubing

When you need quality, affordability, and great service for all your **Sampling**, **Measuring**, and **Monitoring** needs look no further than **ECT MFG**.

PRODUCT QUICK LIST
TUBING
SOIL LINERS
BAILERS
DRIVE POINTS
PURGE PUMPS
WELL PROTECTION
WELL GRAVEL
WELL SUPPLIES
PADLOCKS
INDUSTRIAL GLOVES
TOOLS/ACCESSORIES
CLEANING SUPPLIES

Well Protection

Choose a section below:

Plugs And Caps | **Manholes** | **Covers And Vaults**

Well Locking Plugs

VISIT OUR NEW MONITORING WELL LOCKING PLUGS AREA

We stock a full line of Monitoring Well Locking Plugs including

Torquer Plugs
Cherne Yellow and Green Plugs
Morrison Plugs
Eco Plugs
J-Plugs

Torquerplug.Com The Comprehensive Site for Monitoring Well Locking Plugs and Padlocks.

CALL TOLL FREE 1-888-240-4328 TO PLACE AN ORDER

MANHOLES

ECT distributes for the following manufacturers: CP Test / Valvco, Lyco / Nashua Foundries, Pemco. We offer a full line of their entire catalogs at discount pricing. Please let us know what we can quote. Below are some of our most common

9532088

manholes.

Cast Iron Manhole with HDPE Skirt

12" x 12" skirt
8" x 8"skirt
8" x 12" skirt
7" x 9" skirt

Flush Bolt Down Watertight Manhole
Economical - yet durable, this manhole features a Heavy-duty cast iron (ASTM A-48 Class 30 or better) upper assembly. Certified by an independent laboratory to meet H-20 roadway loading. Lightweight, durable, corrosion and hydrocarbon-resistant High Density Polyethylene (HDPE) plastic shirt, painted lid with monitor well triangle. Buna-NO rubber gasket set into collar insures water-tight seal with pressure fit. High quality stainless steel bolts set into gasketed washers maintain water-tight seal.

12X12

8X8

8X12

7X9

CALL TOLL FREE 1-888-240-4328 TO PLACE AN ORDER

Cast Iron Manholes with Galvanized Metal

9532089

Skirt
12" x 12" skirt
12" x 8"skirt
8" x 12" skirt
8" x 8" skirt
7" x 10" skirt

Flush Bolt Down Watertight Manhole
ECT Water Tight Monitoring Manholes provide H-20 traffic-rating and help protect against water infiltration for monitoring wells completed at-grade. The lids are painted white with a black monitoring well triangle and are clearly marked "Monitoring Well" Manholes utilize a Buna-N ™ gasket that expands as the bolts are tightened, forming a leak resistant seal. A 9/16 inch ratchet or wrench is used to gain access to the well. The manholes feature a galvanized shirt construction. Now available in an economic seven inch design for smaller applications.

CALL TOLL FREE 1-888-240-4328 TO PLACE AN ORDER

One Piece Manhole Cast Iron or Aluminum

2" x 4" skirt
4" x 10" skirt

Flush Bolt Down Watertight Manhole
Manholes provide H-20 traffic-rating and help protect against water infiltration for monitoring wells completed at-grade. High grade Buna-N™ gaskets Utilizes a single brass Penta bolt for minimum interference. Clearly marked "Do Not Fill" for safety. Designed for ultimate strength with sturdy one-piece construction. Small size allows for greater flexibility.

CALL TOLL FREE 1-888-240-4328 TO PLACE AN ORDER

9532090

Covers and Vaults

Above Grade Well and Manhole Protector

Round steel casing with hinged, lockable lid protects monitoring well from damage, weather and tempering. Will accept a #3 MasterlockÂ® or equivalent size padlock. Painted to provided excellent visability.

Vaults

Our vaults are highest quality available in Non-Locking, Locking, Locking-Watertight and Round styles.

24"X24"X24"
24"X36"X24"
36"X36"X24"

home | **contact** | **company** | **Links** | **links**

Copyright 2002 **ECTMFG.com** all rights reserved
Site Built and maintained by: **MindsetDesigns.com**

9532091

9532092

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE